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AUTH.NAME AUTHOR AFFILIATION
VAN BRUNT,E.E. Arizona Nuclear Power Project (formerly Arizona Public Serv
RECIP.NAME RECIPIENT AFFILIATION
KNIGHTON,G.W. Office of Nuclear Reactor Regulation, Director

SUBJECT: Responds to request & commitments made during 851008 meeting & in 850918 ltr re auxiliary pressurizer spray sys. Implementation of listed enhancements scheduled for first refueling outage for Unit 1.Concurrence requested by 851022.

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ANPP-33713-WFQ/TFQ
October 15, 1985

Director of Nuclear Reactor Regulation
Attention: Mr. George W. Knighton, Project Director
PWR Project Directorate #7
Division of Pressurized Water Reactor Licensing - B
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2 and 3
Docket Nos. STN-50-528 (License No. NPF-41)/529/530
Auxiliary Pressurizer Spray Design
File: 85-056-026; G.1.01.10

Reference: (A) Letter from E. E. Van Brunt, Jr., ANPP, to J. B. Martin, NRC, dated September 18, 1985 (ANPP-33487).
(B) NUREG-0852, "Safety Evaluation Report Related to the Final Design of the Standard Nuclear Steam Supply Reference System, CESSAR System 80", Supplement 1, dated March 1983.
(C) NUREG-1044, "Evaluation of the Need for a Rapid Depressurization Capability for Combustion Engineering Plants", dated December 1984.

Dear Mr. Knighton:

In meetings on September 20, 1985 and October 8, 1985, between representatives from the NRC staff, ANPP and Combustion Engineering, we discussed several aspects of the PVNGS Auxiliary Pressurizer Spray System (APSS). The discussion included design history, Steam Generator Tube Rupture (SGTR) accidents, the existing APSS design, and proposed APSS design modifications. This letter is submitted in response to the request made by the staff and our commitments made during the October 8, 1985 meeting, and our commitments made in Reference (A). The design history included discussions of the licensing basis for the APSS.

The licensing basis for the APSS is founded on Branch Technical Position (BTP) RSB 5-1 for a Class 2 Plant which allows a) dependence on manual actions inside containment after a SSE or single failure or b) remaining at hot standby until manual actions or repairs are complete, if such actions are found to be acceptable for the individual plant. The APSS was reviewed by the NRC staff against the BTP RSB 5-1 requirements for a Class 2 plant, and their approval is documented in Section 5.4.3 of Reference (B).

A001
1/1

The PVNGS SGTR analysis, documented in the PVNGS FSAR Appendix 15A, includes APSS operation at 1015 seconds after a SGTR. This analysis was performed in response to a staff request to model actions required by the operating procedures, rather than to form a licensing basis for mitigation of a SGTR. The effect of the APSS in the analysis is to cause an increase in pressurizer liquid level which (along with adequate heat removal and minimum subcooling) allows the high pressure safety injection (HPSI) flow to be throttled. This HPSI throttling accomplishes the final phase of plant depressurization to shutdown cooling initiating conditions.

To demonstrate that operation of the APSS is not required at 1015 seconds, Attachment 1 provides a revised SGTR analysis which confirms that APSS is not needed in the first two hours to mitigate the consequences of the accident, relative to meeting the acceptance criteria of 10CFR100. This revised SGTR analysis shows a deferred reliance on APSS which is consistent with other accident scenarios which assume a loss-of-offsite power. That is, after the plant has stabilized and the accident has been essentially mitigated, APSS is used to depressurize the Reactor Coolant System to allow entry into shutdown cooling as part of the post-accident recovery.

The scope of the APSS was also discussed at the September 20, 1985 and October 8, 1985 meetings. It is our position that the APSS portion of the CVCS includes two safety-related auxiliary spray valves in parallel (CH-203 and CH-205), a check valve (CH-431) and their associated piping. This is consistent with the NRC staff's description of the APSS portion of the CVCS as documented in Appendix B of Reference (C). The PVNGS depressurization capability includes the APSS and a source of borated water (via charging system). Attachment 2, provides a summary of the design features of each component in the primary path between the refueling water tank and the pressurizer. Attachment 2 also provides information concerning compensating operator actions for failure of a component. Any or all of these operator actions, if necessary, are reasonably achievable within the time period (2 hours) used in the SGTR reanalysis for commencement of operation of the APSS. The capabilities of the PVNGS design meet the requirements of BTP RSB 5-1, for a Class 2 plant, and are commensurate with the needs for depressurization.

At the October 8, 1985 meeting, we also presented a description of our planned enhancements to the CVCS as a result of our evaluation of the September 12, 1985 Outage. These enhancements, which are further described in Attachment 3, will:

- Provide power to CH-501 and 536 from an IE Motor Control Center following a Loss-of-Offsite Power and/or a Safety Injection Actuation Signal.

- Enhance the reliability of the Volume Control Tank (VCT) level indication.

- Provide automatic realignment of CH-501 and 536 on Lo-Lo VCT level and loss-of-offsite power, to align charging pump suction from the refueling water tank.

The schedule for implementation for these enhancements is the first refueling outage for Unit 1, prior to exceeding 5% power for Unit 2, and prior to fuel load for Unit 3.

The information and commitments provided by this letter should address the NRC staff's concerns on the APSS and charging capabilities, and we request your concurrence with the proposed modifications by October 22, 1985 so that committed schedules can be met. Please contact Mr. W. F. Quinn of my staff if you have any questions on this matter.

Very truly yours,

E. E. Van Brunt, Jr.
Executive Vice President
Project Director

EEVB/TFQ/dlm

Attachments
1. Revised Steam Generator Tube Rupture Analysis
2. PVNGS Auxiliary Pressurizer Spray and Charging Component Capability Summary
3. Engineering Evaluation of September 12, 1985 Outage

cc: R. P. Zimmerman
E. A. Licitra
A. C. Gehr
M. Ley

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, Edwin E. Van Brunt, Jr., represent that I am Executive Vice President, Arizona Nuclear Power Project, that the foregoing document has been signed by me on behalf of Arizona Public Service Company with full authority to do so, that I have read such document and know its contents, and that to the best of my knowledge and belief, the statements made therein are true.

Edwin E. Van Brunt

Edwin E. Van Brunt, Jr.

Sworn to before me this 15 day of October, 1985.

Nora E. Meador
Notary Public

My Commission Expires:

My Commission Expires April 6, 1987

ATTACHMENT 1

STEAM GENERATOR TUBE RUPTURE WITH A LOSS OF OFFSITE POWER AND A FULLY STUCK OPEN ATMOSPHERIC DUMP VALVE (ADV)

The Steam Generator Tube Rupture (SGTR) analysis currently contained in the PVNGS FSAR Appendix 15A, was performed in response to a NRC staff concern that operator actions may affect the assumption of a worst single failure. As a result, the Appendix 15A analysis was submitted, (Appendix to Reference 1 and subsequent information in References 2 and 3) considering the operator actions that are outlined in the plant procedures.

These procedures provide guidance to the operator in the event of a SGTR with a Loss of Offsite Power to lower RCS pressure through the use of the Auxiliary Pressurizer Spray System (APSS). Thus, the current Appendix 15A analysis assumes an operator action at 1015 seconds to initiate the APSS.

In response to a staff concern that this action was required to achieve acceptable consequences, the event has been reanalyzed without operator action to initiate the APSS until two hours after the event initiation.

A two-hour time delay was chosen for two reasons. First, this delay will maximize the two-hour Exclusion Area Boundary dose for this event. Second, the two-hour delay provides adequate time to manually establish auxiliary pressurizer spray, even in the event failures in the system occur per BTP 5-1.

IDENTIFICATION OF EVENT AND CAUSES

This transient analysis is similar to that described in the PVNGS FSAR Appendix 15A except that initiation of auxiliary pressurizer spray occurs at two hours. It assumes that the plant is challenged by a steam generator tube rupture including the conservative assumptions of the Standard Review Plan Section 15.6.3 (loss of offsite power, accident meteorology, iodine spiking, etc.). In addition, the analysis postulates that 1) the operators open an ADV on the affected steam generator and 2) it runs to the full open position and 3) it sticks open for the duration of the transient.

SEQUENCE OF EVENTS AND SYSTEMS OPERATION

Refer to the PVNGS FSAR Appendix 15A for a description of the event assumptions. In addition, Table 1 of this Attachment 1 provides the sequence of events and setpoint values used for the revised steam generator tube rupture analysis. The sequence of events and setpoint values are identical to that described in the PVNGS FSAR Appendix 15A, through 1015 seconds at which time it was assumed the operator initiated auxiliary pressurizer spray. This reanalysis conservatively delays the initiation of auxiliary pressurizer spray until two hours into the event. By delaying auxiliary pressurizer spray to this time, the primary to secondary tube leak is maximized and therefore, the 0-2 hour exclusion area boundary (EAB) radiological consequences are maximized. Most of the dose occurs in the first two hours. At 8 hours, plant conditions are such that the operator initiates shutdown cooling system operation and the radioactive releases are terminated. Therefore, with a delay in initiating auxiliary pressurizer spray until 2 hours, the limiting 0-2 hour EAB radiological consequences of a SGTR will not be reduced by the depressurization caused by auxiliary pressurizer spray. The two-hour time delay for initiating auxiliary pressurizer spray provides the operator adequate time to manually establish auxiliary pressurizer spray, even in the event of failures in the system per BTP 5-1.

Due to the increased primary to secondary leak rate, the steam generator tubes are covered at 1347 seconds which is slightly earlier than the PVNGS FSAR Appendix 15A analysis. Approximately 10 minutes after auxiliary pressurizer spray is initiated, pressurizer level is regained. The operator then controls high pressure safety injection flow, backup pressurizer heater output, and auxiliary pressurizer spray flow to control RCS pressure and subcooling and conducts an orderly approach to shutdown cooling entrance conditions.

The dynamic behavior of important NSSS parameters following this revised steam generator tube rupture analysis are provided in Figures 1-14 of this Attachment 1.

ANALYSIS OF EVENTS AND CONSEQUENCES

The mathematical model used for this analysis is described in CESSAR Section 15D.3.1.A.

RADIOLOGICAL CONSEQUENCES

The physical model is the same as that discussed in CESSAR Section 15D.3.2 except that the ADV of the affected steam generator opens fully. In order to reduce the radiological releases, the operator takes appropriate actions to recover the U-tubes of the affected steam generator. Actions assumed in this analysis included overriding the automatic isolation of Auxiliary Feed Water (AFW) flow to the affected steam generator and diverting the flow of both AFW pumps to the affected steam generator.

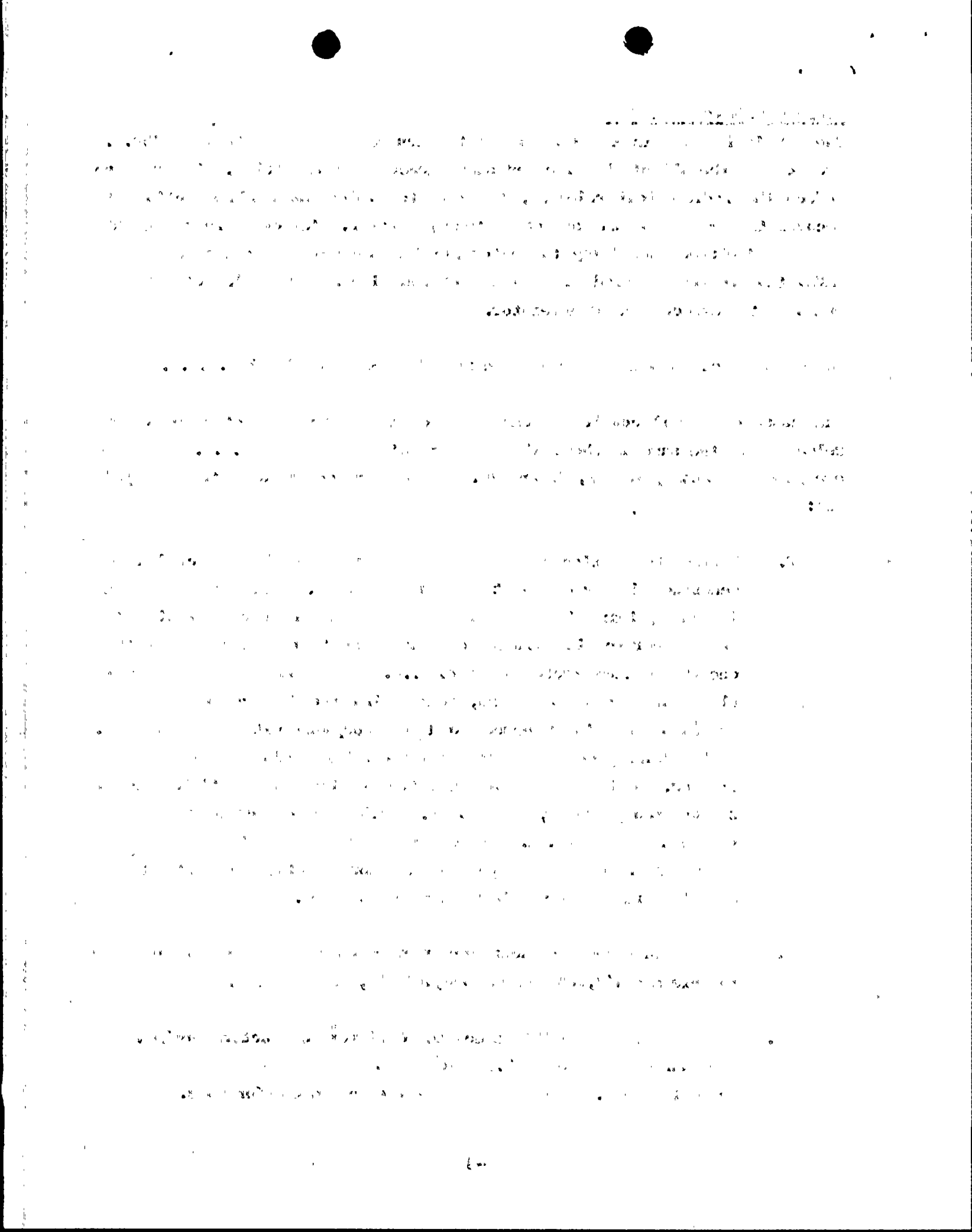
The mathematical dose model is as described in CESSAR Section 15D.3.2.C.

The assumptions and conditions employed for the evaluation of radiological releases are the same as those discussed in CESSAR Section 15D.3.2.B with the exceptions of assumptions 7, 9, and 10. The assumptions used in this analysis are:

7. During the period when the water level in the affected steam generator is above the top of the U-tubes, that portion of the leaking primary fluid which flashes to steam upon entering the steam generator is assumed to be released to the atmosphere with a decontamination factor (DF) of 1.0. The portion of the leaked fluid that does not flash, mixes with the liquid in the steam generator and is released to the atmosphere with a DF of 100. During that period when the water level is below the top of the U-tubes, it is assumed that all the leaking primary fluid escapes to the atmosphere with a DF of 1.0, which is more conservative than the CESSAR assumption. No credit is taken for the presence of steam separators and dryers which would retain a part of the escaping primary liquid in the steam generator.

9. The 0-2 hour and 2-8 hour primary-to-secondary leakage through the rupture are 447,600 lbm and 570,400 lbm, respectively.

10. The PVNGS site specific atmospheric dispersion factors employed in the analyses are: 3.1×10^{-4} sec/m^3 for the exclusion area boundary and 5.1×10^{-5} sec/m^3 for the low population zone.



The two-hour exclusion area boundary (EAB) and the eight-hour low population zone (LPZ) boundary inhalation doses for both the Generated Iodine Spike (GIS) and the Preaccident Iodine Spike (PIS) are presented in Table 2 of this Attachment 1. The calculated EAB and LPZ doses are well within the acceptance criteria of 10CFR Part 100. The dose results from the PVNGS FSAR Appendix 15A are also provided in Table 2 for reference.

CONCLUSIONS

Assuming the APSS is not actuated until two hours after the event, the radiological releases calculated for the SGTR event with a loss of offsite power and a fully stuck open ADV are well within the acceptance criteria of 10CFR100. The secondary system pressures are well below the 110% of the design pressure limits ensuring the integrity of these systems. The time assumed for operator action of the auxiliary spray system is consistent with the system design.

REFERENCES

(1) Letter from E. E. Van Brunt, Jr., APS, to G. W. Knighton, NRC, dated September 19, 1984, ANPP-30572. Subject: Steam Generator Tube Rupture Analysis.

(2) Letter from E. E. Van Brunt, Jr., APS to G. W. Knighton, NRC, dated October 5, 1984, ANPP-30746. Subject: Steam Generator Tube Rupture Analysis.

(3) Letter from E. E. Van Brunt, Jr., APS, to G. W. Knighton, NRC, dated October 24, 1984, ANPP-30938. Subject: Steam Generator Tube Rupture Analysis.

TABLE 1

SEQUENCE OF EVENTS FOR A STEAM GENERATOR TUBE RUPTURE WITH A LOSS OF OFFSITE POWER AND FULLY STUCK OPEN ADV
(Sheet 1 of 3)

(Sec)	Event	Setpoint* or Value	Success Path or Comment
0.0	Tube Rupture Occurs	—	—
40	Third Charging Pump Started, feet below program level	-0.75	Primary System Integrity
40	Letdown Control Valve Throttled Back to Minimum Flow, feet below program level	-0.75	Primary System Integrity
47	CPC Hot Leg Saturation Trip Signal Generated	—	Reactivity Control
47.15	Trip Breakers Open	—	Reactivity Control
48	Turbine/Generator Trip	—	Secondary System Integrity
51	Loss of Offsite Power	—	—
52	LH Main Steam Safety Valves Open, psia	1265	Secondary System Integrity
52	RH Main Steam Safety Valves Open, psia	1265	Secondary System Integrity
56	Maximum Steam Generator Pressures Both Steam Generators, psia	1330	—
121	Steam Generator Water Level Reaches Auxiliary Feedwater Actuation Signal (AFAS) Analysis Setpoint in Unaffected Generator, percent wide range level	25	Secondary System Integrity
122	AFAS Generated	—	—
131	Steam Generator Water level Reaches AFAS Analysis Setpoint in the Affected Generator, percent wide range level	25	Secondary System Integrity

TABLE 1

SEQUENCE OF EVENTS FOR A STEAM GENERATOR TUBE RUPTURE WITH A LOSS OF OFFSITE POWER AND FULLY STUCK OPEN ADV

(Sheet 2 of 3)

(Sec)	Event	Setpoint* or Value	Success Path or Comment
132	AFAS Generated	—	—
167.0	Auxiliary Feedwater Initiated to Unaffected Steam Generator	—	Secondary System Integrity
177.0	Auxiliary Feedwater Initiated to Affected Steam Generator	—	Secondary System Integrity
460	Operator Initiates Plant Cooldown by Opening One ADV on Each SG - ADV of the Affected SG Instantaneously Opens Fully	—	Reactor Heat Removal
484	Pressurizer Empties	—	—
513	MSIS Actuation, Secondary Pressure, psia	919	Secondary System Integrity
535	Automated Isolation of AFW to Affected SG, ΔP SGs, psi	185	Secondary System Integrity
581	Pressurizer Pressure Reaches Safety Injection Actuation Signal (SIAS) Analysis Setpoint, psia	1578 (1837)	Reactivity Control
581	Safety Injection Actuation Signal Generated	—	—
581	Safety Injection Flow Initiated	—	Reactivity Control
655	Operator Overrides the AFW Isolation Signal and Starts Feeding the Affected SG with AFW	—	—
775	Operator Takes Manual Control of the AFW System, Feeds Affected SG with Both AFW Pumps	—	—

TABLE 1

SEQUENCE OF EVENTS FOR A STEAM GENERATOR TUBE RUPTURE WITH A LOSS OF OFFSITE POWER AND FULLY STUCK OPEN ADV

(Sheet 3 of 3)

(Sec)	Event	Setpoint* or Value	Success Path or Comment
895	Operator Shuts the ADV of the Unaffected Steam Generator	—	—
1347	Level in the Affected SG Above the Top of U-tubes, percent wide range	71.5	—
7200	Operator Initiates Auxiliary Spray to the Pressurizer	—	—
7800	Pressurizer Level, percent	50	—
7800	Operator Controls HPSI Flow, Backup Pressurizer Heater Output, and Auxiliary Spray Flow to Control RCS Pressure and Subcooling, °F	20	—
28,800	Shutdown Cooling Entry Conditions are Reached RCS psia/°F	400/350	—
28,800	Operator Activates Shutdown Cooling System	—	—

*Where the Technical Specification (TS) Setpoint is different from what was used, the TS value is listed in parenthesis for reference.

