Duquesne Light

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August 28, 1979

Director of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Attn: A. Schwencer, Chief
Operating Reactor Branch No. 1
Division of Operating Reactors
Washington, DC 20555

Reference: Beaver Valley Power Station, Unit No. 1
Docket No. 50-334
Response to Request for Additional Information
Concerning Technical Specification Change
Request No. 35

Gentlemen:

Enclosed are three signed originals and thirty-seven copies of the Duquesne Light Company response to your July 31, 1979, request for additional information.

Very truly yours,

C. N. Dunn
Vice President, Operations

Enclosures

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(CORPORATE SEAL)

Attest:

H W Staas

H. W. Staas
Secretary

COMMONWEALTH OF PENNSYLVANIA)
) SS:
COUNTY OF ALLEGHENY)

On this 29th day of August, 1979, before me, HENRY G. STOECKER, a Notary Public in and for said Commonwealth and County, personally appeared C. N. Dunn, who being duly sworn, deposed, and said that (1) he is Vice President of Duquesne Light, (2) he is duly authorized to execute and file the foregoing Submittal on behalf of said Company, and (3) the statements set forth in the Submittal are true and correct to the best of his knowledge, information and belief.

Henry G. Stoecker

HENRY G. STOECKER, Notary Public
Pittsburgh, Allegheny County, Pa.
My Commission Expires
February 20, 1982

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Response to the July 31 Request For Additional Information
Concering the Beaver Valley Unit No. 1 Proposed
New Steamline Break Protection System

Introduction

Analyses have been performed to calculate the system response to a steamline break which occurs during a normal plant heatup or cooldown operation, while the safety injection automatic initiation logic for both low pressurizer pressure and low steamline pressure are blocked. The analyses assume that the proposed steamline break protection system, schematically depicted in Figure 1, is in service.

The safety injection signals previously mentioned may be blocked below the setpoint, P-11, set at 2010 psig, leaving the following protection channel operable during the cooldown/heatup operation:

Safety Injection	- 2/3 Hi-1 containment pressure
Steamline Isolation	- 2/3 Hi-2 containment pressure
	- 2/3 High negative steamline pressure rate, any one loop

The RCS is assumed to be borated to the cold shutdown concentration requirements prior to blocking safety injection on low steamline pressure or low pressurizer pressure. This precludes criticality in the event of a complete cooldown while SI is blocked.

During the normal heatup/cooldown mode, pressurizer water level is maintained by the pressurizer level control system. Charging flow is provided by a centrifugal charging pump while letdown continues normally. The level control system modulates charging flow to maintain the no-load programmed pressurizer water level. In the event of a decrease in pressurizer water level, the charging flow is automatically increased, up to full capacity, depending on the magnitude of the level mismatch. Below 14 percent level, letdown is isolated.

The following section describes the analyses performed which show that the ability of the RCS to remove heat from the core are not impaired by a steamline break which occurs while safety injection is blocked during a plant heatup/cooldown.

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Analyses

Many combinations of initial conditions, break size, break location, and transient assumptions are possible during the heatup/cooldown mode. The cases presented in this section each assume the following:

1. The RCS is at the no-load temperature of 547°F. This assumption maximizes the stored energy on the secondary side and minimizes the RCS mass inventory.

2. The RCS pressure is 1120 psig, 100 psi above the saturation pressure at 547°F. This assumption minimizes the margin to RCS saturation and is consistent with plant heatup/cooldown curves.

3. Safety injection has been blocked for these automatic actuation signals:

   Low steamline pressure
   Low pressurizer pressure

4. Steamline isolation has been blocked on the following:

   Low steamline pressure

5. High negative pressure rate steamline isolation signals are active.

   Setpoint -100
   Rate time constant: 50 sec.
   Lag time constant: 50 sec.

6. Status of accumulators (blocked vs. unblocked) is consistent with the initial RCS pressure. Accumulators are assumed to be blocked below 1000 psi, unblocked above 1000 psi.

7. Reactor coolant pumps are running.

A sensitivity study was performed to determine for which break sizes steamline isolation will occur. Several values of initial average system temperature are investigated since initial steam pressure, (hence steam flow and pressure rate) are affected by the initial average temperature. Figure 2 shows the combinations of break areas and initial temperatures for which steamline isolation occurs on the pressure rate signal. As the figure shows for initial temperatures less than approximately 400°F, steamline isolation does not occur for any break. Approximate times for reaching the pressure rate setpoint are shown in Figure 3, the significance being that the steamline isolation signal is either reached in the first hundred seconds of the transient or not reached at all.

Consistent with Figure 2, 0.09 square feet per loop at 547°F was chosen as the largest break for which steamline isolation on high negative pressure rate does not occur. Two cases are run as defined on Table 1, Case 1 having charging available and Case 2 having charging unavailable.

