Arizona Public Service Company
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September 13, 1983
ANPP-27792 - WFQ/TFQ

Director of Nuclear Reactor Regulation
Attention: Mr. George Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

CORRECTED COPY

Subject: Palo Verde Nuclear Generating Station
(PVNGS) Units 1, 2 and 3
Docket Nos. STN-50-528/529/530
File: 83-056-026; G.1.01.10

Reference: Letter from A. E. Scherer, CE to D. G. Eisenhut, NRC, LD-83-066, dated July 22, 1983.

Dear Mr. Knighton:

Attached for your review is the PVNGS Steam Generator Tube Rupture (SGTR) analysis. This analysis refers to applicable sections of the CESSAR-F SGTR analysis, which is attached to the referenced letter. The attached analysis will be included in an upcoming PVNGS FSAR amendment.

Please contact me if you have any questions on this matter.

Very truly yours,

E. E. Van Brunt

E. E. Van Brunt, Jr.
APS Vice President,
Nuclear Projects
ANPP Project Director

EEVBJR/TFQ/sp
Attachment

cc: E. A. Licitra (w/a)
C. Liang "
A. C. Gehr "

September 13, 1983
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STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, Edwin E. Van Brunt, Jr., represent that I am Vice President Nuclear Projects of Arizona Public Service Company, that the foregoing document has been signed by me on behalf of Arizona Public Service Company with full authority so to do, 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, Jr.

Edwin E. Van Brunt, Jr.

Sworn to before me this 13th day of September, 1983.

Nora E. Mentor

Notary Public

My Commission expires:

My Commission Expires April 6, 1987

15.6.3.3 STEAM GENERATOR TUBE RUPTURE WITH A LOSS OF OFFSITE POWER AND SINGLE FAILURE

15.6.3.3.1 IDENTIFICATION OF EVENT AND CAUSES

Refer to CESSAR Section 15D.1. Additionally, it is assumed that the ADV of the affected steam generator remains open throughout the transient. In CESSAR Section 15.D.1 it is assumed that the operator is able to isolate the ADV by closing the associated block valve. The ADVs of the Palo Verde Nuclear Generating Station Units 1, 2, and 3 do not have block valves.

15.6.3.3.2 SEQUENCE OF EVENTS AND SYSTEMS OPERATION

This section is the same as CESSAR Section 15D.2 with the following differences:

1. The operator opens one ADV in each steam generator in order cool the RCS to 550°F at the PVNGS plant procedure specific maximum cooldown rate of 75°F/hr. This cooldown rate translates into a 10.5% opening of one ADV of each steam generator.

2. When the RCS temperature is below 550°F the operator unsuccessfully attempts to close the ADV of the affected steam generator. The ADV of the affected steam generator is assumed to remain open for the remainder of the transient.

3. The operator initiates auxiliary spray flow in order to regain pressurizer level two minutes after attempting to close the affected steam generator.

4. A cooldown rate of 75°F/hr is assumed until 30 minutes after the attempted closing of the affected steam generator ADV. After this period a cooldown rate of 30°F/hr is assumed until shutdown cooling entry conditions are reached.

5. Since steam is being continuously released through the stuck open ADV, concern regarding affected steam generator overfill due to the primary to secondary leak does not arise.

Table 15.6.3.3-1 presents a chronological sequence of events which occur during the steam generator tube rupture event with a loss of offsite power and stuck open ADV, from the time the operator takes control. Prior to operator intervention the sequence of events is the same as that presented in Table 15D-1 of CESSAR.

The major operator actions are listed in Figure 15.6.3.3-1.

15.6.3.3.3 ANALYSIS OF EFFECTS AND CONSEQUENCES

15.6.3.3.3.1 CORE AND SYSTEM PERFORMANCE

A. Mathematical Model

Refer to CESSAR Section 15D.3.1.A.

B. Input Parameters and Initial Conditions

Refer to CESSAR Section 15D.3.1.B.

C. Results

The dynamic response of the plant parameters for the first 460 seconds of the transient, i.e., from the time of rupture until the operator takes control of the plant, is the same as that described in CESSAR Section 15D.3.1.C. The dynamic behavior of important NSSS parameters after operator intervention is presented in Figures 15.6.3.3-2 to 15.6.3.3-15.

At 460 seconds the operator takes control of the plant and opens one ADV on each SG to cool down the plant. At 2700 seconds the RCS has been cooled to 550°F. The operator isolates the auxiliary feedwater to the affected generator, closes the main steam isolation valves of both steam generators, and attempts to close the ADV of the affected generator. The operator recognizes that the ADV did not close. The ADV of the affected steam generator remains open for the remainder of the transient. The operator then initiates an orderly cooldown and depressurization using the atmospheric dump valves, auxiliary feedwater flow to the unaffected steam generator, pressurizer auxiliary sprays, pressurizer heaters and safety injection flow.

The maximum RCS and secondary pressures do not exceed 110% of design pressure following a steam generator tube rupture event with a loss of offsite power and stuck open ADV, thus, assuring the integrity of the RCS and the main steam system.

At 460 seconds, when operator action is assumed, no more than 41,500 lbm of steam from the damaged steam generator and 41,470 lbm from the intact steam generator are discharged via the main steam safety valves. Also, during the same time period approximately 17560 lbm of primary system mass is leaked to the damaged steam generator. Subsequently, the operator begins a plant cooldown at the PVNGS plant procedure specific maximum cooldown rate (75°F/hr) using both steam generators, the atmospheric dump valves, and the emergency feedwater system. Thirty minutes after attempting to isolate the affected steam generator, it is assumed that the operator reduces the cooldown rate to 30°F/hr. For the first two hours following the initiation of the event, 488,000 lbms of steam are released to the environment through the atmospheric dump valves. For the two to eight hour cooldown period an additional 982,000 lbms of steam are released via the atmospheric dump valves.

15.6.3.3.3.2 RADIOLOGICAL CONSEQUENCES

A. Physical Model

The physical model is the same as that discussed in CESSAR Section 15D.3.2 with the following exception.

After 460 seconds, the operator inititates a plant cooldown at the PVNGS plant procedure specific maximum cooldown rate of 75°F/hr. Thirty minutes after attempting to isolate the affected steam generator, the operator lowers the cooldown rate to 30°F/hr.

B. Assumptions and Conditions

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 and 10. They 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 the 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. 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.

10. The 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.

C. Mathematical Model

Refer to CESSAR Section 15D.3.2.C.

D. Results

The two-hour exclusion area boundary (EAB) and the eight-hour low population zone (LPZ) boundary inhalation doses for both the GIS and the PIS are presented in Table 15.6.3.3-2. The calculated EAB and LPZ doses are well within the acceptance criteria.

15.6.3.3.4 CONCLUSIONS

The radiological releases calculated for the SGTR event with a loss of offsite power and a stuck open ADV are within the 10CFR100 guidelines. The RCS and secondary system pressures are well below the 110% of the design pressure limits, thus, assuring the integrity of these systems. Additionally, no violation of the fuel thermal limits occurs, since the minimum DNBR remains above the 1.19 value throughout the duration of the event.

15.6.3.3.5 REFERENCES

Refer to CESSAR Section 15D.5. In addition -

6) Palo Verde Nuclear Generating Station Manual, "Steam Generator Tube Leak", Procedure No. 41RO-1ZZ06, Revision 0.

TABLE 15.6.3.3-1

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

Time* (Sec)	Event	Setpoint or Value	Success Path
460	Operator Initiates Plant Cooldown by Opening One ADV on each SG	---	Reactor Heat Removal
546	Pressurizer Empties	---	
570	Safety Injection Actual Signal, psia	1578	Reactivity Control
620	Safety Injection Flow Initiated	---	Reactivity Control
2700	Operator Attempt to Isolate the Damaged Generator, RCS Tem., °F	550	Secondary System Integrity
2820	Operator Initiates Auxiliary Spray Flow		Primary System Inventory
3400	Operator Controls Auxiliary Spray Flow, Backup Pressurizer Heater Output, and HPSI Flow to Reduce RCS Pressure and Control Subcooling, °F	20	Primary System Integrity
~28,800	Shutdown Cooling Entry Conditions are Assumed to be Reached, RCS Pressure, psia/Temp., °F	400/350	Reactor Heat Removal

* The sequence of events for the first 460 seconds is the same as that presented in Table 15D-1 of CESSAR.

