STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

Caution

- *If any steam generator repressurizes above (1) psig at any time during this procedure, immediately go to E-2, LOSS OF SECONDARY COOLANT.*
- *If any steam generator level increases rapidly at any time during this procedure, immediately go to E-3, STEAM GENERATOR TUBE RUPTURE.*

NOTE *Foldout page should be open.*

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
1	**Verify Secondary Pressure Boundary:**	Manually close valves. IF valves do not close, THEN dispatch operator to locally close valves, or block valves, one loop at a time and continue.
	• Main steam line isolation and bypass valves - CLOSED	
	• Feedwater control and bypass control valves - CLOSED	
	• Feedwater isolation valves - CLOSED	
	• Steam supply valves to turbine driven-AFW pumps - CLOSED	
	• Steam generator blowdown isolation valves - CLOSED	
	• Steam generator PORVs - CLOSED	
	• Steam generator safety valves -CLOSED	
2	**Reduce Cooldown Rate:**	
	a. Throttle AFW flow to each SG as required. *MAINTAIN MINIMUM AFW FLOW OF 25 GPM TO EACH SG*	a. Dispatch operator to locally align valves.

(1) Enter plant specific value corresponding to low steamline pressure SI setpoint.

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
3	**Check CST Level:**	
	a. CST level - GREATER THAN (1) %	a. IF CST level low, THEN switch to alternate AFW water supply.
4	**Check Steam Generator Pressures:**	
	a. All steam generator pressures - LESS THAN (2) PSIG	a. Go to E-2, LOSS OF SECONDARY COOLANT.
5	**Check Level in SGs:**	
	a. Narrow range levels - LESS THAN 50%	a. Throttle AFW flow to maintain narrow range level below 50%.
6	**Check Secondary Radiation:**	
	a. Request periodic activity sample of all steam generators: [Enter plant specific steps]	
	b. Secondary radiation - NORMAL	b. Go to E-3, STEAM GENERATOR TUBE RUPTURE.
7	**Check Pressurizer PORV Block Valves:**	
	a. Power available to block valves	a. Restore power to block valves.
	b. Block valves - OPEN	b. Open block valve unless it was closed to isolate a faulty PORV.

(1) Enter plant specific low level setpoint.

(2) Enter plant specific value corresponding to low steamline pressure SI setpoint.

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
8	**Check Pressurizer PORVs:**	
	a. PORVs - CLOSED	a. IF RCS pressure less than 2335 psig, THEN manually close PORVs. If any valve cannot be closed, THEN manually close its block valve. IF block valve cannot be closed, THEN go to E-1, LOSS OF REACTOR COOLANT.

Caution *If any pressurizer PORV opens because of high RCS pressure, repeat Step 8 after pressure drops below PORV setpoint.*

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
9	**Check if Low-Head SI Pumps Should be Stopped:**	
	a. Check RCS pressure:	
	1) Pressure - GREATER THAN (1) PSIG	1) IF less than (1) psig, THEN go to E-1, LOSS OF REACTOR COOLANT, STEP 8.
	2) Pressure - STABLE OR INCREASING	2) IF decreasing, THEN go to Step 10.
	b. Reset SI	
	c. Stop low-head SI pumps and place in standby	

(1) Enter shutoff head pressure of low head SI pumps.

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

Caution

- *If RCS pressure drops below (1) psig, the low-head SI pumps must be manually restarted to supply water to the RCS.*
- *Seal injection flow should be maintained to all RCPs.*

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
10	**Check if RCPs Should be Stopped:**	
	a. SI running - CHECK FOR FLOW OR PUMP BREAKER INDICATOR LIGHTS LIT • Charging/SI - OR - • High-head SI	a. DO NOT STOP RCPs, go to Step 11.
	b. RCS pressure - EQUAL TO OR LESS THAN (2) PSIG	b. DO NOT STOP RCPs, go to Step 11.
	c. Stop all RCPs	

(1) Enter shutoff head pressure of low head SI pumps.
(2) Enter plant specific value derived from background document to E-0.

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
11	**Check Containment Spray System:**	
	a. Spray pumps - RUNNING	a. IF pumps NOT running, THEN go to Step 12.
	b. Containment pressure - LESS THAN (1) PSIG	b. Maintain containment spray until containment pressure is below (1) psig.
	c. Reset containment spray signal	
	d. Stop containment spray pumps and place in standby:	
	1) [Enter plant specific steps]	
12	**Check RWST Level:**	
	a. RWST level - GREATER THAN (2)	a. IF less than (2), THEN align SI system for cold leg recirculation per ES-2.2, TRANSFER TO COLD LEG RECIRCULATION FOLLOWING LOSS OF SECONDARY COOLANT.
13	**Check RCS Hot Leg Temperature:**	
	a. RCS hot leg temperature - STABLE OR DECREASING	a. Control AFW to establish a stable or decreasing RCS hot leg temperature.
14	**Check RCS Cold Leg Temperatures:**	
	a. All RCS cold leg temperatures - GREATER THAN 350°F	a. IF any RCS cold leg temperature less than 350°F, THEN go to Step 20.

(1) Enter containment HI-1 pressure setpoint.

(2) Enter plant specific value corresponding to RWST switchover alarm in plant specific units.

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
15	**Check Containment Conditions:**	
	a. Containment pressure - NORMAL	a. IF high, THEN go to Step 18.
	b. Containment radiation - NORMAL	b. IF high, THEN go to Step 18.
	c. Containment recirculation sump level - NORMAL	c. IF high, THEN go to Step 18.

Caution *If containment conditions exhibit abnormally high or increasing readings while doing Step 16, go to Step 18.*

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
16	**Check if SI Can Be Terminated (Under Normal Containment Conditions):**	
	a. RCS pressure - GREATER THAN 2000 PSIG AND INCREASING	a. DO NOT TERMINATE SI. Return to Step 12.
	b. Pressurizer level - GREATER THAN 20%	b. DO NOT TERMINATE SI. Return to Step 12.
	c. RCS subcooling - GREATER THAN (1)°F	c. DO NOT TERMINATE SI. Return to Step 12.
	d. Secondary heat sink:	
	1) Flow to at least (2) SG(s) - GREATER THAN 25 GPM	1) DO NOT TERMINATE SI. Return to step 12.
	2) RCS hot leg temperatures - STABLE OR DECREASING	2) DO NOT TERMINATE SI. Return to step 12.

(1) Enter sum of temperature and pressure measurement errors translated into temperature using saturation tables.
(2) Enter minimum number of steam generators supplied by one auxiliary feedwater pump.

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
17	**Terminate SI:**	
	a. Go to ES-2.3, SI TERMINATION FOLLOWING EXCESSIVE RCS COOLDOWN	
18	**Check if SI Can Be Terminated (Under Abnormal Containment Conditions):**	
	a. RCS pressure - GREATER THAN 2000 PSIG AND INCREASING	a. DO NOT TERMINATE SI. Return to Step 12.
	b. Pressurizer level - GREATER THAN 50%	b. DO NOT TERMINATE SI. Return to Step 12.
	c. RCS subcooling - GREATER THAN (1)°F	c. DO NOT TERMINATE SI. Return to Step 12.
	d. Secondary heat sink:	
	1) Flow to at least (2) SG(s) - GREATER THAN 25 GPM	1) DO NOT TERMINATE SI. Return to step 12.
	2) RCS hot leg temperatures -STABLE OR DECREASING	2) DO NOT TERMINATE SI. Return to step 12.
19	**Terminate SI:**	
	a. Go to ES-2.3, SI TERMINATION FOLLOWING EXCESSIVE RCS COOLDOWN	

(1) Enter sum of temperature and pressure measurement system errors translated into temperature using saturation tables.
(2) Enter minimum number of steam generators supplied by one auxiliary feedwater pump.

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

Caution *If RCS cold leg temperature is less than 350°F, SI must be terminated when termination criteria are met to protect vessel integrity.*

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
20	**Check if SI Can Be Terminated (RCS Cold Leg Temperature Below 350°F):**	
	a. RCS pressure - GREATER THAN 700 PSIG AND STABLE OR INCREASING	a. DO NOT TERMINATE SI. Return to Step 12.
	b. Pressurizer level - GREATER THAN 20%	b. DO NOT TERMINATE SI. Return to Step 12.
	c. RCS subcooling - GREATER THAN (1)°F	c. DO NOT TERMINATE SI. Return to Step 12.
	d. Secondary heat sink:	
	1) Flow to at least (2) SG(s) - GREATER THAN 25 GPM	1) DO NOT TERMINATE SI. Return to step 12.
	2) RCS hot leg temperatures -STABLE OR DECREASING	2) DO NOT TERMINATE SI. Return to step 12.
21	**Terminate SI:**	
	a. Go to ES-2.3, SI TERMINATION FOLLOWING EXCESSIVE RCS COOLDOWN	

- END -

(1) Enter sum of temperature and pressure measurement system errors translated into temperature using saturation tables.
(2) Enter the minimum number of steam generators supplied by one auxiliary feedwater pump.

FOLDOUT FOR GUIDELINE ECA-4

1. **SYMPTOM FOR E-2, LOSS OF SECONDARY COOLANT**

   Go to E-2, LOSS OF SECONDARY COOLANT, if any steam generator repressurizes above (1) psig at any time.

2. **SYMPTOM FOR E-3, STEAM GENERATOR TUBE RUPTURE**

   Go to E-3, STEAM GENERATOR TUBE RUPTURE, if any steam generator level increases rapidly at any time.

3. **SECONDARY HEAT SINK CRITERION**

   Auxiliary feedwater flow should be controlled to stablize RCS hot leg temperature if temperature is increasing at any time.

4. **COLD LEG RECIRCULATION SWITCHOVER CRITERION**

   IF RWST level less than (2)%, THEN align SI system for cold leg recirculaton per ES-2.2, COLD LEG RECIRCULATION FOLLOWING LOSS OF SECONDARY COOLANT.

(1) Enter plant specific value corresponding to low steamline pressure SI setpoint.

(2) Enter plant specific value corresponding to RWST switchover alarm in plant specific units.

BACKGROUND INFORMATION FOR

WESTINGHOUSE

EMERGENCY RESPONSE GUIDELINES

ECA-4

RESPONSE TO MULTIPLE STEAM GENERATOR DEPRESSURIZATION

BASIC REVISION

NOVEMBER 1, 1982

1.0 INTRODUCTION

This document provides contingency emergency recovery instructions for multiple steam generator depressurization events for which the E-2, Loss of Secondary Coolant, guidelines are not adequate. In particular, this guideline mitigates the consequences of the event where no steam generator pressure boundary is intact. Potential initiating events for this contingency could include seismic events, steamline rupture with a common mode of failure of the steamline isolation valves, stuck open relief or safety valves, or any combination of conditions that would affect all steam generators. System parameter trends that must be recognized to diagnose the transients associated with this contingency are the same as those presented in E-2, Loss of Secondary Coolant.

2.0 EVENT DESCRIPTION

A multiple steam generator depressurization event initiates from a rupture in a main steamline, main feedwater line and/or in any piping system that interconnects with the secondary side pressure boundary as in E-2, Loss of Secondary Coolant. The results of the multiple steam generator depressurization is a more extensive cooldown and pressure transient since the steamline isolation signal does not restore the pressure integrity of any steam generator. The consequences vary considerably depending upon several system parameters: size(s) and location(s) of the rupture(s); safety systems that are operational; control systems that are operational; initial power level; and failures that occur.

A summary review of an intermediate size line rupture and large secondary system pipe rupture are presented in order to describe the system transient characteristics an operator may encounter following a multiple steam generator depressurization event.

Intermediate Size Rupture

A rupture is assumed that will result in all loops experiencing decreasing steam pressure and increasing steam load for which control systems are unable to compensate. Steam generator water level and primary average temperature will slowly decrease and the control rods will commence stepping out of the core in an attempt to maintain nominal primary system average temperature. Also, due to the decreasing temperature, a primary pressure decrease occurs. This trend will continue until either the operator diagnoses the cause of the incident or a trip setpoint is reached on overpower, low steamline pressure, or low pressurizer pressure. In any case, signals would eventually be generated for reactor trip, turbine trip, safety injection, feedwater isolation, steamline isolation, and auxiliary feedwater initiation. With a failure to restore integrity to any steam generator, all steam generators would continue to blowdown to atmospheric pressure resulting in a continued decrease in primary system temperature and pressure. As the primary system temperature drops the heat transfer to the steam generators and the primary system cooldown rate will be reduced. This trend will continue to the point where the primary system water volume shrinkage (caused by the cooldown) is overcome by the safety injection system flowrate and primary system pressure and pressurizer water volume will be restored. If the auxiliary feedwater flowrate is not adjusted, primary system cooldown would continue. The primary trend for diagnosing this event is all steam generator pressures below the low steam pressure safety injection setpoint.

Large Secondary System Pipe Rupture

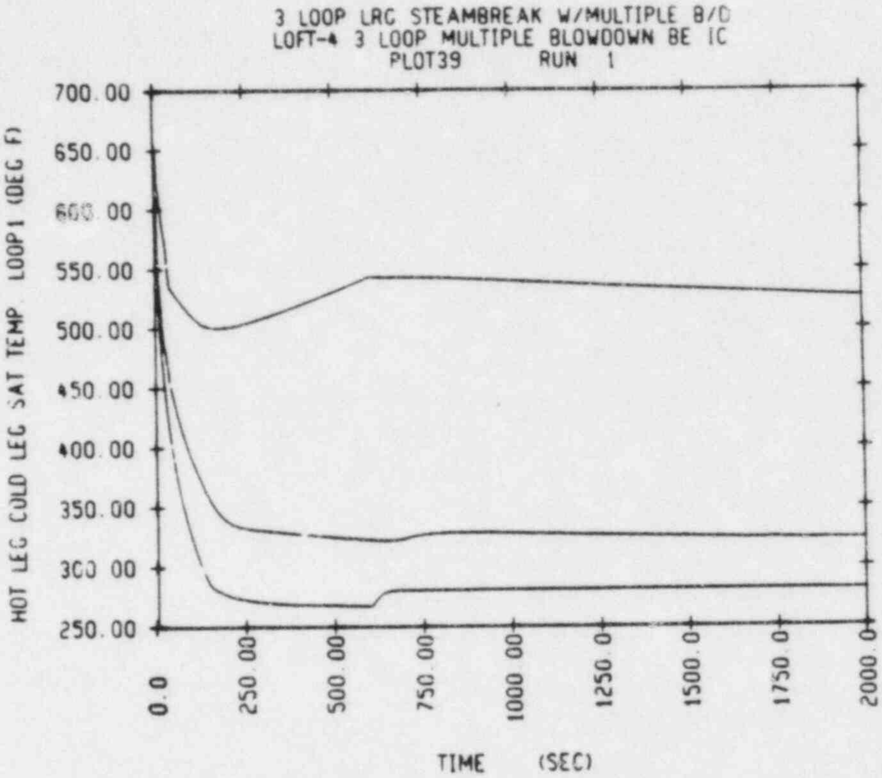
For the double ended rupture, an immediate decrease in steamline pressure to the low steamline pressure setpoint (0.5-10 seconds) results in safety injection, feedline isolation, reactor trip, turbine trip and auxiliary feedwater initiation signals. With the failure to restore secondary pressure boundary integrity to any steam generator (i. e., common mode failure of the main steam isolation valves), a rapid, extensive primary system cooldown and depressurization occurs. As the primary system temperature drops, the heat transfer to the steam generators and primary system cooldown rate will be reduced. This trend will continue to the point where the primary system water volume shrinkage (caused by the cooldown) is overcome by the safety injection system flowrate. This results in the primary system pressure and pressurizer water volume restoration. Depending on the initial conditions of the systems and the size and location of the rupture, one of two conditions will be reached on the blowdown. The first is where the steam generator blowdowns are essentially completed and further cooldown of the primary system is controlled by the auxiliary feedwater flow. The second is where the primary temperature is reduced so far that the heat transfer to the steam generators matches the heat generation in the primary system which results in a stabilized primary temperature. As for the intermediate size rupture, the primary trend for diagnosing this event is when all steam generator pressures are below the low steam pressure safety injection setpoint.

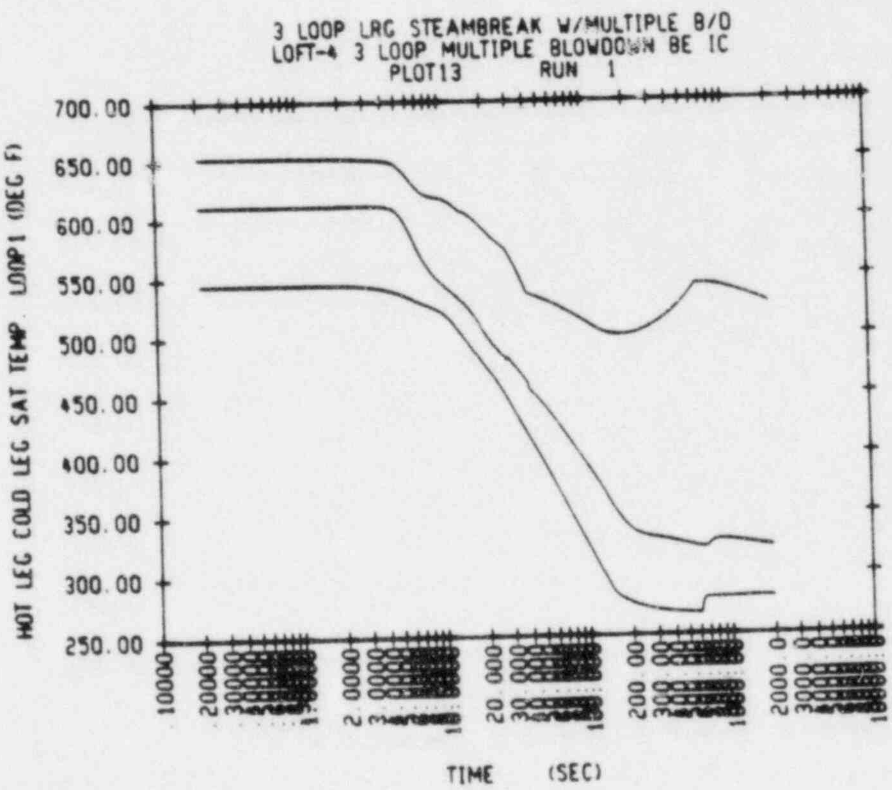
SEQUENCE OF EVENTS

LARGE STEAMLINE RUPTURE

HIGH HEAD INJECTION - MAXIMUM SAFEGUARDS

TIME (SEC)	EVENT
0.0	Steambreak Initiated
0.7	Low Steam Pressure Trip Setpoint (600 psig) Reached - Rx Scram
2.7	Inward Rod Motion Achieved
5.7	Main Feedwater Isolation - Aux. Feed Flow Rate of 500 gal/min. Initiated to Each Steam Generator
10.4	Safety Injection System - Low Pressurizer Pressure Setpoint
27.8	Pressurizer Empty
168.8	Minimum System Pressure Reached (685 psig)
173.0	Pressurizer Begins Refilling
175.0	Steam Generators Depressurized (< 50 psig)
180.0	Throttle Aux. Feed Flow to 25 gal/min per Steam Generator
182.7	Reactor Coolant Pumps Trip
600.0	Minimum T_{cold} (267.3 ^{o}F)
600.0	Secure Safety Injection System
1600.0	Raise Aux. Feed Flow to 150 gal/min per Steam Generator


3 LOOP LRC STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT39 RUN 1
HOT LEG COLD LEG SAT TEMP LOOP1 (DEG F)
700.00
650.00
600.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
0.0
250.00
500.00
750.00
1000.00
1250.0
1500.0
1750.0
2000.0
TIME (SEC)


3 LOOP LRC STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT13 RUN 1
HOT LEG COLD LEG SAT TEMP LOOP1 (DEG F)
700.00
650.00
600.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
TIME (SEC)

system water volume shrinkage (caused by the cooldown) is overcome by the safety injection system flowrate and primary system pressure and pressurizer water volume will be restored. If the auxiliary feedwater flowrate is not adjusted, primary system cooldown would continue. The primary trend for diagnosing this event is all steam generator pressures below the low steam pressure safety injection setpoint.

Large Secondary System Pipe Rupture

For the double ended rupture, an immediate decrease in steamline pressure to the low steamline pressure setpoint (0.5-10 seconds) results in safety injection, feedline isolation, reactor trip, turbine trip and auxiliary feedwater initiation signals. With the failure to restore secondary pressure boundary integrity to any steam generator (i. e., common mode failure of the main steam isolation valves), a rapid, extensive primary system cooldown and depressurization occurs. As the primary system temperature drops, the heat transfer to the steam generators and primary system cooldown rate will be reduced. This trend will continue to the point where the primary system water volume shrinkage (caused by the cooldown) is overcome by the safety injection system flowrate. This results in the primary system pressure and pressurizer water volume restoration. Depending on the initial conditions of the systems and the size and location of the rupture, one of two conditions will be reached on the blowdown. The first is where the steam generator blowdowns are essentially completed and further cooldown of the primary system is controlled by the auxiliary feedwater flow. The second is where the primary temperature is reduced so far that the heat transfer to the steam generators matches the heat generation in the primary system which results in a stabilized primary temperature. As for the intermediate size rupture, the primary trend for diagnosing this event is when all steam generator pressures are below the low steam pressure safety injection setpoint.

3.0 TRANSIENT PRESENTATION

Five cases are presented of steamline break transients with the multiple steam generator depressurization being implemented through a failure of all the main steam isolation valves to close. A summary is provided for each case to indicate the automatic actions, operator actions and various conditions that are reached.

Each parameter (i. e., pressurizer water volume, reactor coolant system pressure, etc.) is provided on linear and semi-log time scales for comparison. The cases presented are results of best estimate analyses.