TABLE 2

RADIOLOGICAL CONSEQUENCES OF THE STEAM GENERTOR TUBE RUPTURE WITH A LOSS OF OFFSITE POWER AND FULLY STUCK OPEN ADV APSS OPERATION DELAYED TWO HOURS

Location	Offsite Doses, Rems GIS	PIS
1. Exclusion Area Boundary 0-2 hr. Thyroid	42	208
2. Low Population Zone Outer Boundary 0-8 hr. Thyroid	22	44

RADIOLOGICAL CONSEQUENCES OF THE STEAM GENERTOR TUBE RUPTURE WITH A LOSS OF OFFSITE POWER AND FULLY STUCK OPEN ADV APSS OPERATION AT 1015 SECONDS (PVNGS FSAR APPENDIX 15A)

Location	Offsite Doses, Rems GIS	PIS
1. Exclusion Area Boundary 0-2 hr. Thyroid	40	200
2. Low Population Zone Outer Boundary 0-8 hr. Thyroid	20	41

FIGURE 1

CORE POWER VS. TIME

(SHEET 1 OF 2)

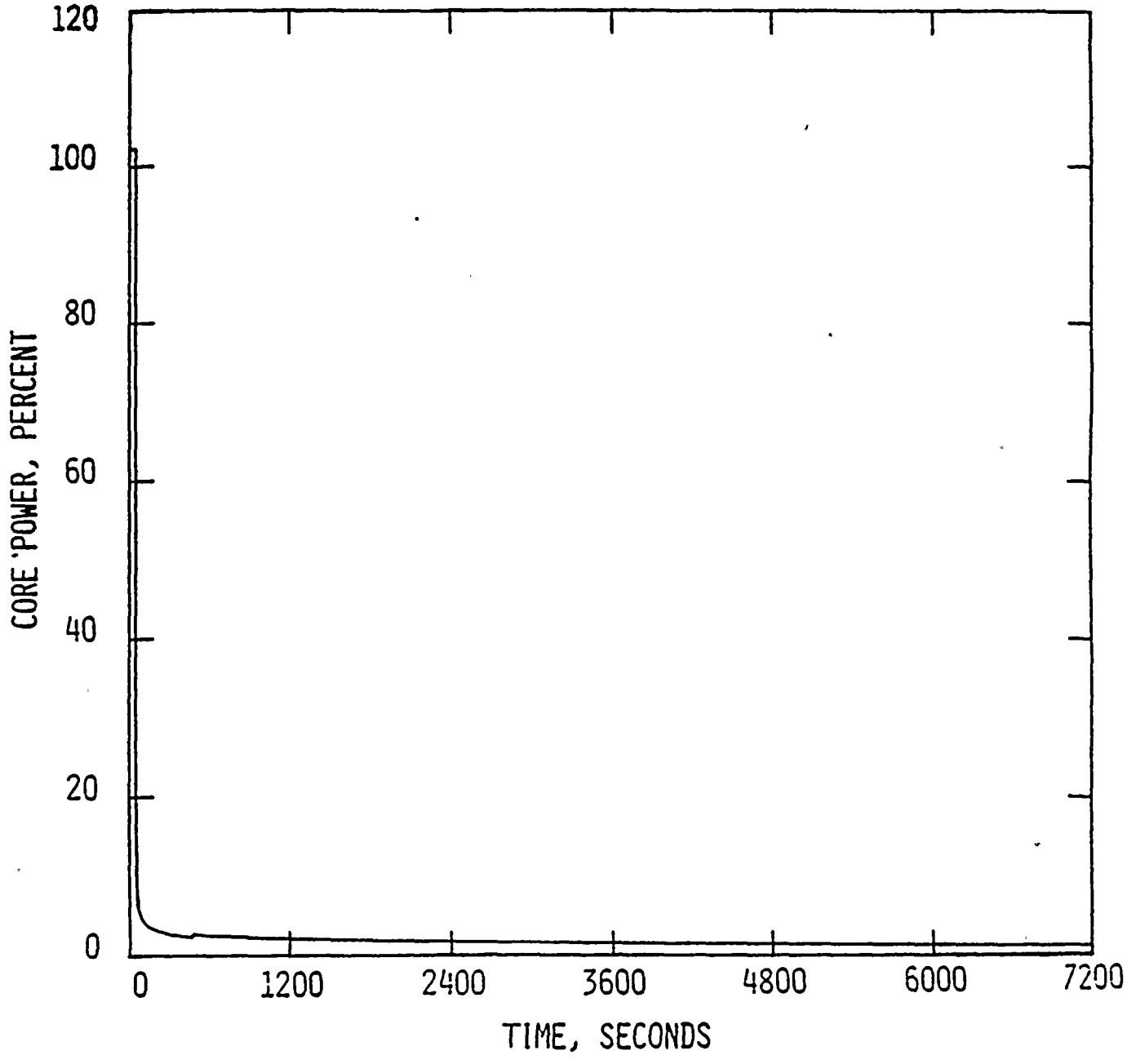


FIGURE 1
CORE POWER VS. TIME
(SHEET 2 OF 2)

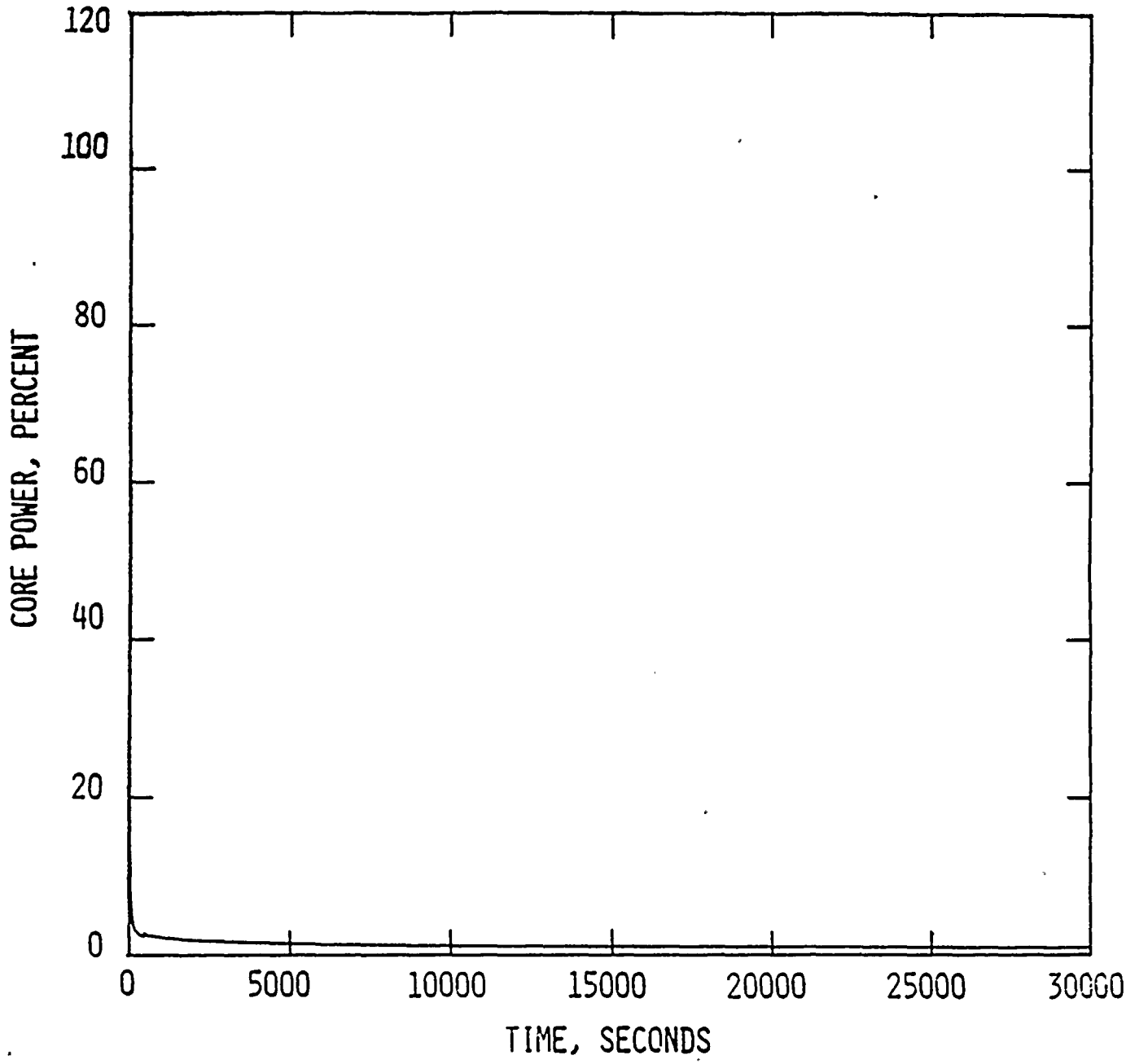


FIGURE 2
RCS PRESSURE VS. TIME
(SHEET 1 OF 2)

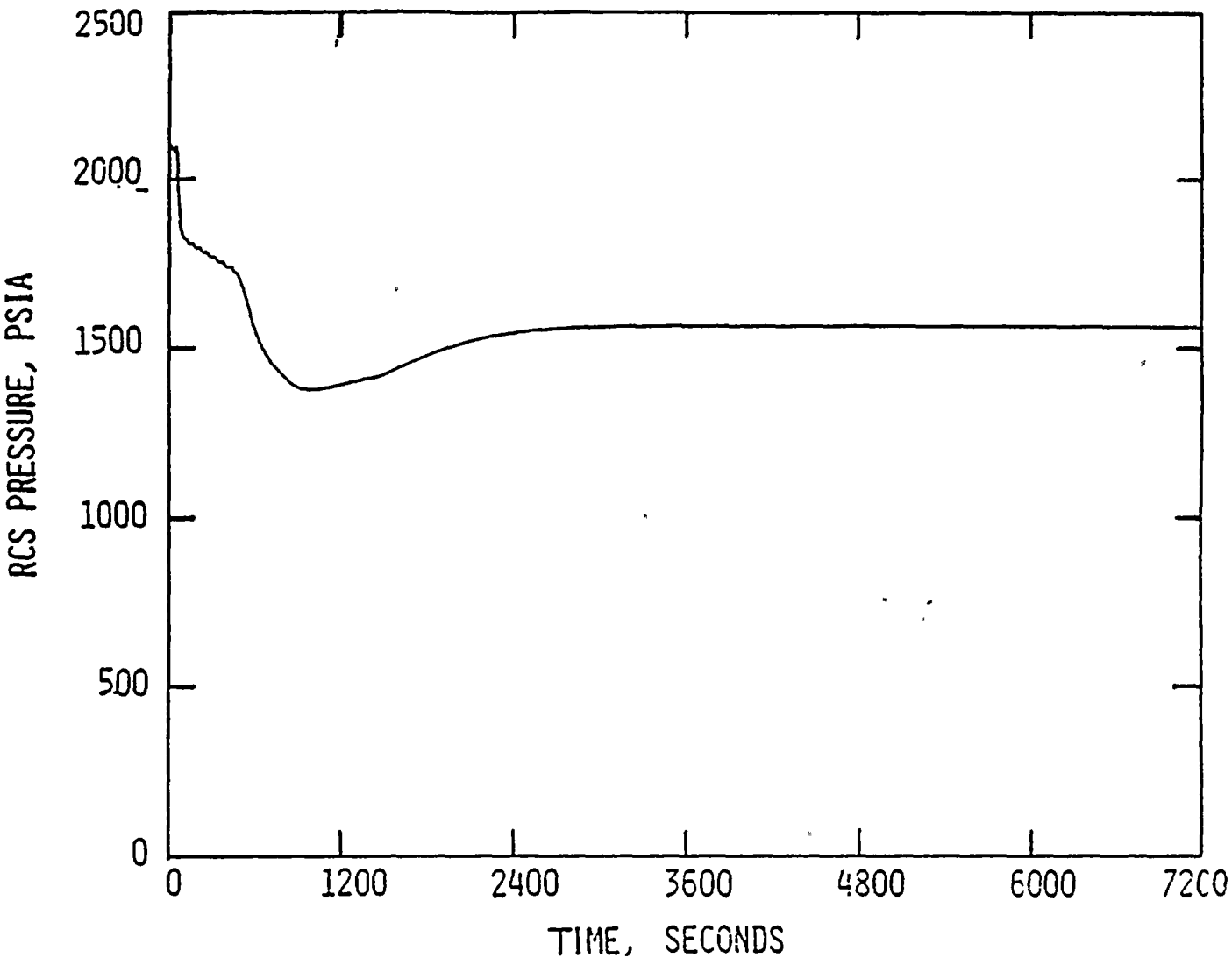


FIGURE 2

RCS PRESSURE VS. TIME

(SHEET 2 OF 2)

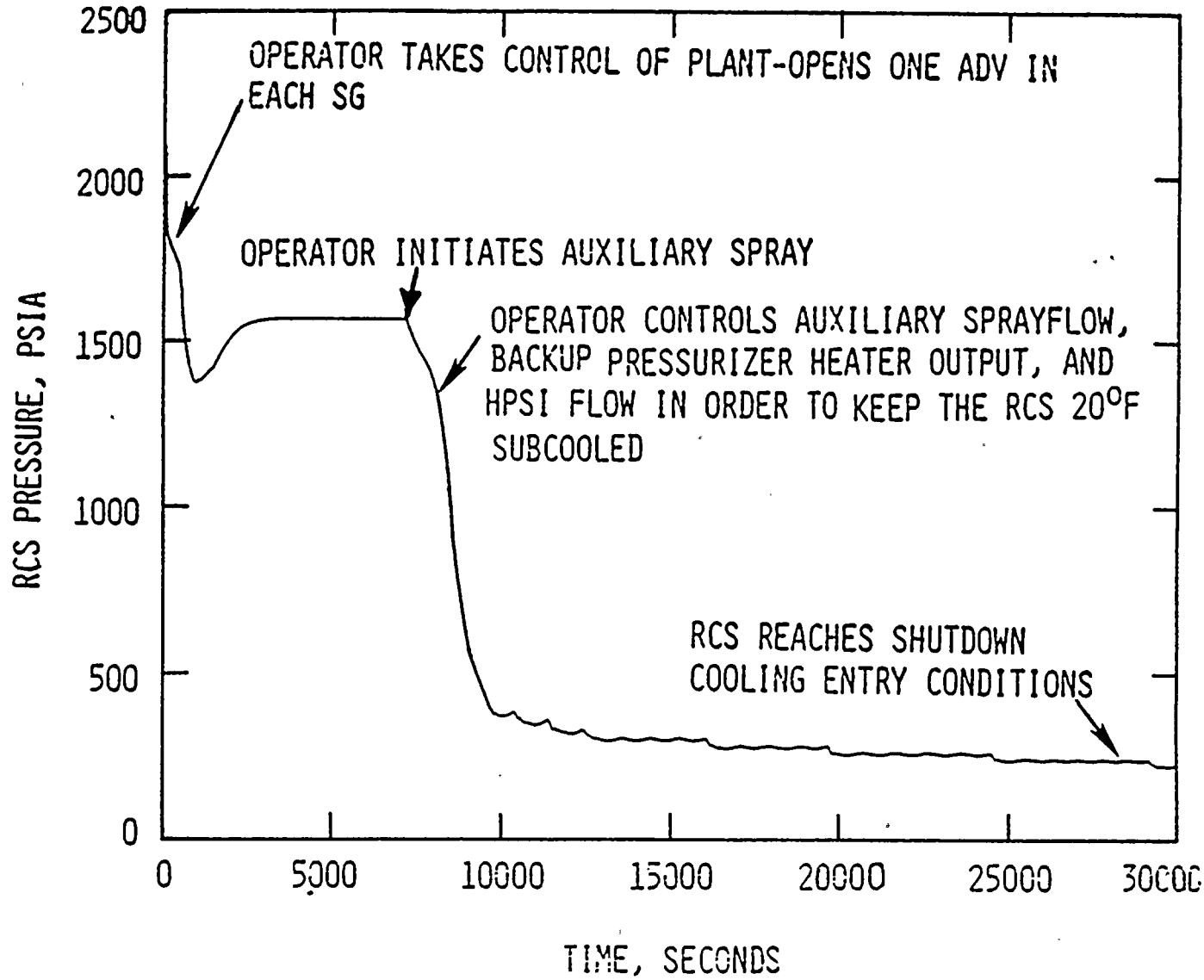


FIGURE 3
CORE COOLANT TEMPERATURES VS. TIME
(SHEET 1 OF 2)

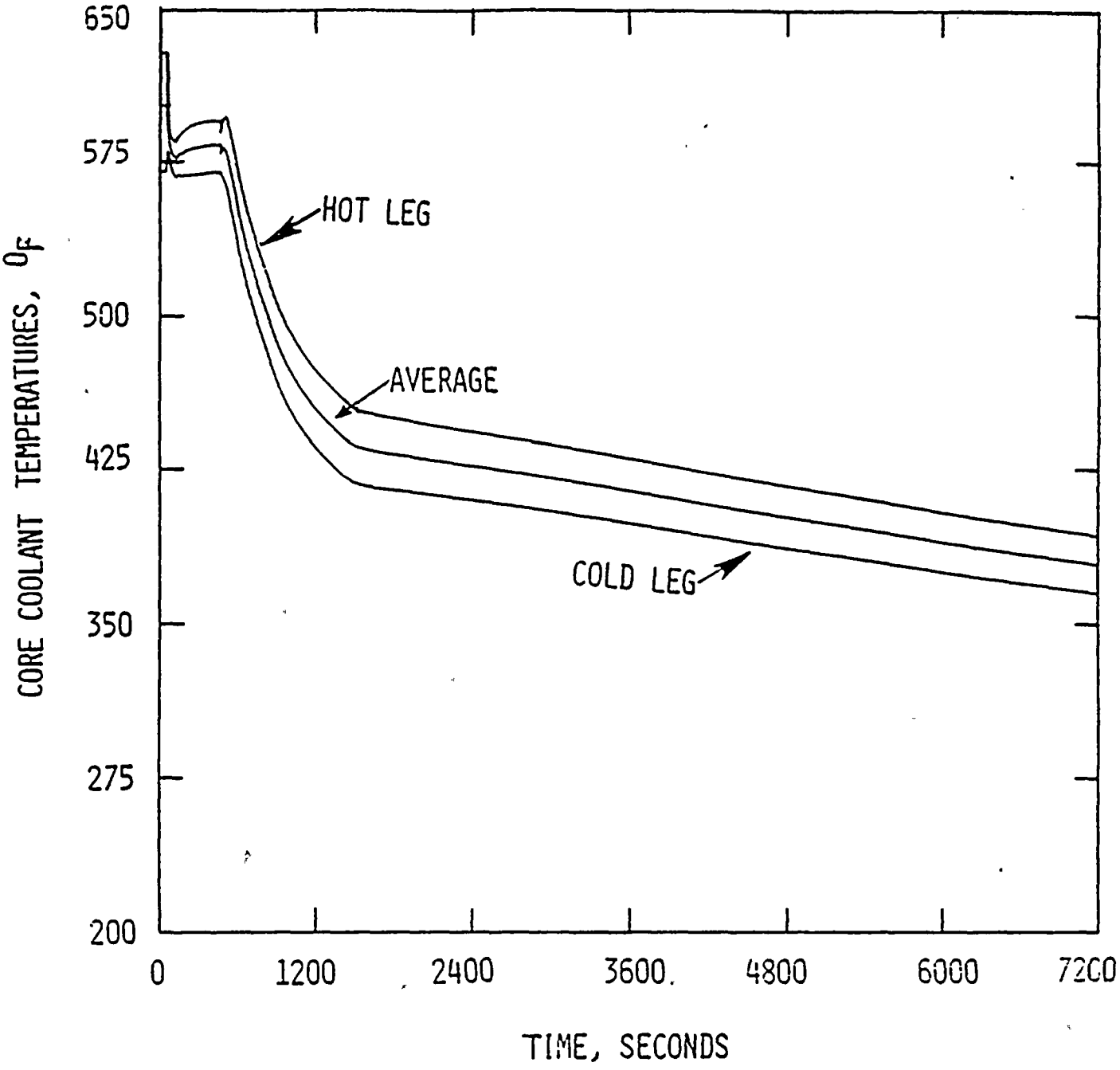


FIGURE 3
CORE COOLANT TEMPERATURE VS. TIME
(SHEET 2 OF 2)