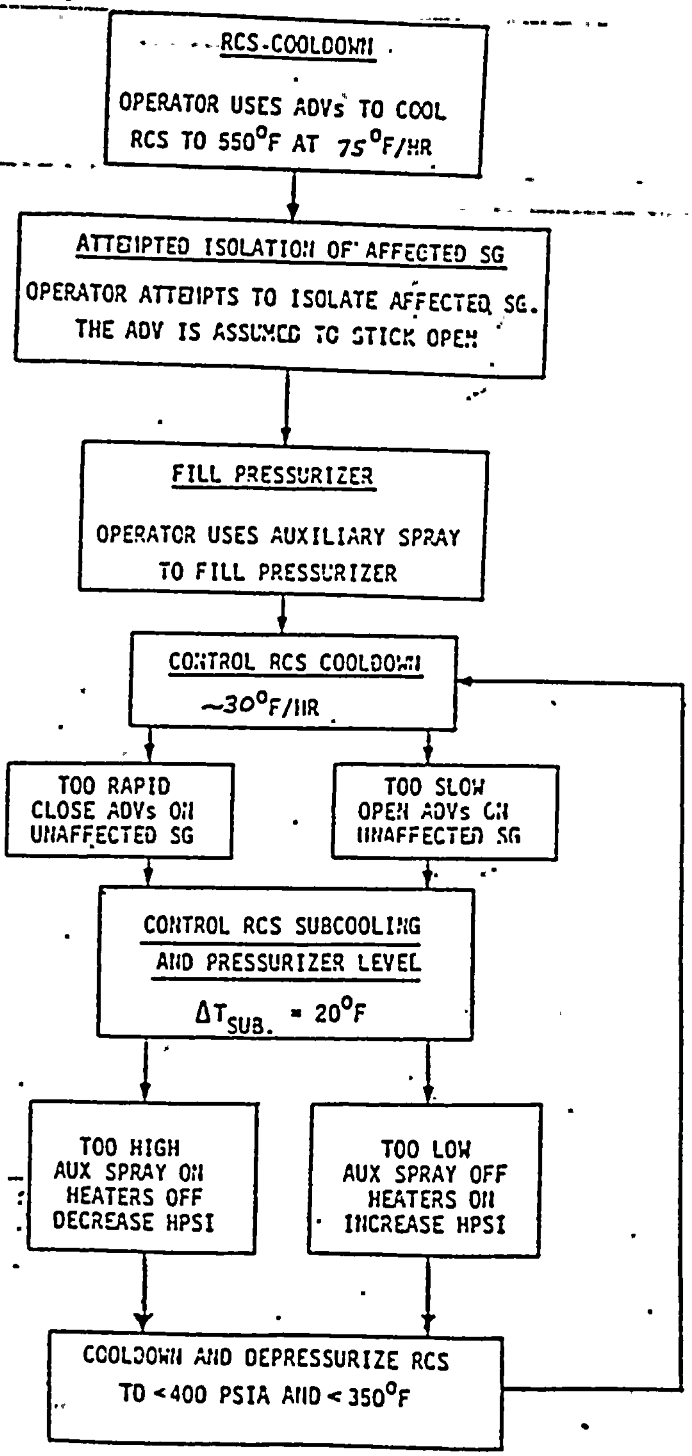
TABLE 15.6.3.3-2

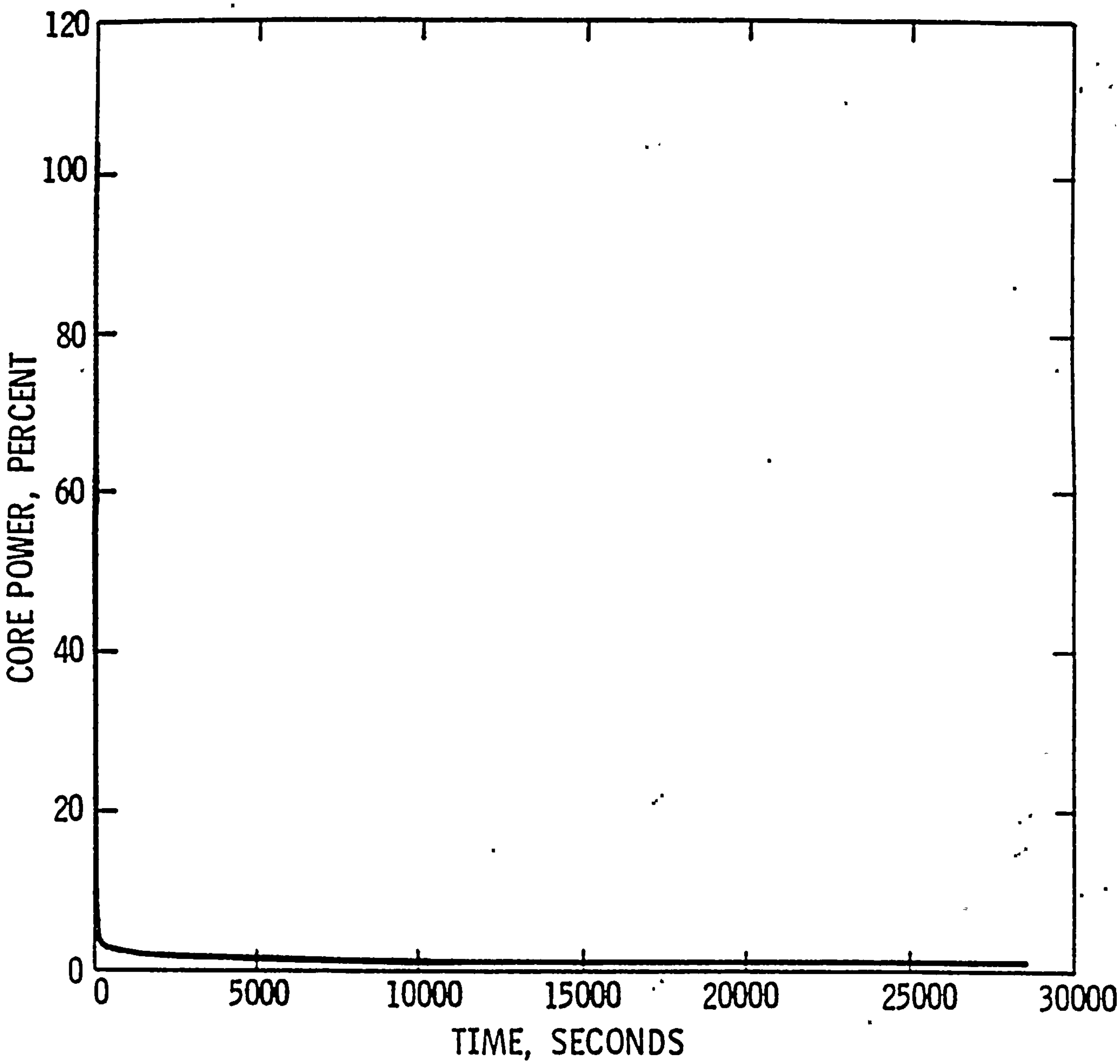
RADIOLOGICAL CONSEQUENCES OF THE STEAM GENERATOR TUBE RUPTURE WITH A LOSS OF OFFSITE POWER AND STUCK OPEN ADV

Location	Offsite Doses, Rems GIS	PIS
1. Exclusion Area Boundary 0-2 hr. Thyroid	116	148
2. Low Population Zone Outer Boundary 0-8 hr. Thyroid	222	121