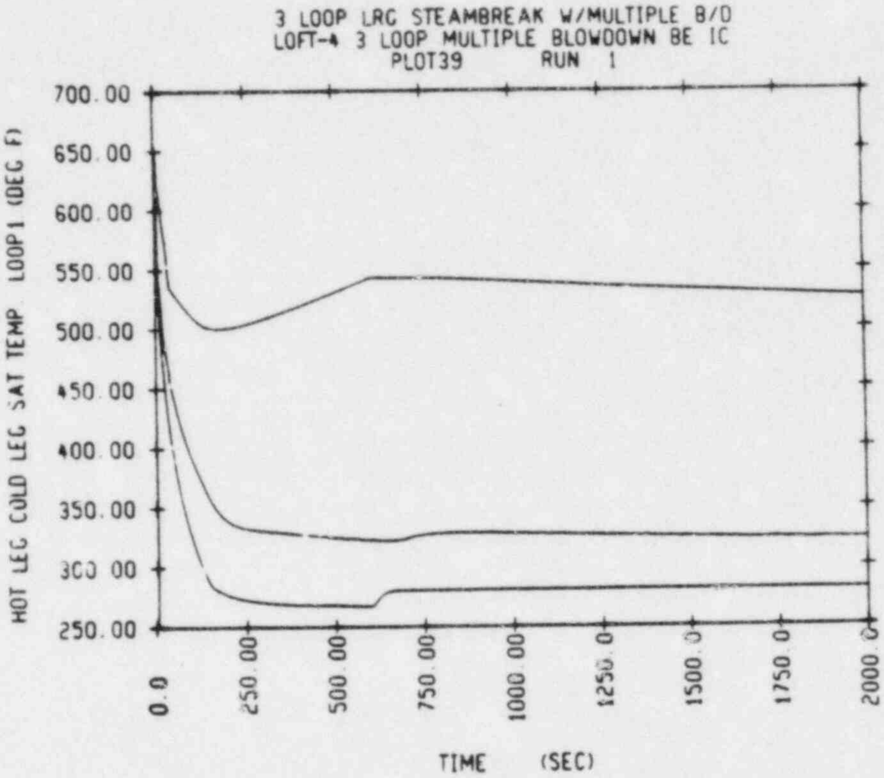
For all cases presented, no charging flow is simulated after the safety injection system is secured.

SEQUENCE OF EVENTS

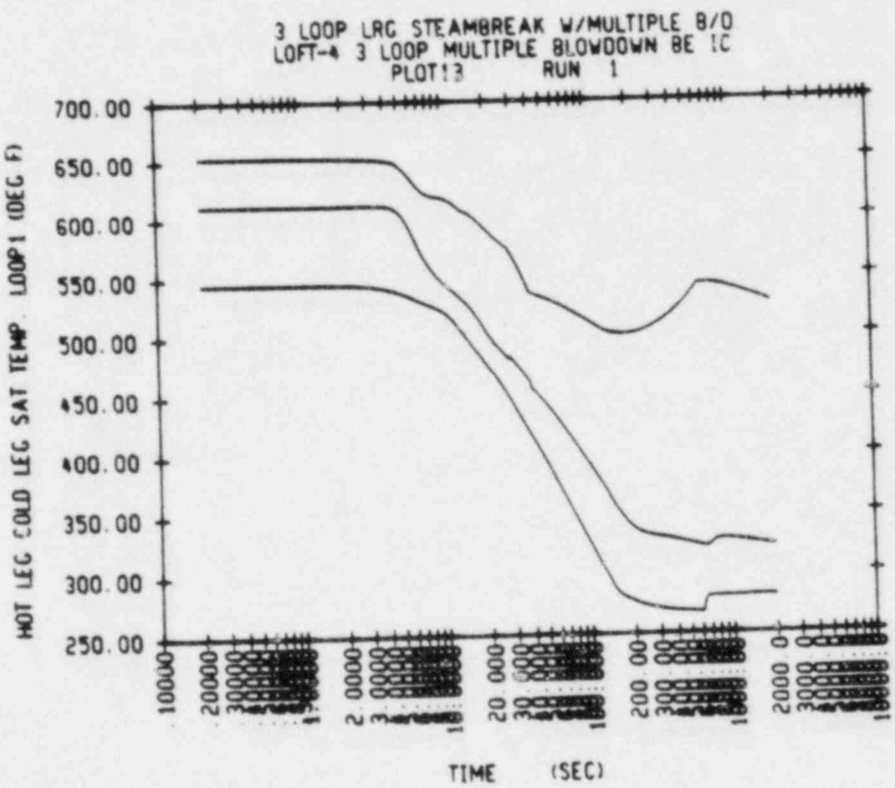
LARGE STEAMLINE RUPTURE

HIGH HEAD INJECTION - MAXIMUM SAFEGUARDS

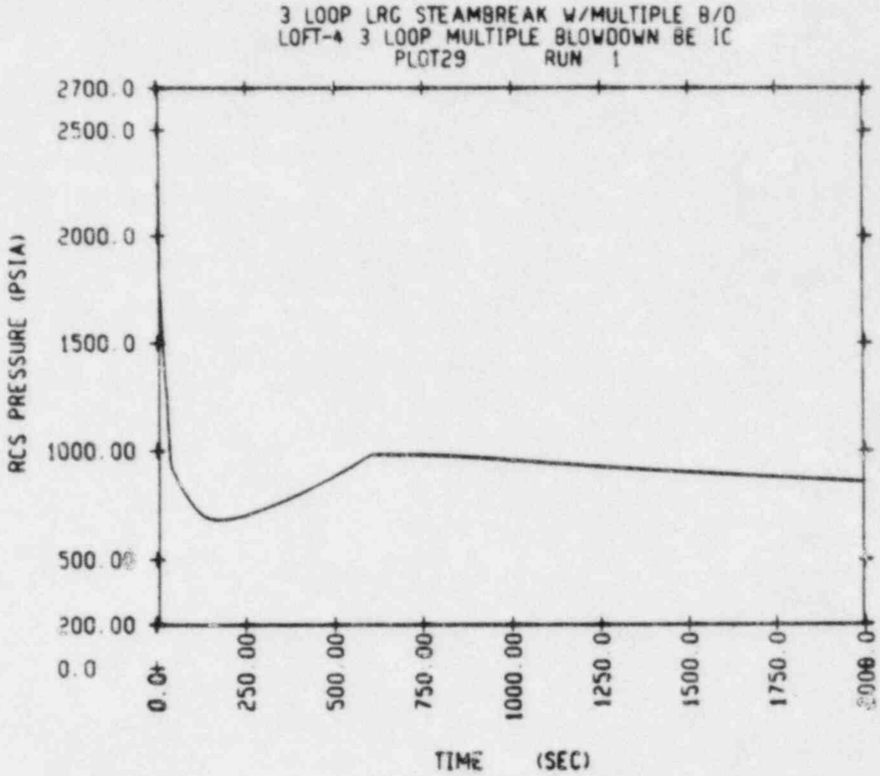
TIME (SEC)	EVENT
0.0	Steambreak Initiated
0.7	Low Steam Pressure Trip Setpoint (600 psig) Reached - Rx Scram
2.7	Inward Rod Motion Achieved
5.7	Main Feedwater Isolation - Aux. Feed Flow Rate of 500 gal/min. Initiated to Each Steam Generator
10.4	Safety Injection System - Low Pressurizer Pressure Setpoint
27.8	Pressurizer Empty
168.8	Minimum System Pressure Reached (685 psig)
173.0	Pressurizer Begins Refilling
175.0	Steam Generators Depressurized (< 50 psig)
180.0	Throttle Aux. Feed Flow to 25 gal/min per Steam Generator
182.7	Reactor Coolant Pumps Trip
600.0	Minimum T_{cold} (267.3 ^{o}F)
600.0	Secure Safety Injection System
1600.0	Raise Aux. Feed Flow to 150 gal/min per Steam Generator



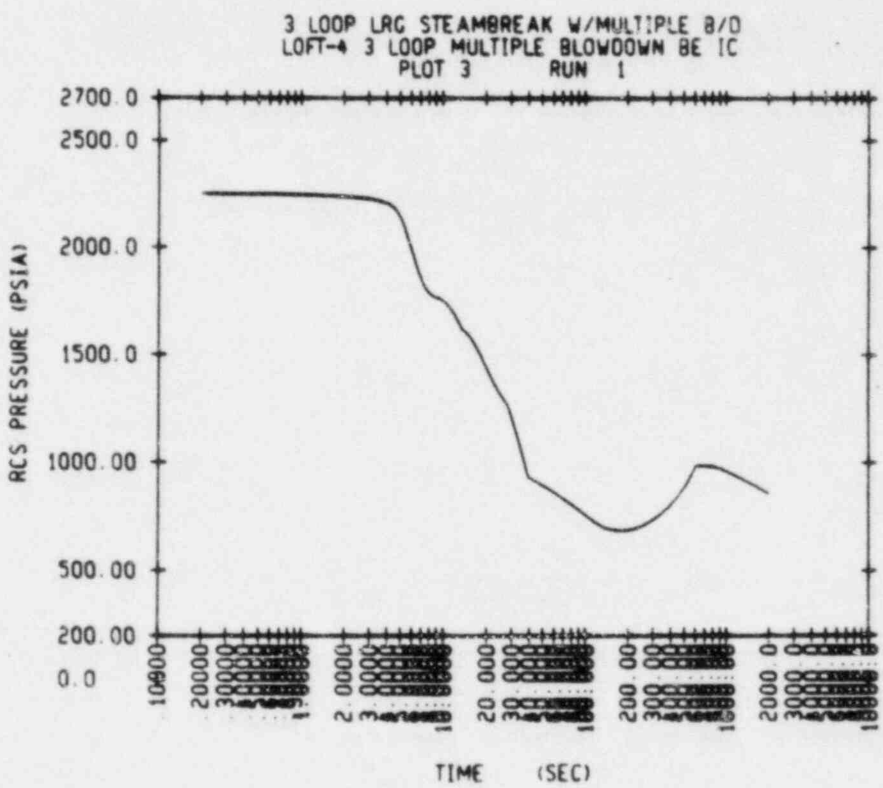
3 LOOP LRG STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT39 RUN 1
HOT LEG COLD LEG SAT TEMP LOOP1 (DEG F)
700.00
650.00
600.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
0.0
250.00
500.00
750.00
1000.00
1250.0
1500.0
1750.0
2000.0
TIME (SEC)



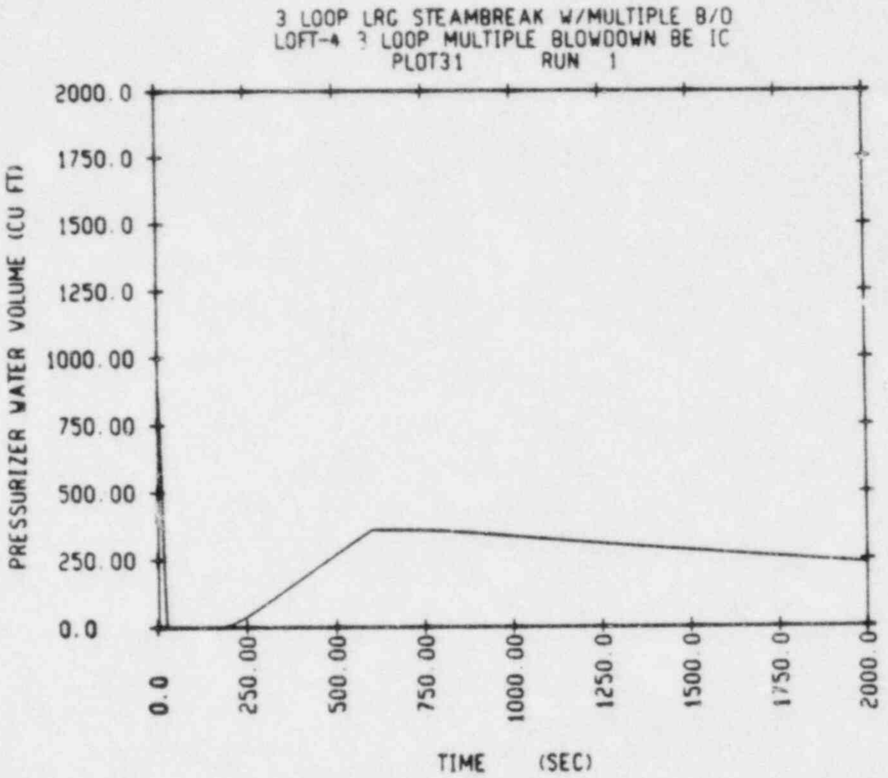
3 LOOP LRG STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT13 RUN 1
HOT LEG COLD LEG SAT TEMP LOOP1 (DEG F)
700.00
650.00
600.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
TIME (SEC)

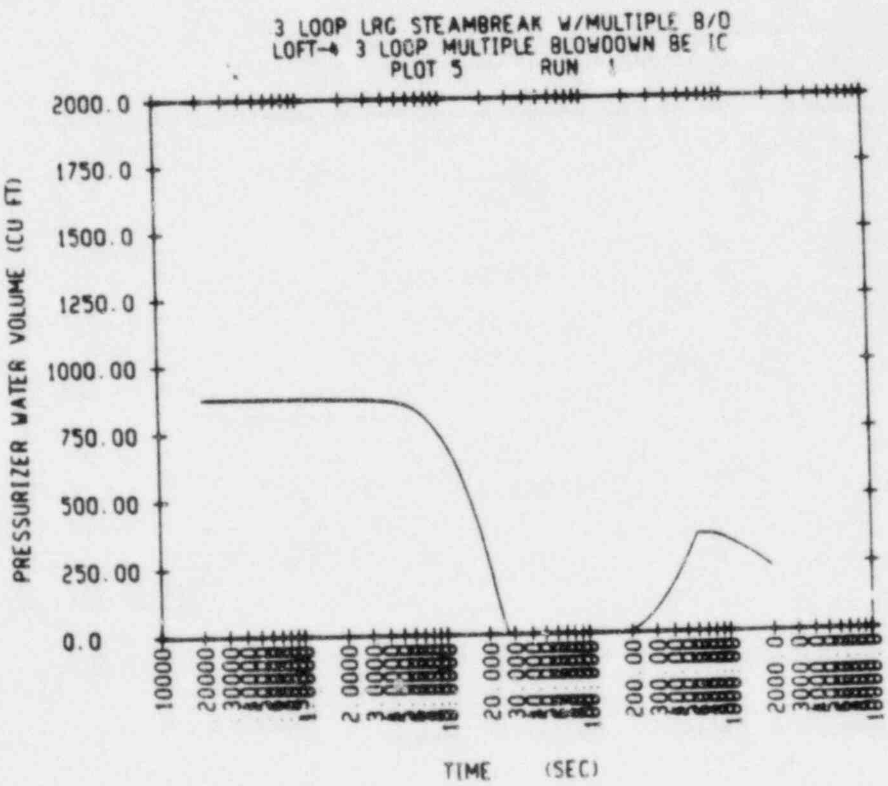


3 LOOP LRG STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT29 RUN 1
RCS PRESSURE (PSIA)
2700.0
2500.0
2000.0
1500.0
1000.00
500.00
200.00
0.0
0.0
250.00
500.00
750.00
1000.00
1250.0
1500.0
1750.0
2000.0
TIME (SEC)

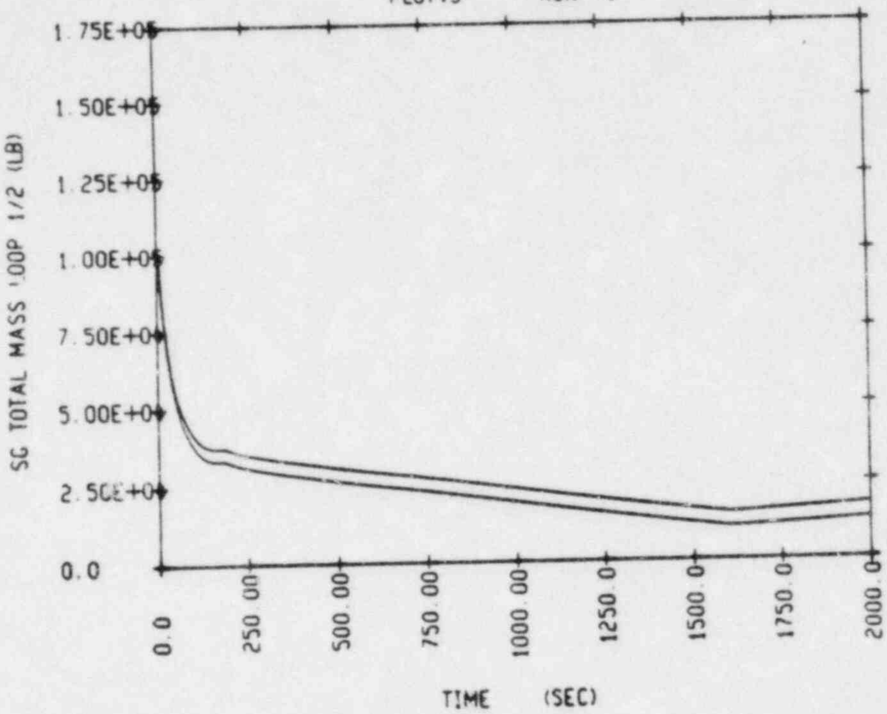


3 LOOP LRG STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT 3 RUN 1
RCS PRESSURE (PSIA)
2700.0
2500.0
2000.0
1500.0
1000.00
500.00
200.00
0.0
TIME (SEC)

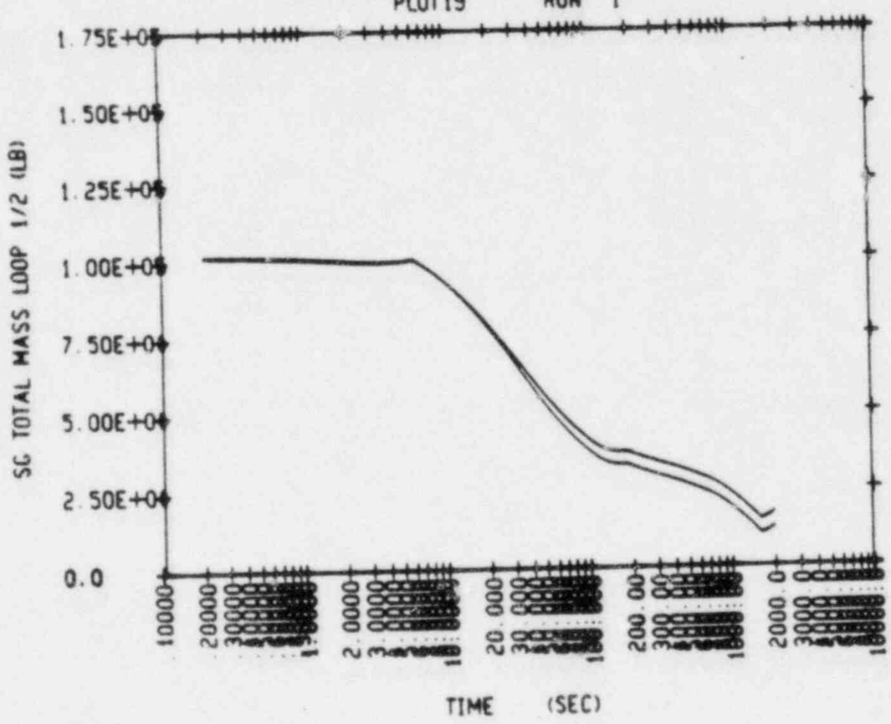

3 LOOP LRG STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT31 RUN 1
PRESSURIZER WATER VOLUME (CU FT)
TIME (SEC)

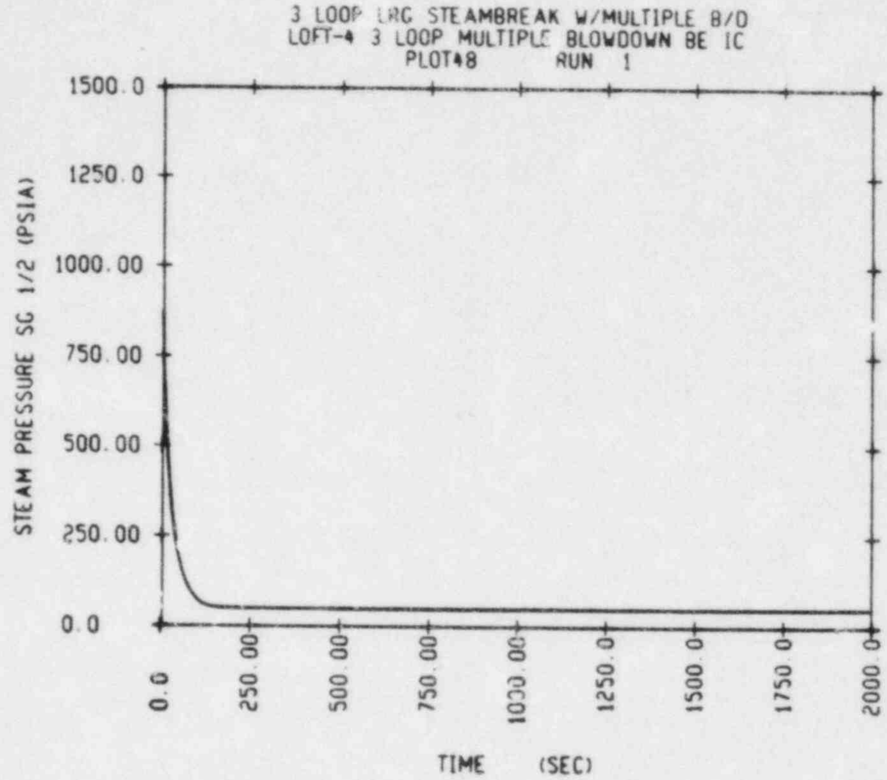

3 LOOP LRG STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT 5 RUN 1
PRESSURIZER WATER VOLUME (CU FT)
TIME (SEC)

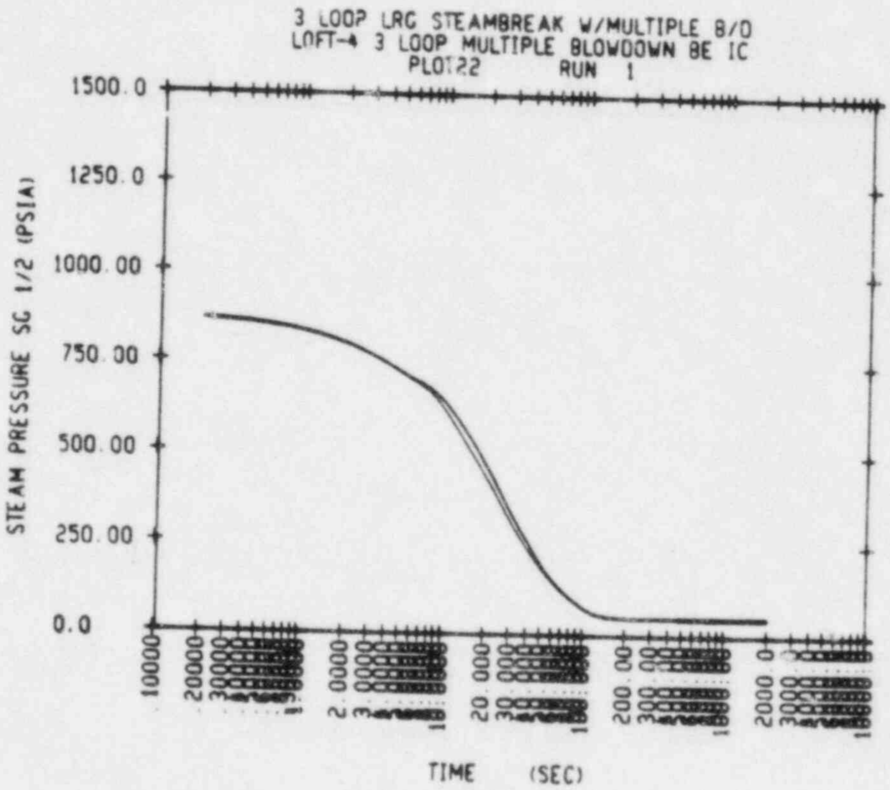
3 LOOP LRG STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT45 RUN 1