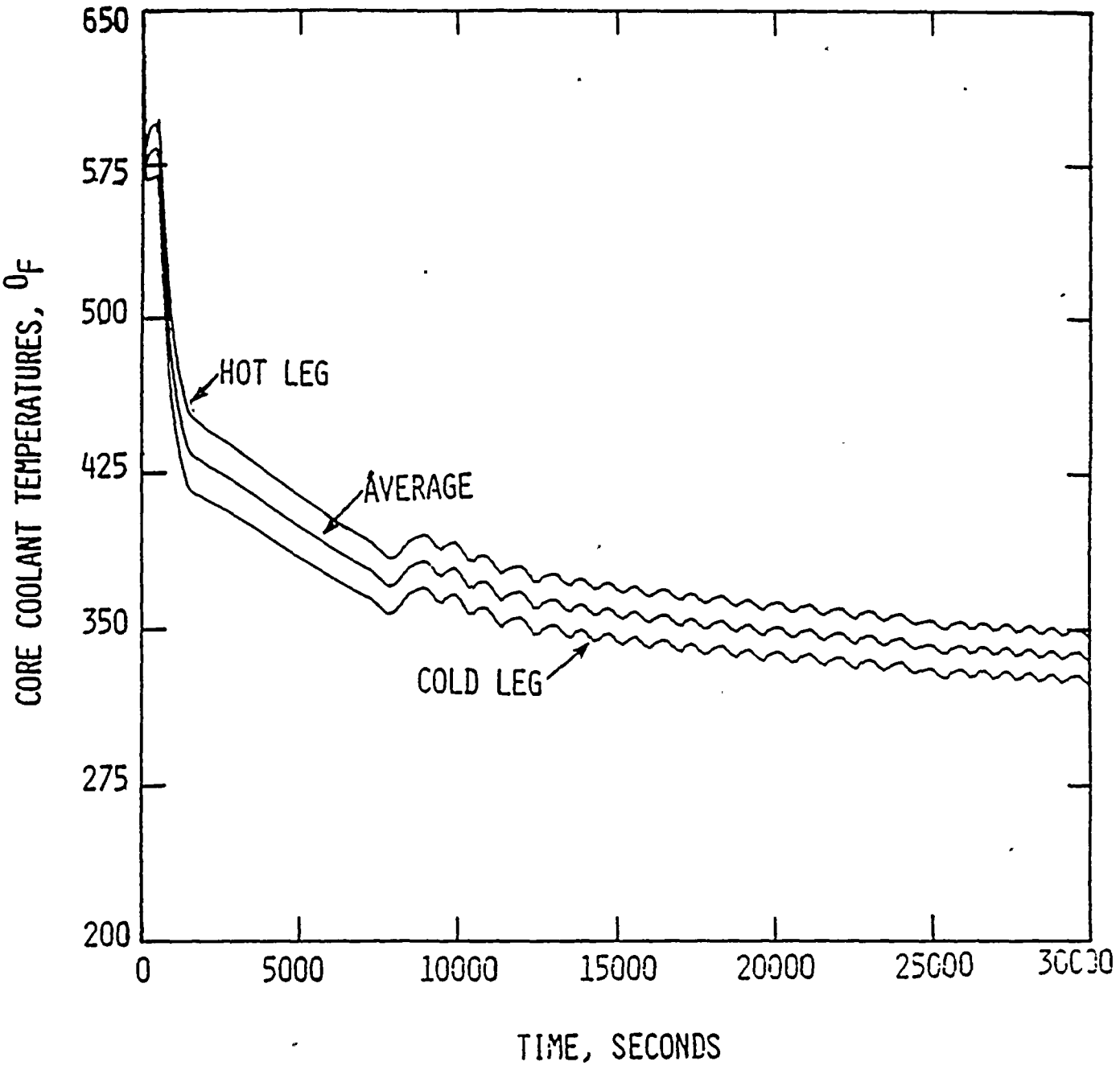


FIGURE 4

UPPER HEAD TEMPERATURE VS. TIME

(SHEET 1 OF 2)

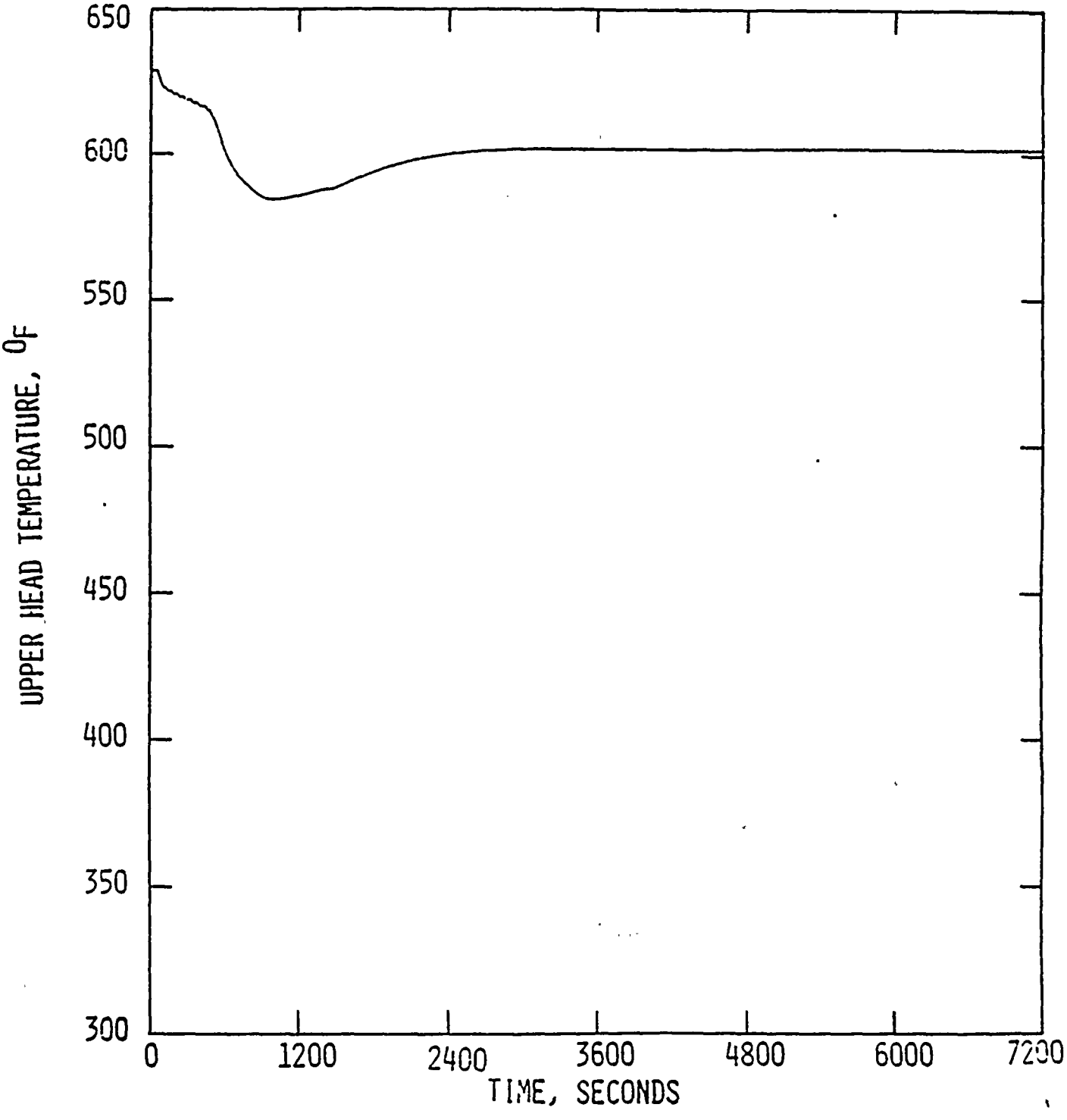


FIGURE 4
UPPER HEAD TEMPERATURE VS. TIME
(SHEET 2 OF 2)

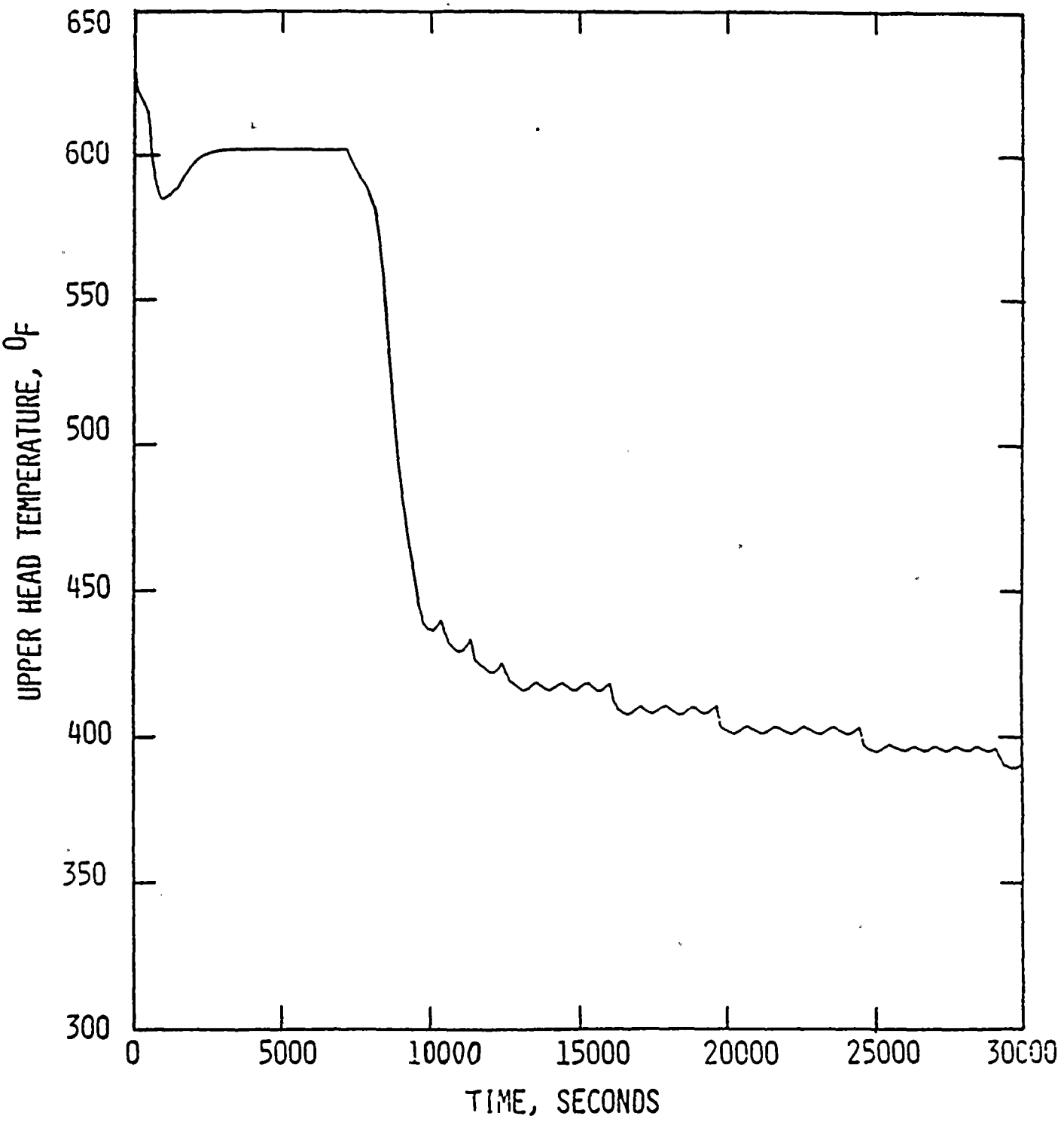


FIGURE 5

PRESSURIZER WATER VOLUME VS. TIME

(SHEET 1 OF 2)

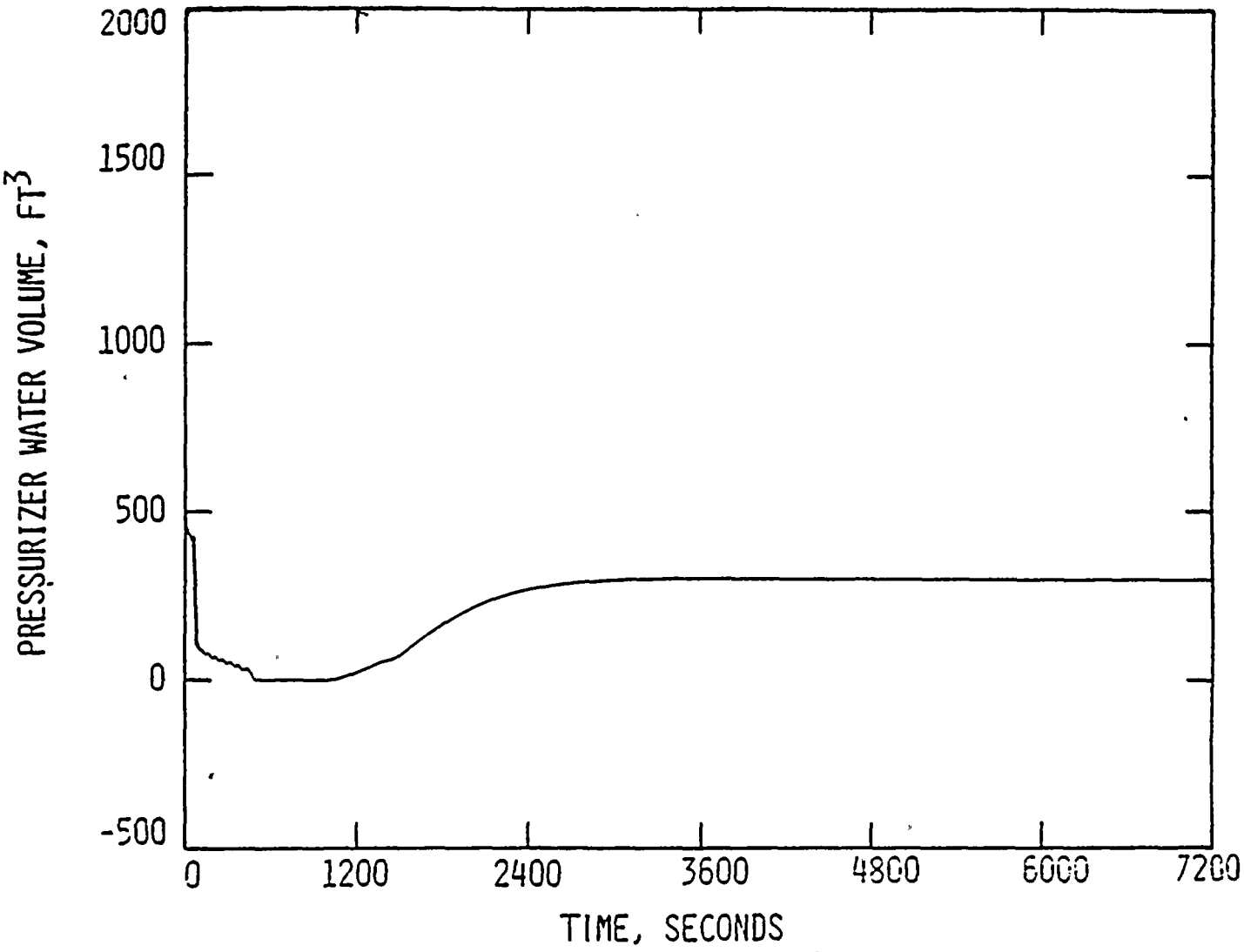


FIGURE 5

PRESSURIZER WATER VOLUME VS. TIME

(SHEET 2 OF 2)

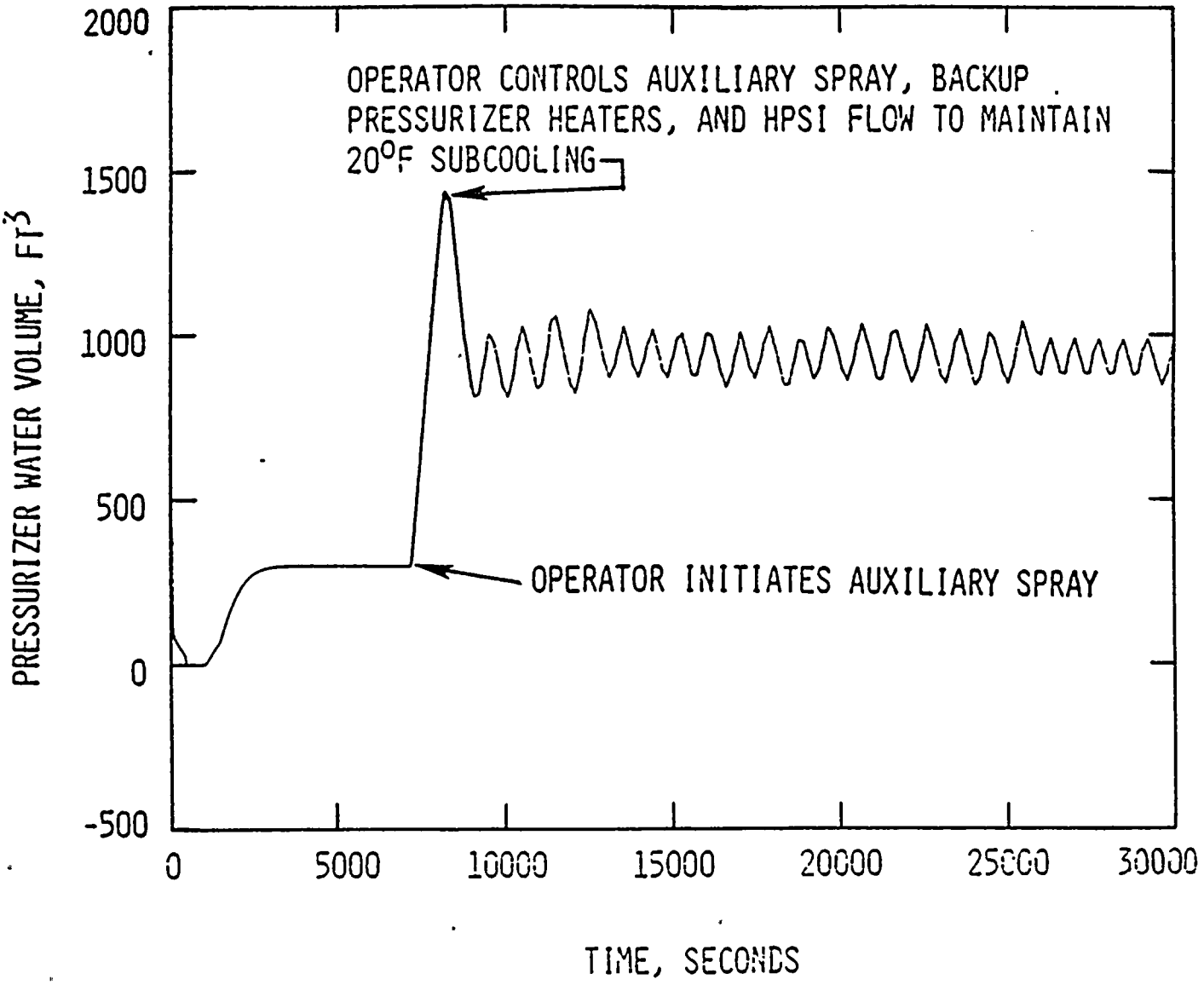


FIGURE 6

LIQUID LEVEL ABOVE TOP OF HOT LEGS

(SHEET 1 OF 2)