Figure 75.6.3.3-1

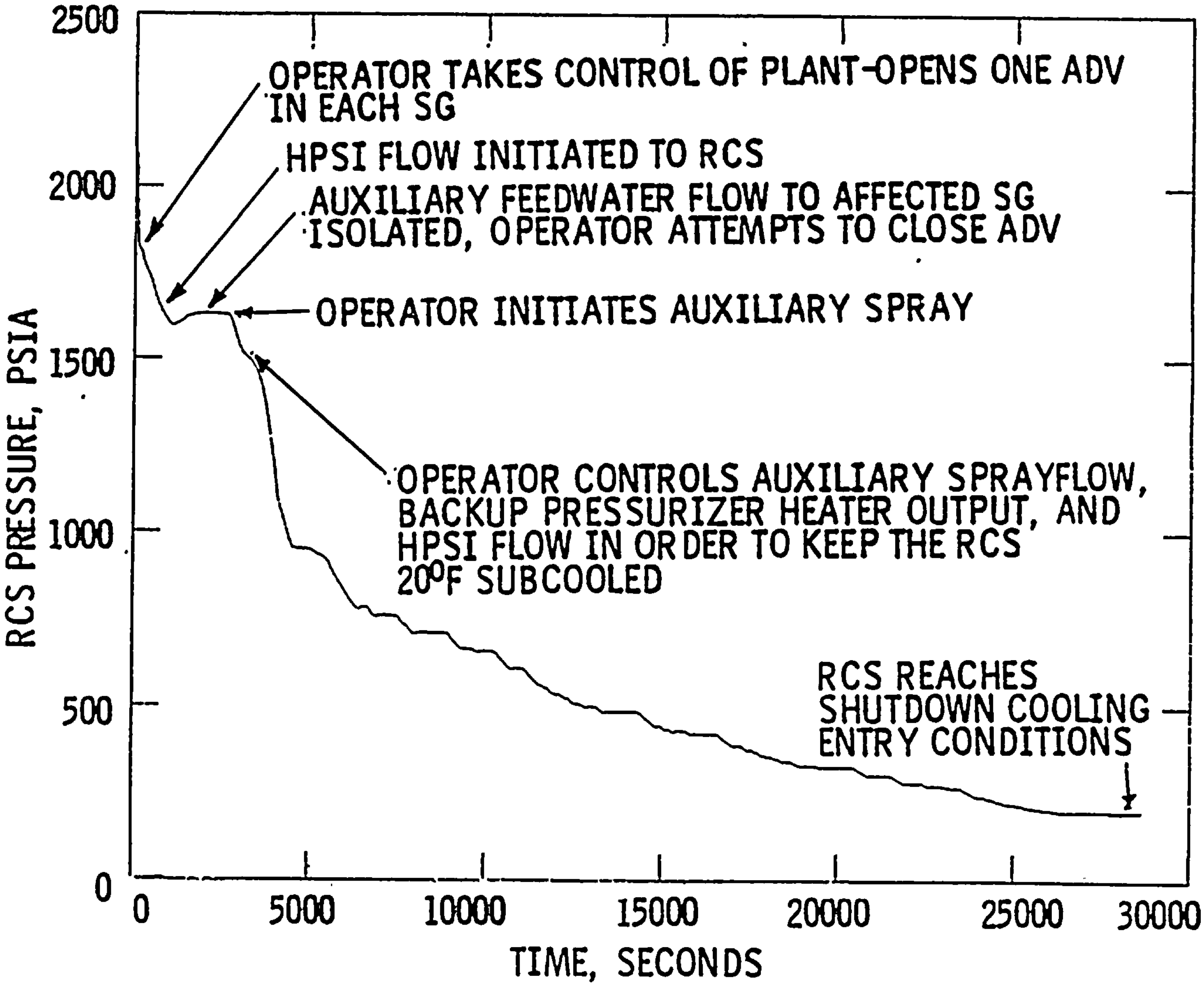
OPERATOR ACTION DURING SGTR + LOP + STUCK OPEN ADV



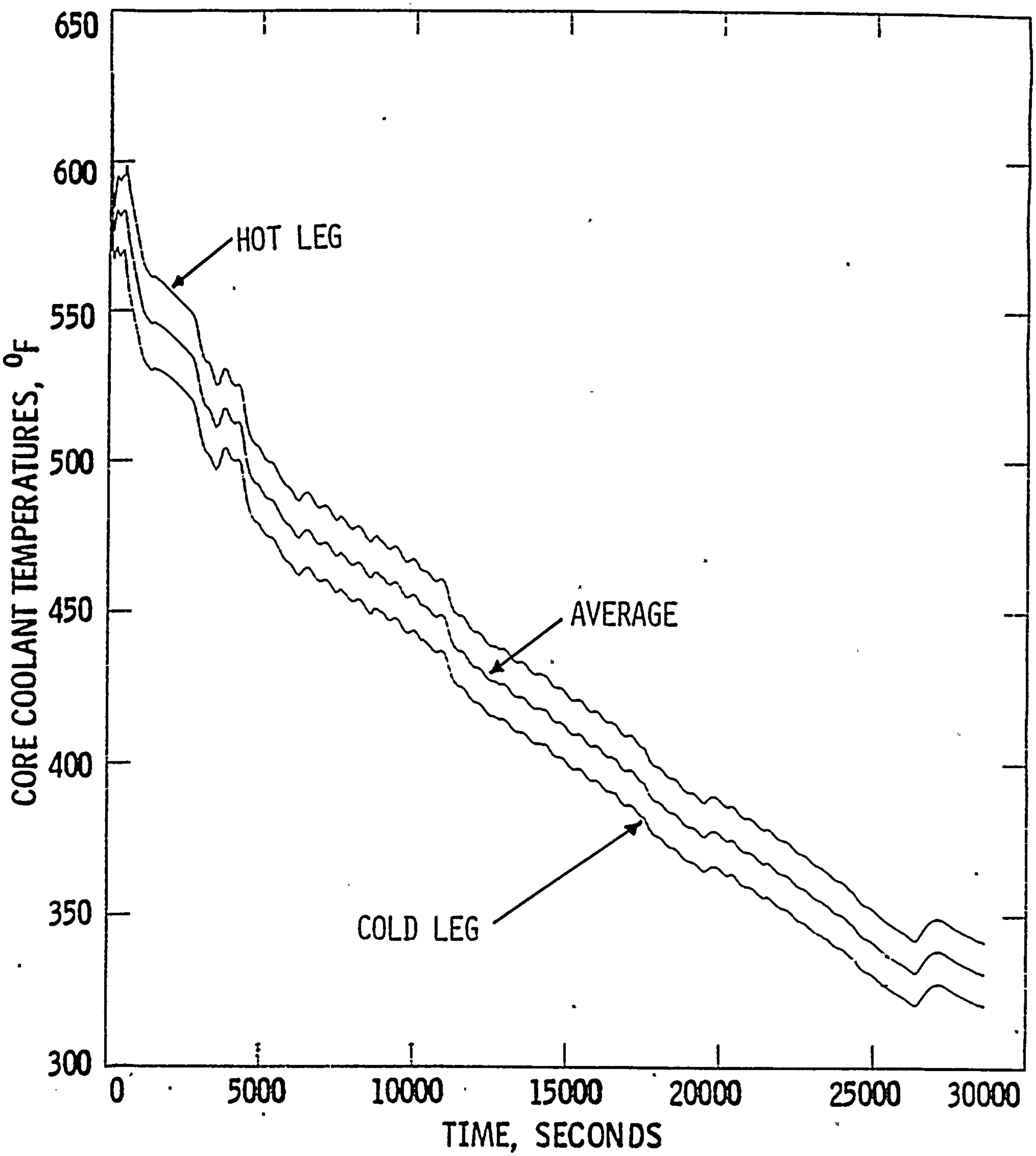


STEAM GENERATOR TUBE RUPTURE WITH LOSS OF OFFSITE POWER AND A STUCK OPEN ADV CORE POWER vs TIME

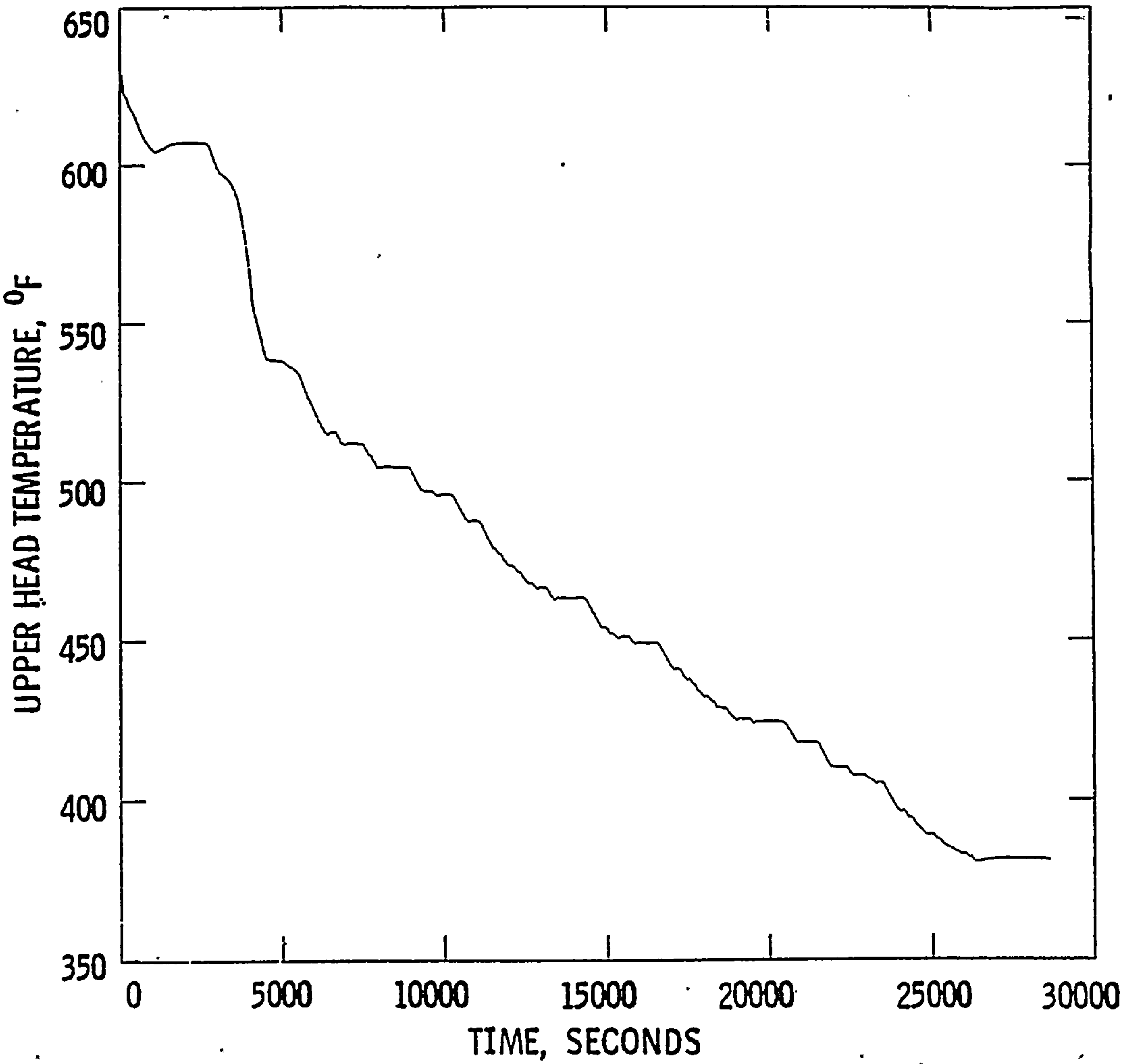
Figure 15.6.3.3-2