3 LOOP LRG STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT19 RUN 1




3 LOOP LRG STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT48 RUN 1
STEAM PRESSURE SG 1/2 (PSIA)
1500.0
1250.0
1000.00
750.00
500.00
250.00
0.0
0.0
250.00
500.00
750.00
1000.00
1250.0
1500.0
1750.0
2000.0
TIME (SEC)

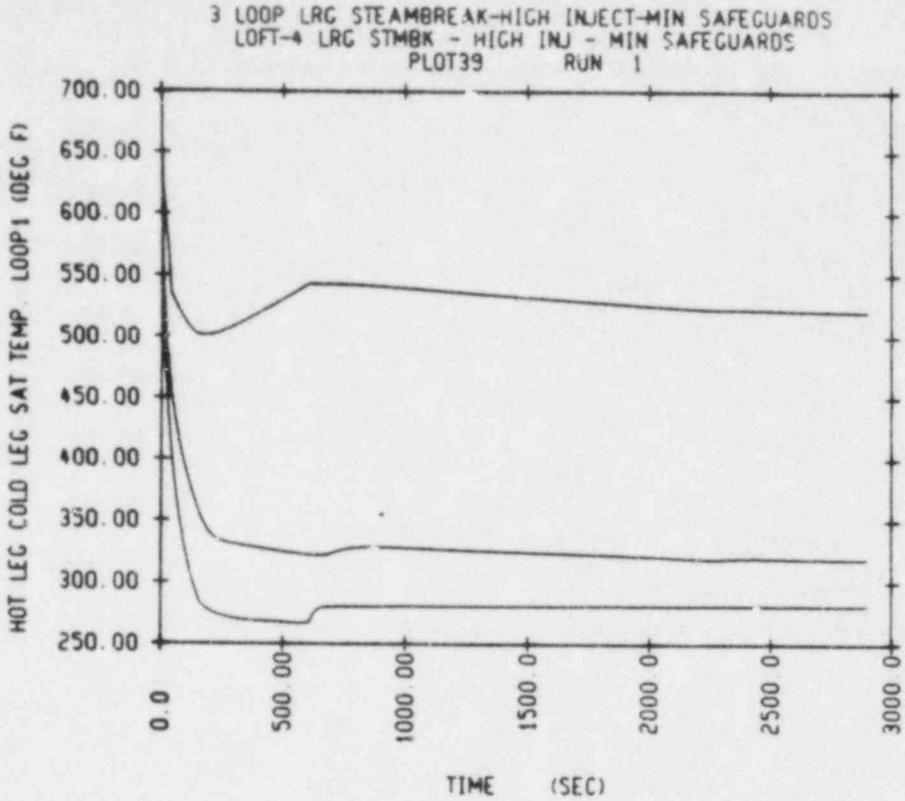

3 LOOP LRG STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT22 RUN 1
STEAM PRESSURE SG 1/2 (PSIA)
1500.0
1250.0
1000.00
750.00
500.00
250.00
0.0
TIME (SEC)

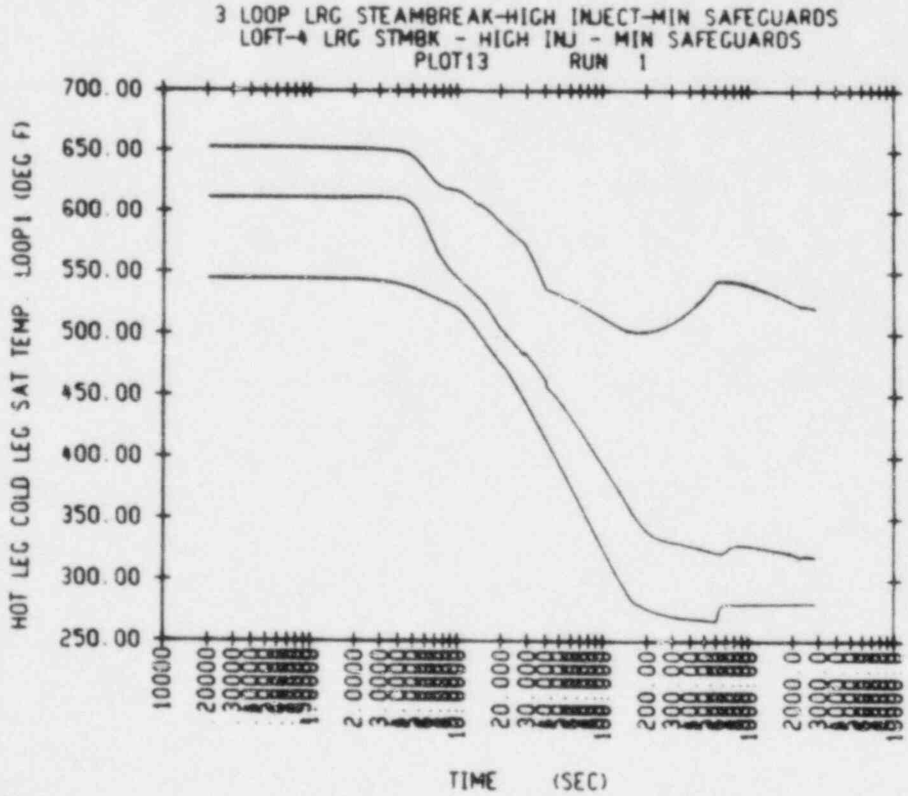
SEQUENCE OF EVENTS

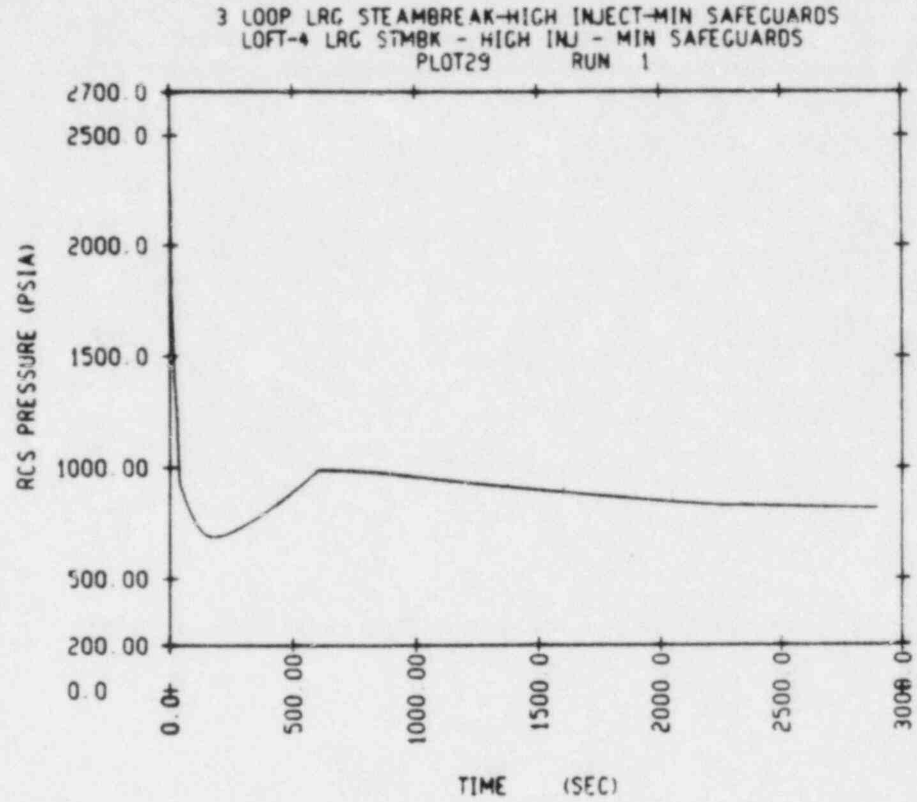
LARGE STEAMLINE RUPTURE (1.4 FT^2/LOOP)

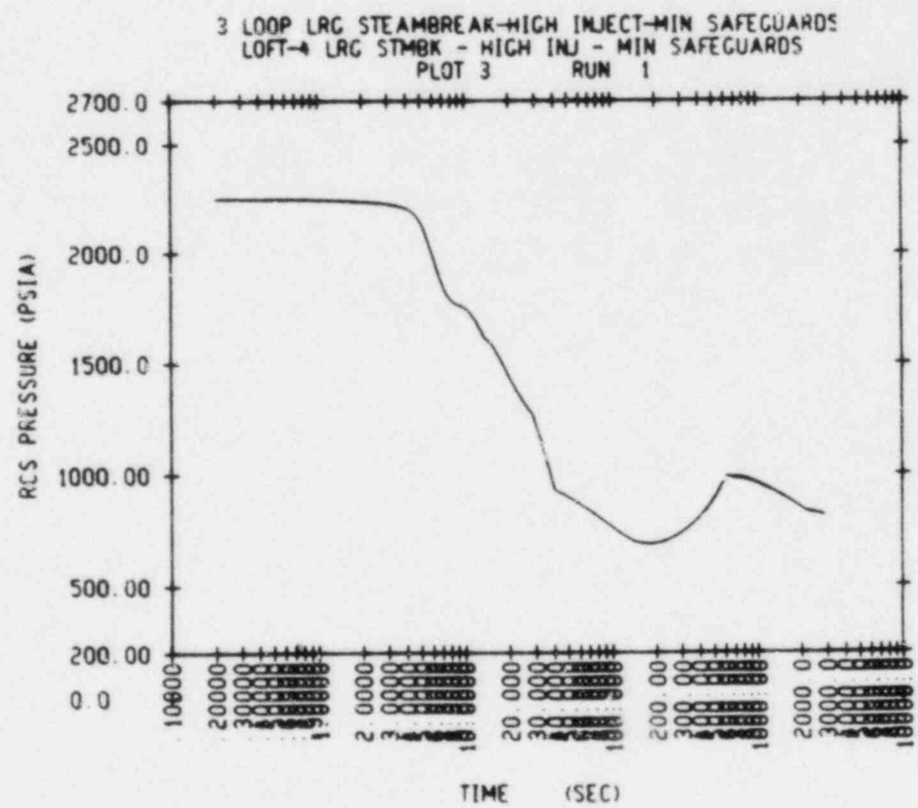
HIGH HEAD INJECTION - MINIMUM SAFEGUARDS

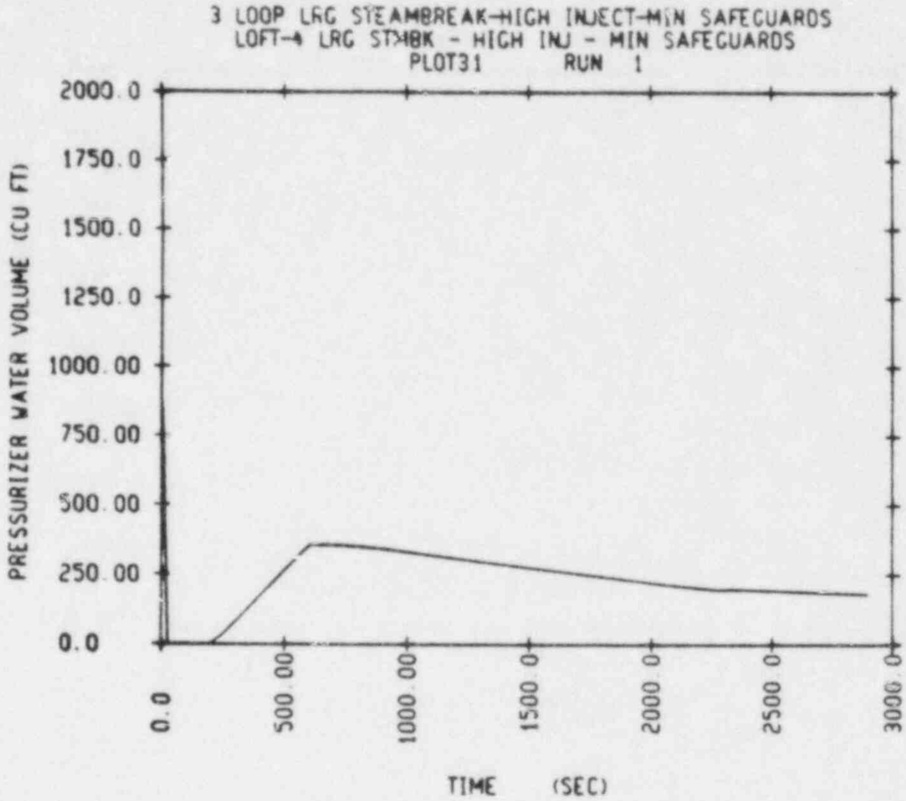
Time	Event
0.0	Steambreak Initiated
0.7	Low Steam Pressure Trip Setpoint Reached (600 psig) - Rx Scram and Safety Injection System Initiated
2.7	Inward Rod Motion Achieved
3.2	Turbine Trip
5.7	Main Feedwater Isolation; Auxiliary Feed Flow Rate of 500 gpm per Steam Generator Initiated
18.0	RCS Pressure <1500 psia
19.7	RCPs Tripped
28.2	Pressurizer Empty
80.4	RCS Cold Leg Temperatures <350°F
170.0	Minimum RCS Pressure Reached (689.5 psia)
180.0	Auxiliary Feedwater Flow Rate Throttled to 25 gpm per Steam Generator
224.2	RCS Pressure >700 psia
515.4	Pressurizer Water Volume >280 Ft^3
600.0	Safety Injection System Flow Terminated (Pressurizer Water Volume = 358.1 Ft^3; RCS Pressure = 989.6 psia; Tcold = 266.9°F = Minimum RCS Temperature Reached)
2096.	Steam Generators Dryout
2300.	Increase Auxiliary Feed Flow Rate to 150 gpm per Steam Generator
2600.	Cooldown Rate Approximately 40°F/Hr

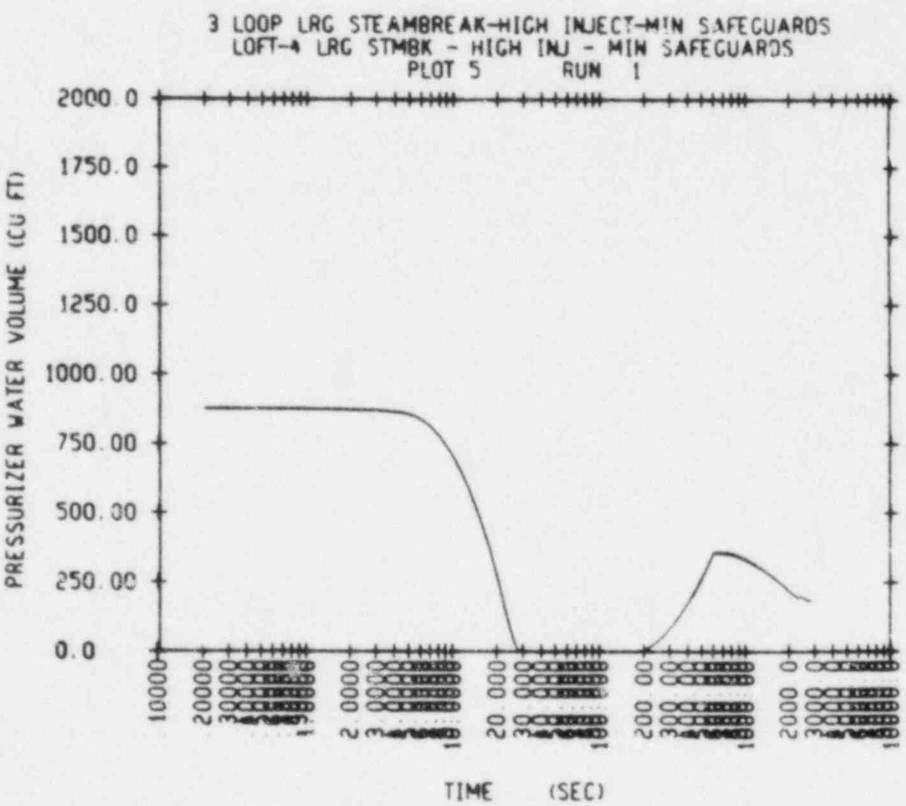

3 LOOP LRG STEAMBREAK-HIGH INJECT-MIN SAFEGUARDS
LOFT-4 LRG STMBK - HIGH INJ - MIN SAFEGUARDS
PLOT39 RUN 1
HOT LEG COLD LEG SAT TEMP LOOP1 (DEG F)
700.00
650.00
600.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
0.0
500.00
1000.00
1500.0
2000.0
2500.0
3000.0
TIME (SEC)

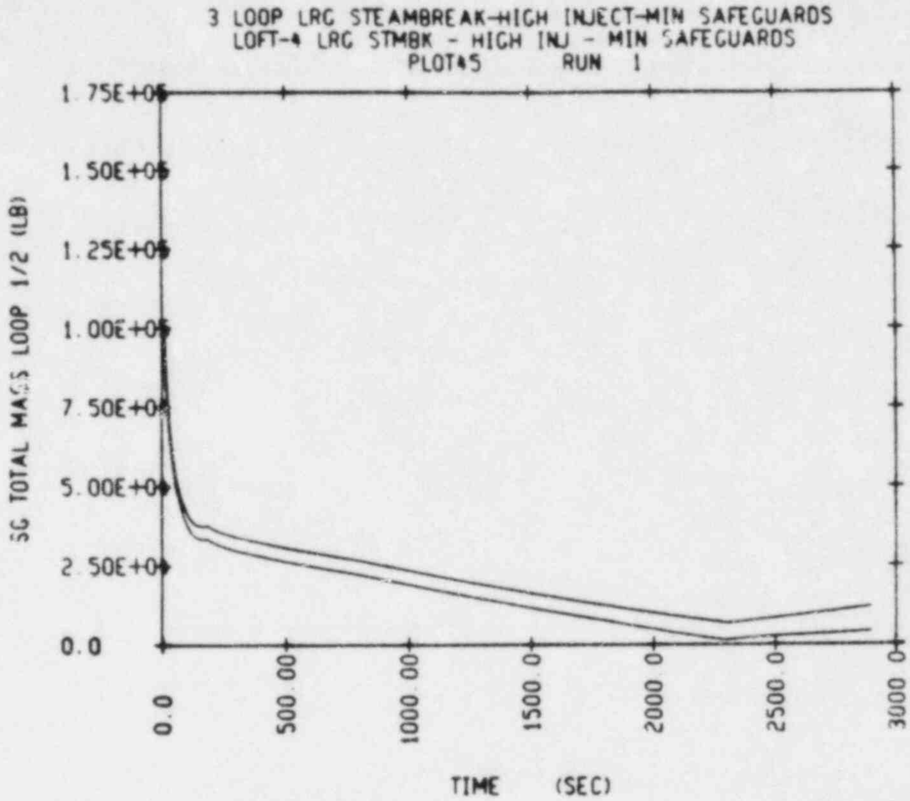

3 LOOP LRG STEAMBREAK-HIGH INJECT-MIN SAFEGUARDS
LOFT-4 LRG STMBK - HIGH INJ - MIN SAFEGUARDS
PLOT13 RUN 1
HOT LEG COLD LEG SAT TEMP LOOP1 (DEG F)
700.00
650.00
600.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
TIME (SEC)

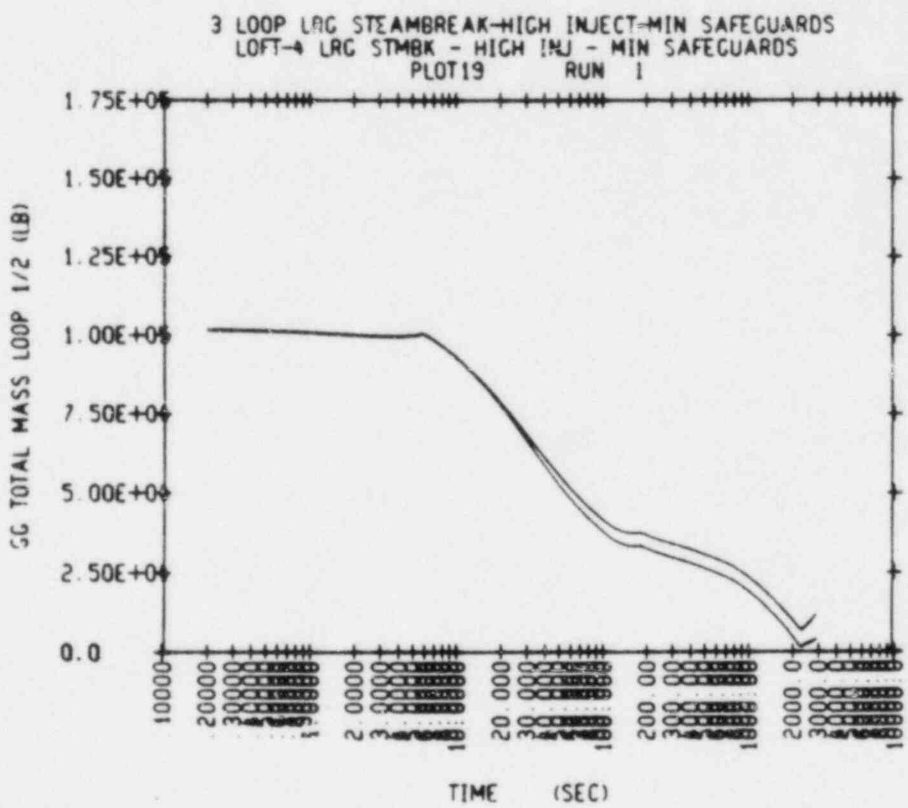

3 LOOP LRG STEAMBREAK-HIGH INJECT-MIN SAFEGUARDS
LOFT-4 LRG STMBK - HIGH INJ - MIN SAFEGUARDS
PLOT29 RUN 1
RCS PRESSURE (PSIA)
TIME (SEC)