Analyses (Continued)

Figure 4 shows the relevant parameters for Case 1, the largest unisolated break outside containment with charging available. The steam pressure in Figure 4 is representative of all steam generators. The output of the derivative-lag unit (which is the input to the high negative steam pressure rate) is shown in the figure; the negative rate setpoint is -100. The analysis assumes that the auxiliary feedwater flow initially assumed (consistent with a 50°/hr. cooldown) does not change. Although in reality, flow would increase as steam generator pressure decreases, and the operator will maintain steam generator level until the break is diagnosed and isolated. The charging system is assumed operable from the beginning of the transient. The model used for this study is an on/off model thus the dotted line on the pressurizer water volume plot represents the predicted pressurizer level after the no-load level is recovered. The final graph shows the core average temperature and saturation temperature as a function of time. The calculation shows that all void in the reactor coolant systems is confined to the pressurizer for this case. Core cooling capability is maintained via the steam generators and reactor coolant pumps. In conclusion, the pressurizer will not empty, the reactor coolant system remains subcooled, and heat may be removed via the steam generators via operable reactor coolant pumps.

Figure 5 shows salient transient parameters for Case 2, without charging available. The steam generator pressure, steamline pressure rate, steam generator inventory and core flow follow similar responses to those in Case 1. For this case, however, the pressurizer empties at approximately 250 seconds and does not recover throughout the transient due to the continued cooldown. The temperature plot indicates subcooling in the loops and core throughout the transient. Voiding in the RCS was confined to the reactor vessel upper head for a short period of time, due to the slightly warmer coolant residing there.

Breaks occuring inside containment will be confined to one steam generator due to the presence of check valves in the steam lines. Hi-1 containment pressure is available at all times to provide a safety injection initiation while Hi-2 containment pressure provides a steamline isolation signal in addition to the check valve and steamline isolation signal in addition to the check valve and steamline pressure rate. Calculations performed indicate that a 0.6 square foot break inside containment will actuate SI at approximately 50 seconds from HZP conditions. Initiation of SI following such a break will result in a system response similar to that in the FSAR Condition II or Condition IV breaks.

The reactor coolant pumps will remain running throughout the transient, since no automatic or adminstrative trips are encountered. Isolation of component cooling water can only occur on Hi-3 containment pressure; this cannot happen prior to the initiation of safety injecton on Hi-1 containment pressure. Reactor coolant pumps are thus expected to operate at least until SI is initialed due to the availability of component cooling water.

Conclusions - Analysis

The following is a summary of the results obtained from Case 1, Case 2, and a comparison of similar cases inside containment:

1. For the largest break outside containment which is not isolated, the RCS remains subcooled, and the pressurizer does not empty if the charging sytem is operable and functioning as designed (Table 1, Case 2).

2. For the largest break outside containment which is not isolated, the small amount of voiding which occurs, with charging unavailable, is confined to the pressurizer and upper head. (Table 1, Case 2).

3. There are no expected demands for reactor coolant pump trips, either administrative or automatic, without prior initiation of SI.

4. For the cases above, the steam generators provide adequate core cooling capability in conjunction with auxiliary feedwater and reactor coolant pumps.

5. All steamline breaks of any significance inside containment will provide Hi-1 containment SI initiation.

6. Flow from breaks outside containment of greater size than the line on Figure 2 will be terminated by steamline isolation on high negative pressure rate. All breaks smaller than the line on Figure 2 will result in cooldowns less severe than Case 1 or Case 2.

7. The above conclusions are satisfied with normal expected operator action, i.e., maintaining pressurizer pressure, pressurizer level, and steam generator level as would be done during a normal heatup/cooldown operation. The cases above do not assume operator action. At a time when operator action can be supported, it would be desirable that the operator do the following:

   a. Terminate steam flow via steamline isolation if this has not occurred already.

   b. Identify the broken loop if blowdown does not terminate on SLI.

   c. Isolate auxiliary feedwater to the broken loop.

   d. Initiate charging or SI to recover pressurizer level and maintain pressure and level until blowdown terminates.

System Comparison

A study follows which shows the locus of conditions for the old and new steamline break protection systems where steamline isolation does not occur.

Figure 6 shows the largest break size as a function of initial temperature which will not cause steamline isolation. A curve is plotted for each of the steamline protection systems. For the present system, steamline isolation is actuated on a high steam flow signal, set at 40 percent of rated steam flow during heatup and cooldown. For the new system, the steamline isolation signal is actuated by high negative steamline pressure rate. Safety injection will not be initiated with either protection system for those cases where steamline isolation does not occur. Both of these actuation systems lead to acceptable transient results.