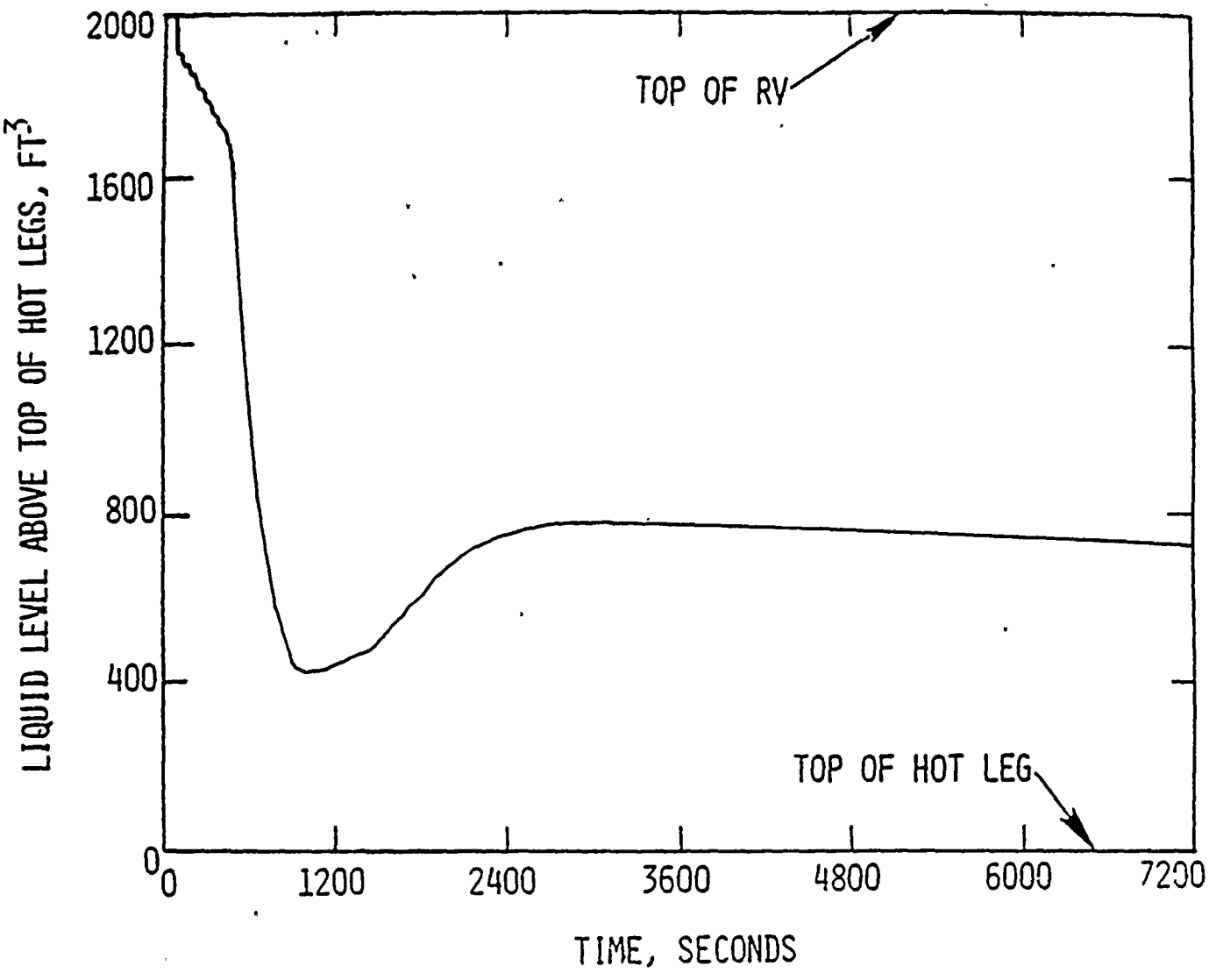


FIGURE 6

LIQUID LEVEL ABOVE TOP OF HOT LEGS

(SHEET 2 OF 2)

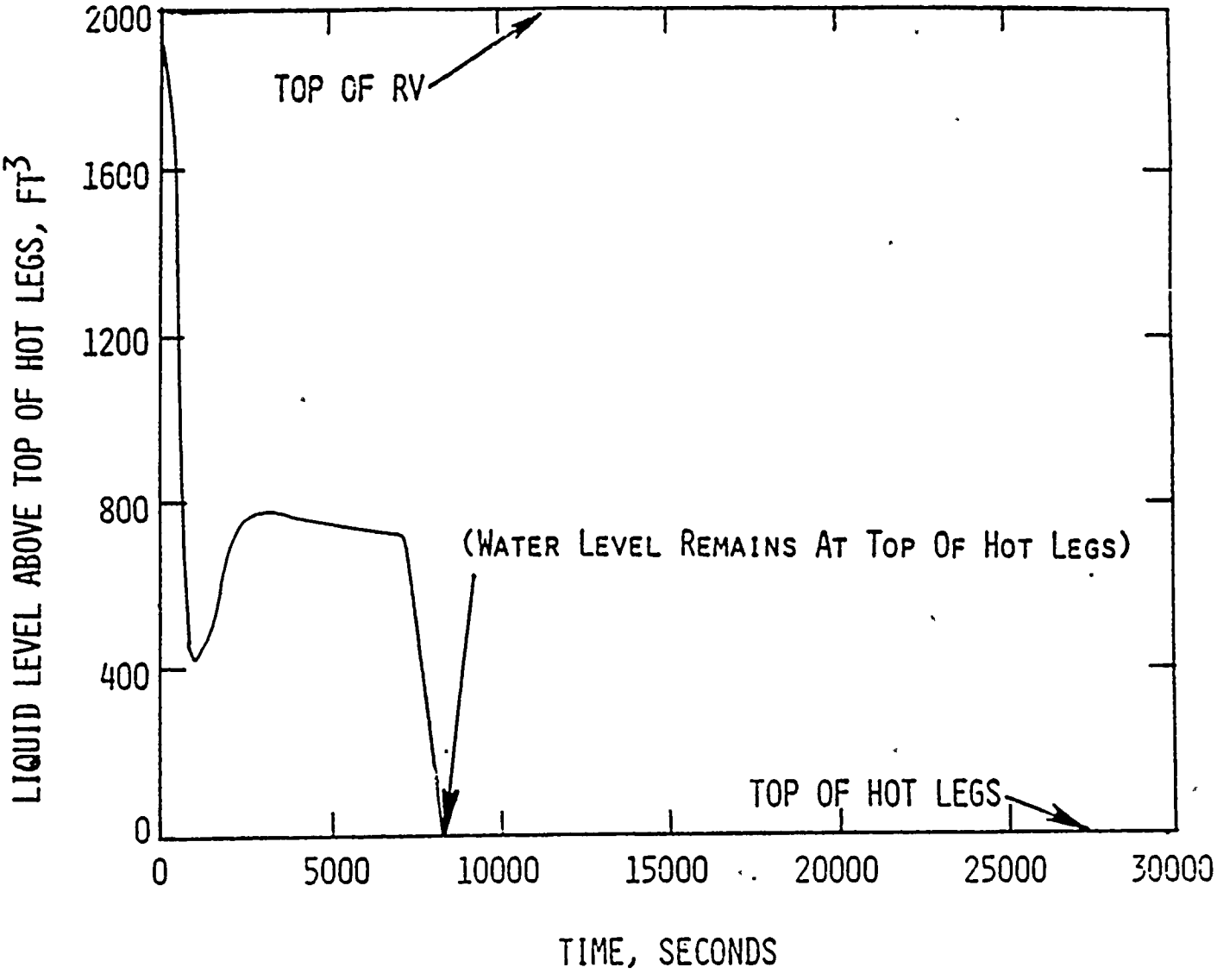


FIGURE 7
RCS LIQUID MASS VS. TIME
(SHEET 1 OF 2)

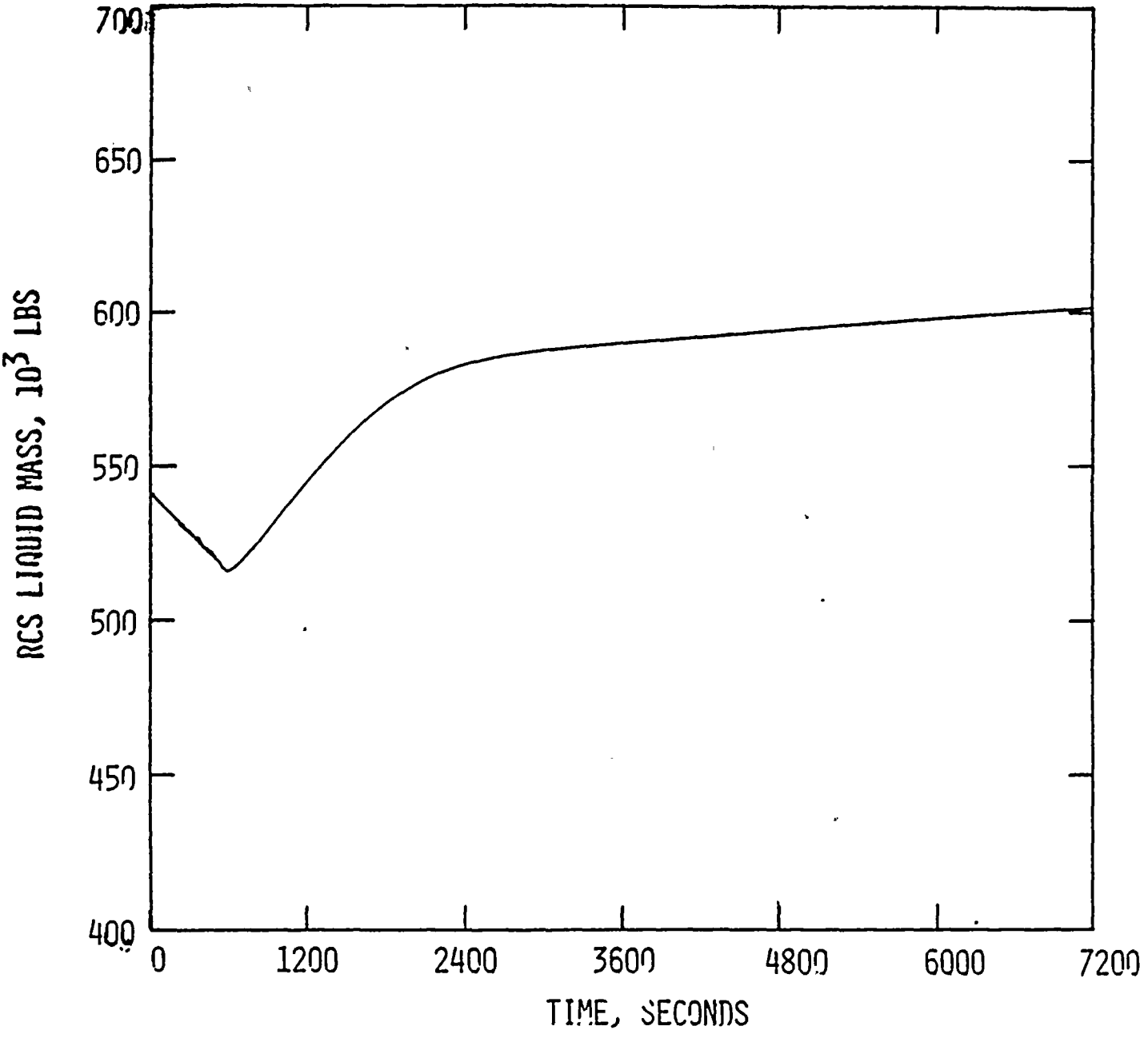


FIGURE 7
RCS LIQUID MASS VS. TIME
(SHEET 2 OF 2)

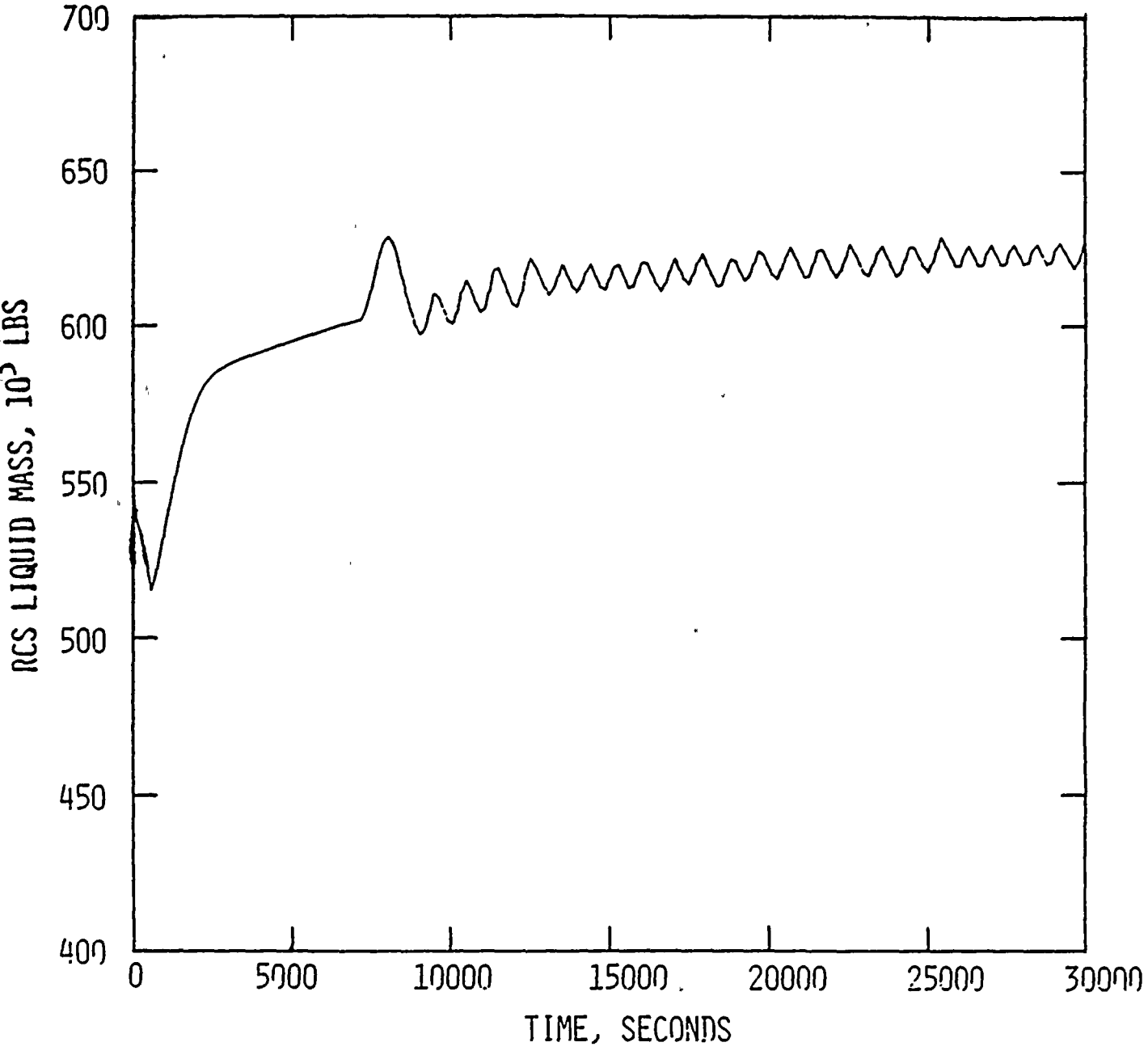


FIGURE 8

STEAM GENERATOR PRESSURE VS. TIME

(SHEET 1 OF 2)

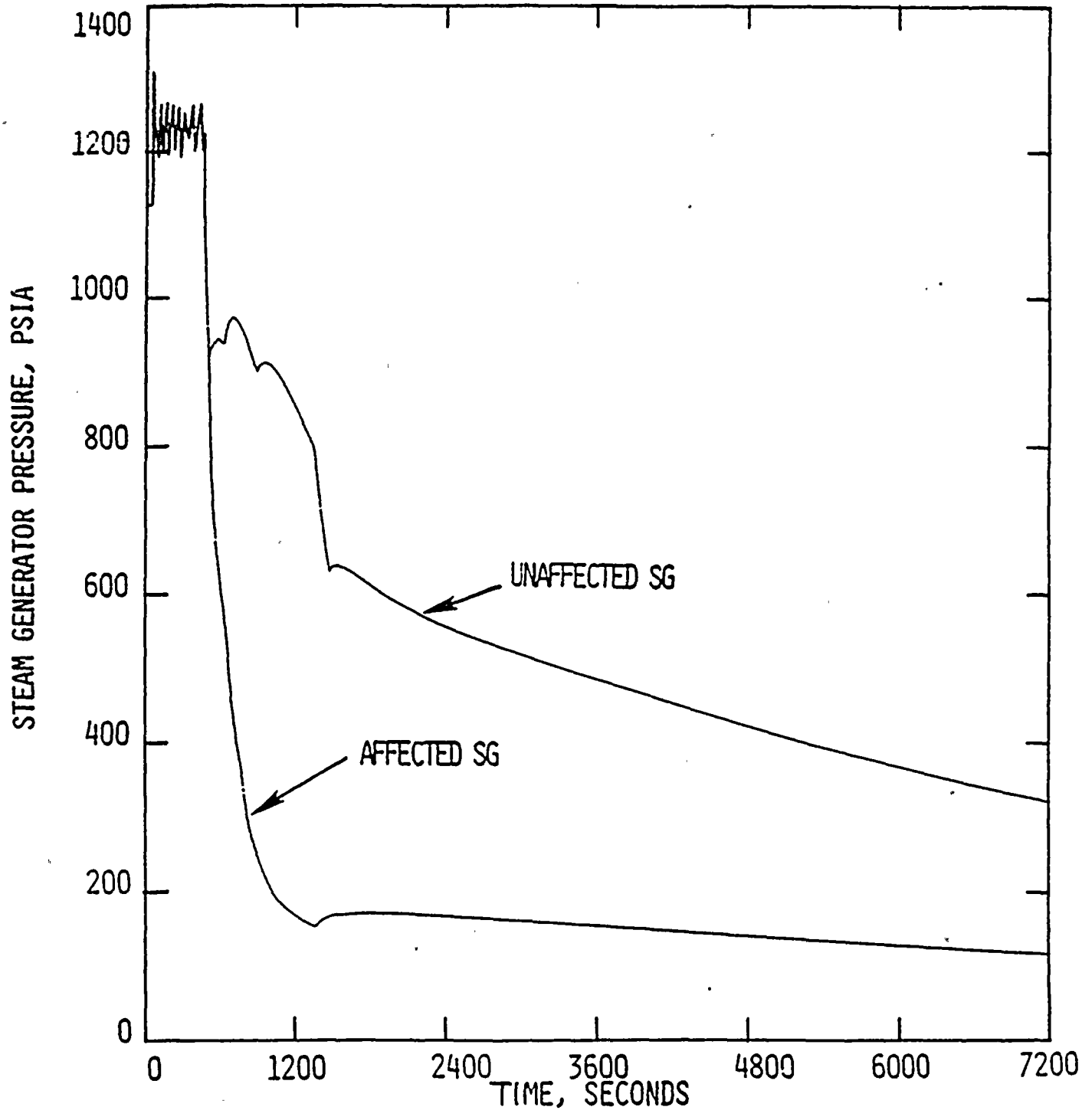


FIGURE 8

STEAM GENERATOR PRESSURE VS. TIME

(SHEET 2 OF 2)

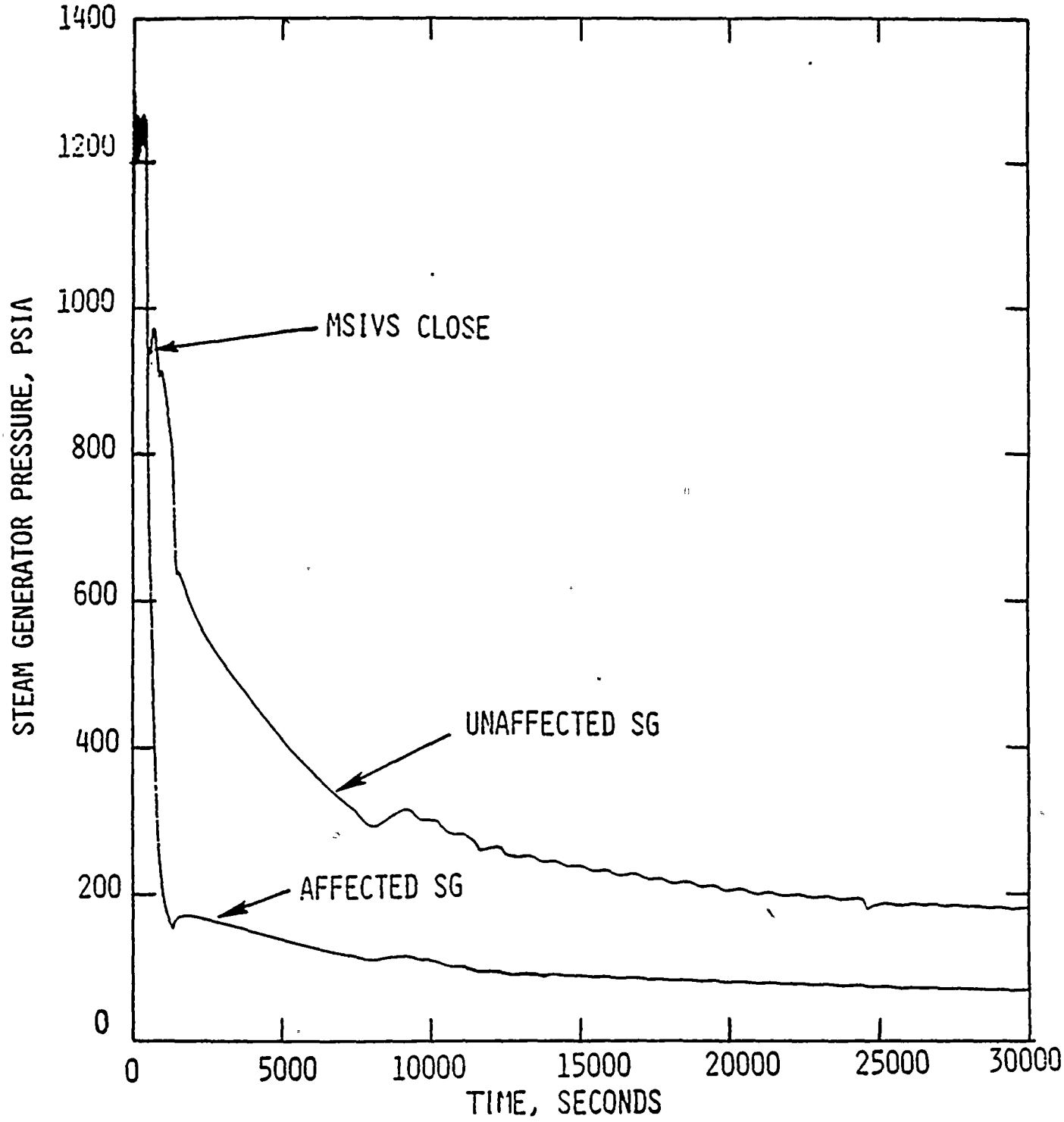


FIGURE 9

INTEGRATED AFW FLOW TO AFFECTED SG VS. TIME

(SHEET 1 OF 2)