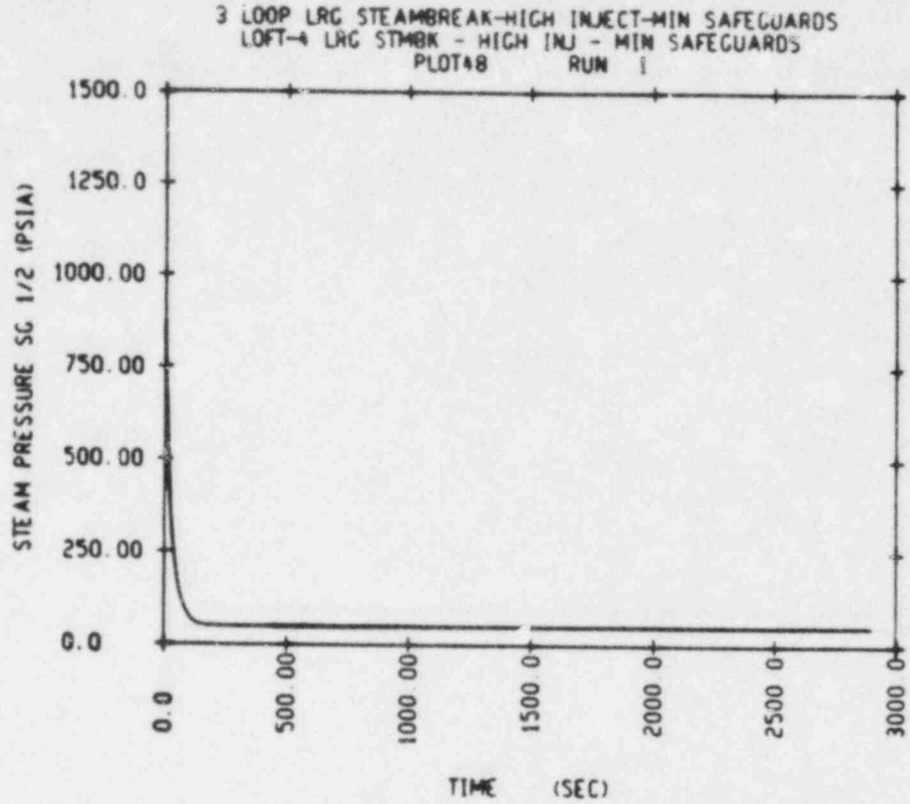

3 LOOP LRG STEAMBREAK-HIGH INJECT-MIN SAFEGUARDS
LOFT-4 LRG STMBK - HIGH INJ - MIN SAFEGUARDS
PLOT 3 RUN 1
RCS PRESSURE (PSIA)
TIME (SEC)

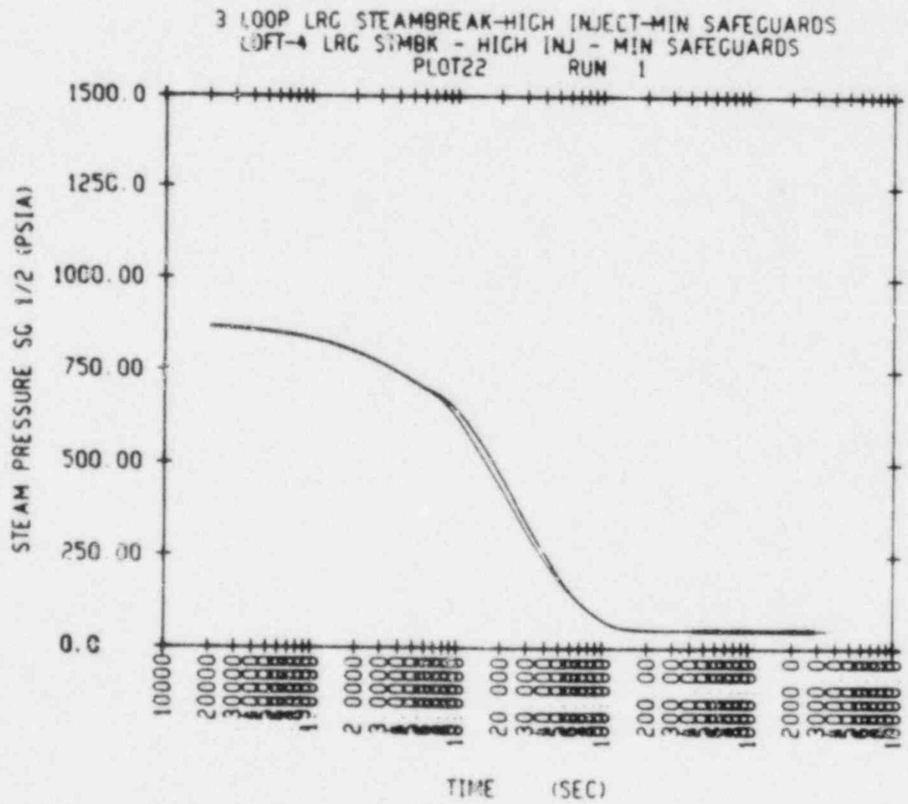

3 LOOP LRG STEAMBREAK-HIGH INJECT-MIN SAFEGUARDS
LOFT-4 LRG STMBK - HIGH INJ - MIN SAFEGUARDS
PLOT31 RUN 1
PRESSURIZER WATER VOLUME (CU FT)
2000.0
1750.0
1500.0
1250.0
1000.00
750.00
500.00
250.00
0.0
0.0
500.00
1000.00
1500.0
2000.0
2500.0
3000.0
TIME (SEC)


3 LOOP LRG STEAMBREAK-HIGH INJECT-MIN SAFEGUARDS
LOFT-4 LRG STMBK - HIGH INJ - MIN SAFEGUARDS
PLOT 5 RUN 1
PRESSURIZER WATER VOLUME (CU FT)
2000.0
1750.0
1500.0
1250.0
1000.00
750.00
500.00
250.00
0.0
10000
20000
2.0000
20.000
200.00
2000.0
TIME (SEC)


3 LOOP LRG STEAMBREAK-HIGH INJECT-MIN SAFEGUARDS
LOFT-4 LRG STMBK - HIGH INJ - MIN SAFEGUARDS
PLOT45 RUN 1
SG TOTAL MASS LOOP 1/2 (LB)
1.75E+05
1.50E+05
1.25E+05
1.00E+05
7.50E+04
5.00E+04
2.50E+04
0.0
0.0
500.00
1000.00
1500.0
2000.0
2500.0
3000.0
TIME (SEC)


3 LOOP LRG STEAMBREAK-HIGH INJECT-MIN SAFEGUARDS
LOFT-4 LRG STMBK - HIGH INJ - MIN SAFEGUARDS
PLOT19 RUN 1
SG TOTAL MASS LOOP 1/2 (LB)
1.75E+05
1.50E+05
1.25E+05
1.00E+05
7.50E+04
5.00E+04
2.50E+04
0.0
10000
20000
2.0000
20.000
200.00
2000.0
TIME (SEC)


3 LOOP LRG STEAMBREAK-HIGH INJECT-MIN SAFEGUARDS
LOFT-4 LRG STMBK - HIGH INJ - MIN SAFEGUARDS
PLOT48 RUN 1
STEAM PRESSURE SG 1/2 (PSIA)
1500.0
1250.0
1000.00
750.00
500.00
250.00
0.0
0.0
500.00
1000.00
1500.0
2000.0
2500.0
3000.0
TIME (SEC)

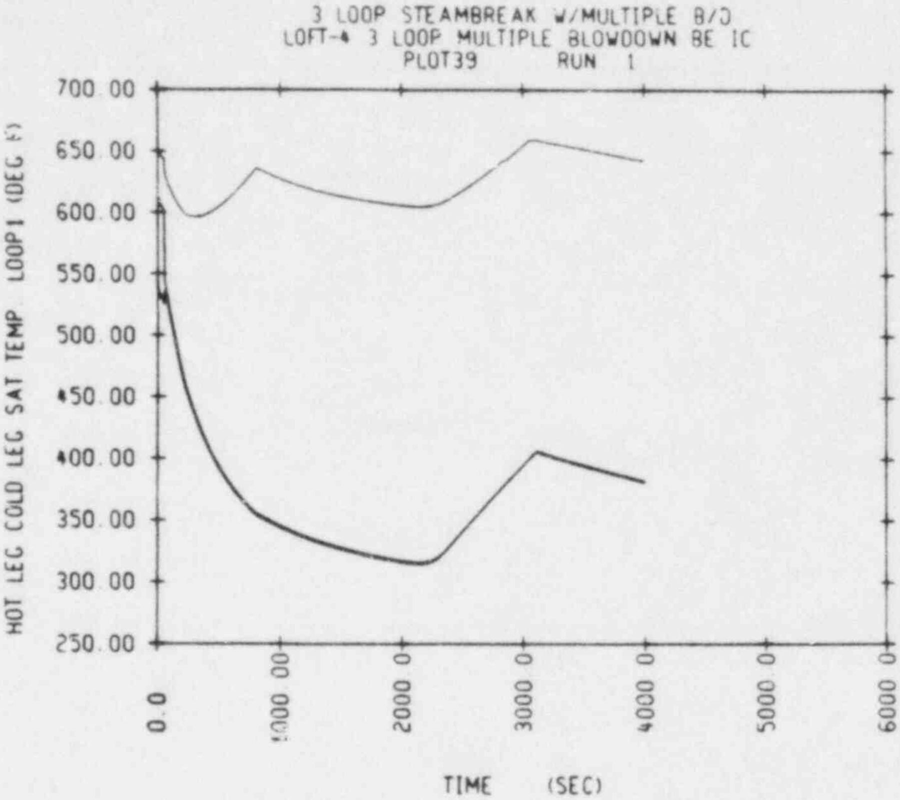

3 LOOP LRG STEAMBREAK-HIGH INJECT-MIN SAFEGUARDS
LOFT-4 LRG STMBK - HIGH INJ - MIN SAFEGUARDS
PLOT22 RUN 1
STEAM PRESSURE SG 1/2 (PSIA)
1500.0
1250.0
1000.00
750.00
500.00
250.00
0.0
TIME (SEC)

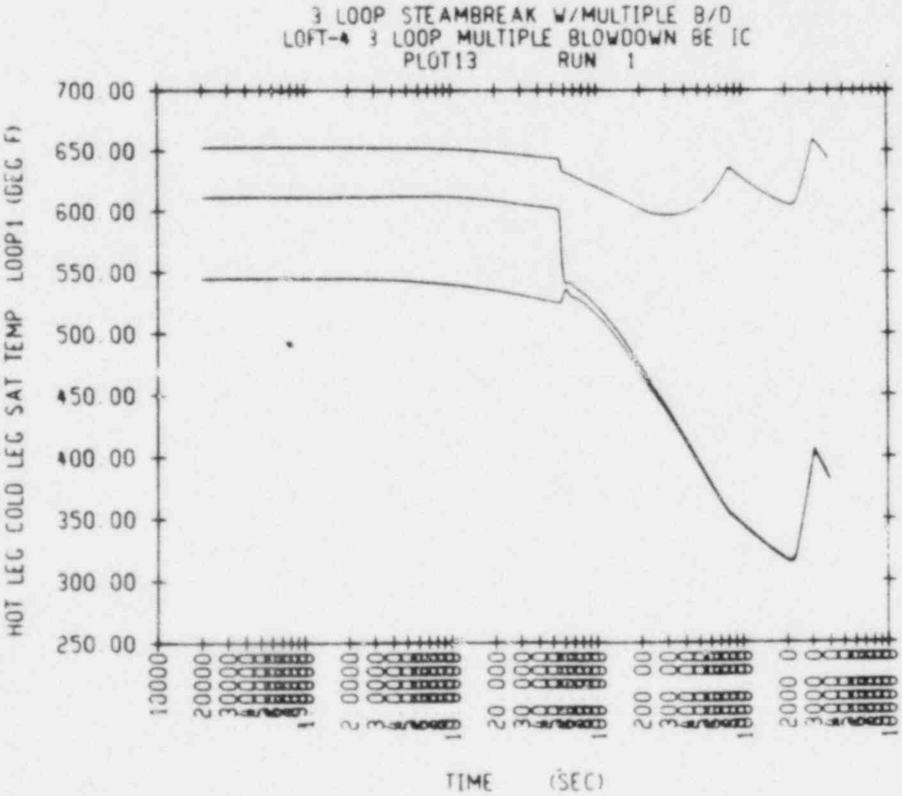
SEQUENCE OF EVENTS

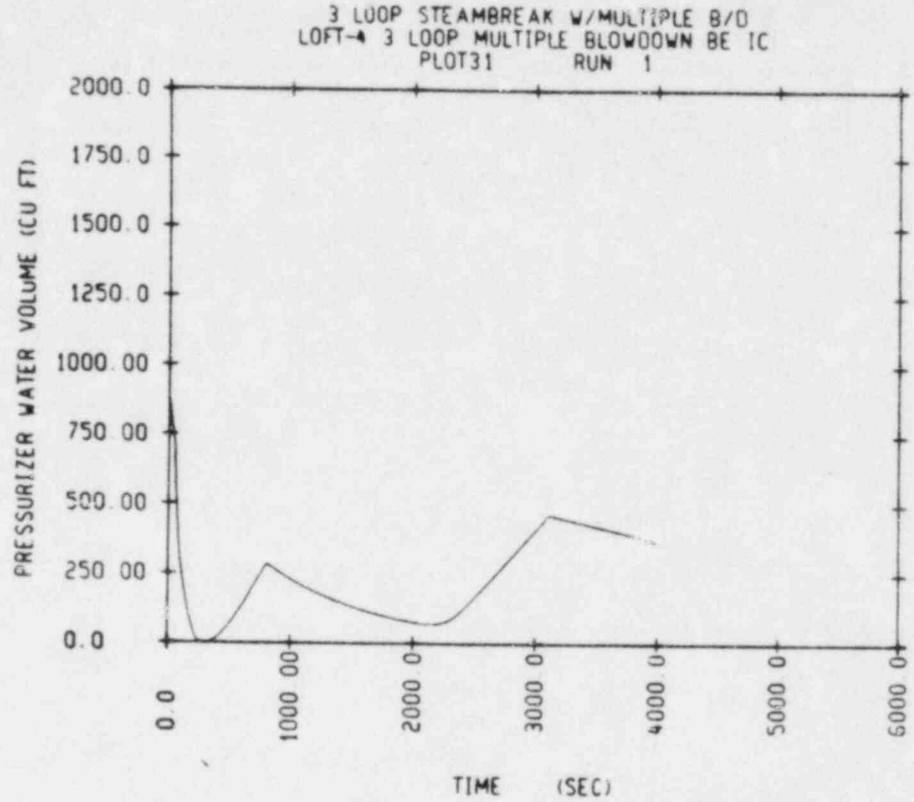
INTERMEDIATE STEAMLINE RUPTURE (0.15 FT^2/LOOP)

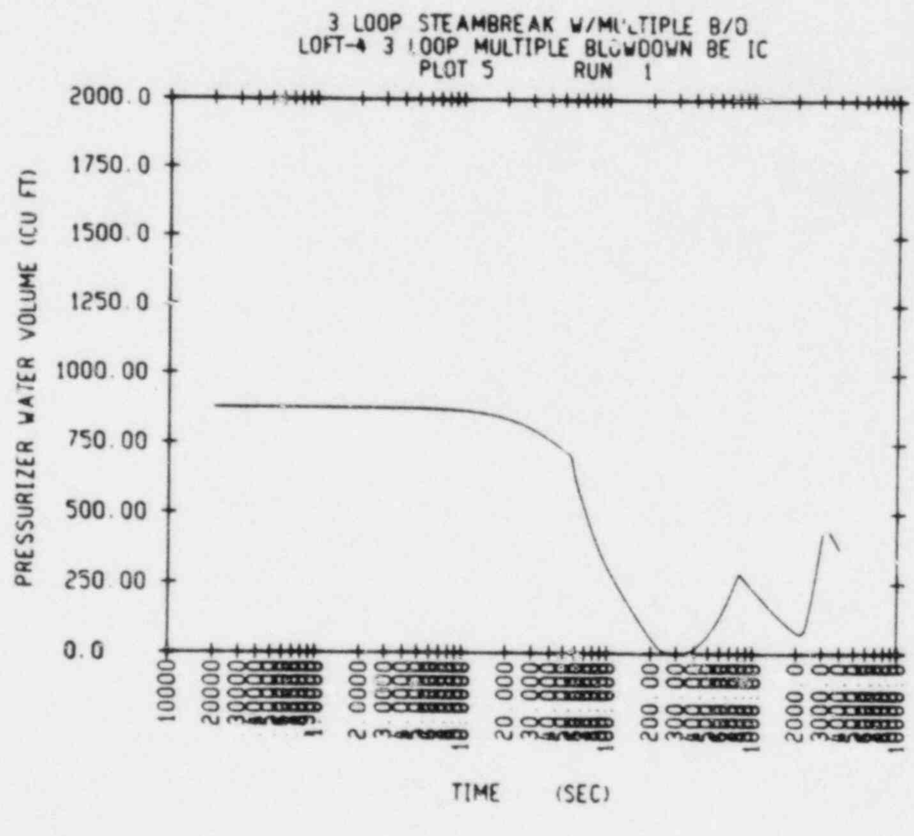
HIGH HEAD INJECTION - MAXIMUM SAFEGUARDS

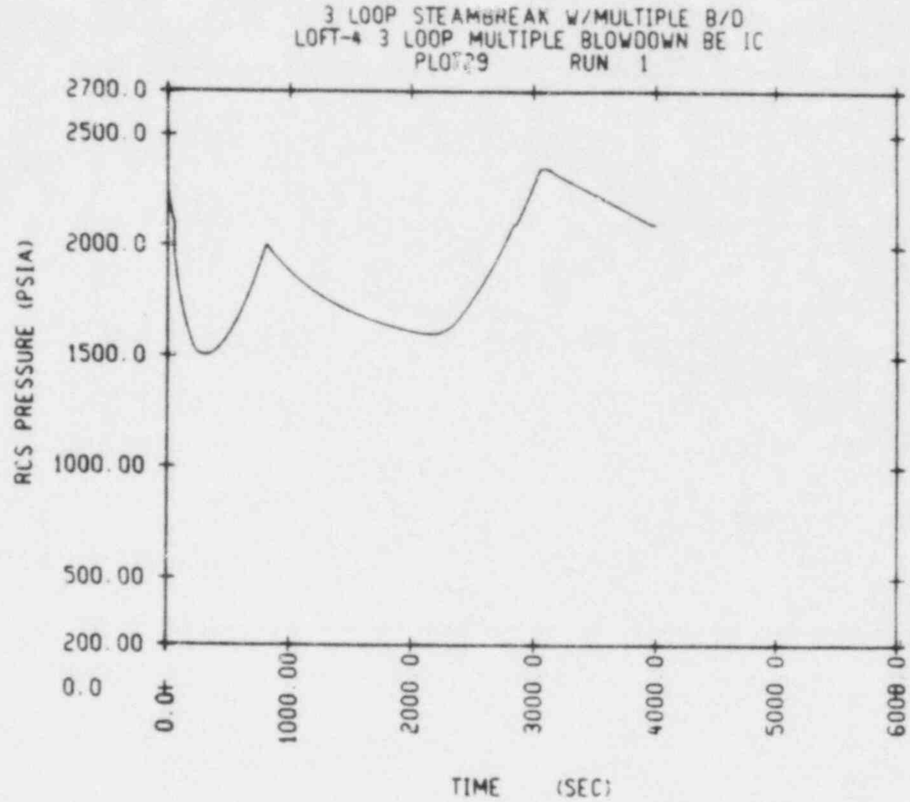
Time	Event
0.0	Steambreak Initiated
51.2	Overpower ΔT Reactor Trip Setpoint Reached
53.2	Inward Rod Motion Achieved
53.7	Turbine Trip
78.0	Safety Injection System - Low Pressurizer Pressure Setpoint Reached
83.0	Feedwater Isolation; Auxiliary Feedwater (AFW) Flow Initiates at 500 gpm per Loop
231.0	AFW Flow Throttled to 25 gpm per Loop
284.0	Pressurizer Empties
804.2	Safety Injection System Flow Terminated
2130.	Steam Generators Dryout; Minimum Cold Leg Temperature Reached (314.7°F)
3048.	Primary Reliefs Lift
3100.	Auxiliary Feedwater Flow Rate Increased to 150 gpm per Steam Generator
3102.	Primary Relief Reseats
3500.	Cooldown Rate Approximately 90° F/Hr


3 LOOP STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT39 RUN 1
HOT LEG COLD LEG SAT TEMP LOOP1 (DEG F)
700.00
650.00
600.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
0.0
1000.00
2000.0
3000.0
4000.0
5000.0
6000
TIME (SEC)

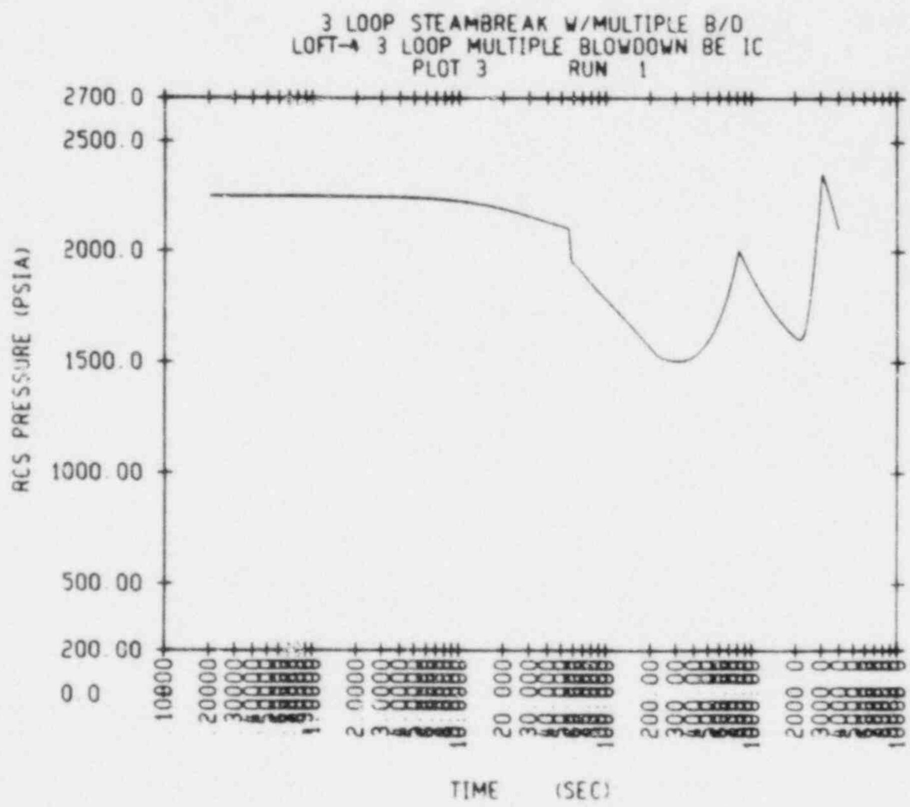

3 LOOP STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT13 RUN 1
HOT LEG COLD LEG SAT TEMP LOOP1 (DEG F)
700.00
650.00
600.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
TIME (SEC)