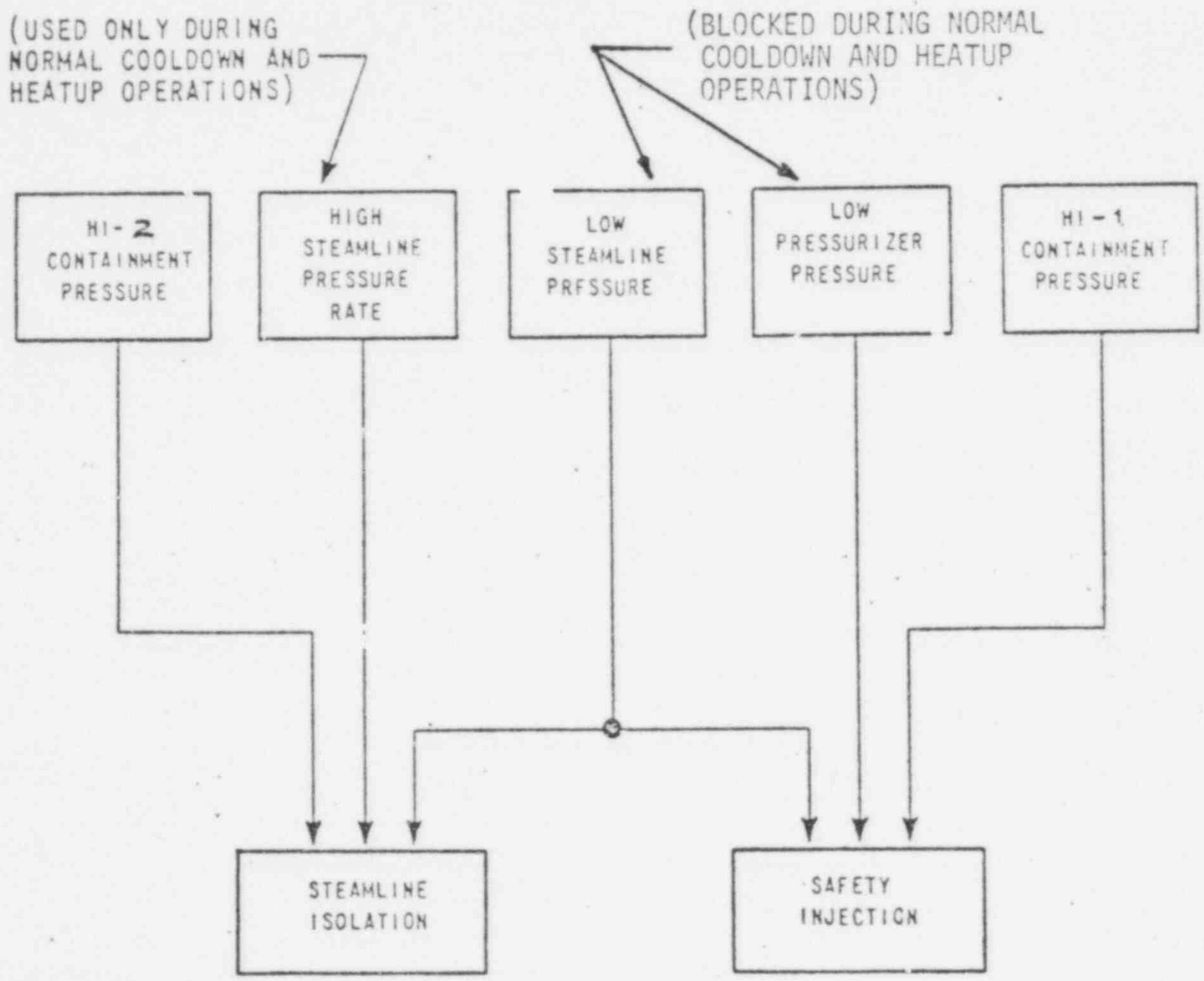

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Figure 1
New Steamline Break Protection System