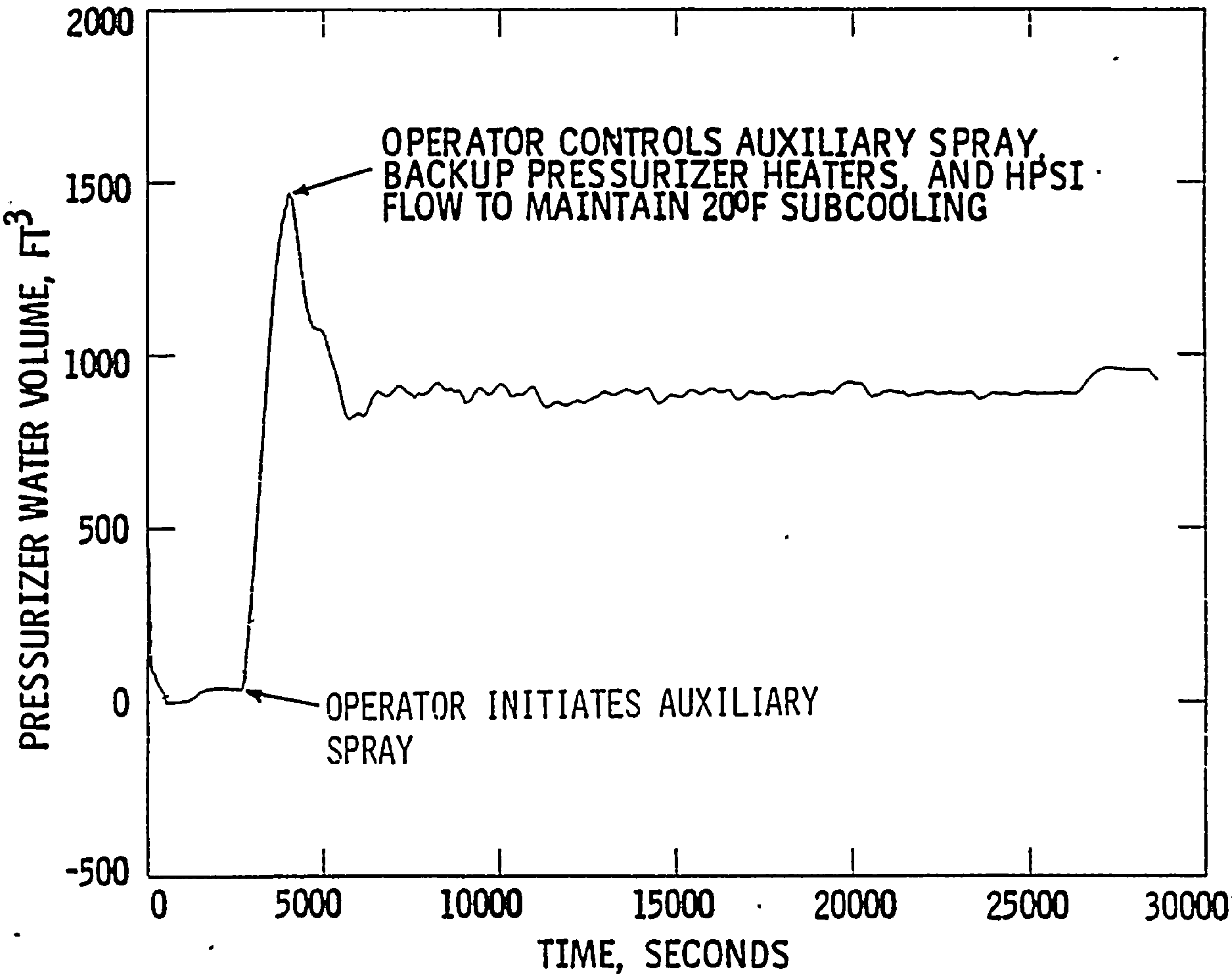
STEAM GENERATOR TUBE RUPTURE WITH LOSS OF OFFSITE POWER AND A STUCK OPEN ADV RCS PRESSURE vs TIME	Figure 15.6.3.3-3



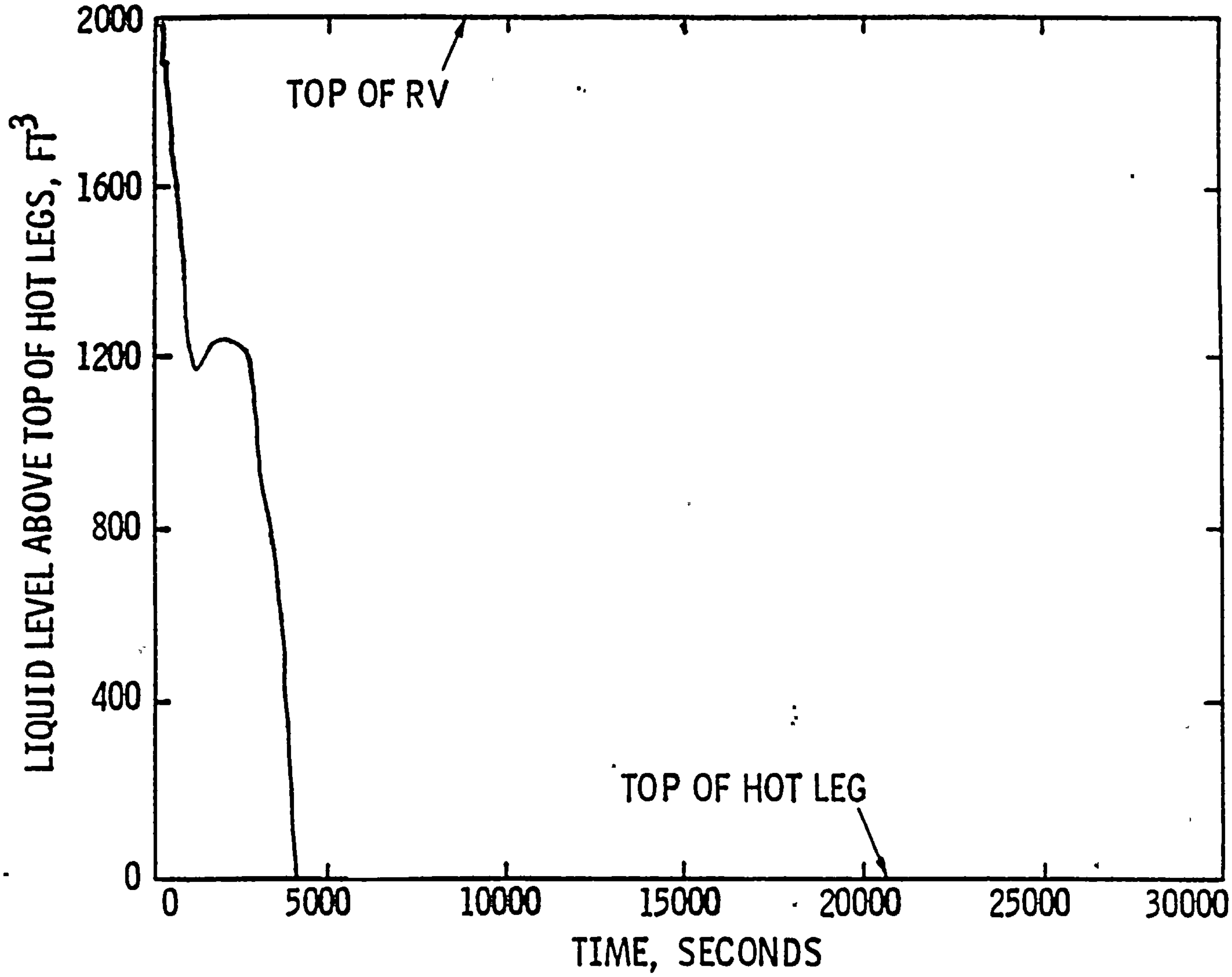
STEAM GENERATOR TUBE RUPTURE WITH LOSS OF OFFSITE POWER AND A STUCK OPEN ADV CORE COOLANT TEMPERATURES vs TIME	Figure 15.6.3.3-4