3 LOOP STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT31 RUN 1
PRESSURIZER WATER VOLUME (CU FT)
2000.0
1750.0
1500.0
1250.0
1000.00
750.00
500.00
250.00
0.0
0.0
1000.00
2000.0
3000.0
4000.0
5000.0
6000.0
TIME (SEC)

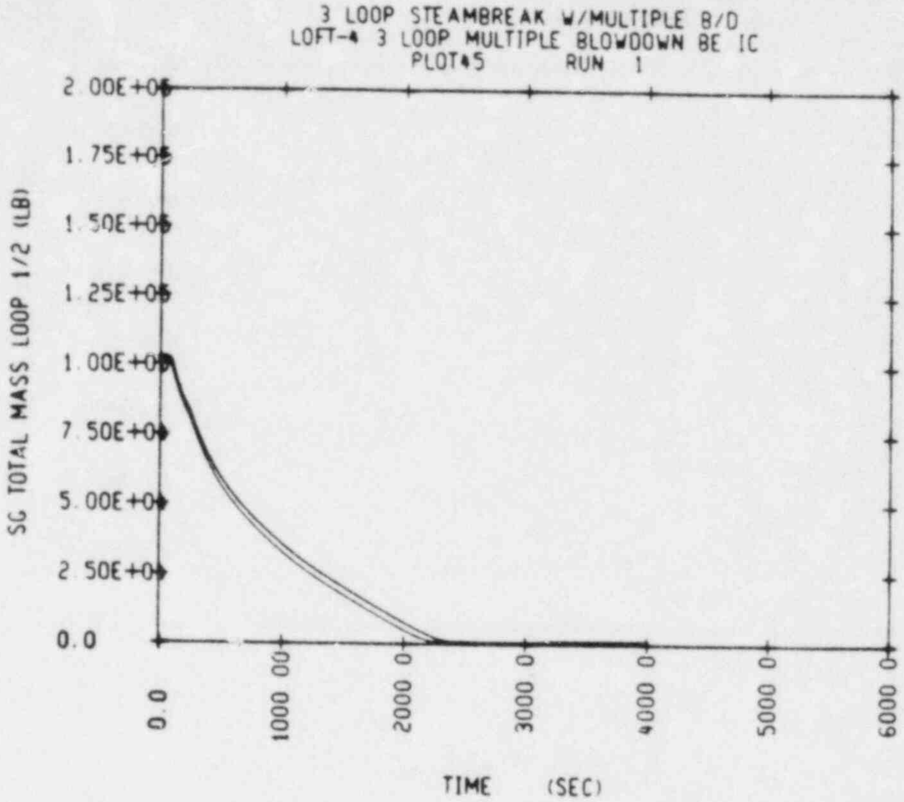

3 LOOP STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT 5 RUN 1
PRESSURIZER WATER VOLUME (CU FT)
2000.0
1750.0
1500.0
1250.0
1000.00
750.00
500.00
250.00
0.0
TIME (SEC)

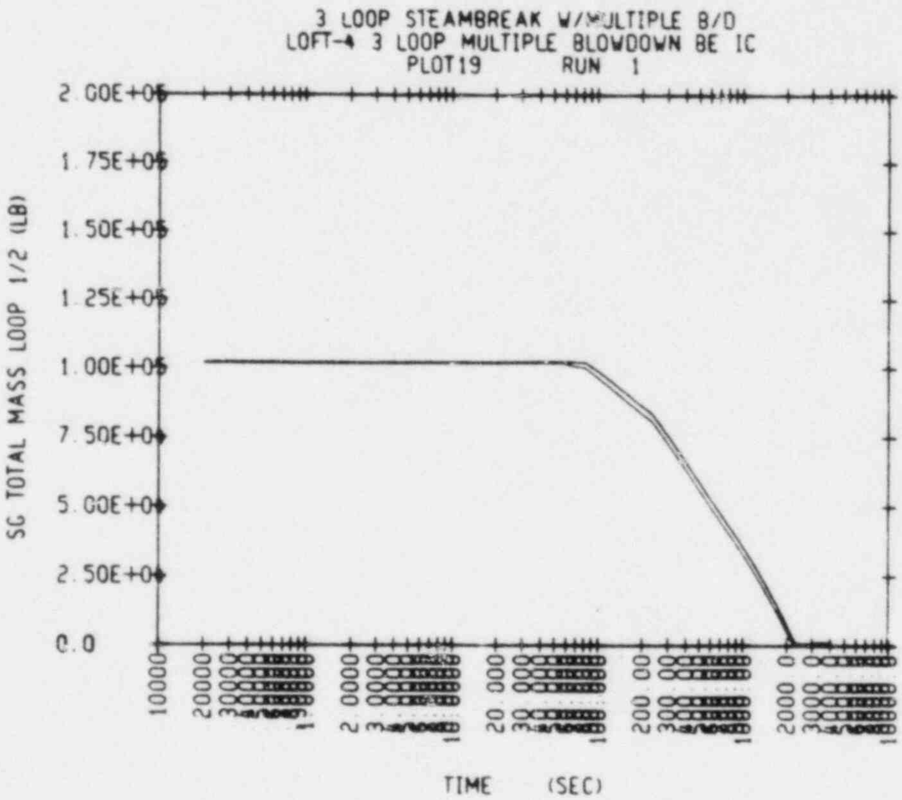


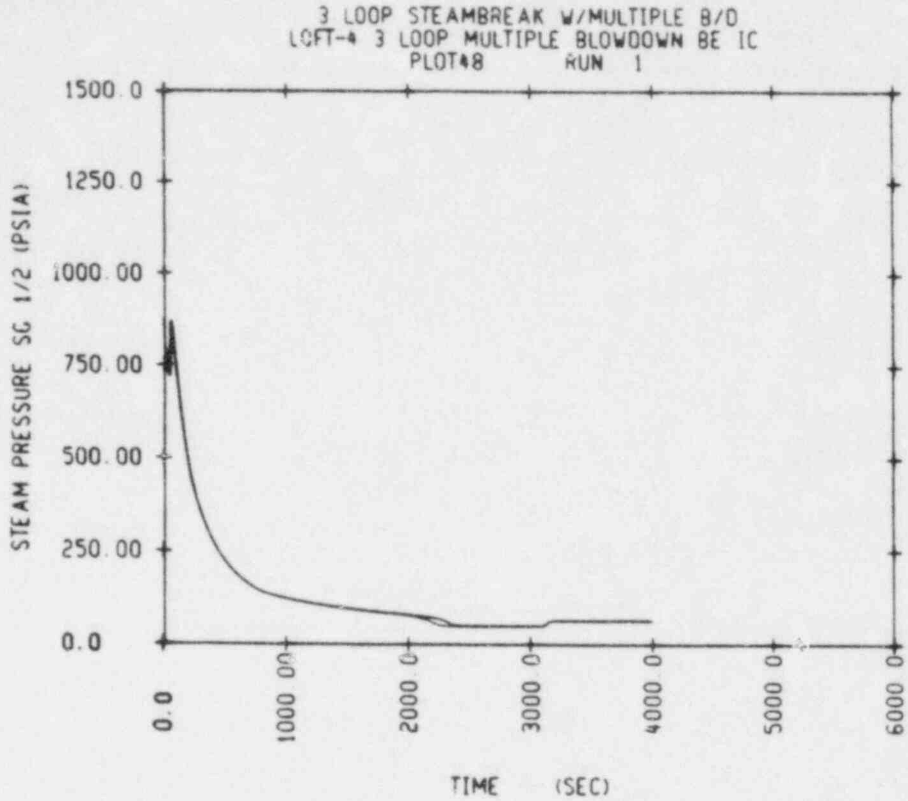
3 LOOP STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT 29 RUN 1
RCS PRESSURE (PSIA)
2700.0
2500.0
2000.0
1500.0
1000.00
500.00
200.00
0.0
0.0
1000.0
2000.0
3000.0
4000.0
5000.0
6000.0
TIME (SEC)

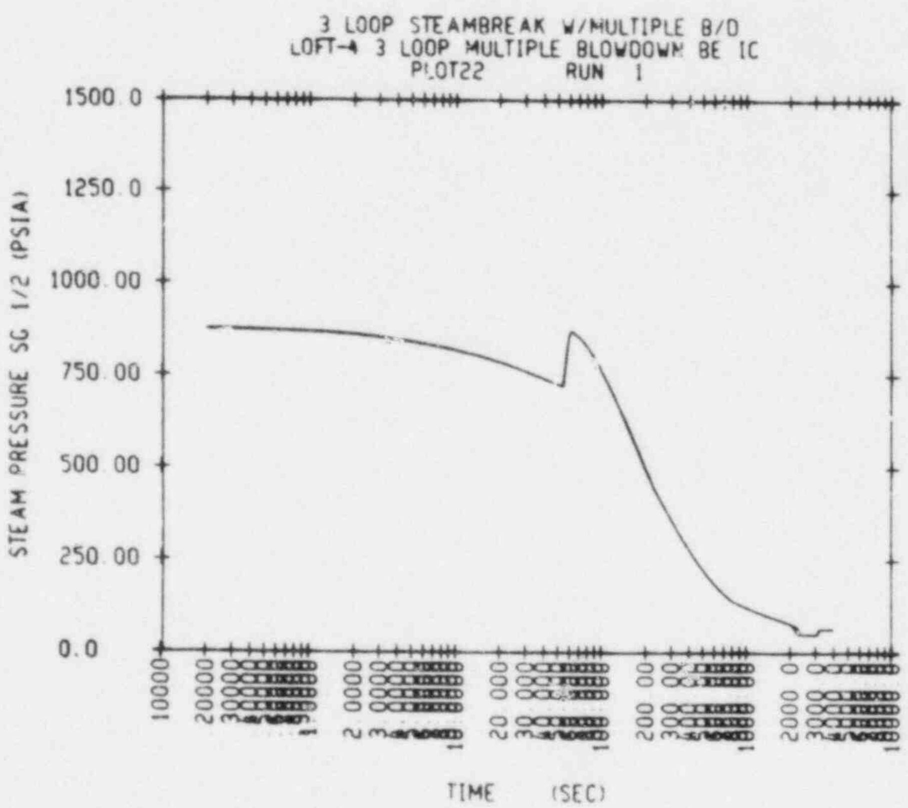


3 LOOP STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT 3 RUN 1
RCS PRESSURE (PSIA)
2700.0
2500.0
2000.0
1500.0
1000.00
500.00
200.00
0.0
TIME (SEC)


3 LOOP STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT45 RUN 1
SG TOTAL MASS LOOP 1/2 (LB)
TIME (SEC)

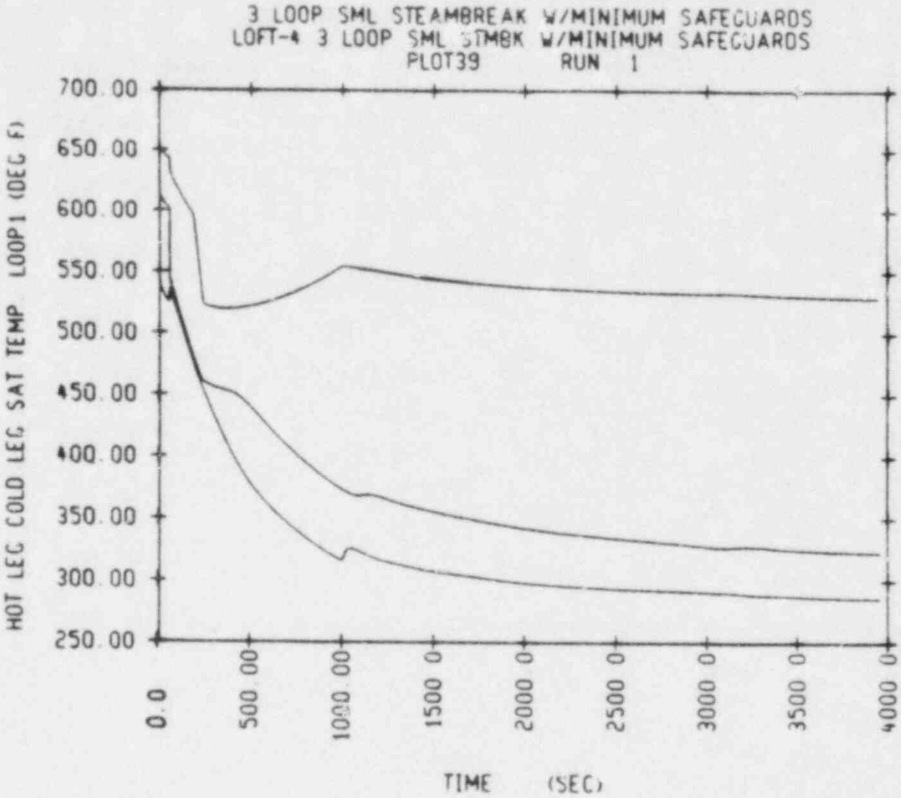

3 LOOP STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT19 RUN 1
SG TOTAL MASS LOOP 1/2 (LB)
TIME (SEC)

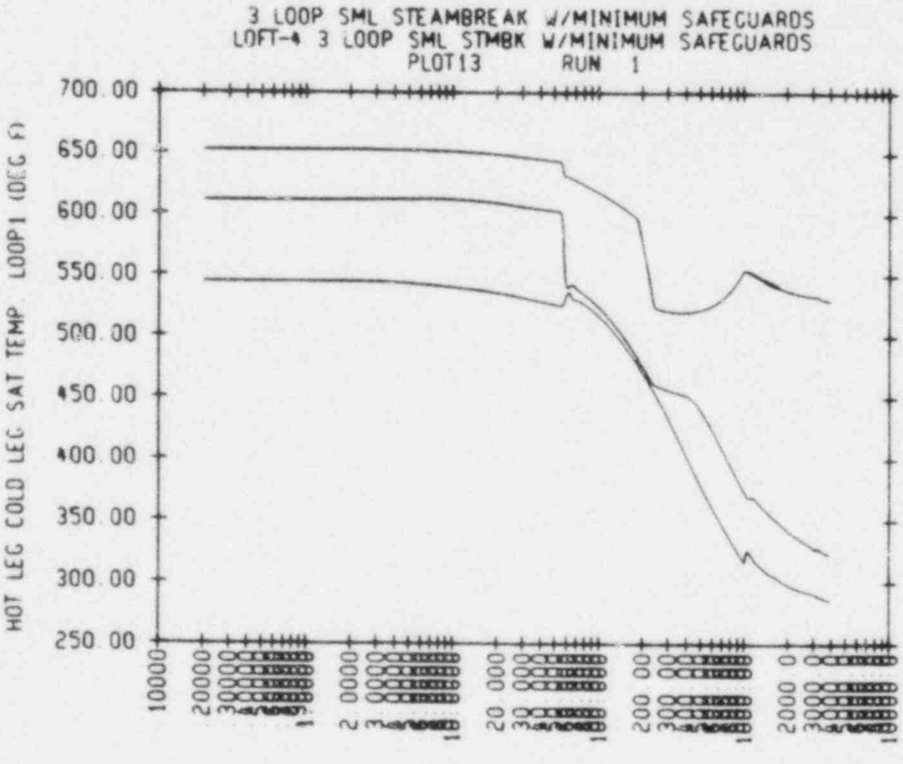

3 LOOP STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT48 RUN 1
STEAM PRESSURE SG 1/2 (PSIA)
TIME (SEC)

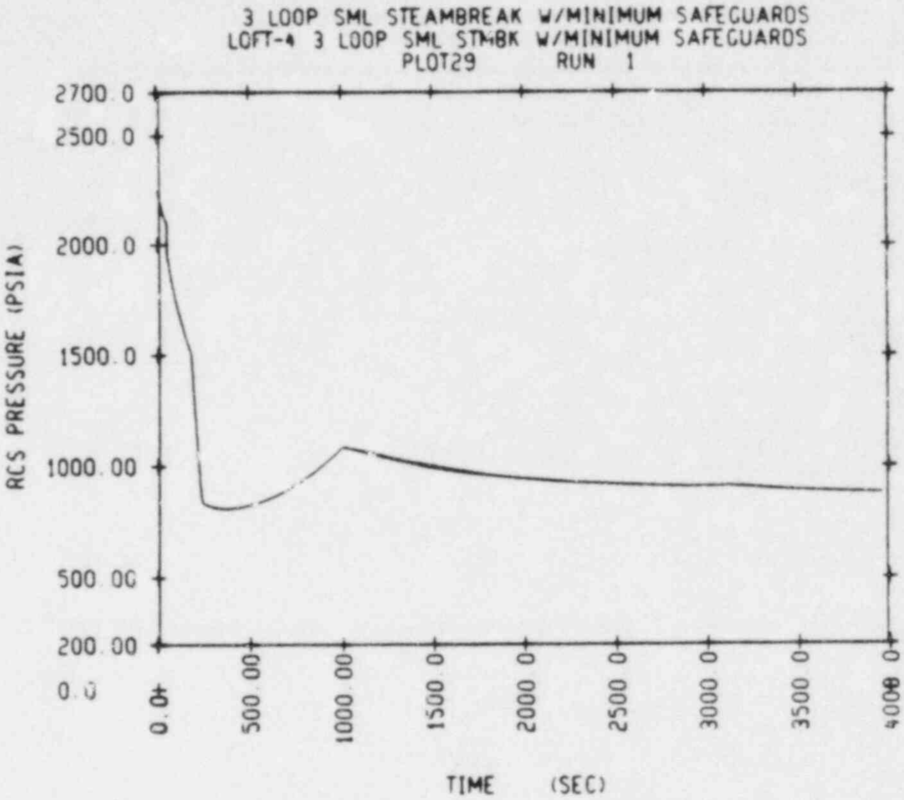

3 LOOP STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP MULTIPLE BLOWDOWN BE IC
PLOT22 RUN 1
STEAM PRESSURE SG 1/2 (PSIA)
TIME (SEC)

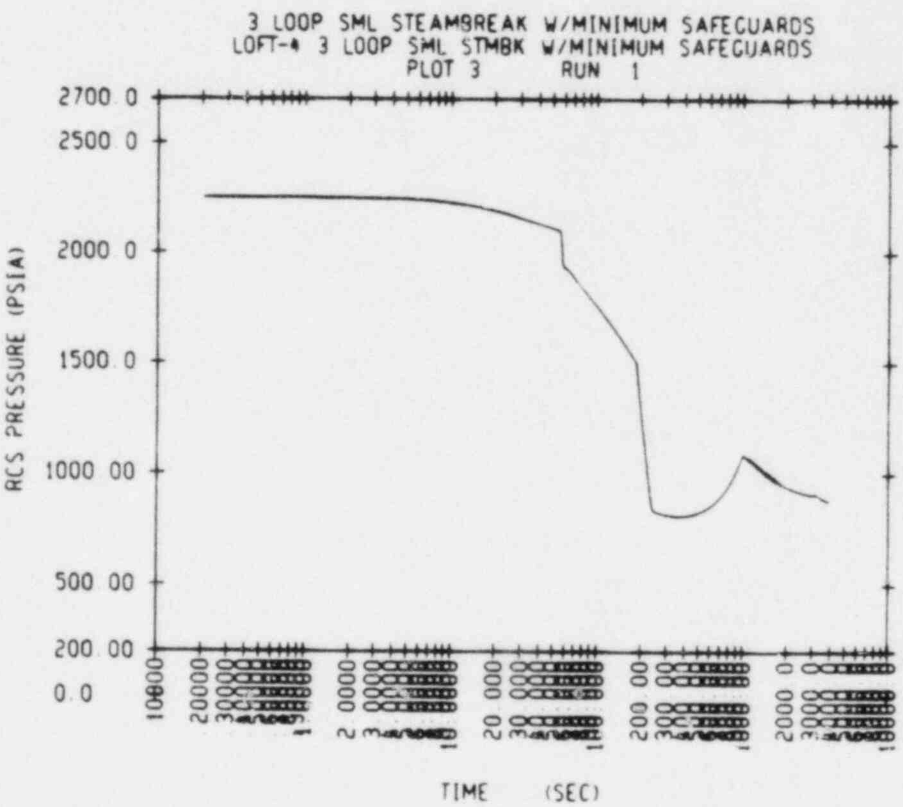
SEQUENCE OF EVENTS
INTERMEDIATE STEAMBREAK (0.15 FT^2/LOOP)
HIGH HEAD INJECTION - MINIMUM SAFEGUARDS

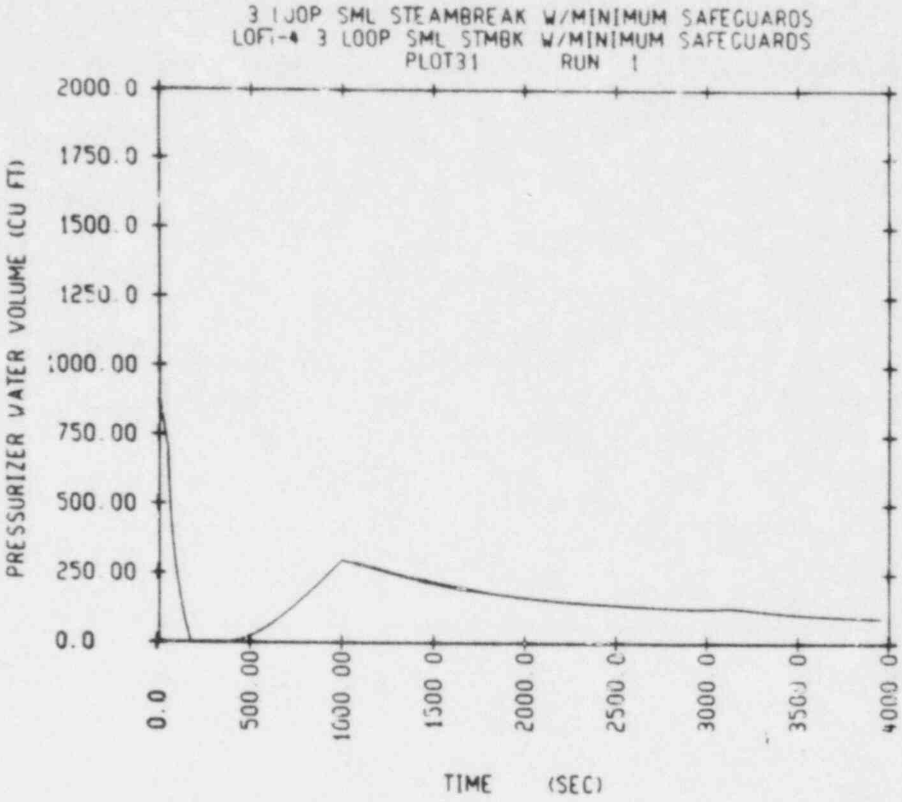
Time	Event
0.0	Steambreak Initiated
51.3	Overpower ΔT Reactor Trip Setpoint Reached
53.3	Inward Rod Motion Achieved
53.8	Turbine Trip
75.1	Safety Injection System Low Pressurizer Pressure Setpoint Reached
80.1	Feedwater Isolation; Axuiliary Feedwater (AFW) Flow Initiates at 500 gpm per Loop
185.2	Pressurizer Empties; RCS Pressure Drops Below 1500 psia
231.0	AFW Flow Throttled to 25 gpm per Loop
232.0	Reactor Coolant Pumps Tripped
346.2	Minimum Reactor Coolant System Pressure Reached (811.0 psia)
372.2	Pressurizer Refilling
672.5	RCS Cold Leg Temperature <350°F
974.6	Pressurizer Water Volume >20%
1000.	Safety Injection System Flow Terminated (RCS Pressure = 1087 psia; Pressurizer Water Volume = 297.3 Ft^3; Tcold = 315.99^3)
2925.	Steam Generator Dryout (Tcold = 292.7°F)
3100.	AFW Flow Increased to 150 gpm/Loop
3700.	Cooldown Rate Approximately 30°F/Hr