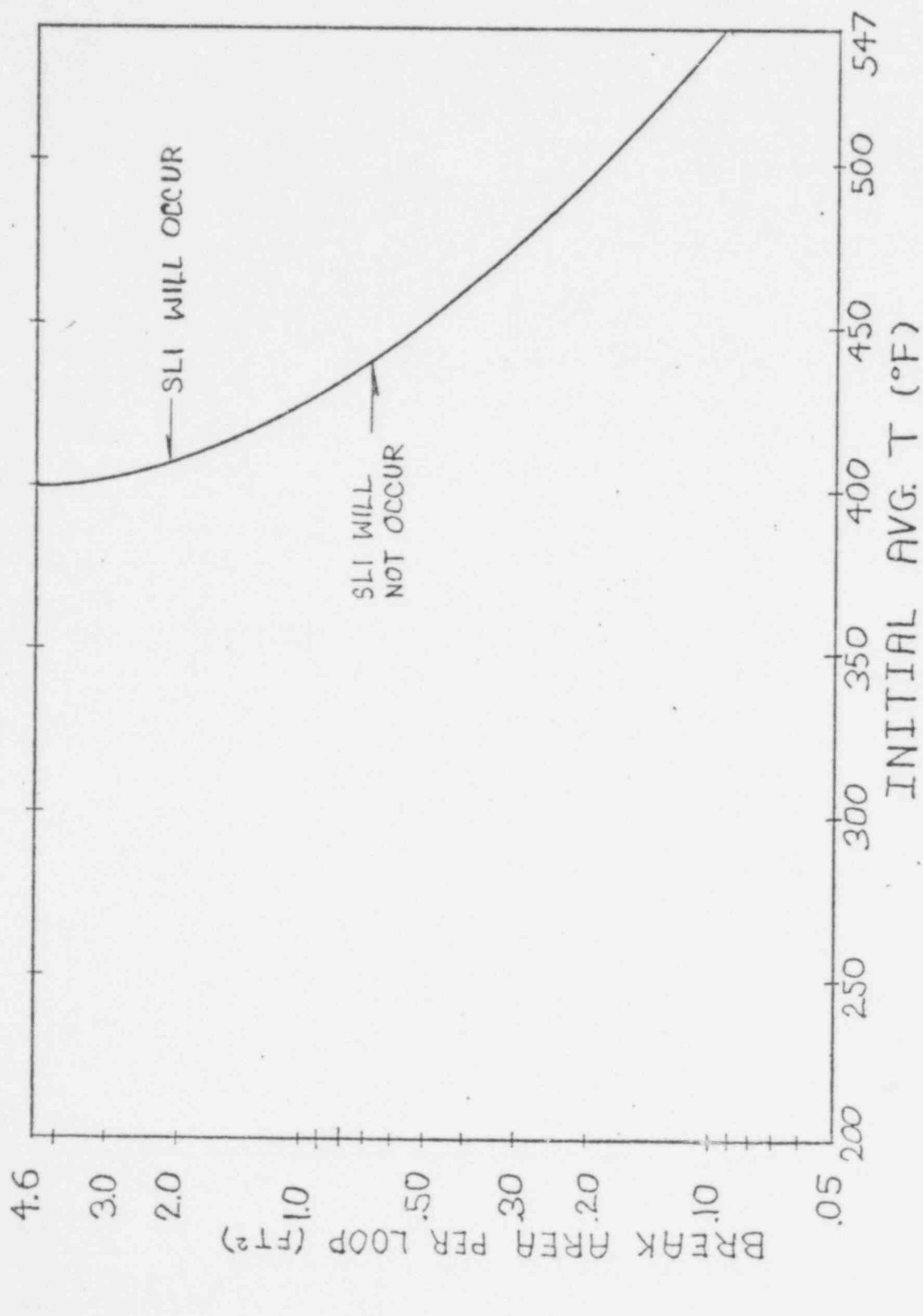

FIGURE 2: CONDITIONS FOR WHICH STEAMLINE ISOLATION WILL OCCUR WITH PRESSURE RATE STEAMLINE BREAK PROTECTION SYSTEM

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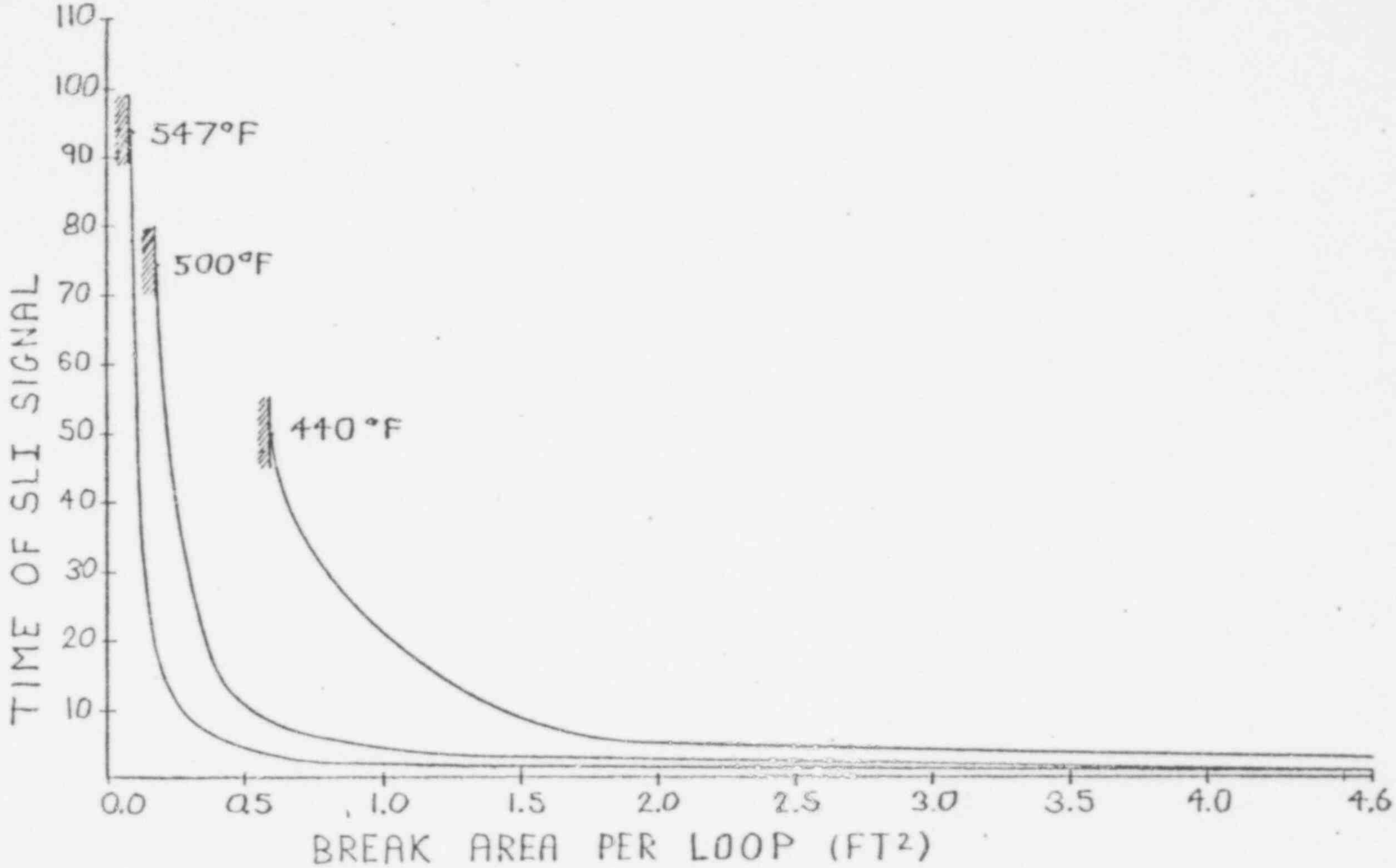