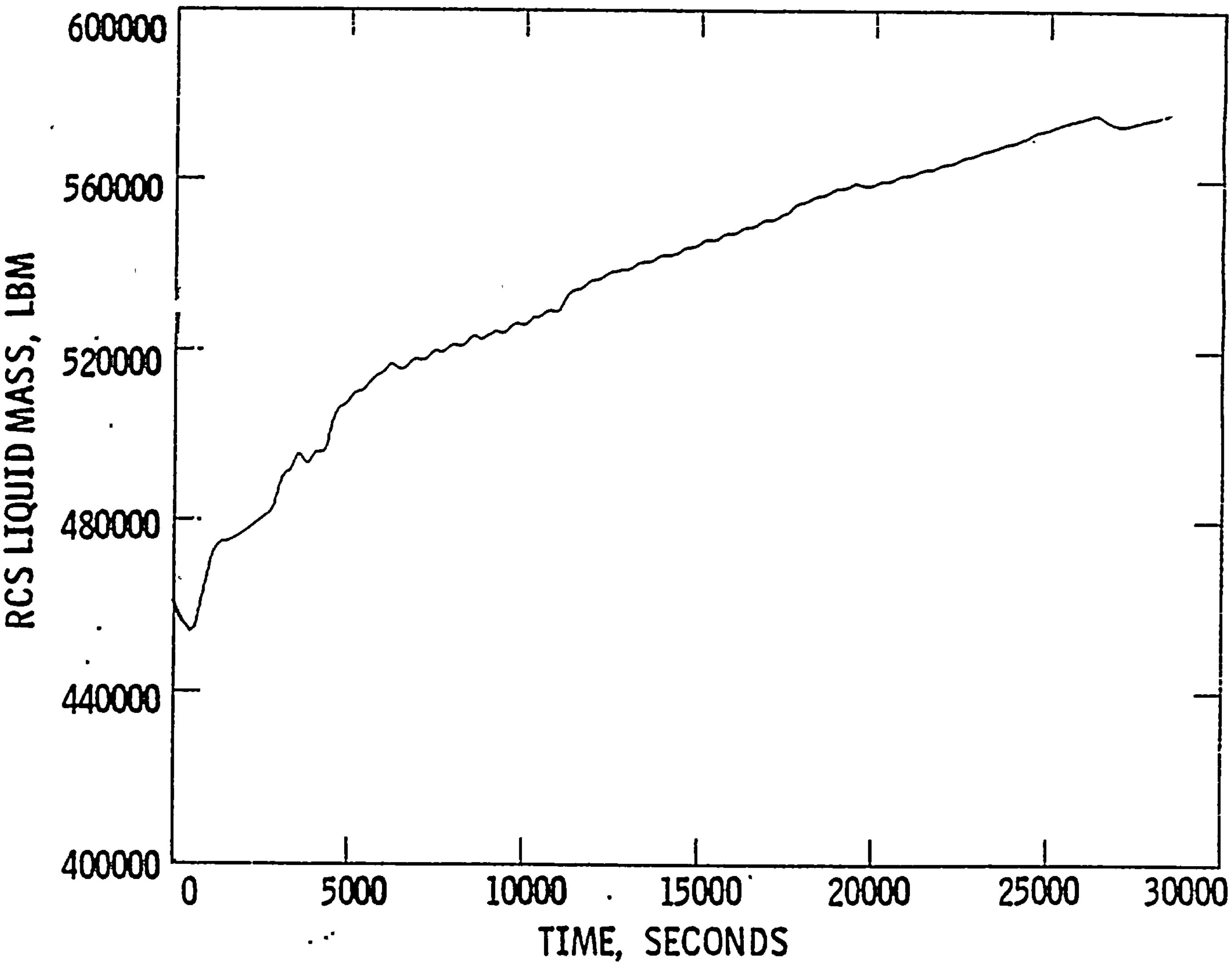
STEAM GENERATOR TUBE RUPTURE WITH LOSS OF OFFSITE POWER AND A STUCK OPEN ADV UPPER HEAD TEMPERATURE vs TIME	Figure 15.6.3.3-5



STEAM GENERATOR TUBE RUPTURE WITH LOSS OF OFFSITE POWER AND A STUCK OPEN ADV PRESSURIZER WATER VOLUME vs TIME	Figure 15.6.3.3-6

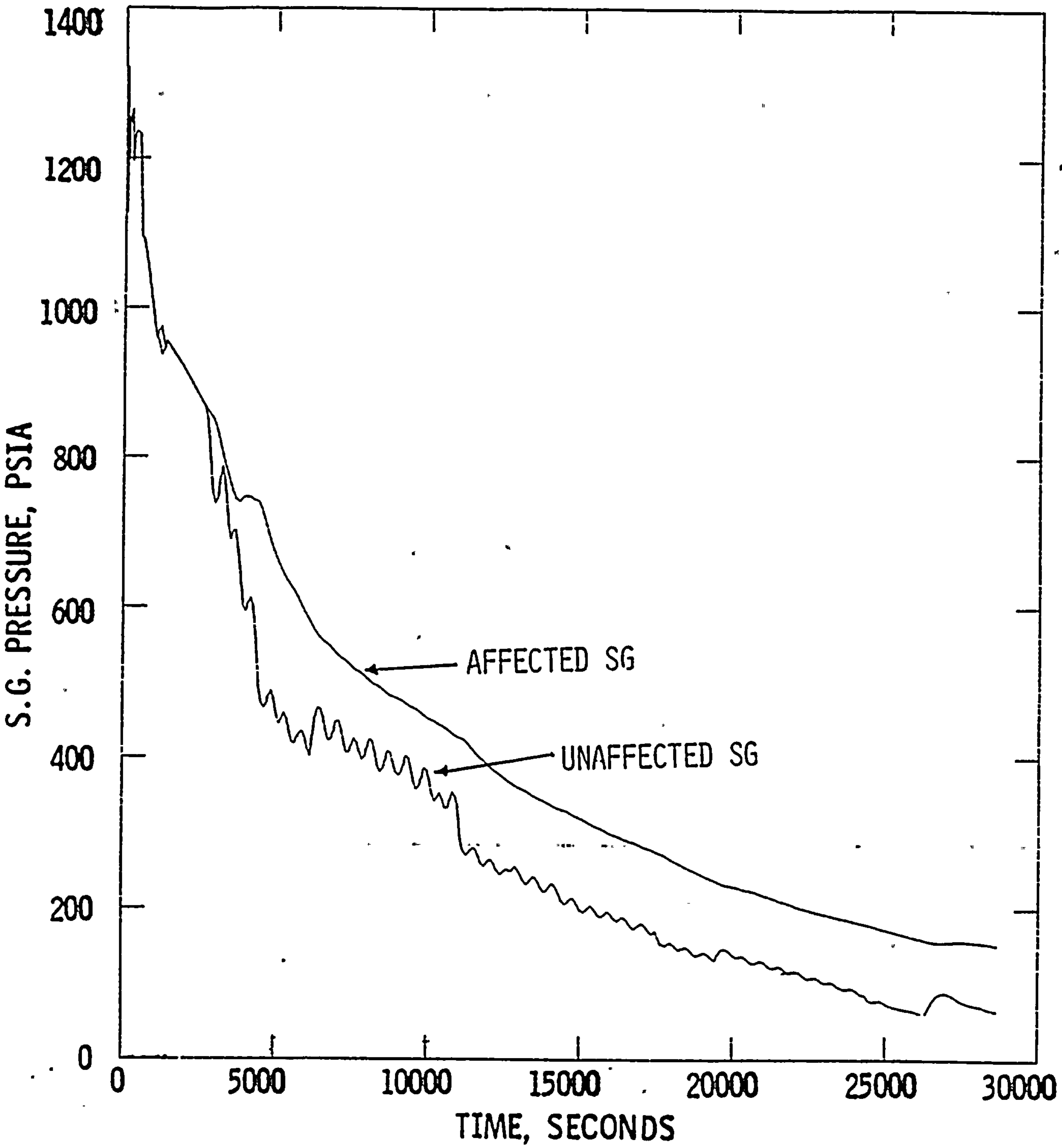


STEAM GENERATOR TUBE RUPTURE WITH LOSS OF OFFSITE POWER AND A STUCK OPEN ADV LIQUID VOLUME ABOVE TOP OF HOT LEGS vs TIME	Figure 15.6.3.3-7