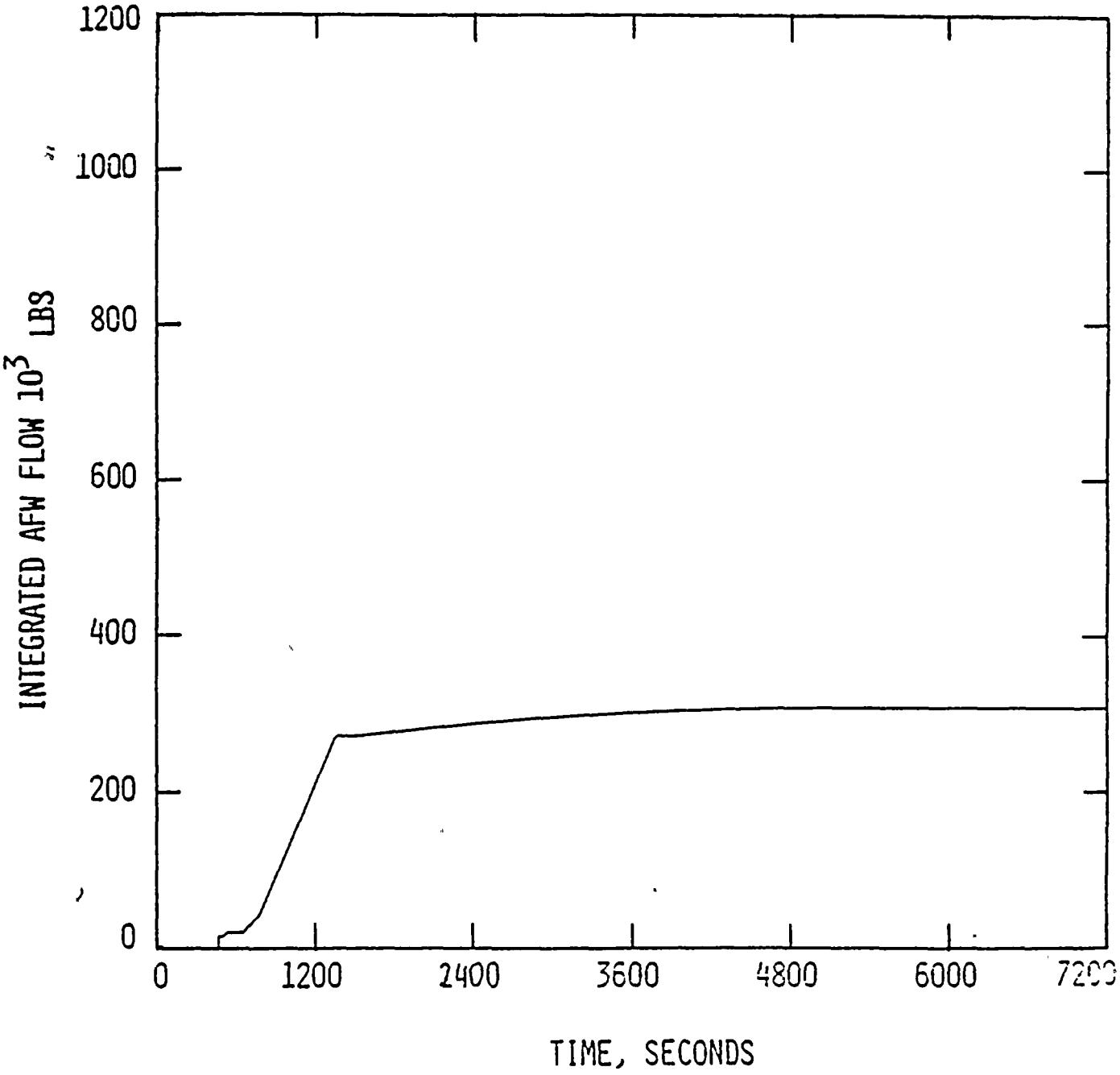


FIGURE 9

INTEGRATED AFW FLOW TO AFFECTED SG VS. TIME

(SHEET 2 OF 2)

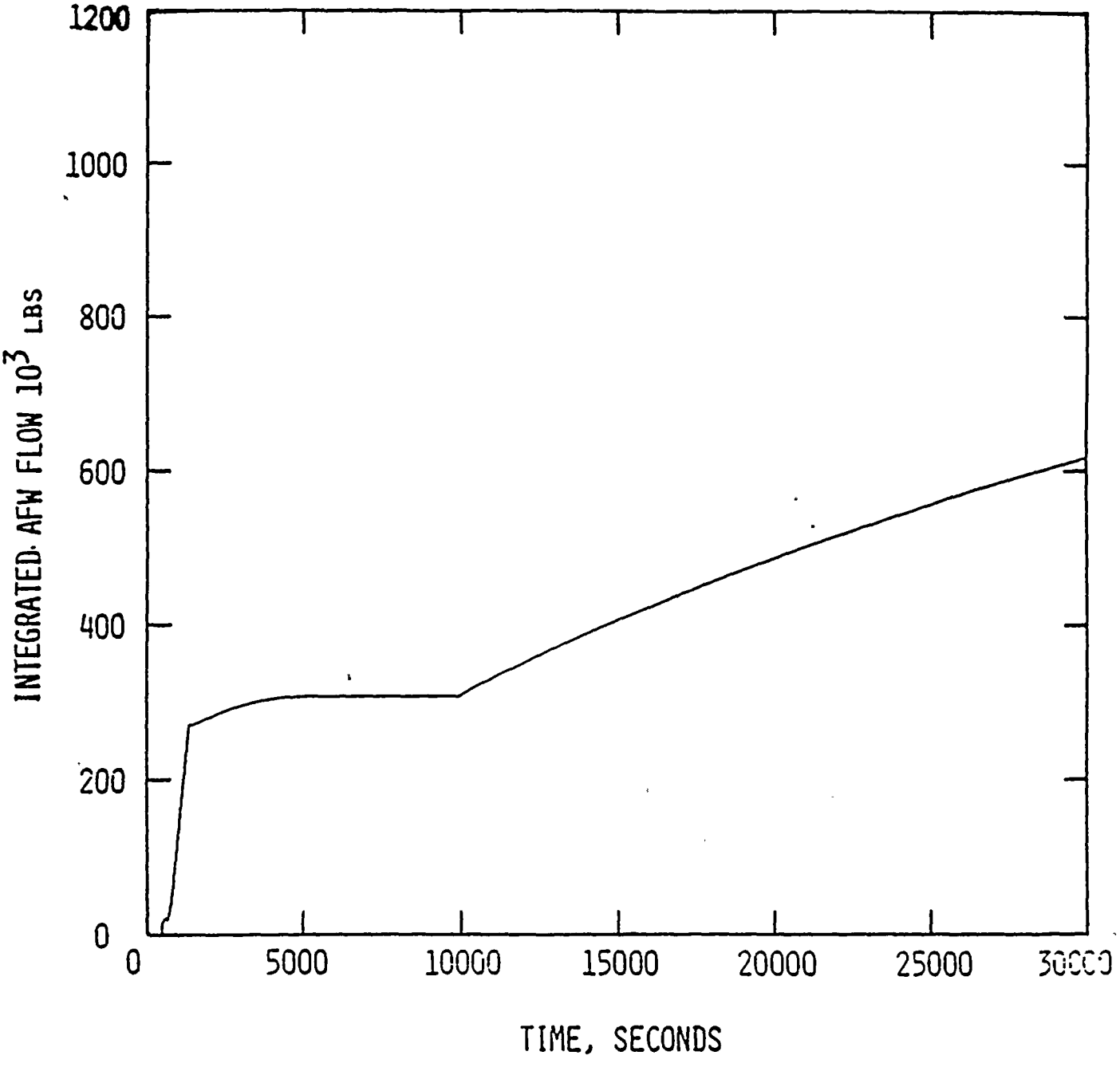


FIGURE 10
TUBE LEAK RATE VS. TIME
(SHEET 1 OF 2)

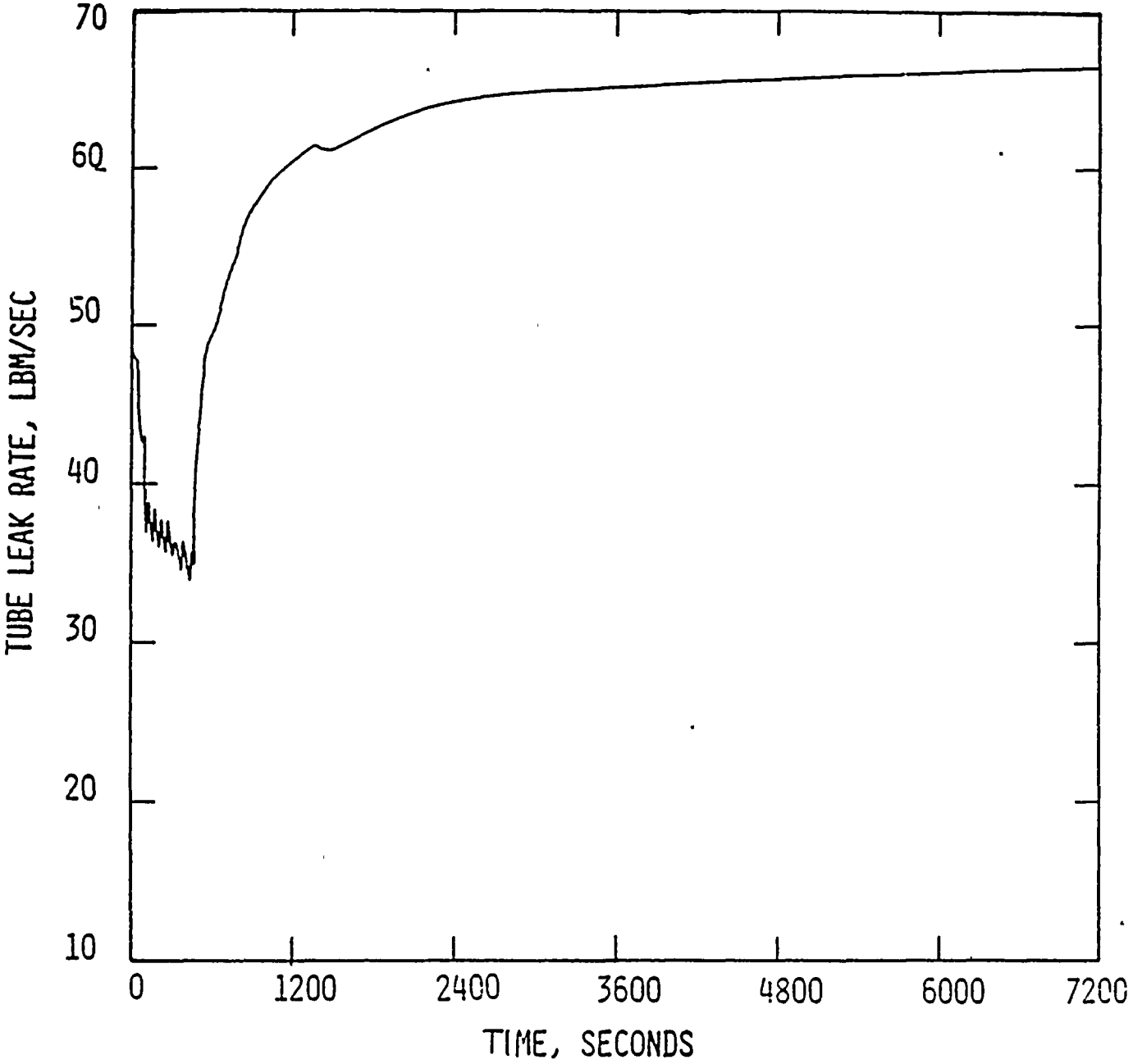


FIGURE 10
TUBE LEAK RATE VS. TIME
(SHEET 2 OF 2)

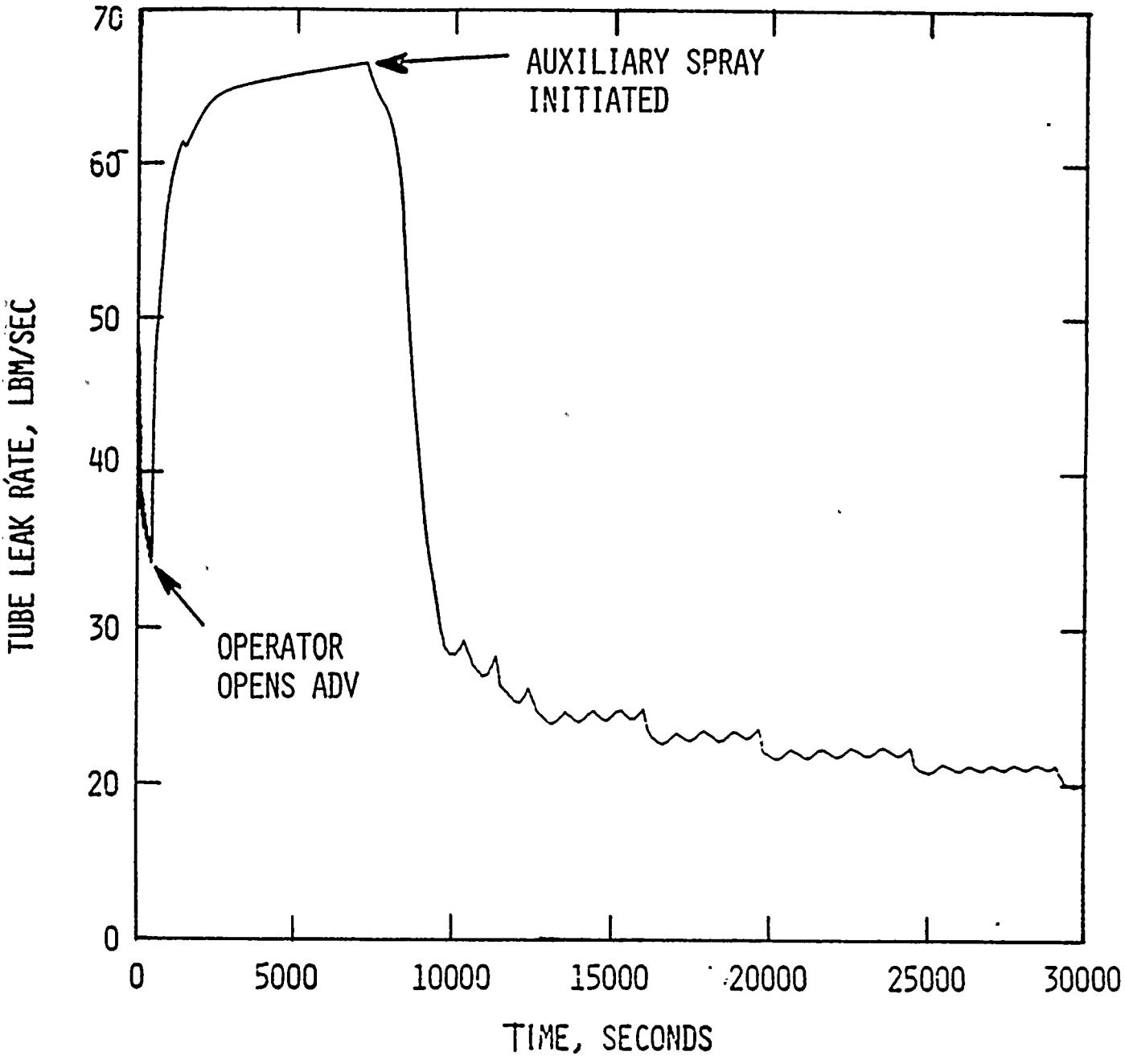


FIGURE 11

INTEGRATED LEAK FLOW VS. TIME

(SHEET 1 OF 2)

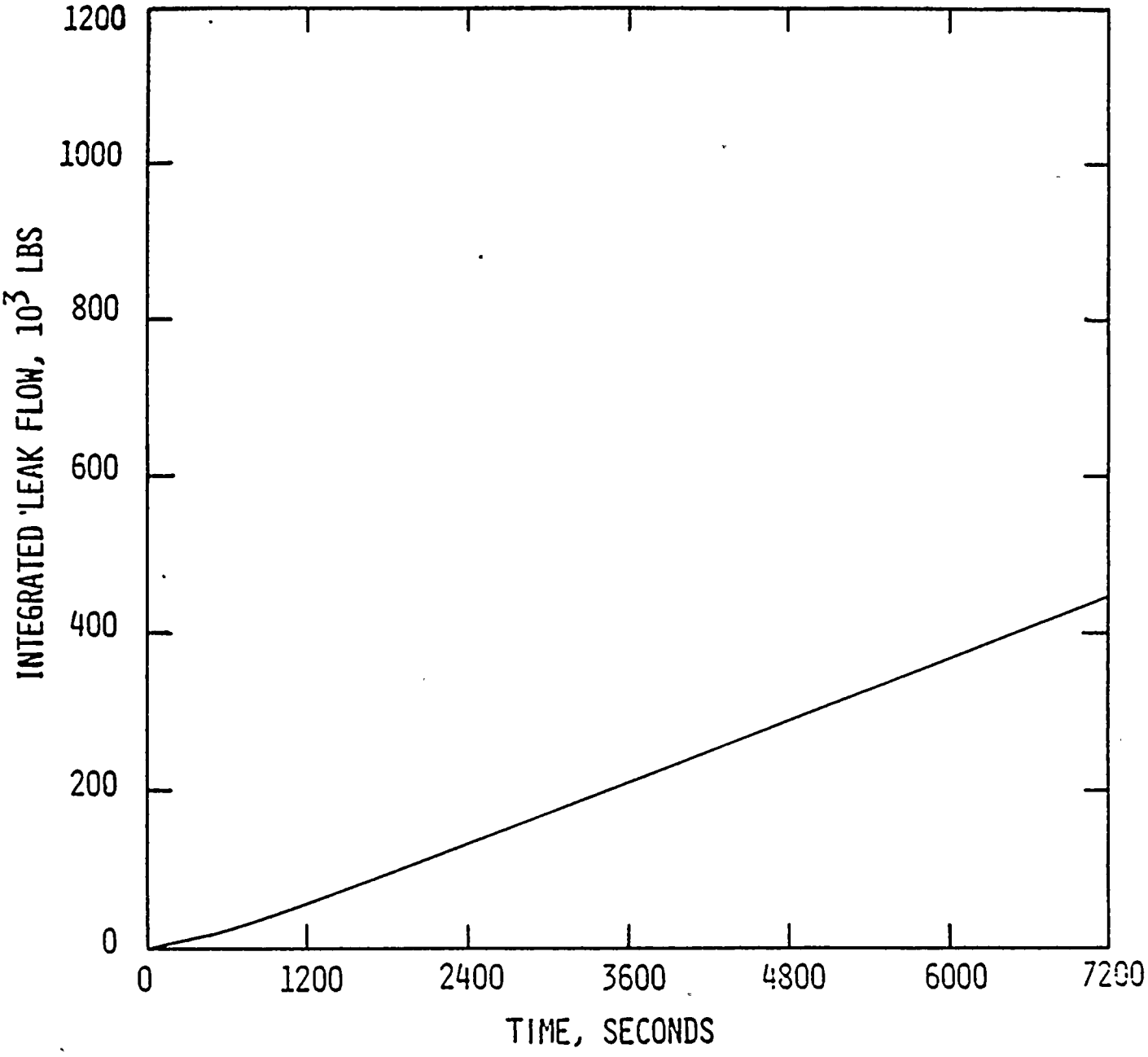


FIGURE 11

INTEGRATED LEAK FLOW VS. TIME

(SHEET 2 OF 2)