FIGURE 3 TIME OF STEAMLINE ISOLATION SIGNAL VS LOOP BREAK AREA NEW STEAMLINE BREAK PRCTECTION

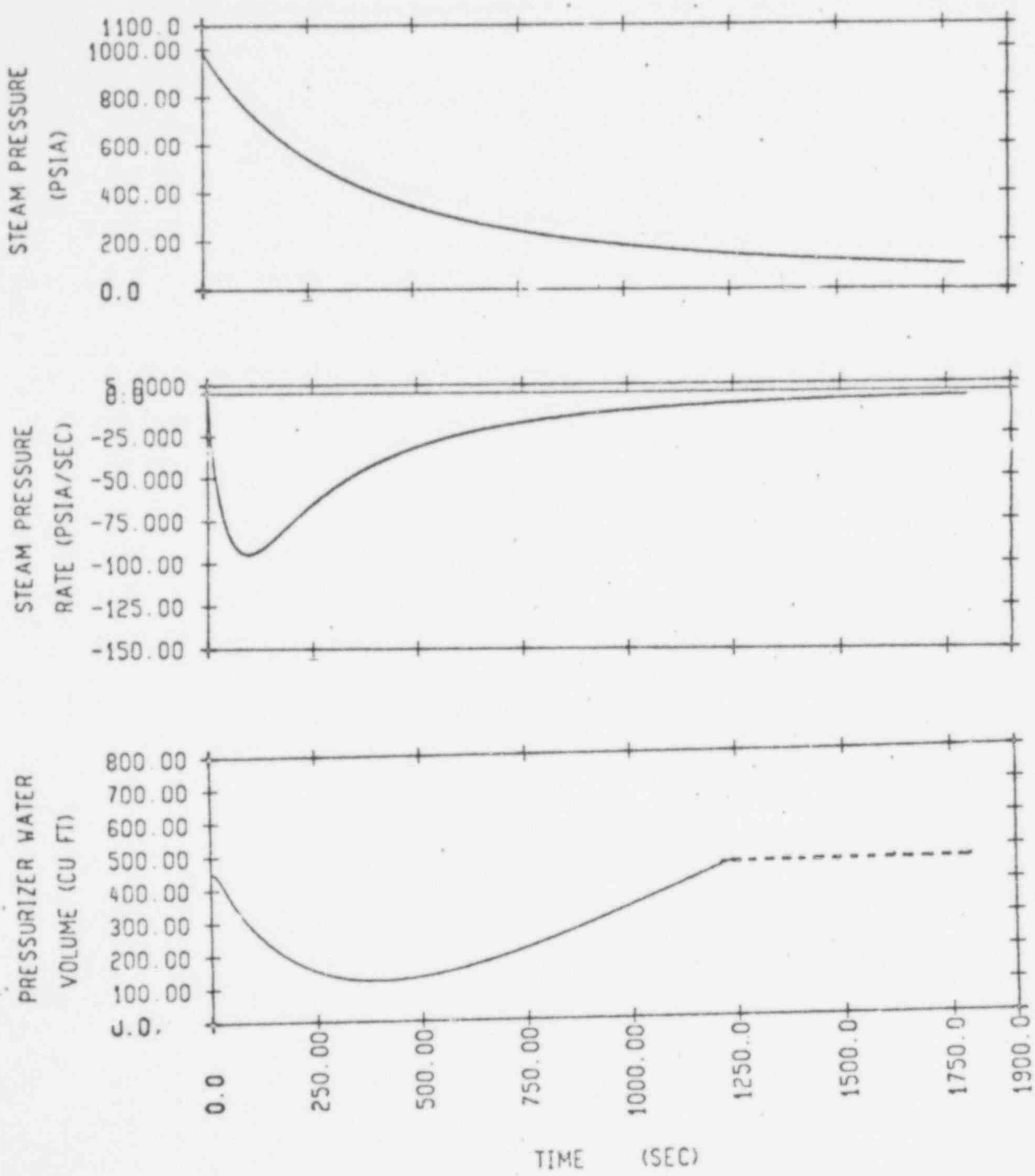