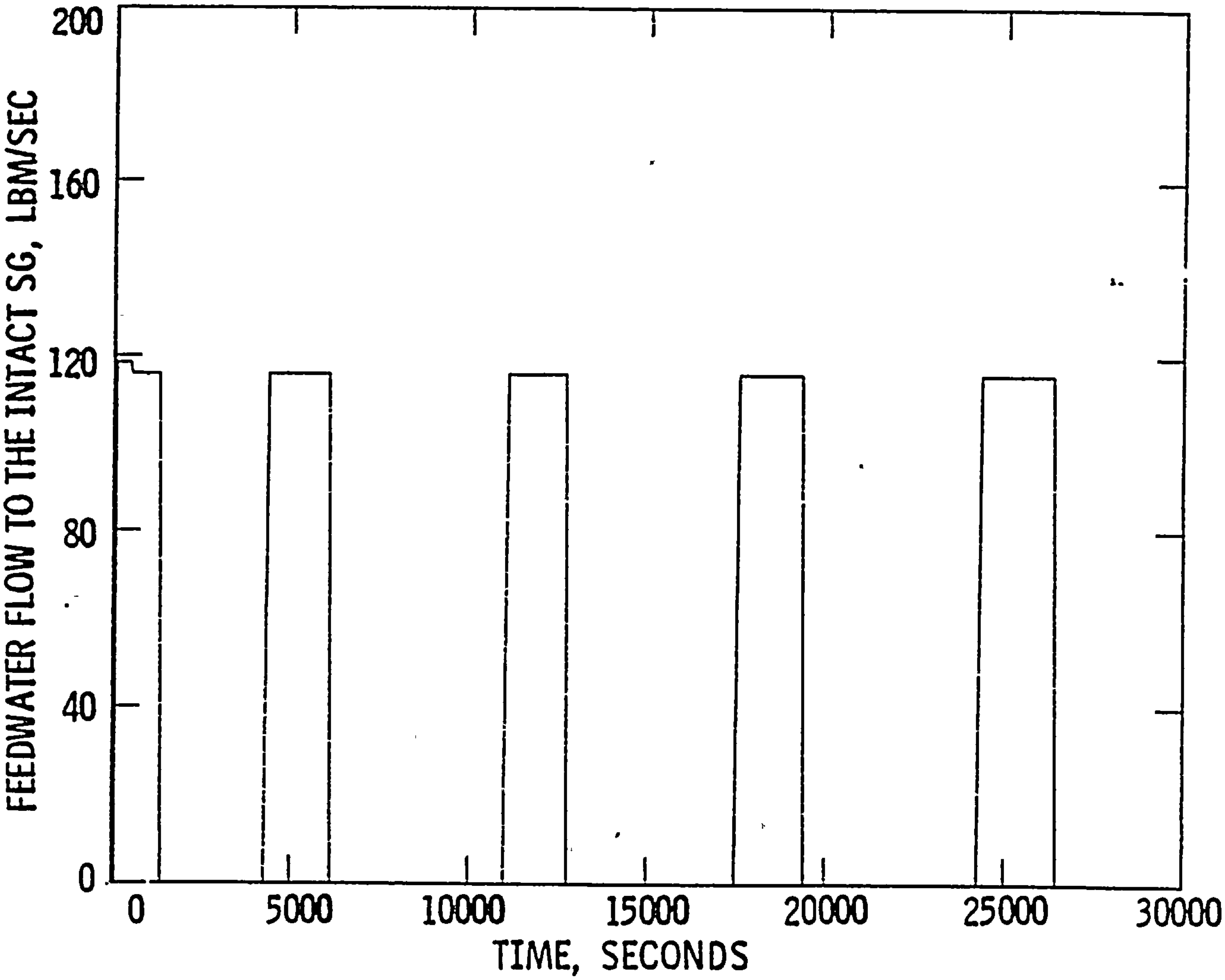
STEAM GENERATOR TUBE RUPTURE WITH LOSS OF OFFSITE POWER AND A STUCK OPEN ADV
RCS LIQUID MASS vs TIME