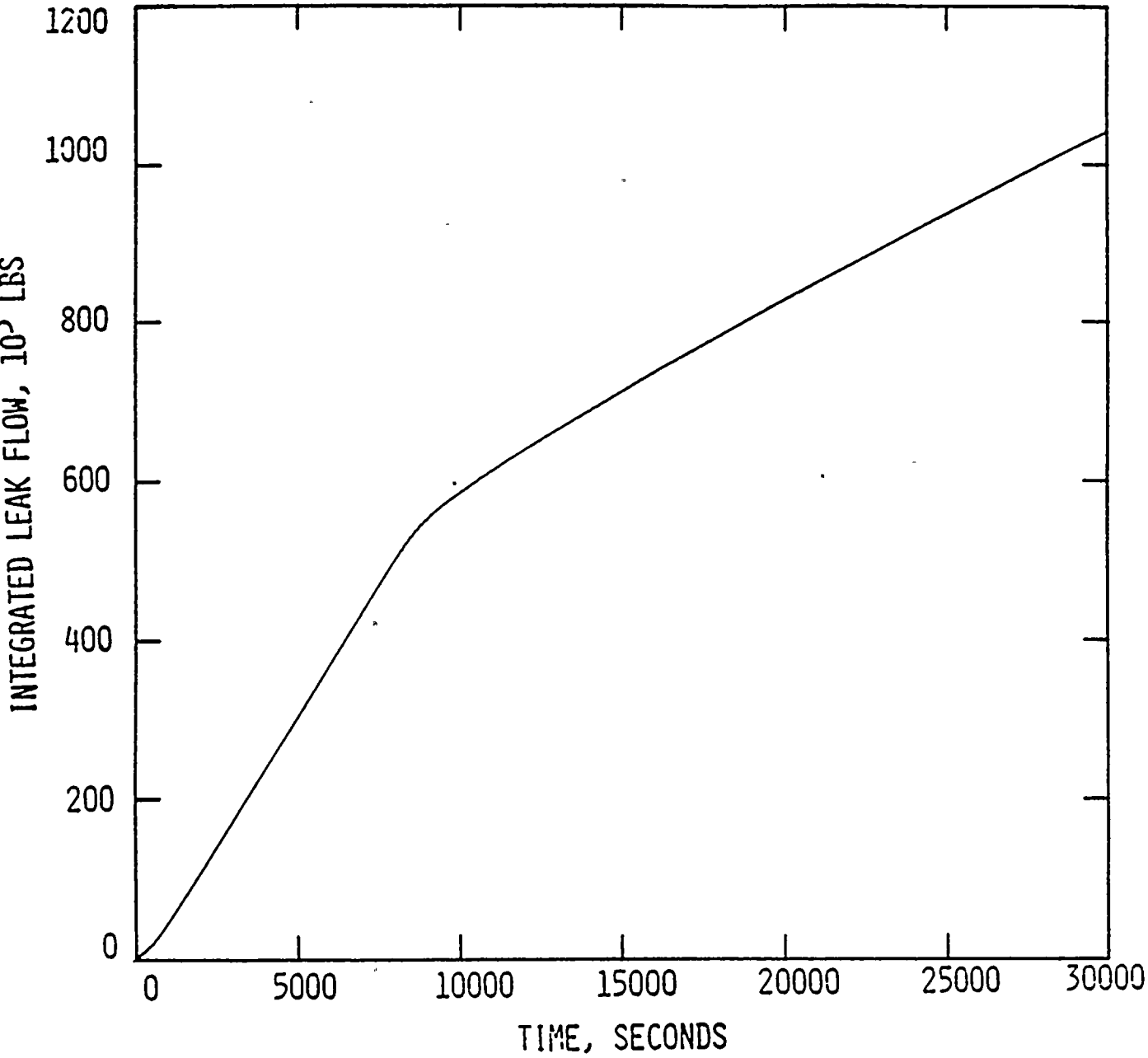


FIGURE 12
FRACTION OF LEAK FLASHED VS. TIME
(SHEET 1 OF 2)

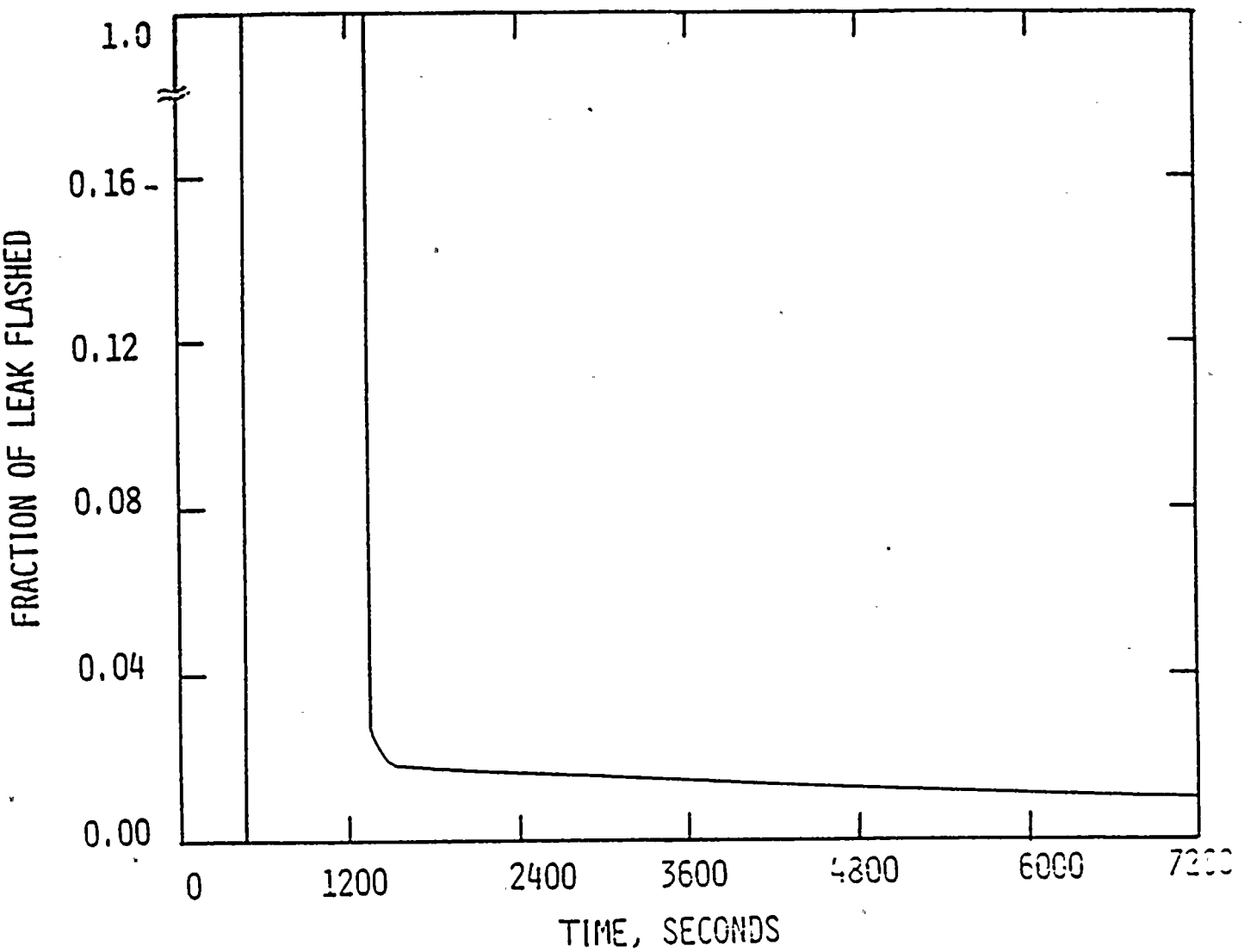


FIGURE 12
FRACTION OF LEAK FLASHED VS. TIME
(SHEET 2 OF 2)

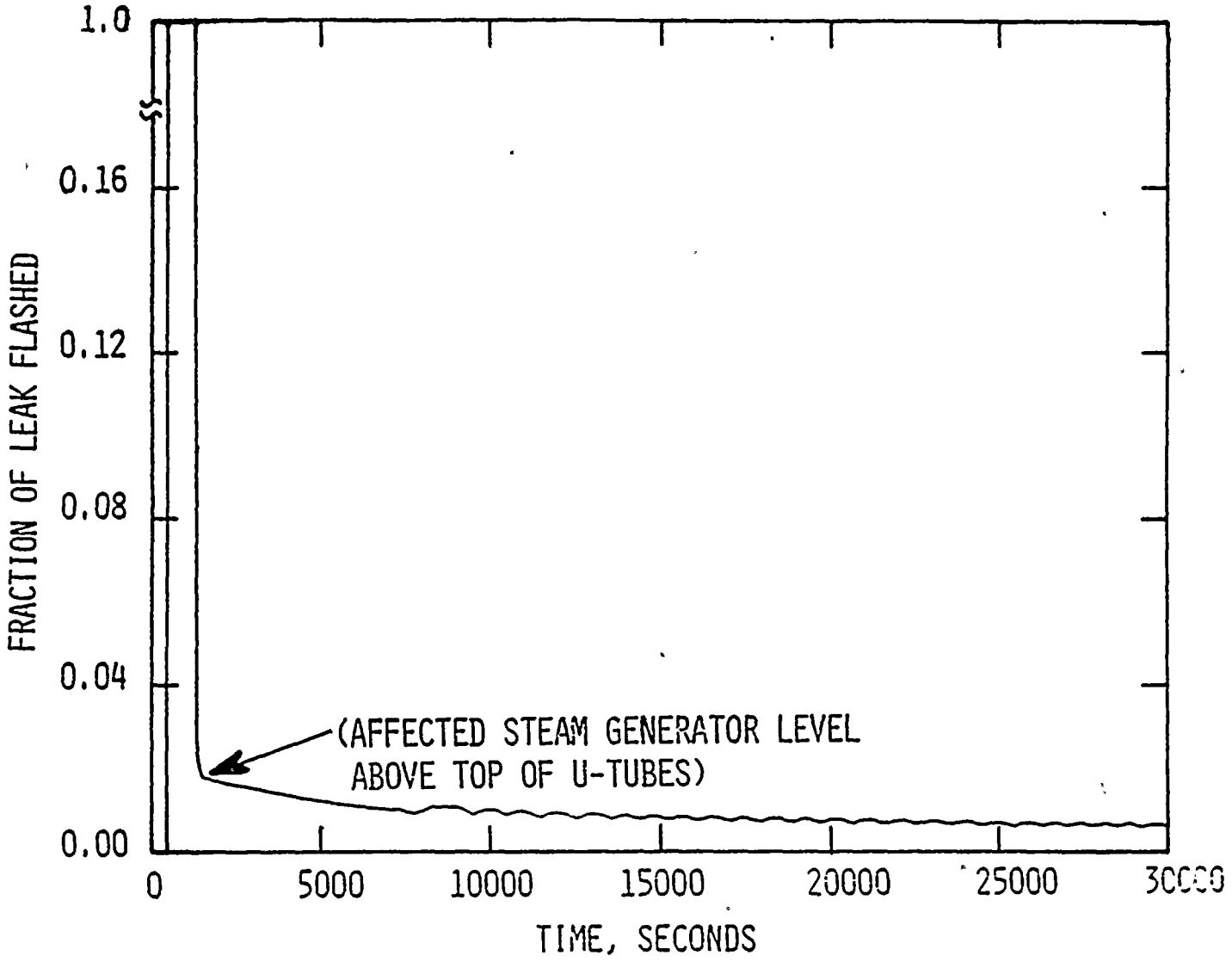


FIGURE 13
STEAM GENERATOR MASS VS. TIME
(SHEET 1 OF 2)

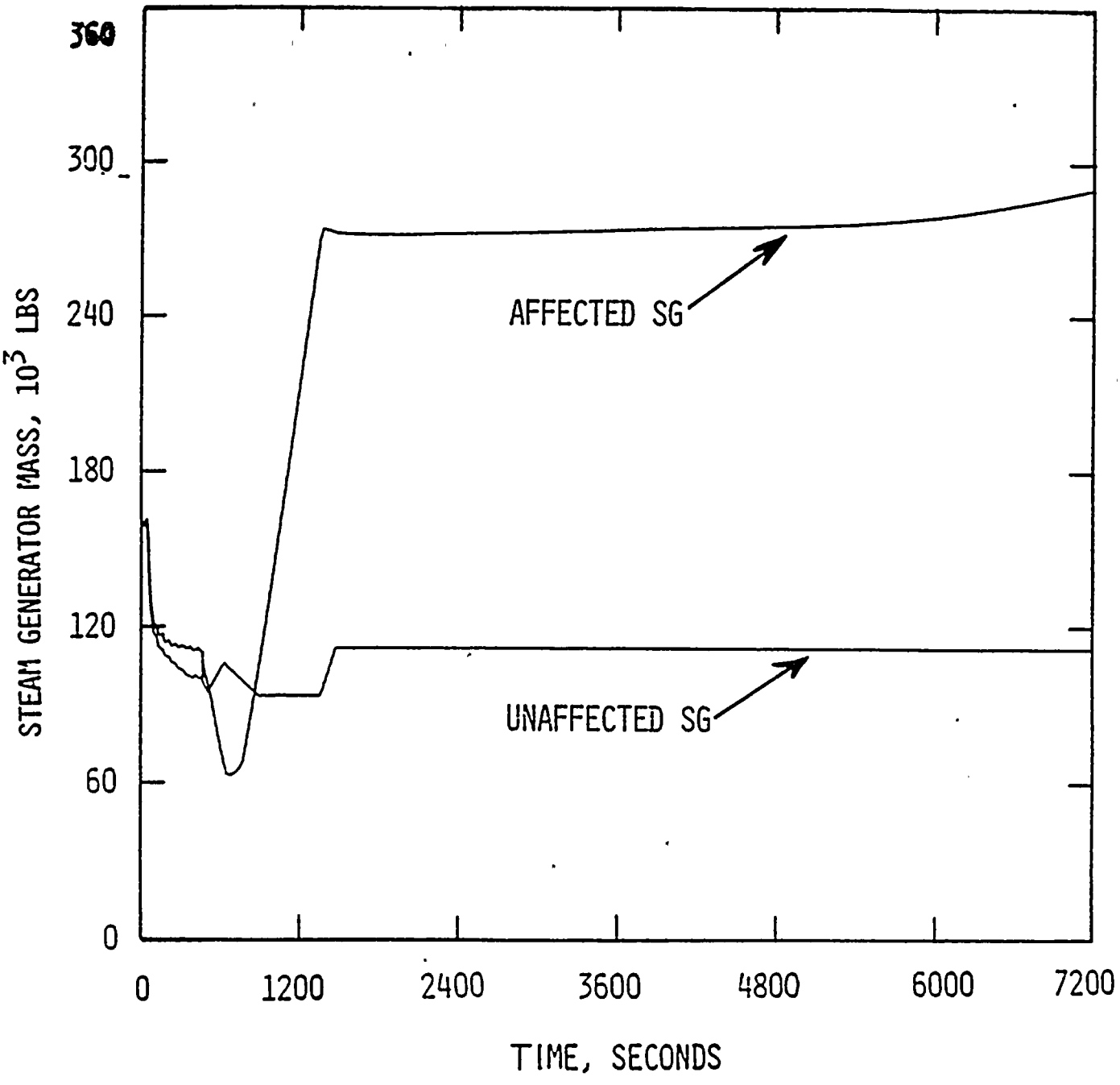


FIGURE 13

STEAM GENERATOR MASS VS. TIME

(SHEET 2 OF 2)

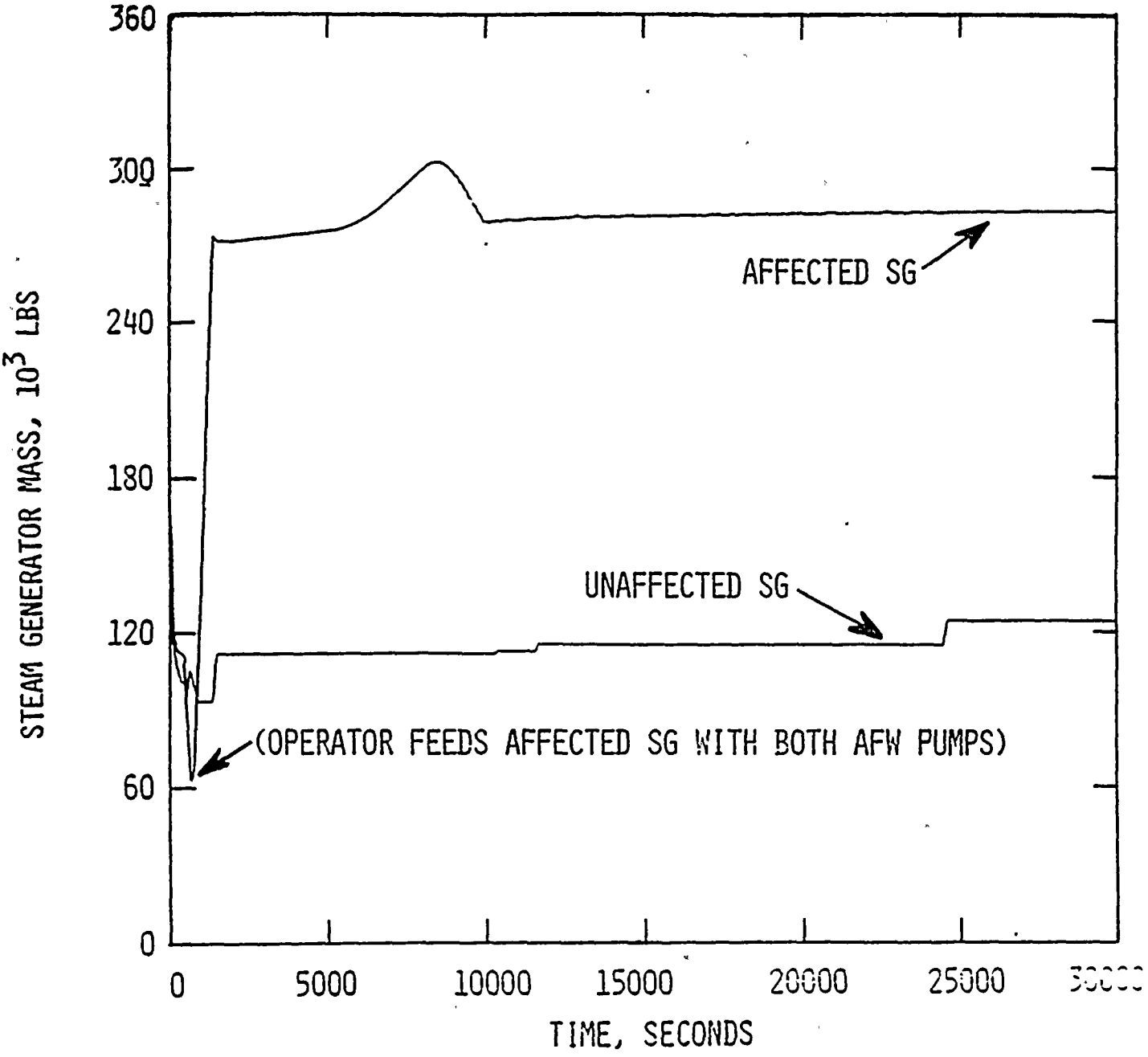


FIGURE 14
INTEGRATED ADV FLOW VS. TIME
(SHEET 1 OF 2)