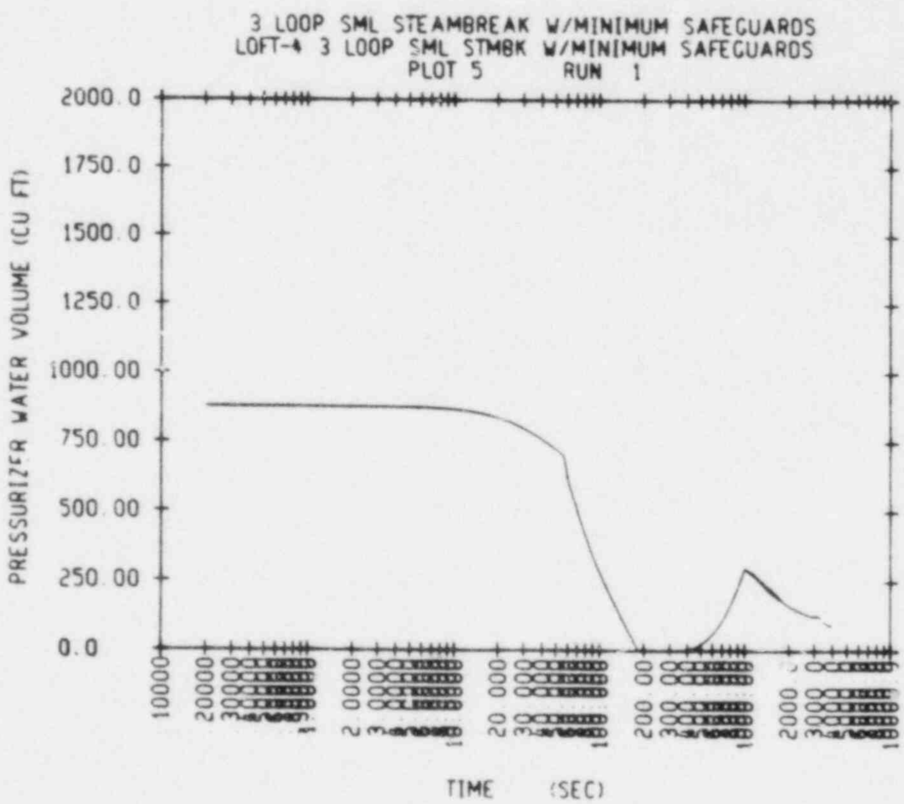

3 LOOP SML STEAMBREAK W/MINIMUM SAFEGUARDS
LOFT-4 3 LOOP SML STMBK W/MINIMUM SAFEGUARDS
PLOT39 RUN 1
HOT LEG COLD LEG SAT TEMP LOOP1 (DEG F)
700.00
650.00
600.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
0.0
500.00
1000.00
1500.0
2000.0
2500.0
3000.0
3500.0
4000.0
TIME (SEC)

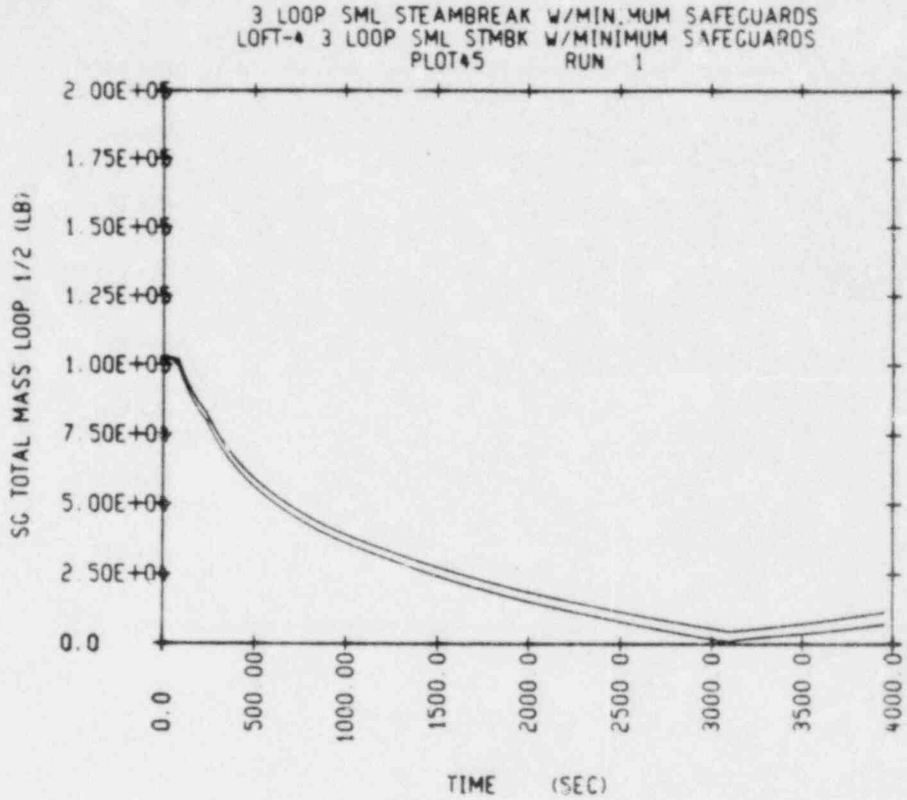

3 LOOP SML STEAMBREAK W/MINIMUM SAFEGUARDS
LOFT-4 3 LOOP SML STMBK W/MINIMUM SAFEGUARDS
PLOT13 RUN 1
HOT LEG COLD LEG SAT TEMP LOOP1 (DEG F)
700.00
650.00
600.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
TIME (SEC)

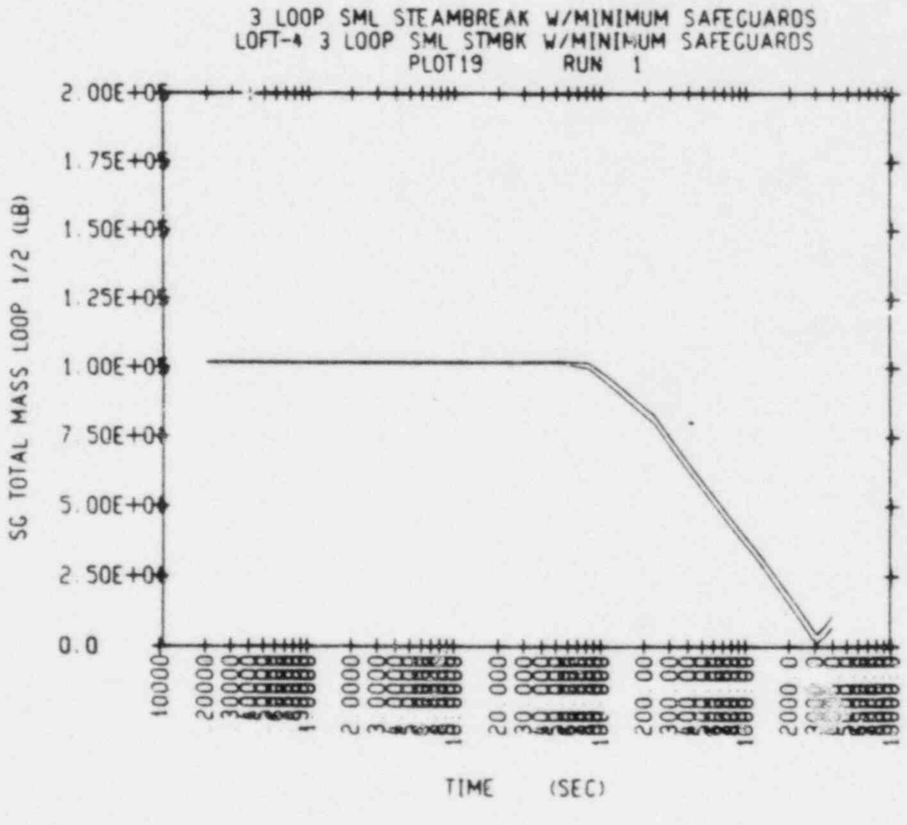

3 LOOP SML STEAMBREAK W/MINIMUM SAFEGUARDS
LOFT-4 3 LOOP SML STMBK W/MINIMUM SAFEGUARDS
PLOT29 RUN 1
RCS PRESSURE (PSIA)
2700.0
2500.0
2000.0
1500.0
1000.00
500.00
200.00
0.0
0.0
500.00
1000.00
1500.0
2000.0
2500.0
3000.0
3500.0
4000.0
TIME (SEC)

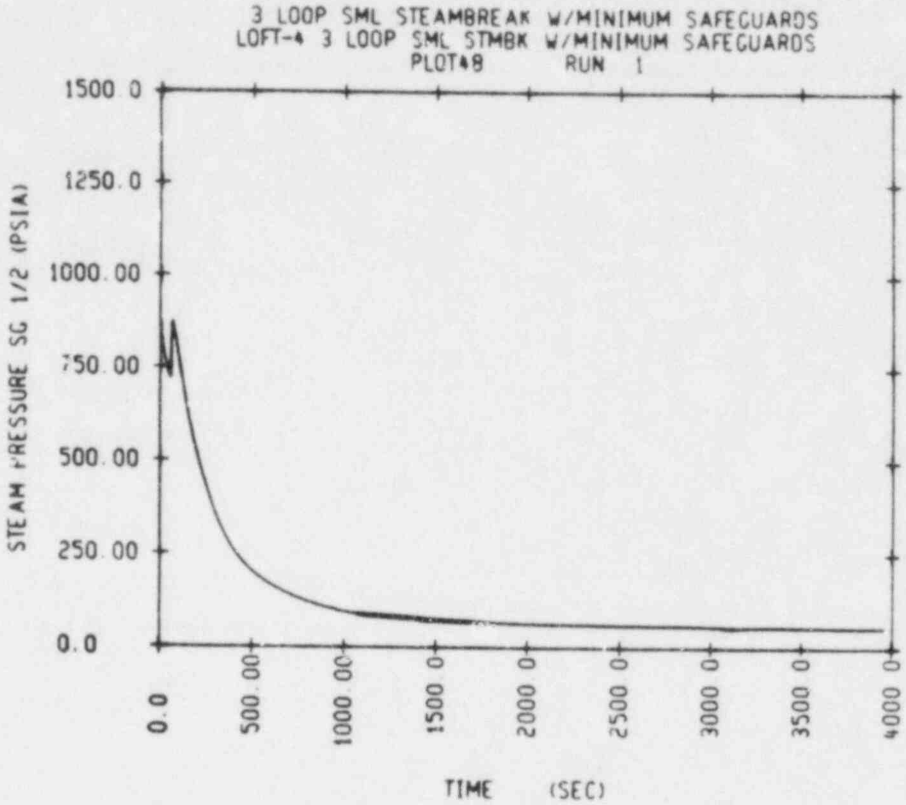

3 LOOP SML STEAMBREAK W/MINIMUM SAFEGUARDS
LOFT-4 3 LOOP SML STMBK W/MINIMUM SAFEGUARDS
PLOT 3 RUN 1
RCS PRESSURE (PSIA)
2700.0
2500.0
2000.0
1500.0
1000.00
500.00
200.00
0.0
TIME (SEC)

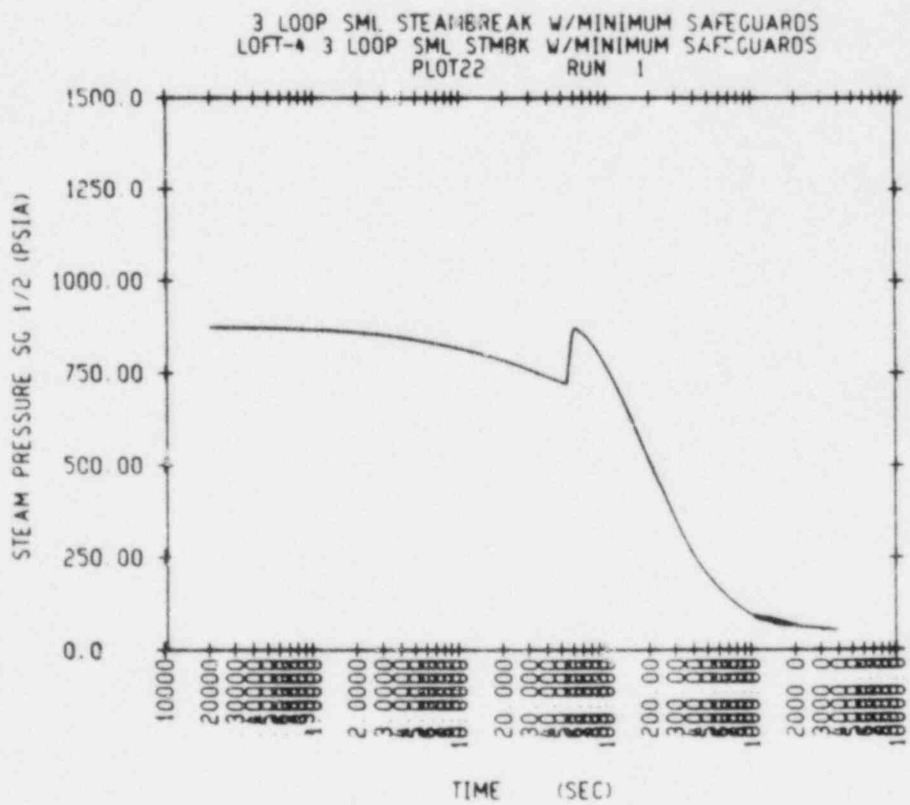

3 LOOP SML STEAMBREAK W/MINIMUM SAFEGUARDS
LOFT-4 3 LOOP SML STMBK W/MINIMUM SAFEGUARDS
PLOT31 RUN 1
PRESSURIZER WATER VOLUME (CU FT)
2000.0
1750.0
1500.0
1250.0
1000.00
750.00
500.00
250.00
0.0
0.0
500.00
1000.00
1500.0
2000.0
2500.0
3000.0
3500.0
4000.0
TIME (SEC)


3 LOOP SML STEAMBREAK W/MINIMUM SAFEGUARDS
LOFT-4 3 LOOP SML STMBK W/MINIMUM SAFEGUARDS
PLOT 5 RUN 1
PRESSURIZER WATER VOLUME (CU FT)
2000.0
1750.0
1500.0
1250.0
1000.00
750.00
500.00
250.00
0.0
TIME (SEC)


3 LOOP SML STEAMBREAK W/MINIMUM SAFEGUARDS
LOFT-4 3 LOOP SML STMBK W/MINIMUM SAFEGUARDS
PLOT45 RUN 1
SG TOTAL MASS LOOP 1/2 (LB)
2.00E+05
1.75E+05
1.50E+05
1.25E+05
1.00E+05
7.50E+04
5.00E+04
2.50E+04
0.0
0.0
500.00
1000.00
1500.0
2000.0
2500.0
3000.0
3500.0
4000.0
TIME (SEC)


3 LOOP SML STEAMBREAK W/MINIMUM SAFEGUARDS
LOFT-4 3 LOOP SML STMBK W/MINIMUM SAFEGUARDS
PLOT19 RUN 1
SG TOTAL MASS LOOP 1/2 (LB)
2.00E+05
1.75E+05
1.50E+05
1.25E+05
1.00E+05
7.50E+04
5.00E+04
2.50E+04
0.0
TIME (SEC)

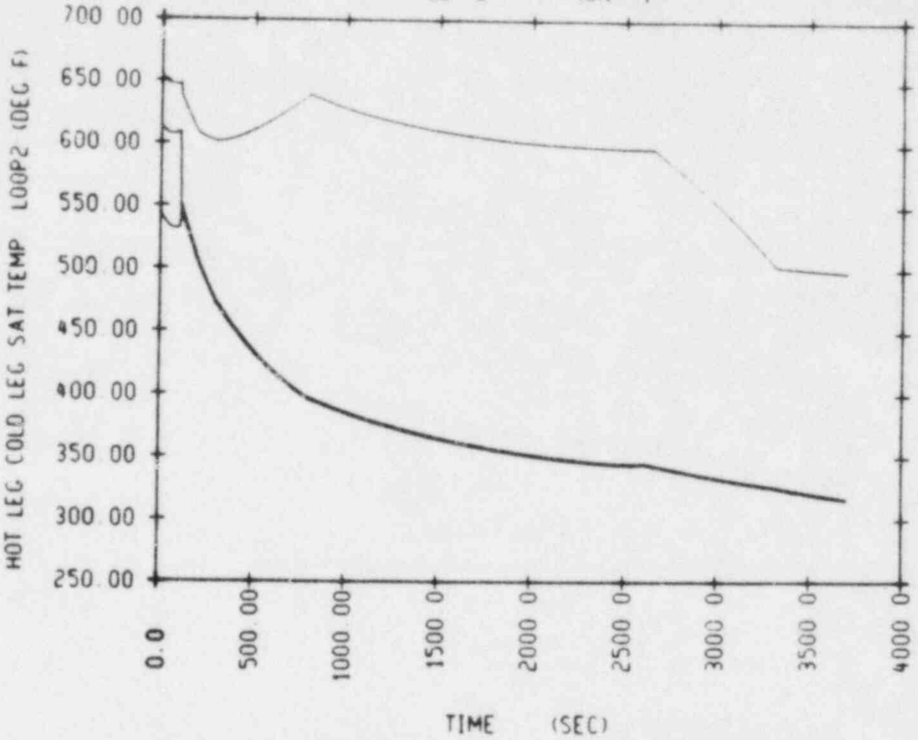

3 LOOP SML STEAMBREAK W/MINIMUM SAFEGUARDS
LOFT-4 3 LOOP SML STMBK W/MINIMUM SAFEGUARDS
PLOT48 RUN 1
STEAM PRESSURE SG 1/2 (PSIA)
1500.0
1250.0
1000.00
750.00
500.00
250.00
0.0
0.0
500.00
1000.00
1500.0
2000.0
2500.0
3000.0
3500.0
4000.0
TIME (SEC)


3 LOOP SML STEAMBREAK W/MINIMUM SAFEGUARDS
LOFT-4 3 LOOP SML STMBK W/MINIMUM SAFEGUARDS
PLOT22 RUN 1
STEAM PRESSURE SG 1/2 (PSIA)
1500.0
1250.0
1000.00
750.00
500.00
250.00
0.0
TIME (SEC)

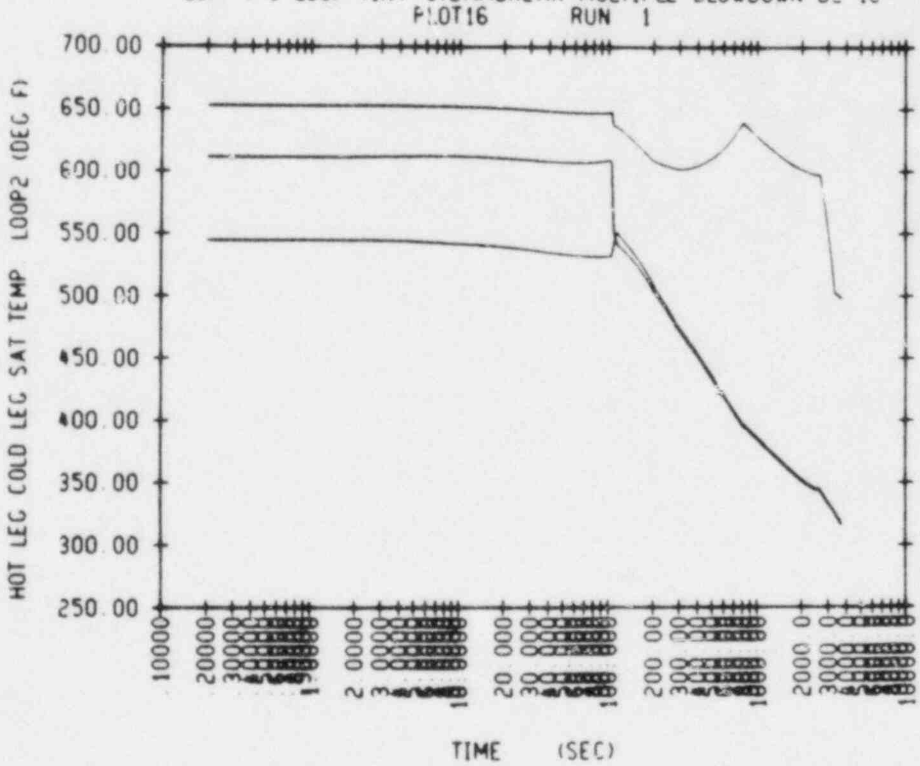
SEQUENCE OF EVENTS
INTERMEDIATE STEAMBREAK (.1 FT^2/LOOP)
HIGH HEAD INJECTION PLANT - MINIMUM SAFEGUARDS

Time	Event
0.0	Steambreak Initiated
101.0	Overpower Delta-T Reactor Trip
103.0	Inward Rod Motion Achieved
103.5	Turbine Trip
182.4	Low Pressurizer Pressure Setpoint Reached for Safety Injection System Actuation
203.5	Auxiliary Feedwater Flow Initiated at 500 gpm per Steam Generator
291.5	Auxiliary Feedwater Flow Throttled to 25 gpm per Steam Generator
297.0	Minimum RCS Pressure Reached = (1563 psia)
297.5	Minimum Pressurizer Water Volume Reached = (51.4 Ft^3)
748.0	Pressurizer Water Volume >20%
768.2	RCS Pressure >2000 psia
800.0	Safety Injection System Flow Secured (Tavg = 396.2; RCS Pressure = 2050 psia; per Water Volume = 314.1 Ft^3
860.2	RCS Pressure <2000 psia
2580.	Heatup Rate = 18°F/Hr
2600.	Auxiliary Feedwater Flow to 200 gpm per Steam Generator
2658.	Pressurizer Empties
3000.	Cooldown Rate ≅ 90°F/Hr