Figure 15.6.3.3-8

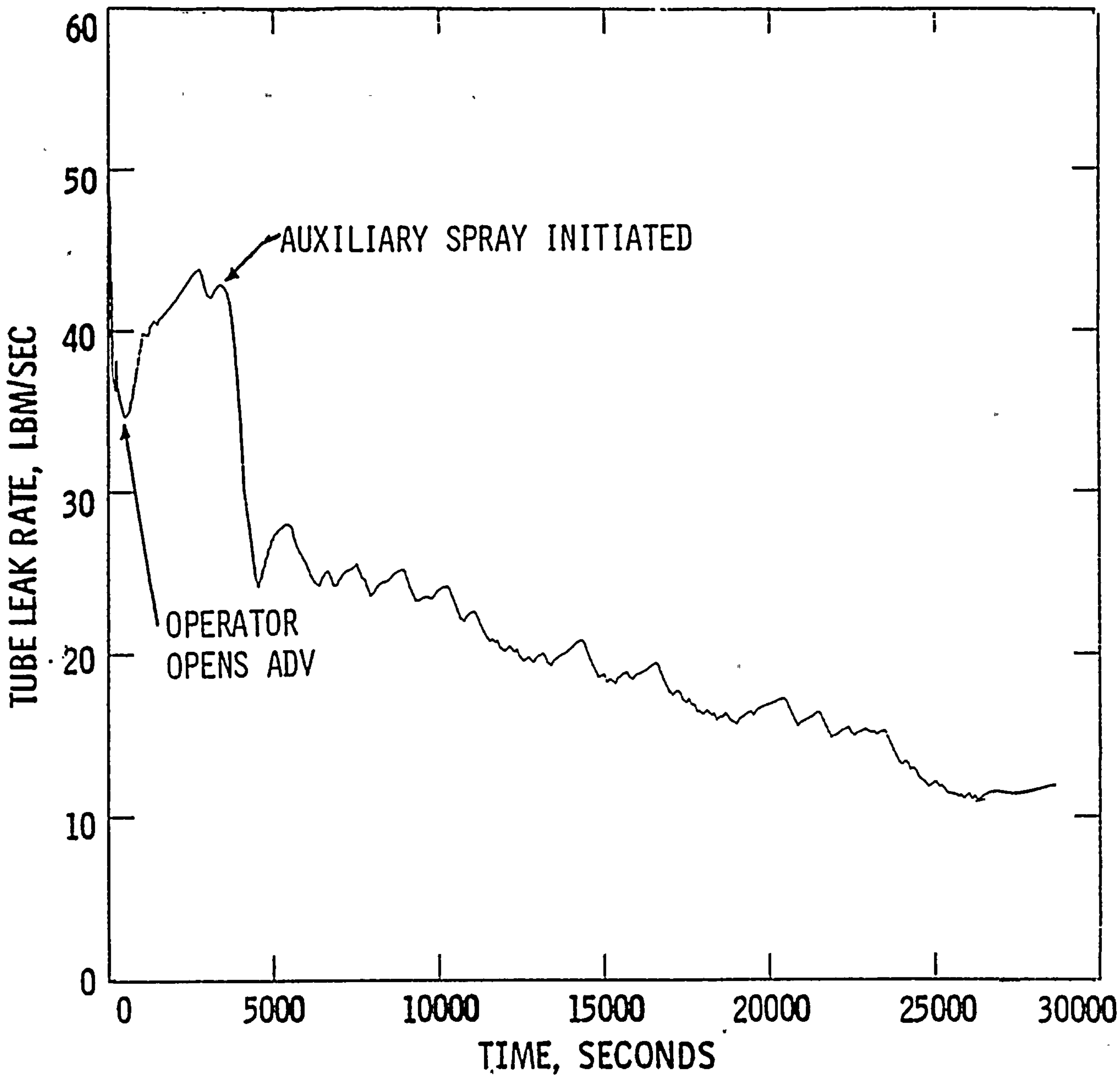


STEAM GENERATOR TUBE RUPTURE WITH LOSS OF OFFSITE POWER AND A STUCK OPEN ADV STEAM GENERATOR PRESSURE vs TIME

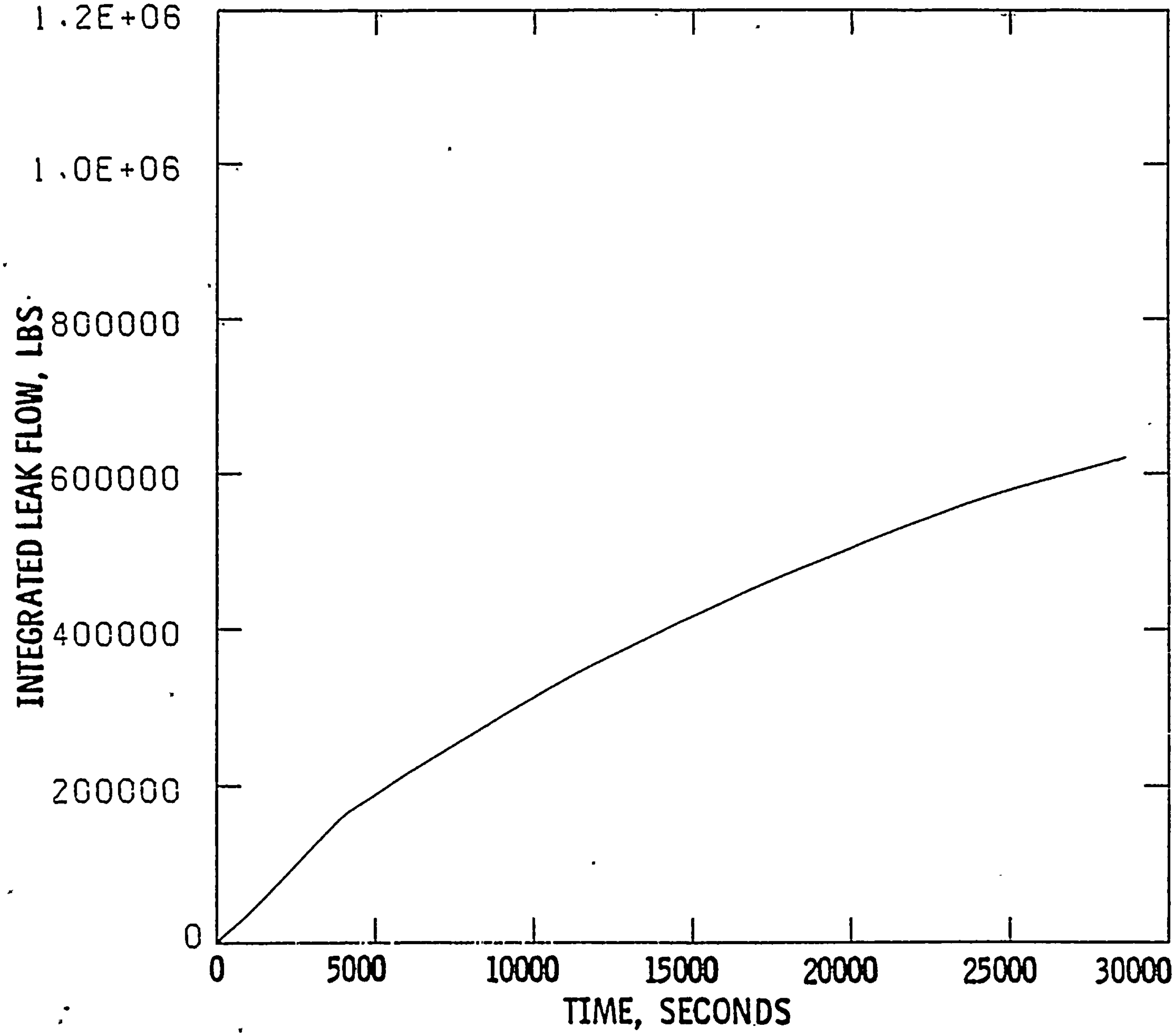
Figure 15.6.3.3-9



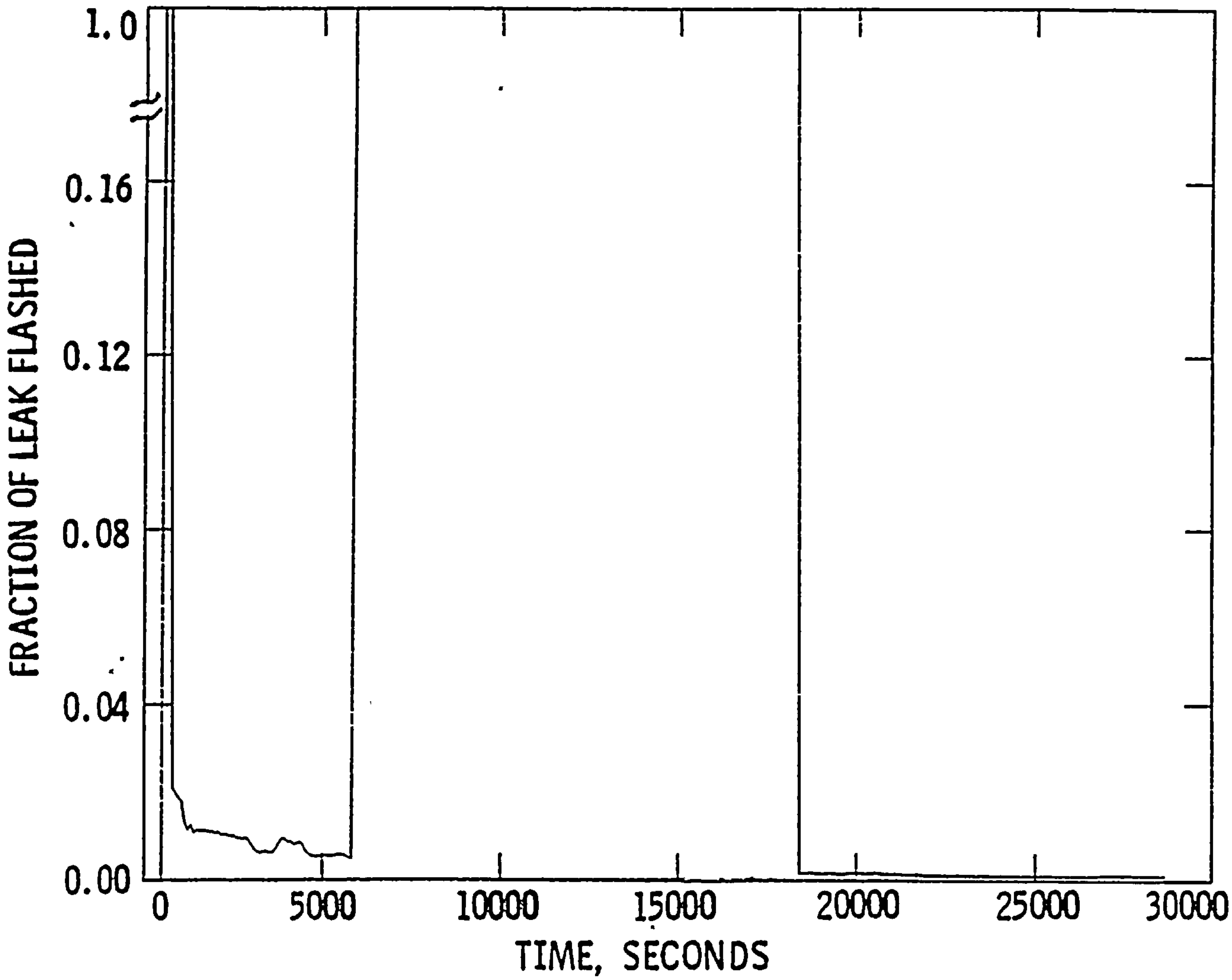
STEAM GENERATOR TUBE RUPTURE WITH LOSS OF OFFSITE POWER AND A STUCK OPEN ADV FEEDWATER FLOW TO THE INTACT SG vs TIME	Figure 15.6.3.3-10



