Nuclear Operating Company

South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

August 1, 2011
NOC-AE-11002703
G25
10CFR50.90
10CFR50.48
STI: 32903186

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

South Texas Project
Units 1 & 2
Docket Nos. STN 50-498, STN 50-499
Supplement to the License Amendment Request for Approval of a
Revision to the South Texas Project Fire Protection Program
Related to the Alternative Shutdown Capability (TAC Nos. ME6346 and ME6347)

Reference: 1. Letter from G. T. Powell, STPNOC, to NRC Document Control Desk, "License Amendment for Approval of a Revision to the South Texas Project Fire Protection Program Related to the Alternate Shutdown Capability," dated June 2, 2011 (NOC-AE-11002643) (ML11161A143)

2. Letter from Balwant K. Singal to Edward D. Halpin, STPNOC, "South Texas Project, Units 1 and 2 -License Amendment Request for Approval of a Revision to the Fire Protection Program Related to the Alternate Shutdown Capability unacceptable for Review with opportunity to supplement," dated July 22, 2011 (AE-NOC-11002123) (ML112010150)

In reference 1, STP Nuclear Operating Company (STPNOC) submitted a licensee amendment request (LAR) for approval of a revision to the South Texas Project (STP) Fire Protection Program (FPP) related to the Alternative Shutdown Capability.

Per Reference 2 of this letter, The Nuclear Regulatory Commission (NRC) notified STPNOC that additional information is necessary to enable the NRC staff to make an independent assessment regarding the acceptability of the proposed amendment request in terms of regulatory requirements and the protection of public health and safety and the environment.

A006
NRR

The enclosure to this letter provides supplemental information to the LAR to support the NRC staff request.

The supplemental information does not impact the No Significant Hazards Determination provided in the LAR

There are no regulatory commitments in this letter.

If there are any questions regarding this amendment request, please contact Ken Taplett at (361) 972-8416 or me at (361) 972-7566.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on August 1, 2011
Date

Charles T. Bowman

Charles T. Bowman
General Manager,
Nuclear Safety Assurance

Enclosure: Supplemental Information to the LAR for approval of a revision to the South Texas Project (STP) Fire Protection Program (FPP) related to the Alternate Shutdown Capability

cc:

(paper copy)

Regional Administrator, Region IV
U. S. Nuclear Regulatory Commission
612 East Lamar Blvd, Suite 400
Arlington, Texas 76011-4125

Balwant K. Singal
Senior Project Manager
U.S. Nuclear Regulatory Commission
One White Flint North (MS 8B1)
11555 Rockville Pike
Rockville, MD 20852

Senior Resident Inspector
U. S. Nuclear Regulatory Commission
P. O. Box 289, Mail Code: MN116
Wadsworth, TX 77483

C. M. Canady
City of Austin
Electric Utility Department
721 Barton Springs Road
Austin, TX 78704

(electronic copy)

A. H. Gutterman, Esquire
Morgan, Lewis & Bockius LLP

Balwant K. Singal
U. S. Nuclear Regulatory Commission

John Ragan
Catherine Callaway
Jim von Suskil
NRG South Texas LP

Ed Alarcon
Kevin Pollo
Richard Pena
City Public Service

Peter Nemeth
Crain Caton & James, P.C.

C. Mele
City of Austin

Richard A. Ratliff
Texas Department of State Health Services

Alice Rogers
Texas Department of State Health Services

Supplemental Information to the LAR for Approval of a Revision to the South Texas Project (STP) Fire Protection Program (FPP) related to the Alternative Shutdown Capability

References:
1. Letter from G. T. Powell, STPNOC, to NRC Document Control Desk, "License Amendment for Approval of a Revision to the South Texas Project Fire Protection Program Related to the Alternative Shutdown Capability," dated June 2, 2011 (NOC-AE-11002643) (ML11161A143)
2. WCAP 11397-P-A, "Revised Thermal Design Procedure," April 1989
3. Letter from Balwant K. Singal to Edward D. Halpin, STPNOC, "South Texas Project, Units 1 and 2 -License Amendment Request for Approval of a Revision to the Fire Protection Program Related to the Alternate Shutdown Capability unacceptable for Review with opportunity to supplement (TAC NOS. ME6346 AND ME6347)," dated July 22, 2011 (AE-NOC-11002123) (ML112010150)

NRC Request for Additional Information(Ref. 3)

Please provide information to supplement the license amendment request in order to facilitate a comparison between the RETRAN analyses performed to support the Appendix R licensing request and a typical RETRAN analysis performed for a licensing basis event. Include information to compare key analytic inputs, and a summary description of the RETRAN results for the Appendix R analyses, including a discussion of the key figures of merit, limiting cases and results.

STPNOC Response

The fire hazard analysis to support the four selected operator actions discussed in Section 3.2 of the enclosure to the referenced license amendment request were based on the RETRAN computer code. The four actions are:

1. Close both pressurizer power-operated relief valve (PORV) block valves
2. Place centrifugal charging pumps in PULL-TO-LOCK (PTL)
3. Initiate feedwater (FW) isolation
4. Place startup feedwater pump (SUFP) in PTL

A comparison between the RETRAN analysis performed to support the fire hazards analysis licensing request and a typical RETRAN analysis performed for a licensing basis event is provided below for each of the above actions.

1. Close Both Pressurizer Power-Operated PORV Block Valves

The RETRAN analysis performed to support the fire hazards analysis licensing request for evaluating the requirement to close both pressurizer PORV block valves assumed a fire-induced spurious opening of one pressurizer PORV coincident with the operator initiated reactor trip when leaving the control room. The purpose of closing the PORV block valves is to protect against an uncontrolled depressurization of and loss of Reactor Coolant System (RCS) inventory resulting in an Engineered Safety Features (ESF) actuation signal based on low pressurizer pressure. The acceptance criteria for the fire hazard analysis was that an ESF safety actuation signal is considered a process variable outside what would be predicted for a normal loss of a-c power event as required by Appendix R, Section III.L.1.