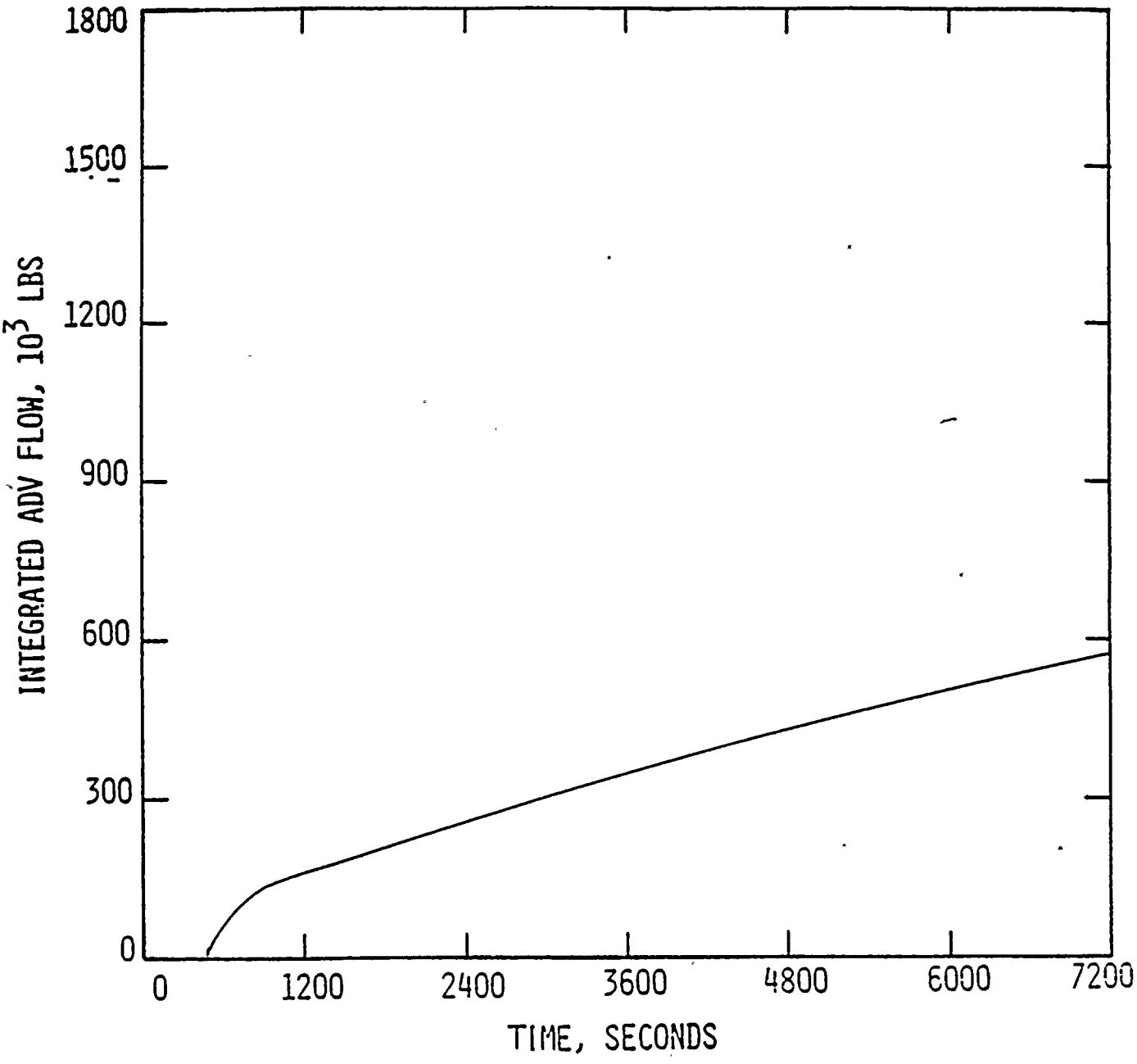
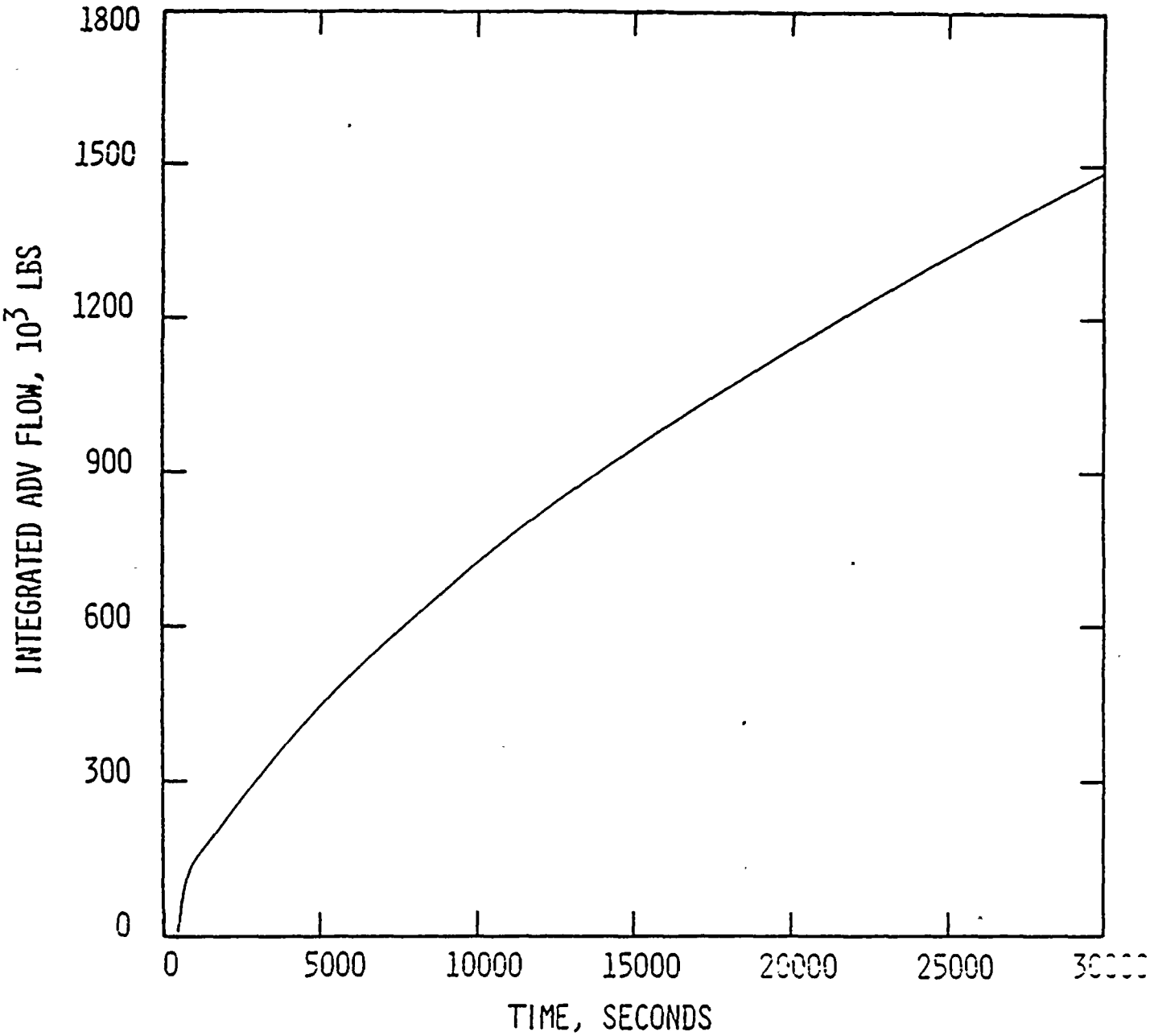


FIGURE 14
INTEGRATED ADV FLOW VS. TIME
(SHEET 2 OF 2)

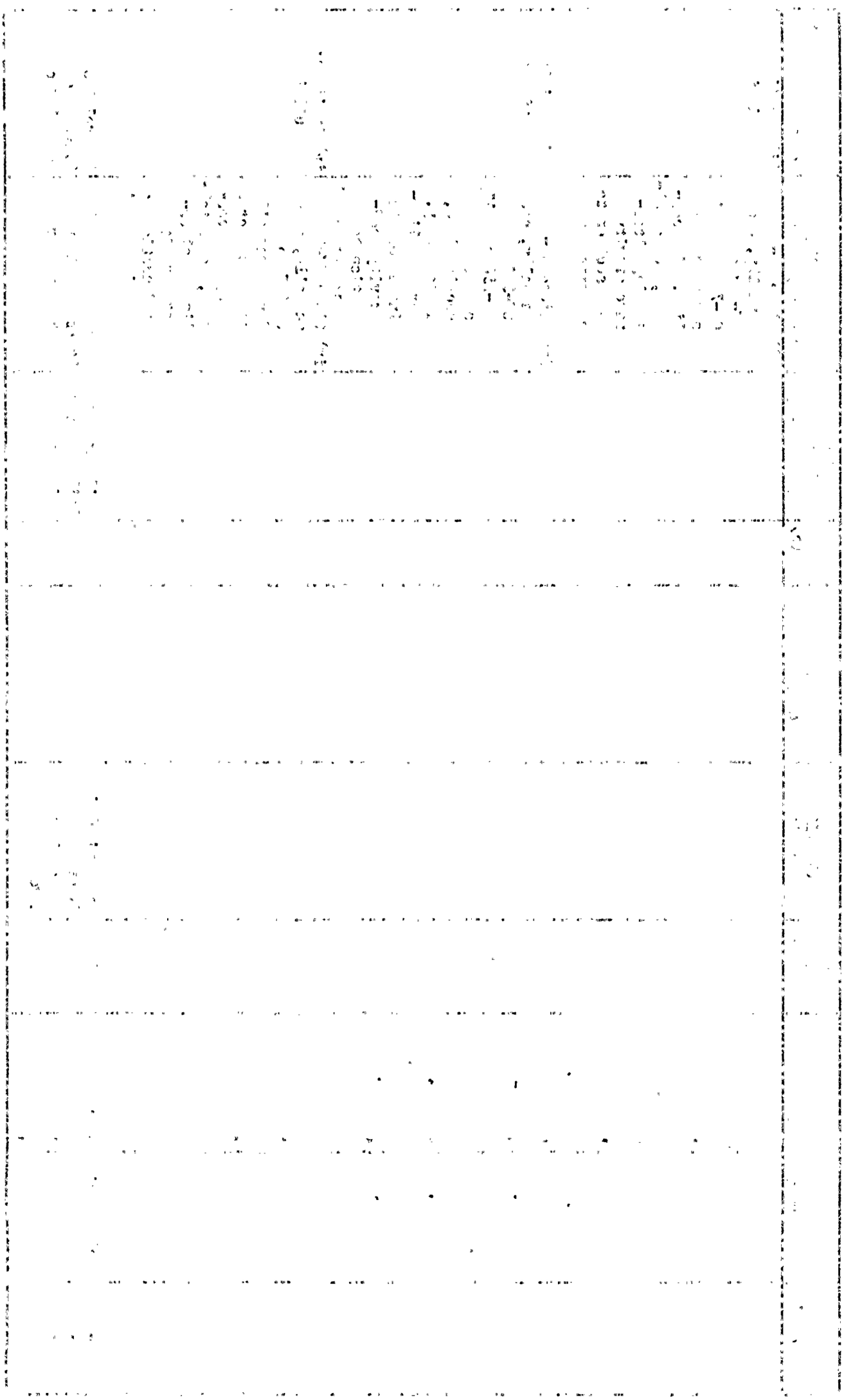


ATTACHMENT 2(a)
(Sheet 1 of 4)

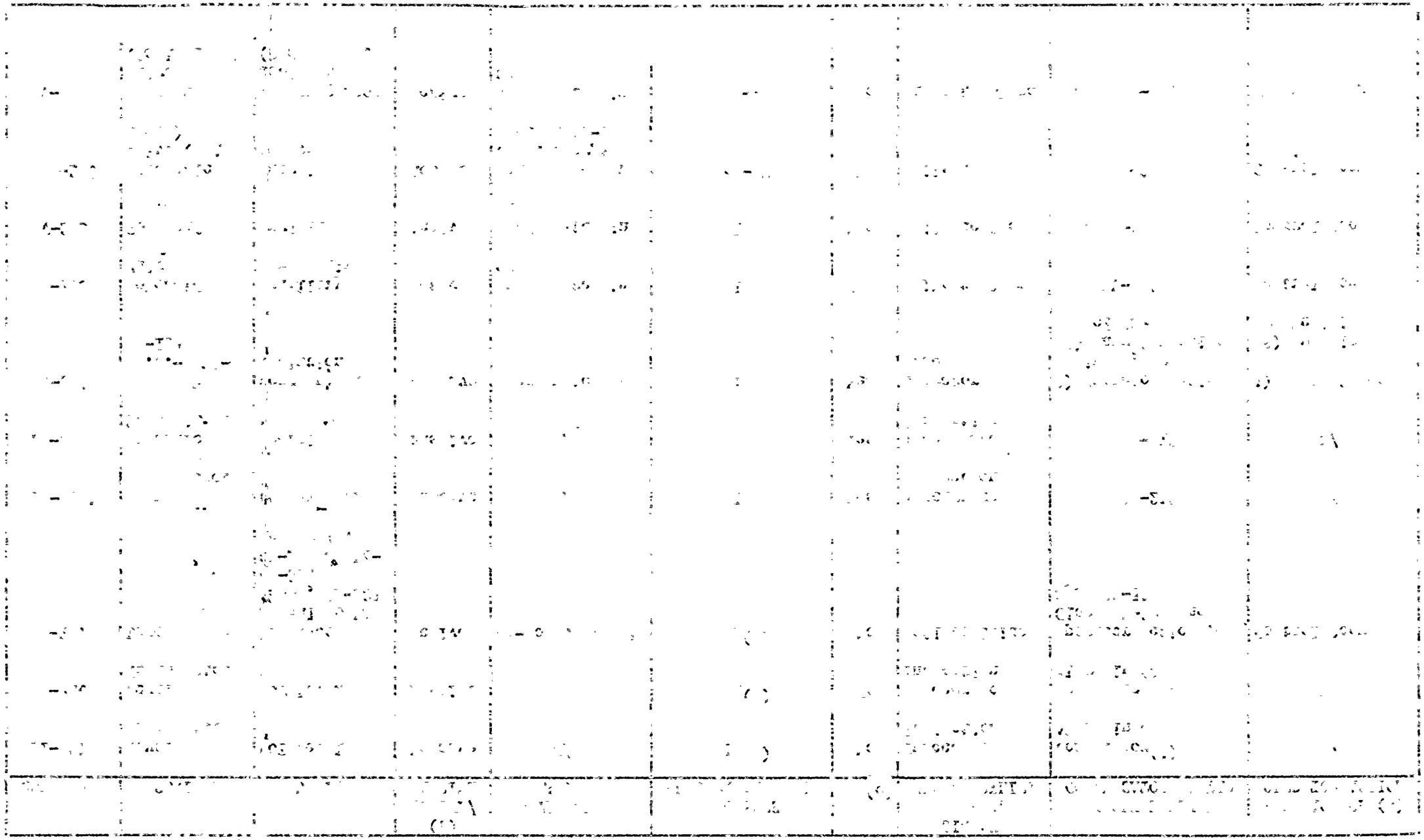
PVNGS AUXILIARY PRESSURIZER SPRAY AND CHARGING COMPONENT CAPABILITY SUMMARY

COMPONENT	DESCRIPTION	FUNCTION	(b) ACTIVE/ PASSIVE	ACTUATION SIGNAL	RECEIVES ELECTRICAL POWER	EQ(c)	SINGLE FAILURE VULNERABILITY	SINGLE FAILURE COMPENSATORY ACTION	LOCATION OF (d) OPERATOR ACTION
HV-532	Pneumatic Valve (Normally Open (NO) - Fail Open)	RWT Isolation	Passive	Hand Switch in Control Room (CR)	Non-IE	No	Operator Error	i) Operator Action to Reopen CH-532, or ii) Alignment of an alternate gravity feed path (via CH-327,755,756, 757)	i) Control Room ii) Auxiliary Building
HV-536(e)	Motor Operated Valve (MOV)	RWT Gravity Feed	Active	Hand Switch in CR or Lo-Lo VCT Level(g)	IE(f)	No	Fails to Open from CR	i) Open CH-536 manually, or ii) Establish alternate gravity feed suction by: a) Opening CH-327 and CH-757 for Charging Pump E, or b) Opening CH-327 and CH-756 for Charging Pump B, or c) Opening CH-327 and CH-755 for Charging Pump A	i) Auxiliary Building ii) Auxiliary Building
UV-501(e)	MOV	VCT Outlet Valve	Active	Hand Switch in CR or Lo-Lo VCT Level	IE(f)	No	Fails to Close from CR	i) Close CH-501 manually and Vent VCT, if necessary or	i) Auxiliary Building

COMPONENT	DESCRIPTION	FUNCTION	(h) ACTIVE/ PASSIVE	ACTUATION SIGNAL	RECEIVES ELECTRICAL POWER	EQ(c)	SINGLE FAILURE VULNERABILITY	SINGLE FAILURE COMPENSATORY ACTION	LOCATION OF (e) OPERATOR ACTION
								ii) Close CH-322 manually, open CH-327 and CH-757 manually and vent suction line, if necessary, for establishing alternate gravity feed suction to charging pump E	ii) Auxiliary Building
								iii) Close CH-319 manually, open CH-327 and CH-756 manually and vent suction line, if necessary, for establishing alternate gravity feed-suction to charging pump B	iii) Auxiliary Building
								iv) Close CH-316 manually, open CH-327 and CH-755 manually and vent suction line, if necessary, for establishing alternate gravity feed suction to charging pump A	iv) Auxiliary Building
CHA-P01 CHB-P01 CHE-P01	Reciprocating Pumps	Charging Pumps	Active	Hand Switch in CR or Pressurizer Level	IE	Yes	Fails to Start Fails to Start Fails to Start	Start Pump B or E Start Pump A or E Start Pump A or B	Control Room Control Room Control Room



COMPONENT	DESCRIPTION	FUNCTION	(b) ACTIVE/ PASSIVE	ACTUATION SIGNAL	RECEIVES ELECTRICAL POWER	EQ(c)	SINGLE FAILURE VULNERABILITY	SINGLE FAILURE COMPENSATORY ACTION	LOCATION OF (d) OPERATOR ACTION
LT-227	Level Transmitter	VCT Level	Passive	N/A	IE(h)	No	Inaccurate Indication	Comparator(i) Alarm in CR	N/A
LT-226	Level Transmitter	VCT Level	Passive	N/A	IE(h)	No	Inaccurate Indication	Comparator(i) Alarm in CR	N/A
LS-227	Level Switch	Provides signal to BAM Pumps, CH-501 CH-514 and CH-536 on Lo-Lo VCT level	Active	Lo-Lo VCT level	IE(h)	No	Fail to Switch	Operator Action to Close CH-501 and Open CH-536	Control Room
FT-212	Flow Transmitter	Charging Flow	Passive	N/A	IE	Yes	Inaccurate Indication	PT-212	N/A
PT-212	Pressure Transmitter	Charging Pressure	Passive	N/A	IE	Yes	Inaccurate Indication	FT-212	N/A
HV-524	MOV (N.O.-Fail-As-Is)	Containment Isolation	Passive	Hand Switch in CR	IE	Yes	Operator Error	i) Operator Action in CR, or ii) Manual Opening of CH-524	i) Control Room ii) Auxiliary Building
HV-203	Solenoid Valve	Auxiliary Spray Valve	Active	Hand Switch in CR	IE	Yes	Fails to Open	Open HV-205	Control Room
HV-205	Solenoid Valve	Auxiliary Spray Valve	Active	Hand Switch in CR	IE	Yes	Fails to Open	Open HV-203	Control Room
PDV-240	Pneumatic Valve (Fail Close)	Charging Control	Active	Hand Switch in CR or Charging Line delta-P	Non-IE	No	Fails to Close	Close HV-239	Control Room
HV-239	Pneumatic Valve (Fail Close)	Charging Loop Isolation (Redundant to PDV-240)	Active	Hand Switch in CR	Non-IE	No	Fails to Close	Close PDV-240	Control Room



NOTES:

(a) The modifications discussed in Attachment 3 are reflected in this Attachment.

(b) An active component is defined as a component which is required to function for operation of the auxiliary pressurizer spray or charging capability. A passive component is defined as a component which is not required to function for operation of the auxiliary pressurizer spray or charging portions of the CVCS, however, the component may provide the operator with system performance indication. Therefore, the failure of these components were considered in this review.