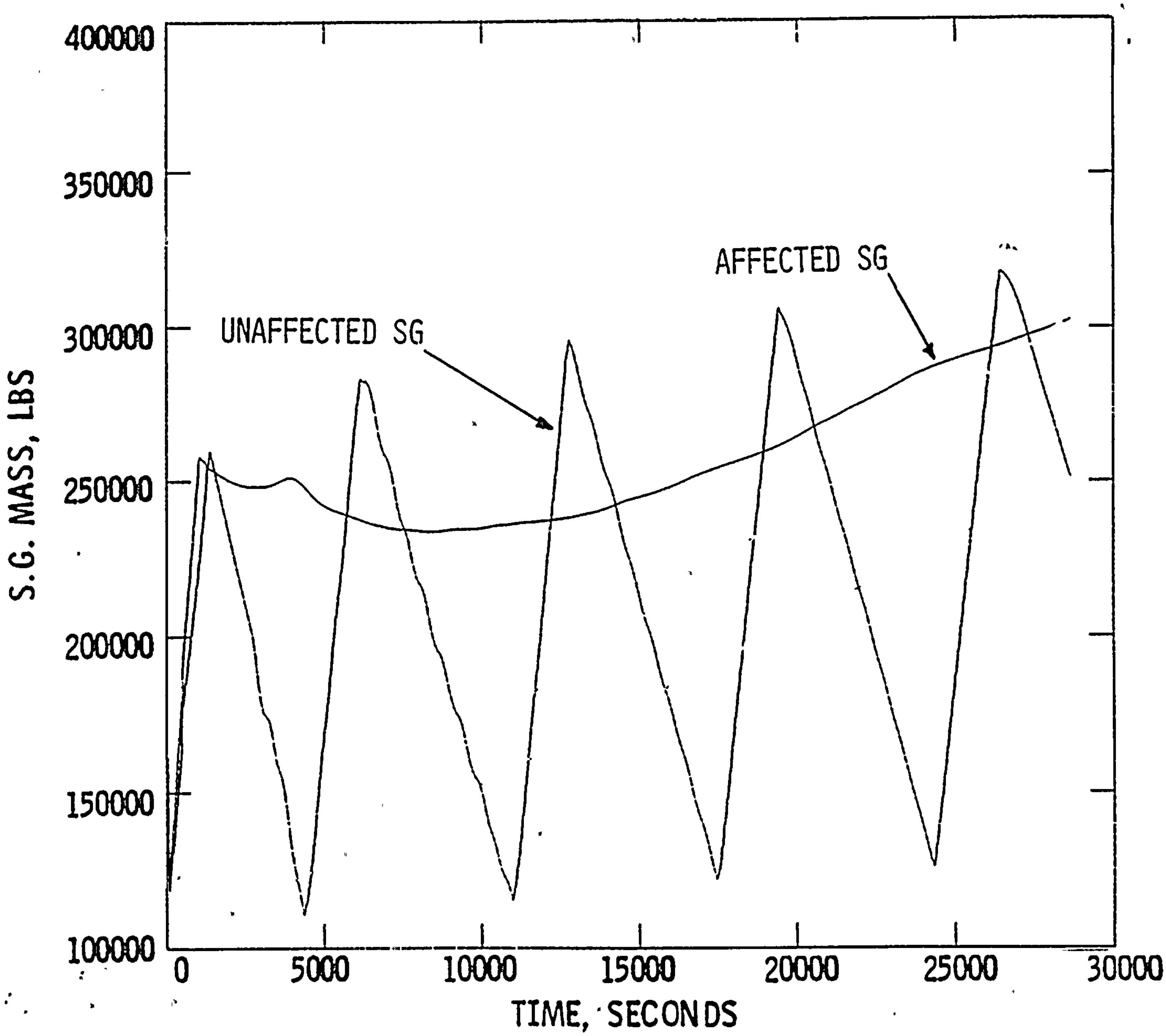
STEAM GENERATOR TUBE RUPTURE WITH LOSS OF OFFSITE POWER AND A STUCK OPEN ADV TUBE LEAK RATE vs TIME	Figure 15.6.3.3-11



STEAM GENERATOR TUBE RUPTURE WITH LOSS OF OFFSITE POWER AND A STUCK OPEN ADV INTEGRATED TUBE LEAK vs TIME	Figure 15.6.3.3-12

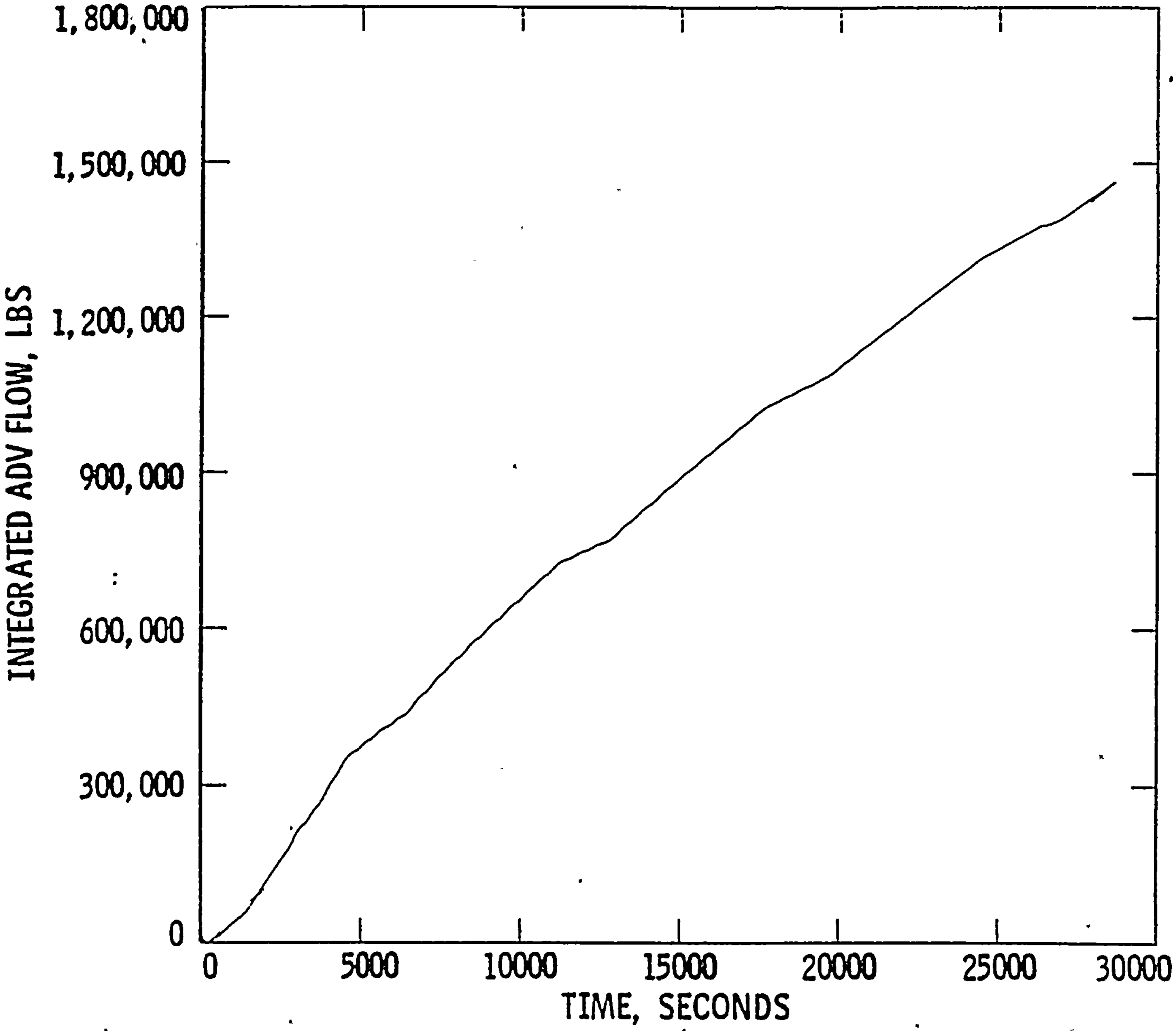


STEAM GENERATOR TUBE RUPTURE WITH LOSS OF OFFSITE POWER AND A STUCK OPEN ADV FRACTION OF LEAK FLASHED vs TIME	Figure 15.6.3.3-13



STEAM GENERATOR TUBE RUPTURE WITH LOSS OF OFFSITE POWER AND A STUCK OPEN ADV
S.G. MASS vs TIME

Figure 15.6.3.3-14



STEAM GENERATOR TUBE RUPTURE WITH LOSS OF OFFSITE POWER AND A STUCK OPEN ADV INTEGRATED ADV FLOW vs TIME	Figure 15.6.3.3-15