Figure 4 0.09 FT^2 BREAK (NO SLI)
WITH CHARGING AVAILABLE

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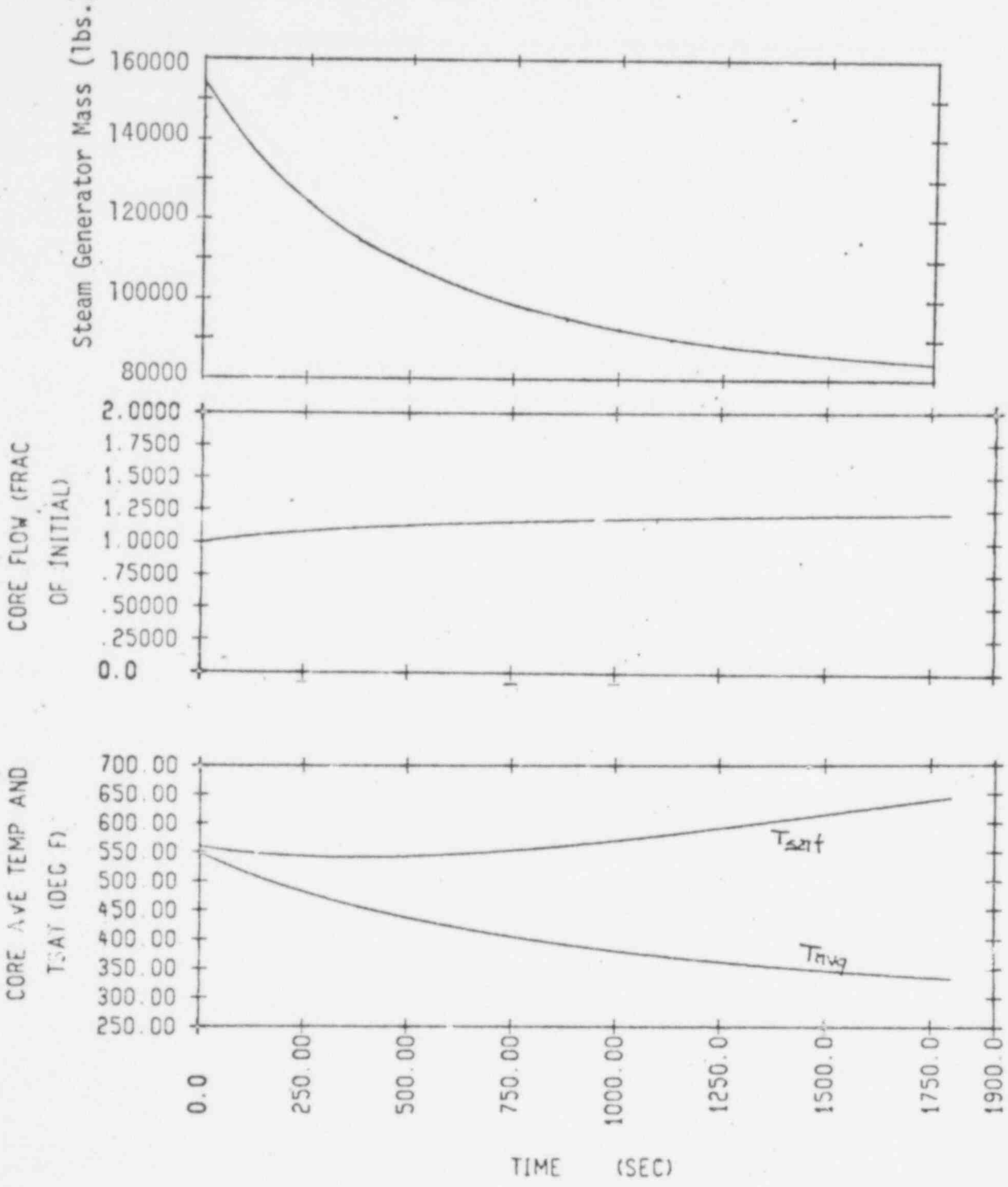