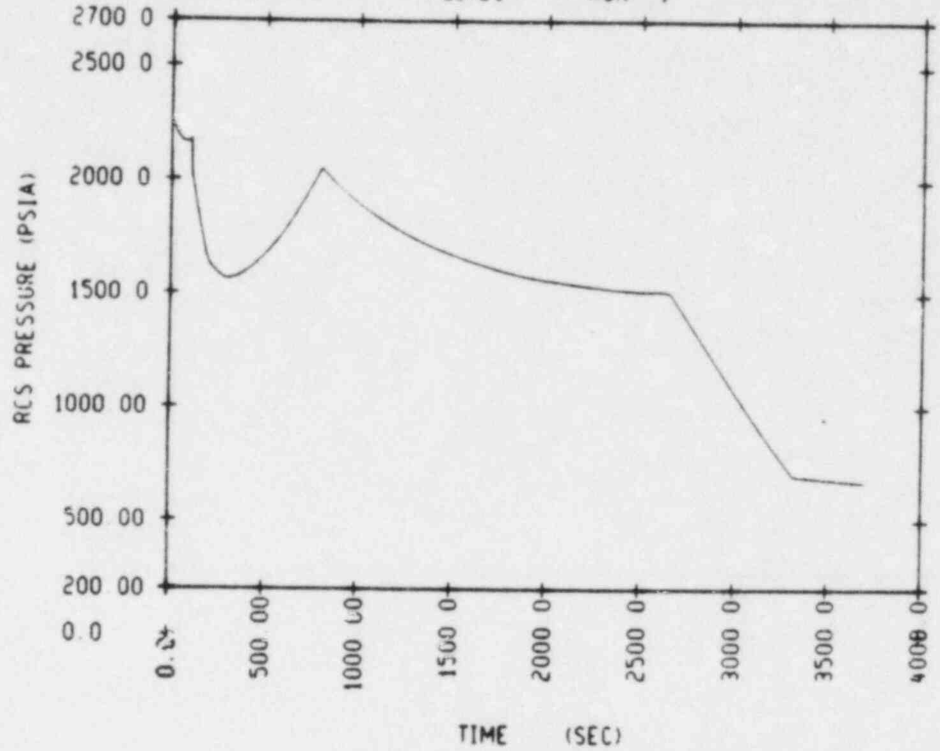
3 LOOP TINY STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP TINY STEAMBREAK MULTIPLE BLOWDOWN BE IC
PLOT42 RUN 1



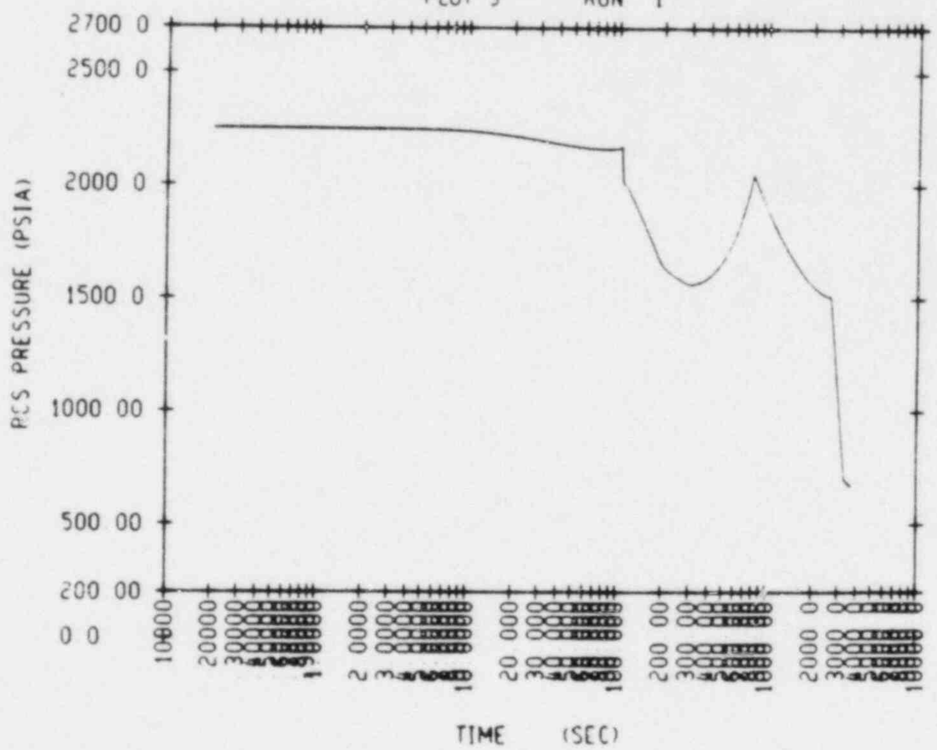
3 LOOP TINY STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP TINY STEAMBREAK MULTIPLE BLOWDOWN BE IC
PLOT16 RUN 1

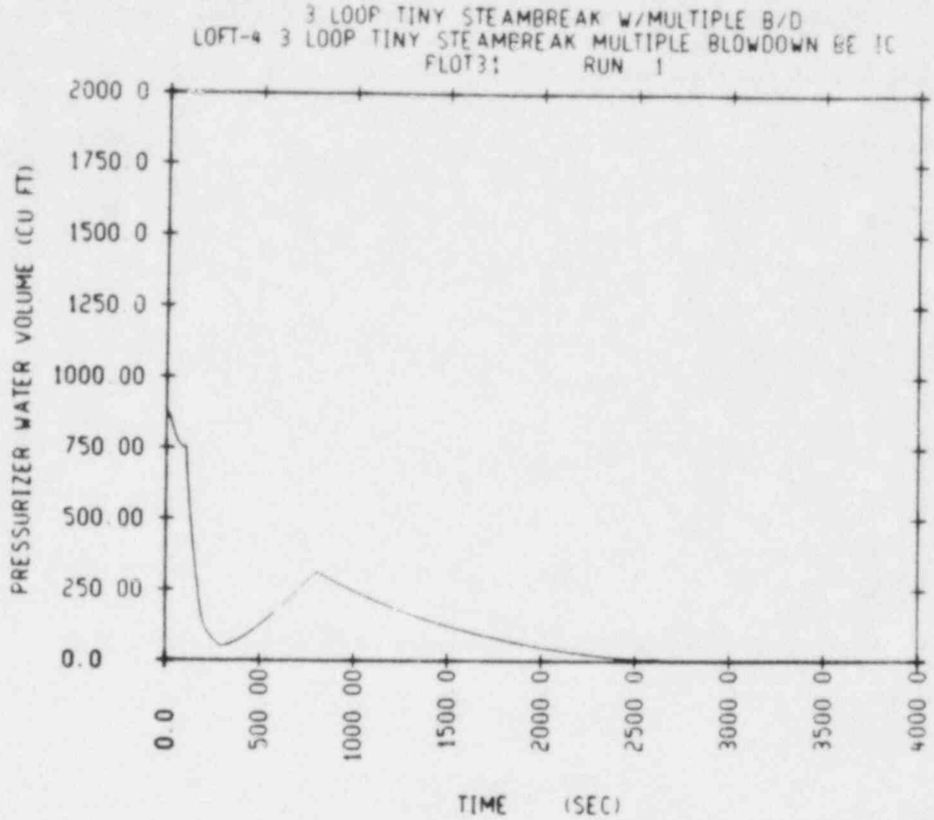


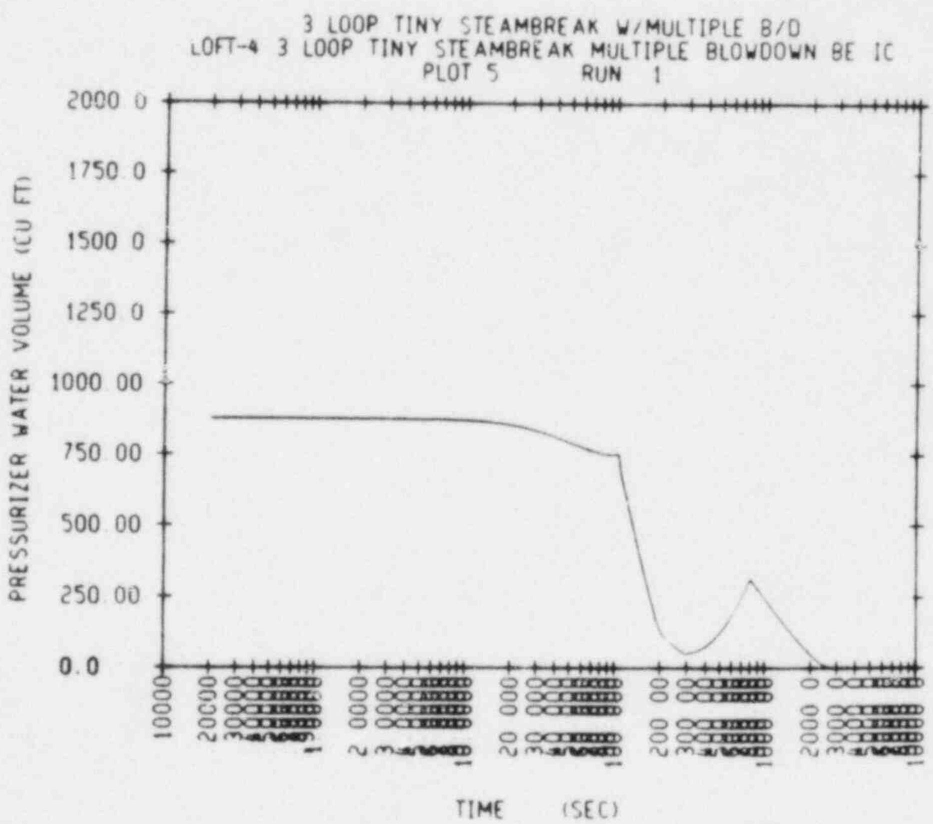
3 LOOP TINY STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP TINY STEAMBREAK MULTIPLE BLOWDOWN BE IC
PLOT29 RUN 1



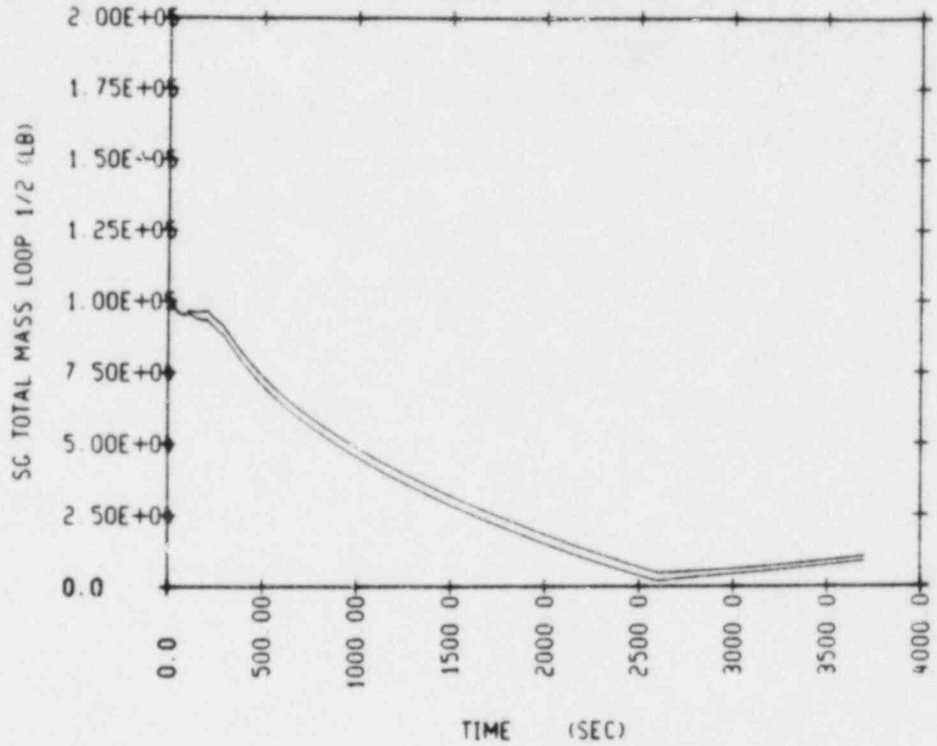
3 LOOP TINY STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP TINY STEAMBREAK MULTIPLE BLOWDOWN BE IC
PLOT 3 RUN 1



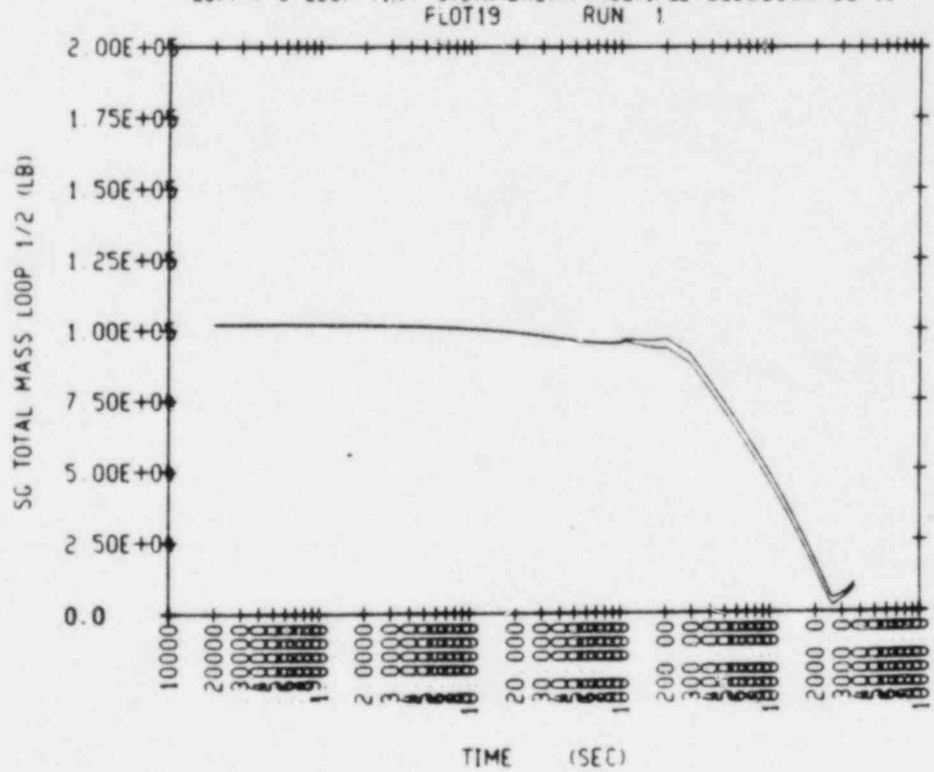

3 LOOP TINY STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP TINY STEAMBREAK MULTIPLE BLOWDOWN BE IC
PLOT31 RUN 1
PRESSURIZER WATER VOLUME (CU FT)
2000.0
1750.0
1500.0
1250.0
1000.00
750.00
500.00
250.00
0.0
0.0
500.00
1000.00
1500.0
2000.0
2500.0
3000.0
3500.0
4000.0
TIME (SEC)

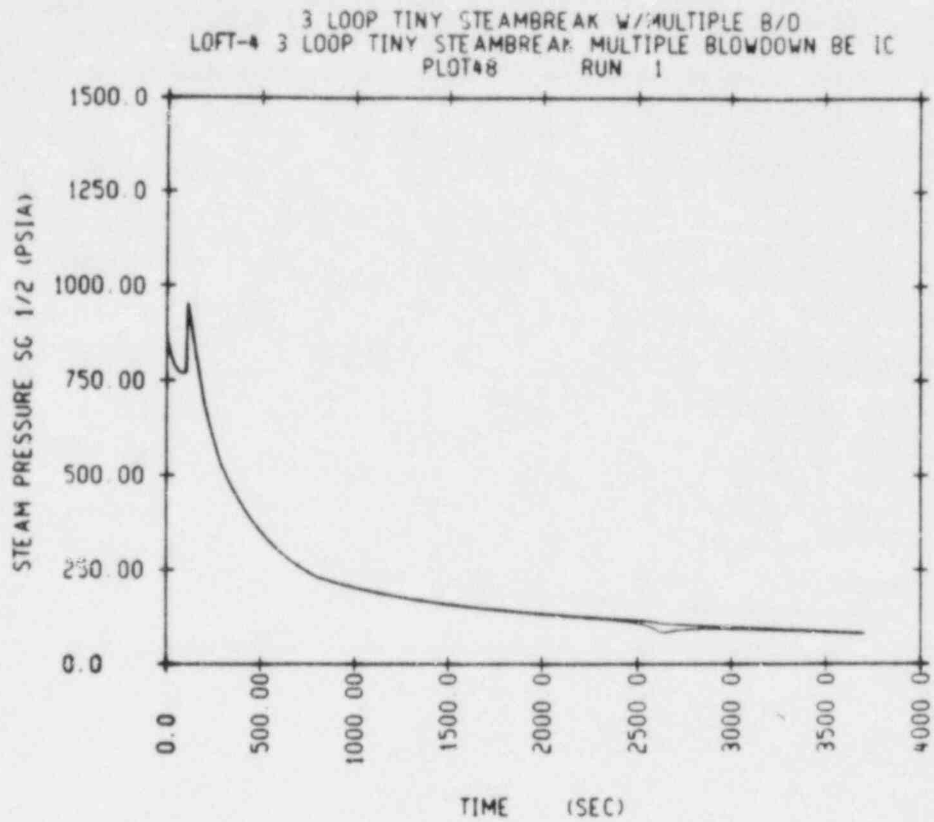

3 LOOP TINY STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP TINY STEAMBREAK MULTIPLE BLOWDOWN BE IC
PLOT 5 RUN 1
PRESSURIZER WATER VOLUME (CU FT)
2000.0
1750.0
1500.0
1250.0
1000.00
750.00
500.00
250.00
0.0
TIME (SEC)

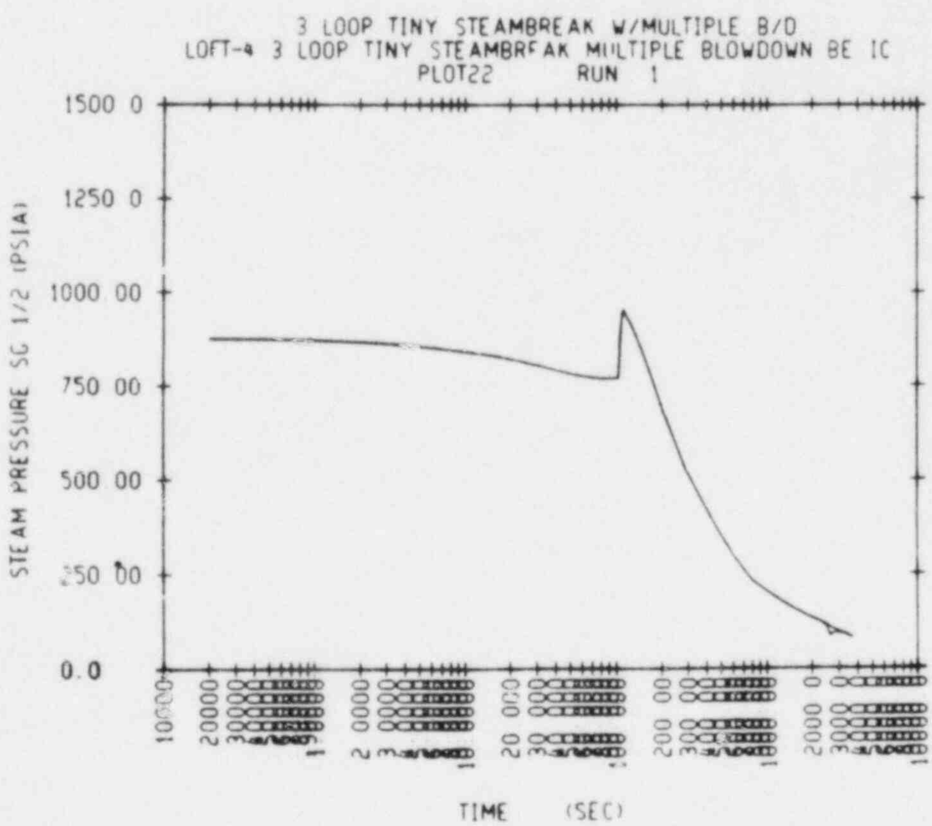
3 LOOP TINY STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP TINY STEAMBREAK MULTIPLE BLOWDOWN BE IC
PLOT45 RUN 1



3 LOOP TINY STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP TINY STEAMBREAK MULTIPLE BLOWDOWN BE IC
PLOT19 RUN 1




3 LOOP TINY STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP TINY STEAMBREAK MULTIPLE BLOWDOWN BE IC
PLOT48 RUN 1
STEAM PRESSURE SG 1/2 (PSIA)
1500.0
1250.0
1000.00
750.00
500.00
250.00
0.0
0.0
500.00
1000.00
1500.0
2000.0
2500.0
3000.0
3500.0
4000.0
TIME (SEC)


3 LOOP TINY STEAMBREAK W/MULTIPLE B/D
LOFT-4 3 LOOP TINY STEAMBREAK MULTIPLE BLOWDOWN BE IC
PLOT22 RUN 1
STEAM PRESSURE SG 1/2 (PSIA)
1500.0
1250.0
1000.00
750.00
500.00
250.00
0.0
TIME (SEC)

4.0 RECOVERY TECHNIQUE

Figures BD-1 through BD-4 provide a flow diagram of the recovery technique employed following a multiple steam generator depressurization event.

The first action the operator performs is to attempt to restore the secondary pressure boundary integrity for the steam generators. If this can be done for any steam generator, the operator is returned to E-2, Loss of Secondary Coolant. If this cannot be completed immediately, the operator continues and throttles auxiliary feedwater flow to 25 gallons per minute to each steam generator. To ensure an adequate secondary heat sink is available, the operator is instructed to verify that the primary water supply is adequate. If not, then switch to an alternate water supply.

After checking the possibility of a malfunctioning pressurizer PORV, the operator determines if the RCP's should be stopped due to decreasing pressure.

If the rupture occurred inside containment, the operator then checks if containment spray, if actuated, can be stopped. The operator verifies that a sufficient supply of water exists in the RWST to supply suction to the safety injection and containment pumps. If the level is low, the operator switches the suction to the containment sump.