(c) Environmental Qualification (EQ) per requirements of 10CFR50.49.

(d) CH-327 Auxiliary Building, Elevation 74'
CH-755, 756, 757 Auxiliary Building, Elevation 100'
CH-501 Auxiliary Building, Elevation 100'
CH-316, 319, 322 Auxiliary Building, Elevation 100'
CH-524, Auxiliary Building, Elevation 88'

(e) NRC Memorandum dated October 6, 1981, "Summary of September 17, 1981 Meeting Regarding CE Appeal of Staff Positions", Item 5, states that the staff required CH-141 (now CH-536) and CH-501 to be operable from the control room, but accepted control-grade operators for these valves provided power is supplied from a vital bus.

(f) Design change will provide power to valves HV-536 and UV-501 from a IE Motor Control Center (MCC). This MCC remains powered on a SIAS and is resequenced on a loss of offsite power.

(g) Design change to implement automatic opening of HV-536 on Lo-Lo VCT level and a loss of offsite power.

(h) Transmitters are automatically switched to a IE power source on LOP.

(i) Design change to implement separate wet/dry reference legs for VCT level transmitters, and to provide a comparator alarm, in the control room, to indicate a difference in indication between transmitters LT-226 and LT-227.

(2)

(3)

(4)

(5)

(6)

(7)

ATTACHMENT 3

RESULTS OF ENGINEERING EVALUATION OF SEPTEMBER 12 EVENT

EVALUATION

In response to the Unit 1 outage on September 12 1985, ANPP conducted an engineering evaluation of the design and operation of the PVNGS charging and auxiliary pressurizer spray systems (APSS). The objectives of the evaluation were to 1) review and verify conformance to the licensing basis for the system, 2) compare the performance of the system during the September 12 outage against its design function, 3) examine the system for vulnerabilities and 4) determine the ability of operator action required to compensate for system and component malfunctions. The evaluation consisted of a coordinated multi-disciplined review by ANPP, Combustion Engineering and Bechtel engineering and the ANPP Operations Department. It included a detailed review of the system, identifying each component according to its safety classification and function during auxiliary spray and charging system operation, and a single failure analysis. Attachment 2 summarizes the system, its component functions, and the operator actions required to accommodate active component failures.

The evaluation of the design and operation of the APSS determined the system, as designed, to be in accordance with the licensing basis for this system. Recognizing that operator action outside the control room may be required to accommodate single active failures, it is concluded that all presently postulated operator actions are acceptable and consistent with BTP RSB 5-1 Class 2 plants. No mechanical or piping enhancements, such as additional redundant valves or flow paths, are necessary to meet the licensing basis for PVNGS.

However, our evaluation determined a system enhancement could be made to prevent a failure to isolate the Volume Control Tank (CH-501 fails to close) upon loss of liquid inventory, resulting in introduction of the VCT hydrogen cover gas into the charging pump suction piping. If this condition were to occur during a loss of off-site power, the reasonable operator action to

recover from this condition would require closing the manual isolation valves on the individual charging pump suction lines (see Figure 1 of this Attachment 3) thereby isolating the VCT from the charging pumps, venting off the short section of piping between the isolation valves and the charging pumps, and aligning an alternate gravity feed line from the Refueling Water Tank (RWT) by opening manual valves CH-327 and CH-755 through -757. This action can be taken and the system restored to operable status within the two hour time requirement established in the revised Steam Generator Tube Rupture analysis. However, to minimize operator actions, enhancements in the reliability of the Volume Control Tank (VCT) level instrumentation, the power supply to valves CH-501 (VCT outlet valve) and CH-536 (RWT gravity feed line), and in the provision for automatic realignment of the charging pumps to alternate suction sources will be made to reduce the potential for gas binding the charging pumps, provide a large reduction in the potential for loss of auxiliary pressurizer spray and charging capability and result in system capabilities commensurate with the system usage.

DESIGN MODIFICATIONS OBJECTIVES

The objectives of the three modifications to the Palo Verde design that will be implemented are to:

1. Improve the operator's ability to operate the charging/auxiliary spray system from the control room,

2. Provide an automatic function to reduce the amount of required operator action, and

3. Improve the reliability of control grade level instrumentation on the Volume Control Tank.

DESIGN MODIFICATIONS

° Provide power to Valves CH-501 and CH-536 From an IE MCC

The existing PVNGS design is such that the non-IE Motor Control Center (MCC) associated with valves CH-501 and CH-536 is automatically shed on a Safety Injection Actuation Signal (SIAS). The power supply to

these valves will be modified to provide power from Class IE Motor Control Center (MCC) M-35. The cable used to connect these valves to the Class IE MCC does not meet Class IE standards, therefore, an appropriate isolation device consisting of two Class IE breakers in series will be provided to meet the requirements of IEEE 279 (see Figure 3). The MCC M-35 that will supply valves CH-501 and CH-536 is not automatically shed from the Class IE bus on a Safety Injection Actuation Signal (SIAS) and is automatically sequenced on to the Emergency Train A Bus following a Loss of Off-site Power (LOP). Therefore, this design change accomplishes design objective number 1.

° Enhanced Automatic Realignment to the RWT

To eliminate the need for the operator to manually align the suction of the charging pumps to the RWT, the existing automatic transfer on lo-lo VCT level indication feature will be enhanced. With the existing design, a lo-lo VCT level indication causes the automatic realignment of the charging pumps to the Boric Acid Make-up Pump flow path by opening valve CH-514 and closing valve CH-501. A design modification will be implemented to allow automatic realignment to the RWT gravity feed line via valve CH-536 on lo-lo VCT level when the non-class IE powered Boric Acid Make-up Pump flow path is unavailable due to loss of off-site power. This will be accomplished by instrumentation sensing a loss of power to valve CH-514 and causing valve CH-536 to open then on lo-lo VCT level signal. Thus, alignment of the charging pumps will be selectively made to either of two flow paths from the RWT depending on whether off-site power is available. This modification will accomplish design objective number 2.

° Enhanced VCT Level Instrumentation

The VCT level monitoring system will be modified to significantly reduce the potential for malfunction (with subsequent loss of automatic control functions) or incorrect operator action based on erroneous level indication.

The incorrect level in the common reference leg to LT-226 and LT-227 in the existing design that caused the erroneous level indication during the September 12 event was caused by a partially drained reference leg. The modification will be to install separate reference legs, one wet and one dry, to each of two (existing) level transmitters, LT-226 and LT-227 (see Figure 4). This diverse redundancy minimizes the potential for incorrect level indication by eliminating the potential for a partially drained wet reference leg going undetected.

A signal comparator will be added to alarm in the control room on the transmitters indicating a level difference. This alarm will alert the operator to possible incorrect indication or malfunction of either transmitter. This modification will accomplish design objective number 3.

SUMMARY

With these three modifications, the operability of the charging and auxiliary spray systems is significantly enhanced and the potential for loss of system function is significantly reduced. In the unlikely event that system function is temporarily lost due to active component failures, acceptable operator action in accordance with BTP RSB 5-1 for a Class 2 plant will restore the system to operable status.

SIMPLIFIED SCHEMATIC OF PALO VERDE CVCS SHOWING AUXILIARY SPRAY PORTION AND SOURCES OF BORATED WATER

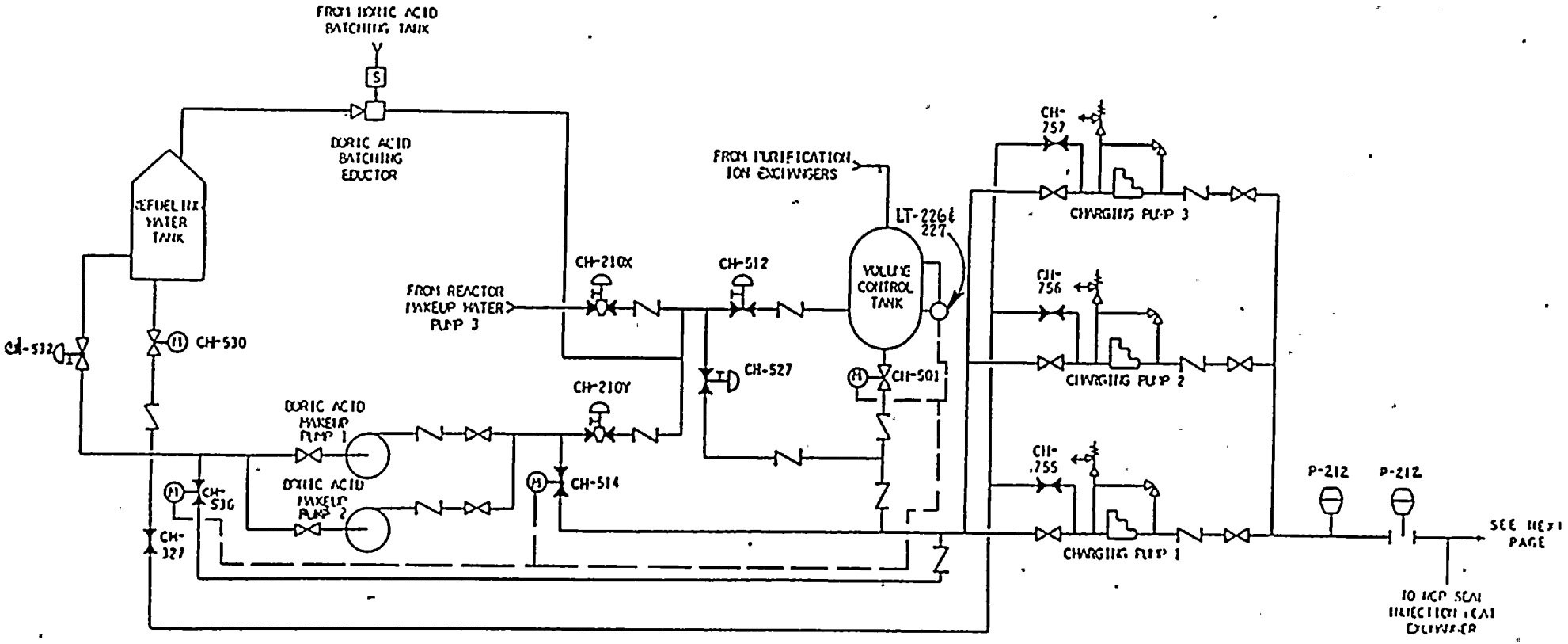


FIGURE 1

SIMPLIFIED SCHEMATIC OF PALO VERDE CVCS SHOWING AUXILIARY PORTION AND SOURCES OF BORATED WATER

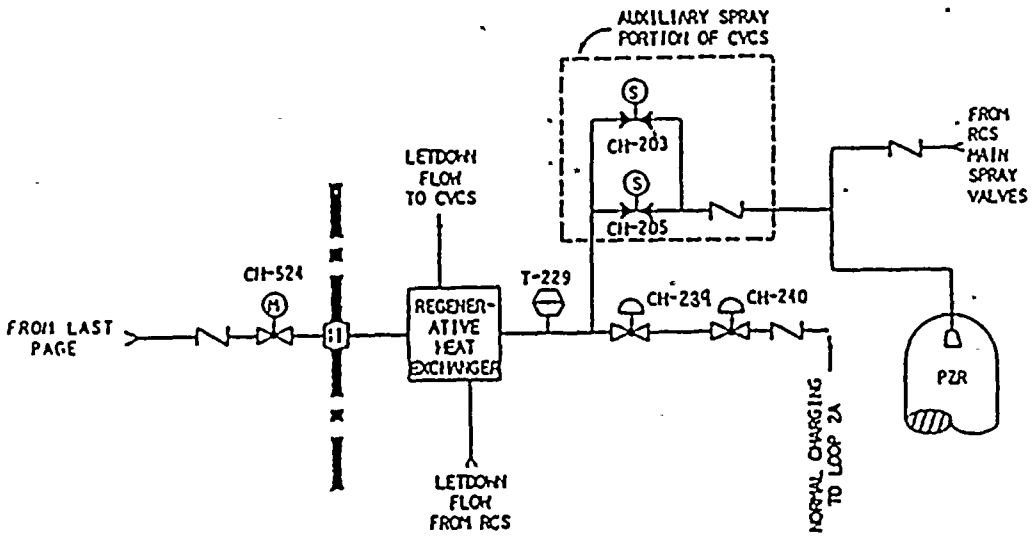
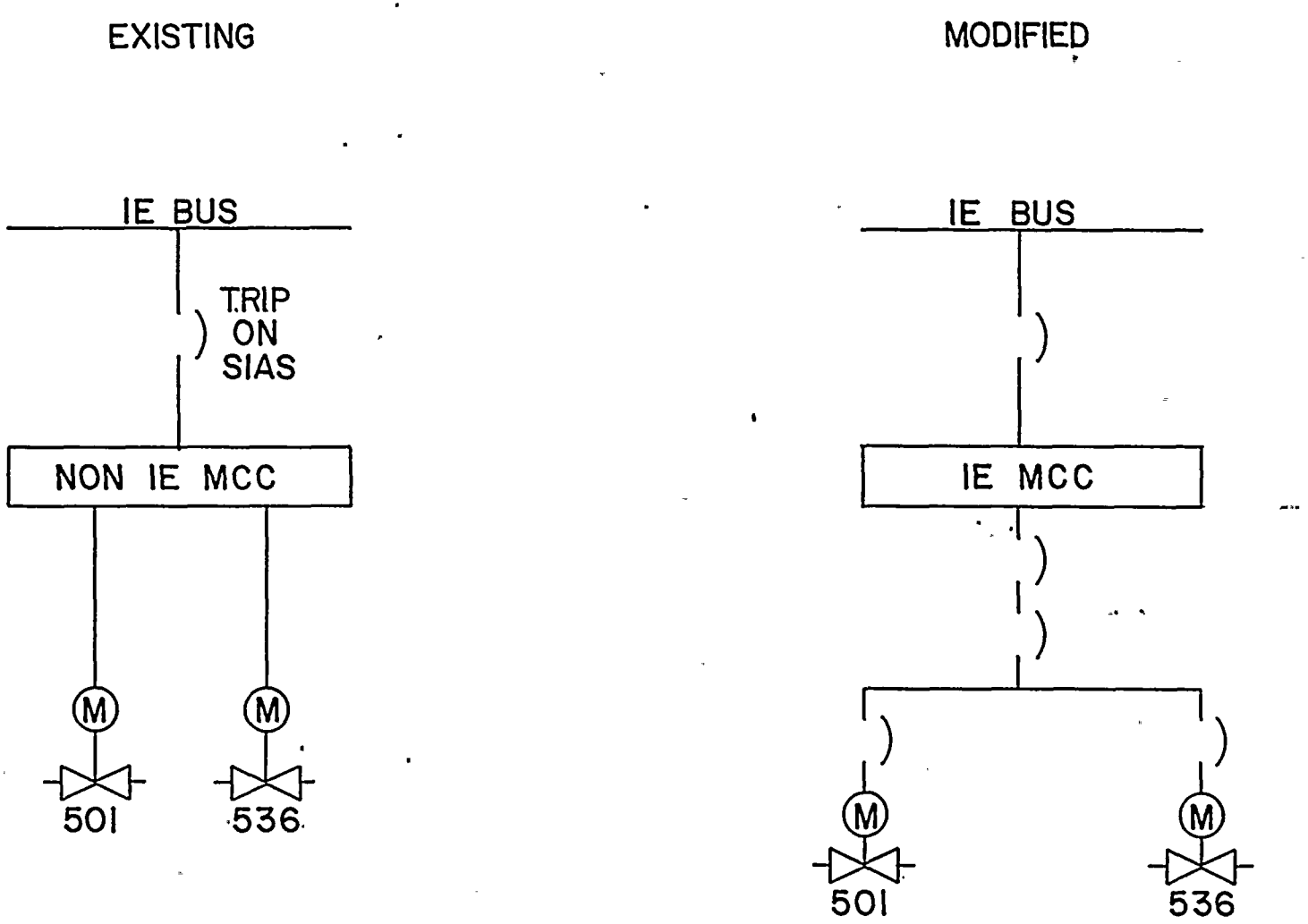


FIGURE 2

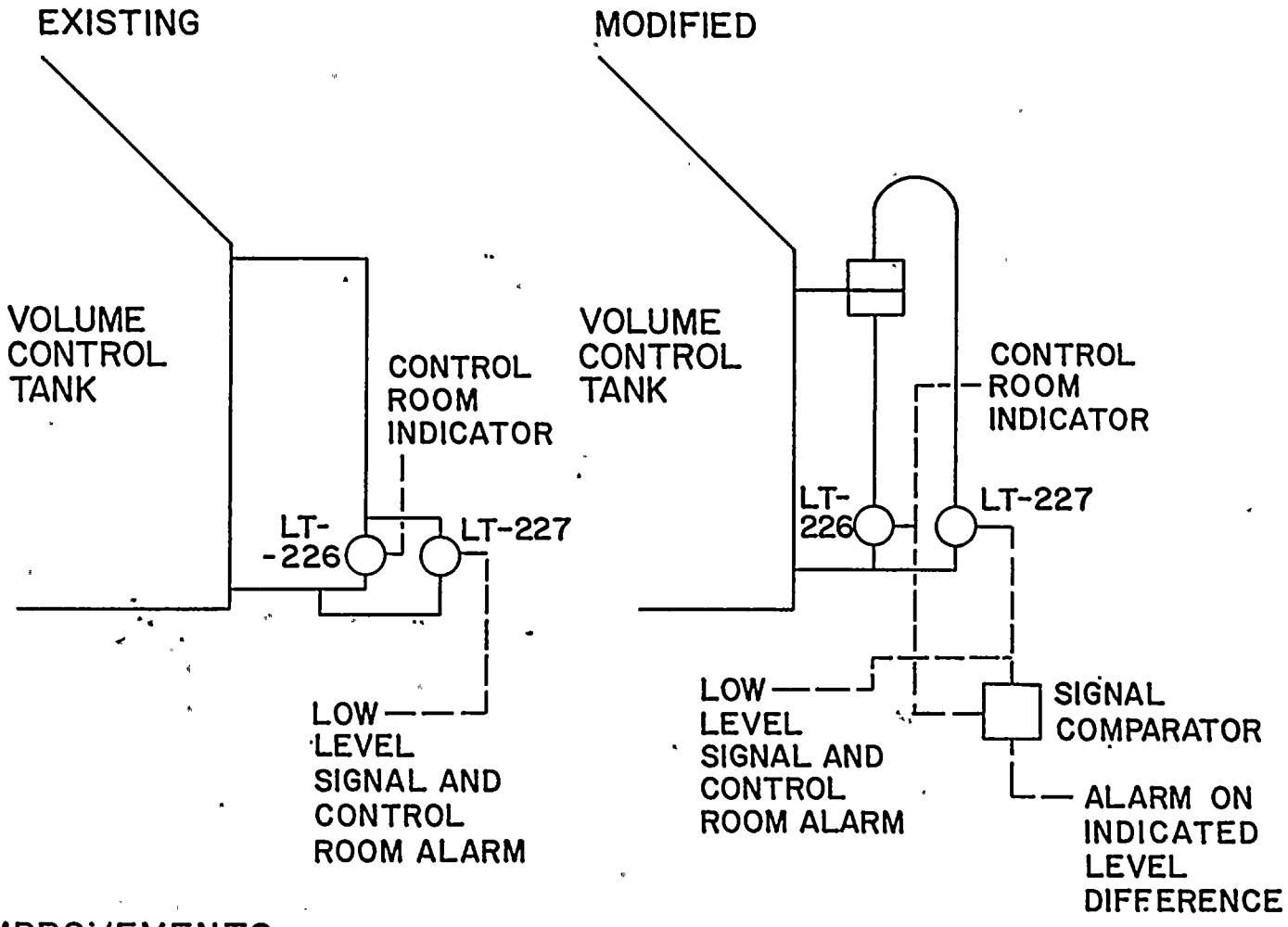
VALVE POWER SUPPLY CHANGE



CHANGE ENSURES OPERABILTY FROM CONTROL ROOM AFTER SIAS AND LOP SUCH THAT SUCTION COULD BE ALIGNED TO RWT FROM VCT.

FIGURE 3

VOLUME CONTROL TANK LEVEL INDICATION



IMPROVEMENTS

1. SEPERATE REFERENCE LEG TO EACH TRANSMITTER
2. ONE WET AND ONE DRY LEG TO PROVIDE DIVERSE REFERENCE
3. COMPARATOR ALARM PROVIDES INDICATION OF POSSIBLE LOSS OF CORRECT REFERENCE TO ONE OF THE TRANSMITTERS

FIGURE 4