Figure 4 (cont) 0.09 FT^2 BREAK (NO SLI)
WITH CHARGING AVAILABLE

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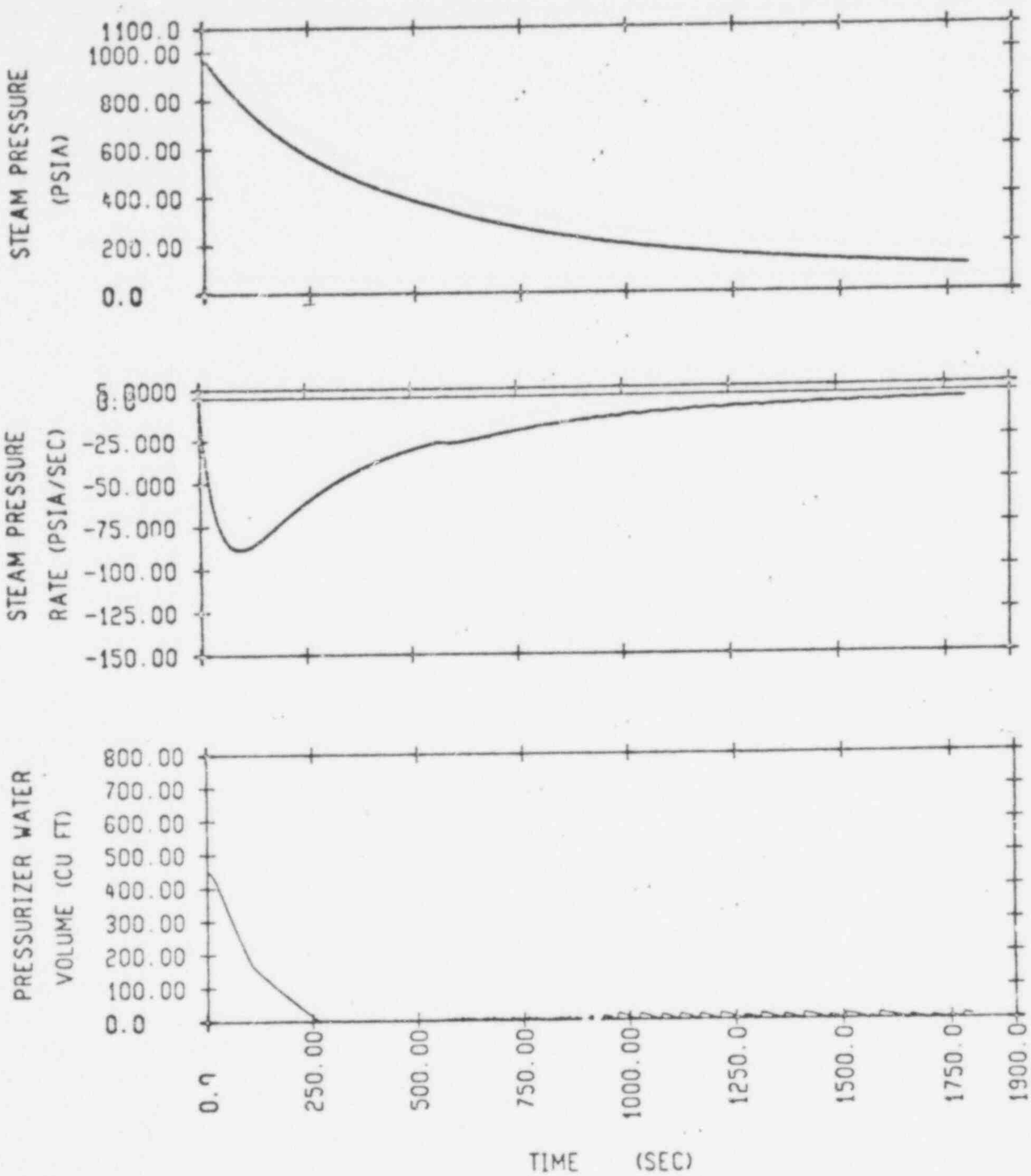

Figure 5 0.09 FT^2 (NO SLI)
CHARGING NOT AVAILABLE

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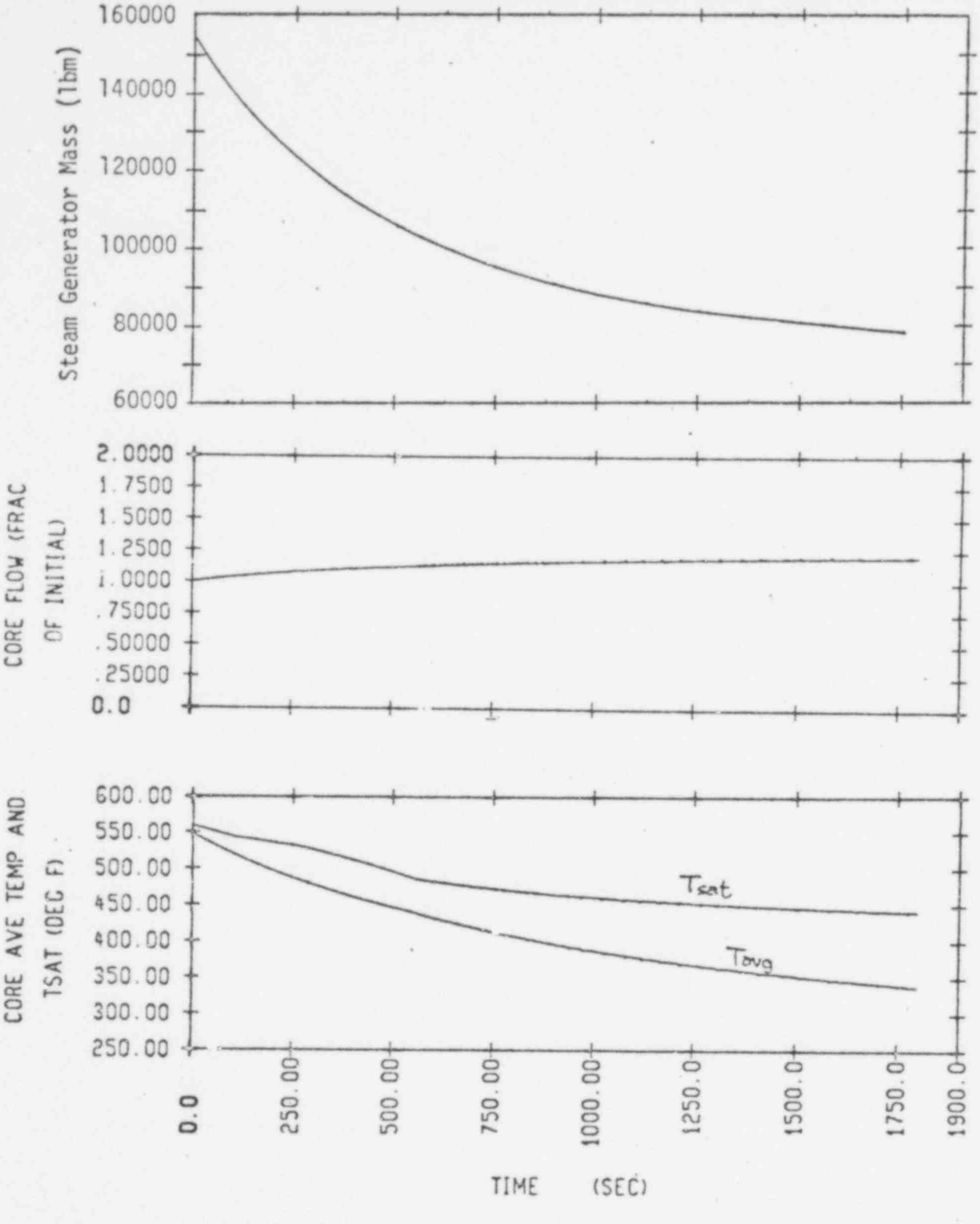