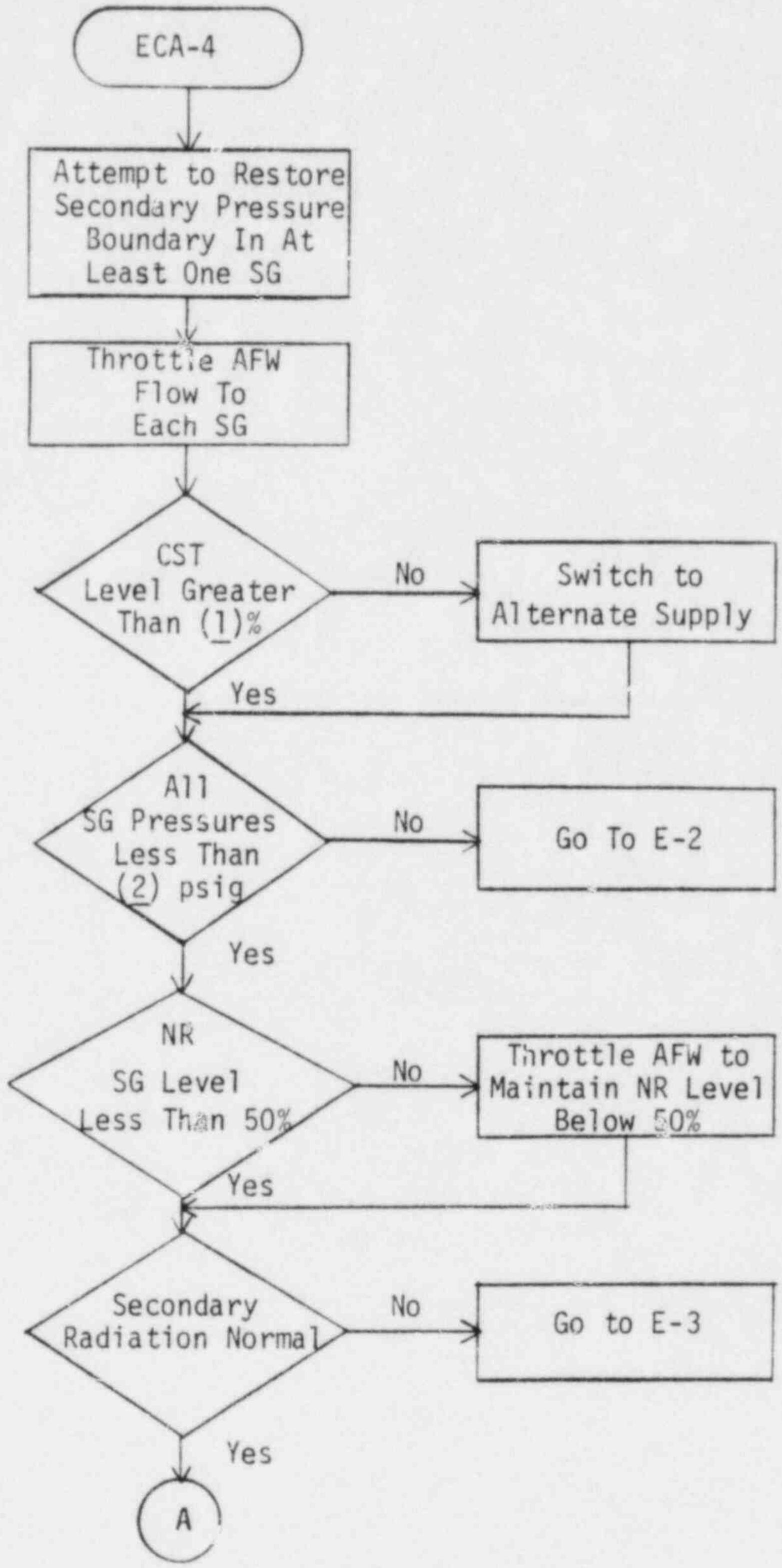
The auxiliary feedwater system flowrate is adjusted as necessary to control the primary system temperature.

Finally, the operator checks to determine if proper conditions exist to terminate the safety injection system flow. The termination criteria are subdivided into three categories:

1. Vessel integrity concerns ($T_{cold} \leq 350^{\circ}F$)
2. Secondary high energy line rupture inside containment
3. Secondary high energy line rupture outside containment

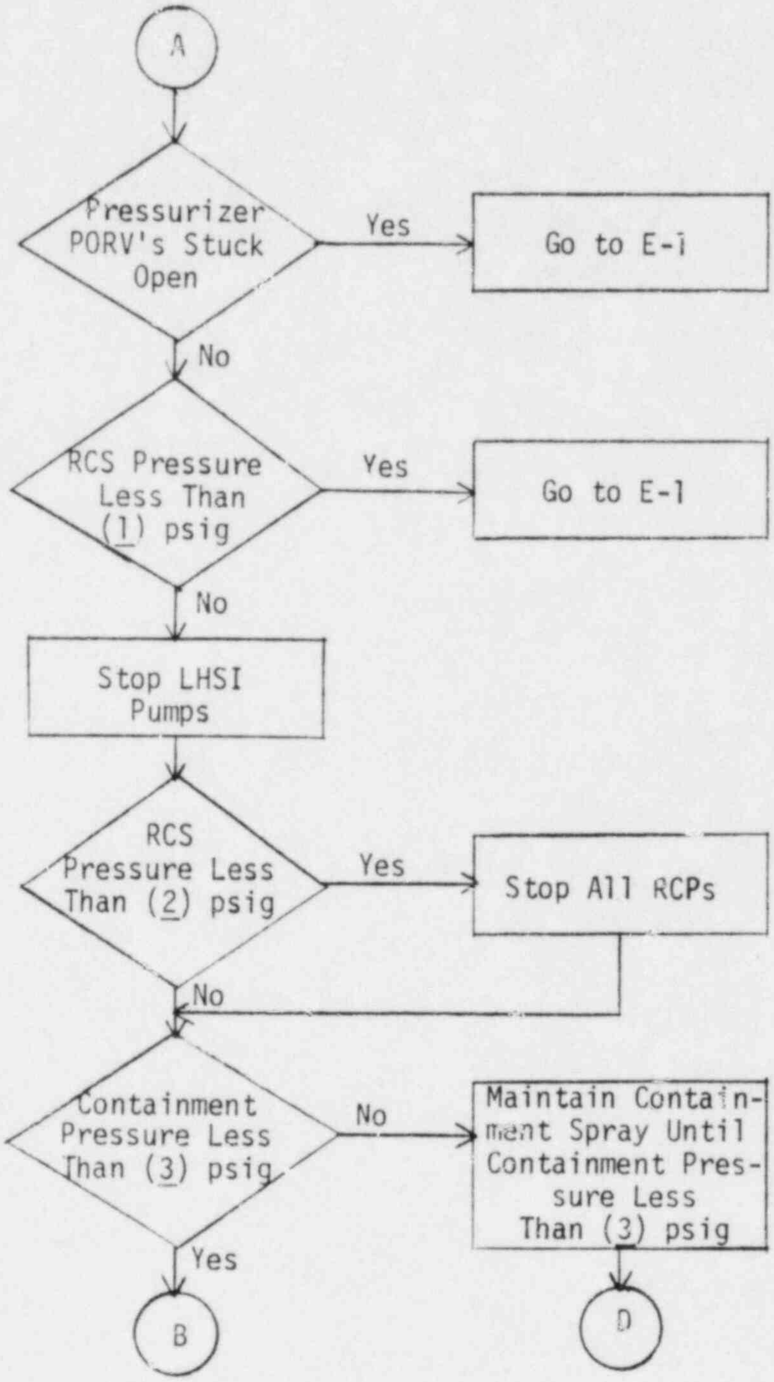
If the correct system parameters exist, the operator terminates safety injection and procedes to the SI termination procedure.

FIGURE BD-1



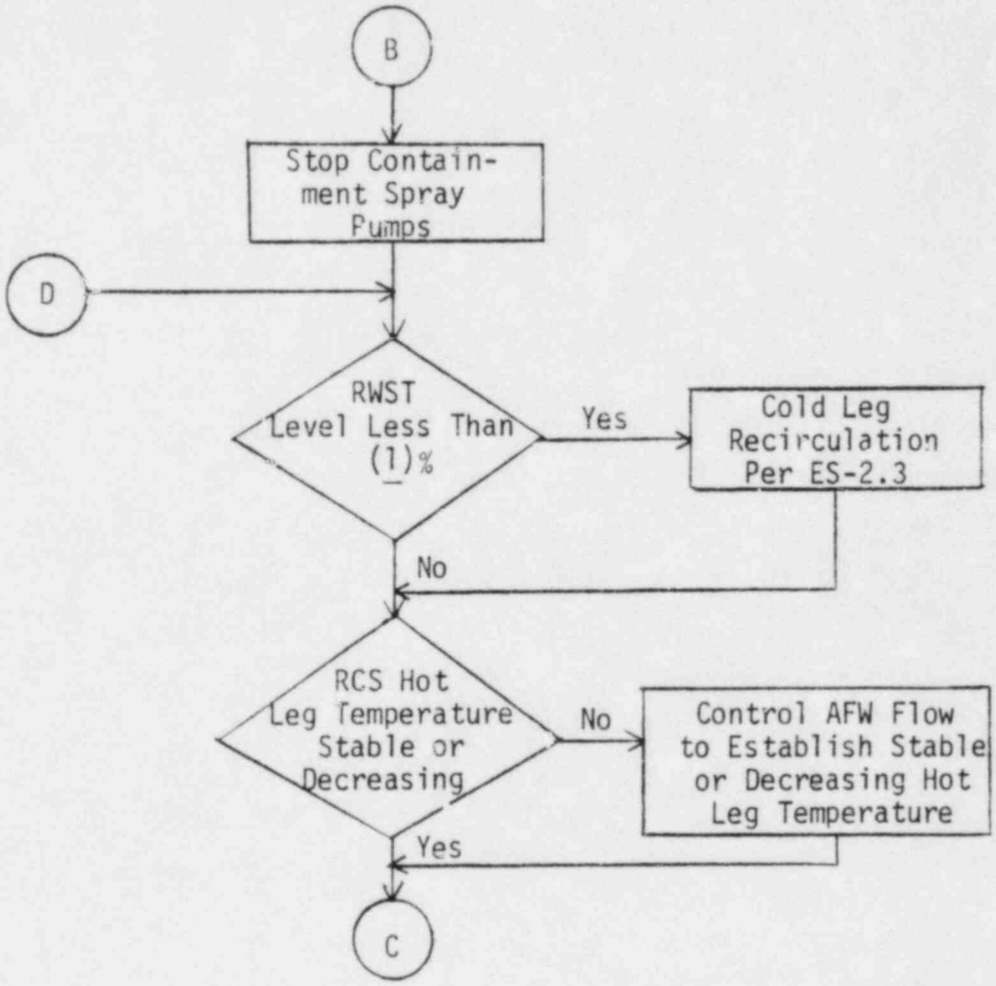
(1) Plant specific low level setpoint
(2) Plant specific value corresponding to low steam line pressure SI setpoint

FIGURE BD-2



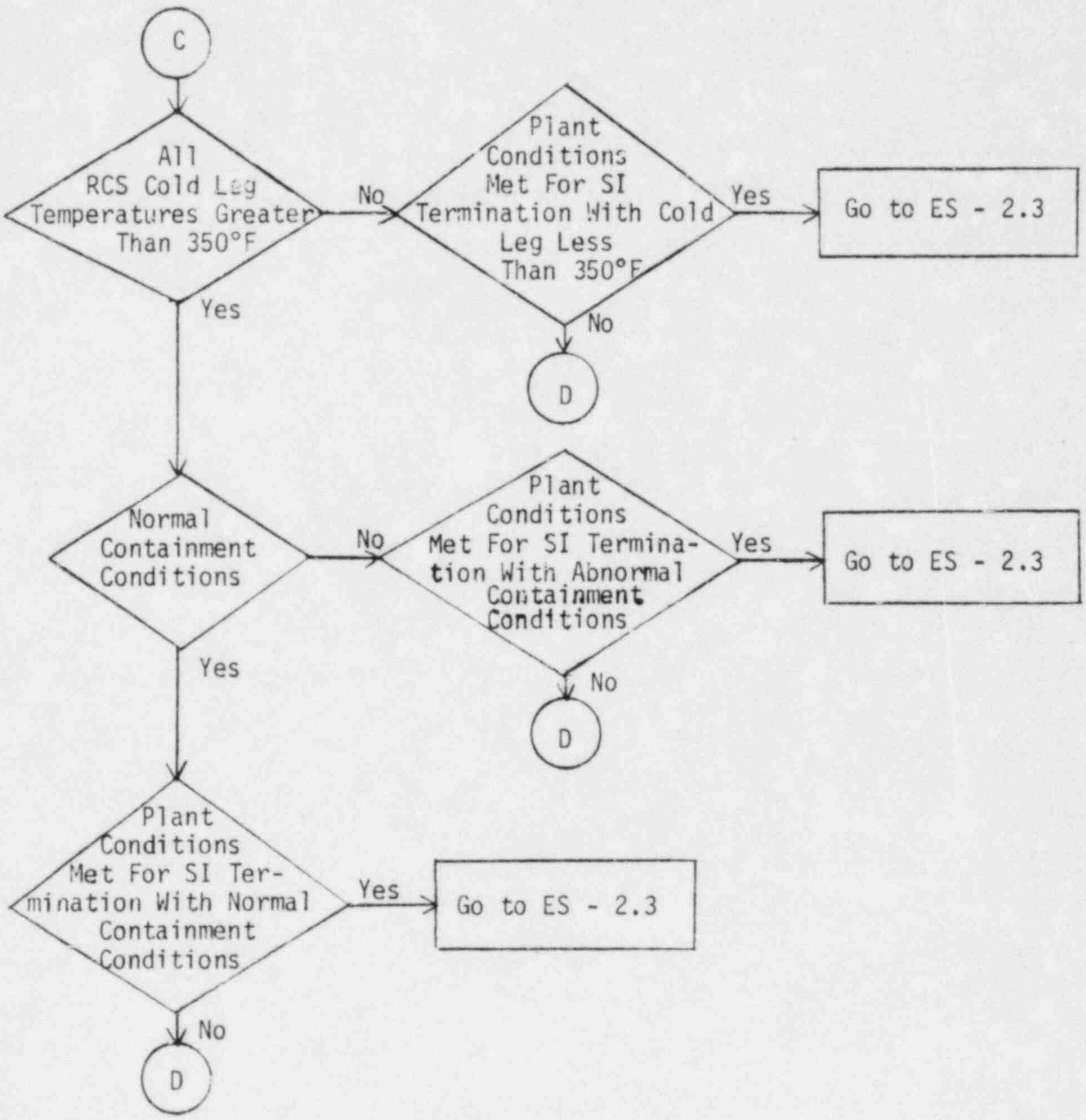
(1) Plant specific shutoff head pressure of low lead SI pumps
(2) Plant specific value derived from background document F - 0
(3) HI - 1 pressure setpoint

FIGURE BD-3



(1) Plant specific value corresponding to RWST switchover alarm

FIGURE BD-4


C
All RCS Cold Leg Temperatures Greater Than 350°F
No
Plant Conditions Met For SI Termination With Cold Leg Less Than 350°F
Yes
Go to ES - 2.3
No
D
Yes
Normal Containment Conditions
No
Plant Conditions Met For SI Termination With Abnormal Containment Conditions
Yes
Go to ES - 2.3
No
D
Yes
Plant Conditions Met For SI Termination With Normal Containment Conditions
Yes
Go to ES - 2.3
No
D

5.0 EXPLANATORY INFORMATION

Step 1

The operator should verify that all valves that provide isolation to other systems, that should be closed, actually are closed. If the valves cannot be verified closed or the valves cannot be closed manually, then an operator is dispatched to locally close the valves (one loop at a time) before continuing to the next loop.

One loop at a time is specified in order to ensure a complete, local check of valves for one steam generator to restore integrity to at least one steam generator as early as possible. The operator's judgement of the situation may provide the best loop on which to attempt the pressure boundary restoration.

If integrity can be restored to any loop, the operator is directed to immediately go the E-2, Loss of Secondary Coolant.

Step 2

Auxiliary feedwater flow to each steam generator is throttled with a minimum flow of 25 GPM in order to provide the following effects:

a. A minimum flow of 25 GPM to each steam generator to prevent steam generator tube dryout.

b. Auxiliary feedwater flow should be minimized to reduce the cooldown that the primary is experiencing from the blowdown of all steam generators

c. Auxiliary feedwater flow should be reduced to minimize the water inventory in the steam generator that eventually provides additional steam flow to containment or the environment.

Step 3

The primary source for auxiliary feedwater should be monitored to assure an adequate supply for cooldown purposes. Upon indication of inadequate supply, efforts should be made to switchover to a secondary heat sink.

Step 5

The operator checks steam generator narrow range level indication. If level is greater than 50 percent indication, then the steam generator tubes are covered and auxiliary feedwater may be throttled below the 25 GPM minimum of step 2 to the affected steam generator(s) to prevent over filling the steam generator(s).

If controllable, levels should be maintained at the nominal no load level. If the operator is unable to control level in a steam generator, i. e., level increases in an uncontrolled manner, then the possibility of a steam generator tube leak should be investigated.

Step 6

Secondary radiation levels are to be checked periodically for indications of steam generator tube rupture or leakage.

Steps 7 and 8

The operator should verify that the pressurizer PORV's operate properly and do not inadvertently remain open after the RCS pressure decreases below the PORV setpoint.

Step 9

Upon safety injection initiation all safeguards pumps are started regardless of the possibility of high RCS pressure with respect to the low head safety injection pump shutoff head. On low head systems where the pump recirculates on a small volume circuit there is concern for pump and motor overheating.

Shutdown of the pump and placement in the standby mode when the RCS is in this condition allows future pump operability.

Step 10

Upon loss of component cooling water and seal injection flow, a concern exists for continued pump availability due to overheating, thus the requirement for expeditious termination of pump operation if at least one train of safeguards equipment is verified to be operating. If the pumps are shutdown, seal injection flow should be restored to maintain pump seal operability, i. e., minimize losses of reactor coolant through the pump.

Step 13

Near the end of the steam generator blowdown(s), the heat removed may drop below that which is generated in the reactor coolant system and temperatures will start increasing. Auxiliary feedwater flow is then controlled to stabilize the primary hot leg temperatures that would otherwise create additional thermal stresses in the reactor coolant system and also prevent potential voiding in the hot leg.

Steps 14, 15, 16, 18, 20

Several concerns must be addressed following a multiple steam generator depressurization event. These include the following:

a. vessel integrity

b. secondary heat sink

c. mass and energy release into containment

d. water relief via the pressurizer safety and/or relief valves due to charging pump operation.

The conditions discussed below for termination and restart of safety injection should be monitored continuously to assure that the RCS is approaching a stable condition or is responding in a controlled manner.

Vessel integrity becomes a concern following a secondary line rupture if <u>any</u> wide range reactor coolant temperature T_H is less than 350°F. If any T_H <350° is observed, safety injection should be terminated after the operator verifies that the RCS pressure is greater than 700 psig or increasing, pressurizer water level is greater than 20 percent of span and increasing, reactor coolant subcooling is greater than X° and auxiliary feedwater is being injected into the intact steam generators or water level is in the narrow range span in a non-faulted steam generator. As a result of the above termination criterion, vessel integrity is assured and a means of controlling RCS pressure is available with adequate RCS inventory and a guaranteed secondary heat sink.

For the situation in which all wide range hot leg temperatures are greater than 350°, the safety injection termination criteria depend upon the environment existing inside the containment. The termination criteria for the situation in which a normal containment environment exists are as follows:

a. RCS Pressure greater than 2000 psig

b. Pressurizer water level greater than 20 percent of span

c. RCS indicated subcooling greater than X°F

d. Auxiliary feedwater flow isolated to all faulted steam generators, and at least Y gpm of auxiliary feedwater injected into the non-faulted steam generators or wide range level in at least non-faulted steam generator above the top of the U-tubes.

The terminiation criteria for the situation in which an adverse environment, i. e., high temperature, pressure, radiation, and humidity, exists inside containment are as follows:

a. RCS pressure greater than 2000 psig

b. Pressurizer water level greater than 50 percent of span

c. RCS subcooling greater than X°F

d. Auxiliary feedwater flow isolated to all faulted steam generators, and at least Y gpm of auxiliary feedwater injected into the non-faulted steam generator in the narrow range span.

The operator is instructed to minimize auxiliary feedwater flow to all steam generators (main feedwater isolation is assumed on a safety injection signal) in order to minimize the mass and energy release into containment or the environment following a secondary line ruputure.

Safety injection cannot be terminated until the operator assures that a source of heat removal is available to the steam generators.

The operator is permitted to utilize auxiliary feedwater flow indication into the steam generators as a primary indication that a source of secondary side heat removal is guaranteed.

The RCS pressue criterion of 2000 psig assures the operator that upon termination of safety injection, sufficient time is available for placing the plant in normal makeup and letdown prior to an RCS pressure drop to the automatic safety injection pressurizer pressure setpoint. Also, the pressurizer level criterion is specified to assure that the level is sufficient to guarantee coverage of the heaters to allow pressure control.

The RCS subcooling criterion is plant specific depending on the accuracy of the instrumentation. Since a cooldown operation has not yet been initiated and the plant could be in natural circulation at this time, the subcooling required for safety injection termination is minimized to avoid overpressurization or overfilling the system. The pressure/temperature conditions satisfying this criterion may violate pressure/temperature requirements in a particular set of plant technical specifications.

Steps 17, 19, 21

After the proper plant parameters are achieved and safety injection is terminated, the operator proceeds to a subprocedure for SI termination. Instructions are provided in the guideline for (1) plant recovery using normal charging and letdown, (2) Checking conditions for SI reinitiation and subsequent rediagnosis, and (3) preparing the plant for going to cold shutdown conditions.

WESTINGHOUSE OWNERS GROUP
EMERGENCY RESPONSE GUIDELINES
CONFIGURATION CONTROL SHEET

GUIDELINE DESIGNATOR: ECA-4

GUIDELINE TITLE: Response to Multiple Steam Generator Depressurization

REVISION: HP-Basic DATE: November 1, 1982

The guideline described above has been reviewed and approved for implementation by the Westinghouse Owners Group Procedures Subcommittee and the Westinghouse Nuclear Technology Division.

NOTICE: THIS EMERGENCY RESPONSE GUIDELINE SET REVISION (HP-BASIC) IS THE ORIGINAL ISSUE OF GENERIC GUIDANCE ON ITS SUBJECT MATTER FOR PLANTS WITH HIGH-PRESSURE SI SYSTEMS AND SUPERSEDES ANY GENERIC GUIDANCE ON THIS SUBJECT BEARING AN ISSUE DATE EARLIER THAN NOVEMBER 1, 1982.

File this sheet with the approved version of this guideline in your Emergency Response Guideline set.

Roger A. Newton
Chairman, Procedures Subcommittee
Westinghouse Owners Group

Mark [illegible]
Manager, Standard Plant Engineering
Westinghouse Nuclear Technology Division