Figure 5 (cont) 0.09 FT^2 (NO SLI)
CHARGING NOT AVAILABLE

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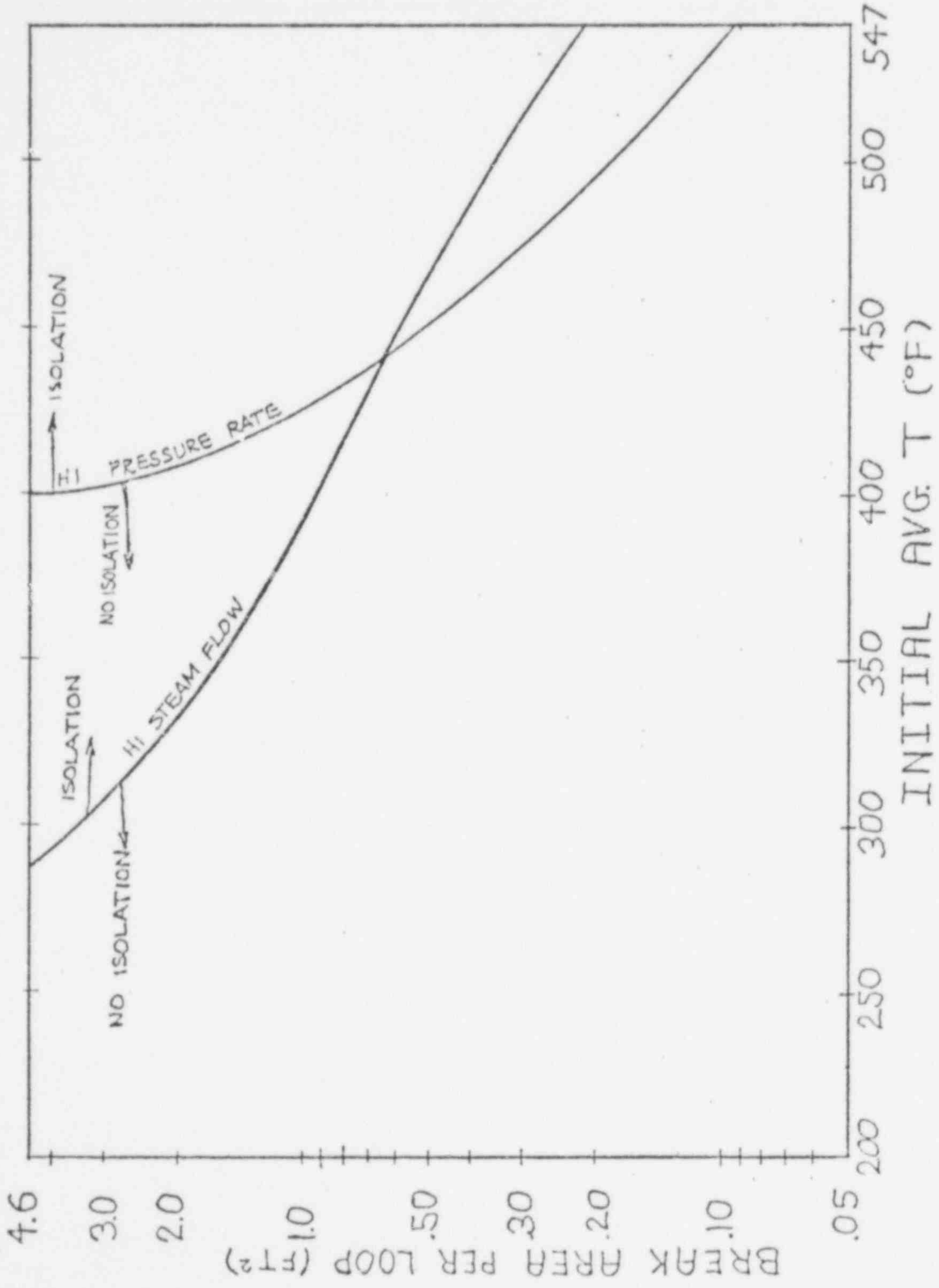

FIGURE 6 COMPARISON OF STEAMLINE BREAK PROTECTION SYSTEM RESPONSES

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	Case 1	Case 2
Initial RCS Pressure	1120 psia	1120 psia
Initial RCS Temperature	547°F	547°F
Charging Available	yes	no
S.I. Accumulators Status	Unblocked	Unblocked
RCS Pump Status	Running	Running

TABLE 1
SUMMARY OF CASE ASSUMPTIONS