The RETRAN analysis assumes the pressurizer PORV spuriously opens when the operator trips the reactor. The pressurizer PORV is assumed to stay open for 5 minutes before the block valve is closed. The analysis shows that the operator has approximately 61 seconds before a safety injection (SI) signal would be expected due to a spurious opening of one pressurizer PORV. A time sequence of events for this analysis is provided on Table 1-1. A plot of reactor power, pressurizer pressure, hot leg temperature and cold leg temperature versus time is provided on Figures 1A-D. As stated in Reference 1, operators have demonstrated that the block valves can be closed before leaving the control room in time to preclude an uncontrolled depressurization of and loss of RCS inventory.

An equivalent typical RETRAN analysis performed for a licensing basis event analysis is provided in Section 15.6.1 of the Updated Final Safety Analysis Report (UFSAR), "Inadvertent Opening of a Pressurizer Safety or Relief Valve." For this event, the reactor is assumed to be at full power at which time a pressurizer PORV or safety fails open. The analysis in the UFSAR assumes a failure of a pressurizer safety valve. The transient continues until a reactor trip occurs terminating the decrease in Departure from Nucleate Boiling (DNBR) margin. The acceptance criteria for this event described in the UFSAR is that the DNBR remains above the safety analysis limit throughout the transient. The DNBR analysis uses the Revised Thermal Design Procedure methodology described in Section 4.4.1.1 of the UFSAR and in WCAP 11397-P-A (Reference 2). A time sequence of events is provided on Table 15.6-1 of the UFSAR. A plot of nuclear power, pressurizer pressure and core average temperature versus time is provided on Figures 15.6-1 and 15.6-2 of the UFSAR.

Table 1-2 provides a comparison of the key analytical inputs for the RETRAN analysis performed to support the fire hazards analysis licensing request and the equivalent typical RETRAN analysis performed for a licensing basis event described in the UFSAR.

2. Place Centrifugal Charging Pumps in PTL

The RETRAN analysis performed to support the fire hazards analysis licensing request for evaluating the requirement to place the centrifugal charging pumps in PTL assumed a fire-induced spurious opening of the pressurizer auxiliary spray valve coincident with the operator initiated reactor trip when leaving the control room. The purpose of placing the centrifugal charging pumps in PTL was to preclude depressurizing the RCS which could result in an ESF actuation signal and to protect against the indicated pressurizer water level going off-scale high. The acceptance criteria for the fire hazard analysis is that an ESF safety actuation signal and the indicated pressurizer water level going off-scale high is considered a process variable outside what would be predicted for a normal loss of a-c power as required by Appendix R, Section III.L.1 and III.L.2.b respectively.

The RETRAN analysis assumes the auxiliary pressurizer spray valve spuriously opens when the operator trips the reactor. The analysis conservatively assumes an initial flow of 150 gallons per minute (21 lbm/sec) of flow from the centrifugal charging pumps through the open auxiliary pressurizer spray valve into the pressurizer which increases as pressurizer pressure decreases. A turbine trip and FW isolation is also assumed to occur at this time. The Reactor Coolant Pumps (RCPs) are assumed to trip two seconds later. The analysis also conservatively assumes auxiliary feedwater (AFW) starts on a steam generator (SG) low-low signal at 19 seconds to maximize the RCS depressurization. The operators are then assumed to secure auxiliary spray 600 seconds (10 minutes) after the initiation of the event. The results show that SI actuation occurs at 146 seconds, and the indicated pressurizer water level goes off-scale high at 465 seconds. A time sequence of events for this analysis is provided on Table 2-1. A plot of pressurizer pressure, indicated pressurizer water level, hot leg temperature, cold leg temperature, pressurizer auxiliary spray flow and SI flow versus time is provided on Figures 2A-F. As stated in Reference 1, operators have demonstrated that the centrifugal charging pumps can be placed in PTL before leaving the control room in time to preclude an uncontrolled RCS depressurization and the indicated pressurizer water level going off-scale high.

The centrifugal charging pumps are also required to achieve and maintain cold shutdown conditions as required by Appendix R, Sections III.2.a and III.L.5. Placing the centrifugal charging pumps in PTL ensures that a fire-induced spurious closure of the Volume Control Tank isolation valve will not result in damage to these pumps. A RETRAN analysis was not performed to address this requirement.

An equivalent typical RETRAN analysis performed for a licensing basis event analysis is provided in Section 15.6.1 of the Updated Final Safety Analysis Report (UFSAR), "Inadvertent Opening of a Pressurizer Safety or Relief Valve." Table 1-2 provides a comparison of the key analytical inputs for the RETRAN analysis performed to support the fire hazards analysis licensing request and the equivalent typical RETRAN analysis performed for a licensing basis event described in the UFSAR.

3. Initiate FW Isolation

The RETRAN analysis performed to support the fire hazards analysis licensing request for evaluating the requirement to initiate FW isolation assumed a fire-induced spurious starting of the SUFP coincident with the operator initiated reactor trip when leaving the control room. The purpose of closing the FW isolation valves is to protect against the indicated pressurizer water level going off-scale low which would be a violation of Appendix R, Section III.L.2.b. In addition, the SG water level would go off scale high due to overfilling the SGs. Overfilling the SGs is considered a process variable outside what would be predicted for a normal loss of a-c power which is a violation of Appendix R, Section III.L.1.

The RETRAN analysis assumes the operators trip the reactor followed by a turbine trip 3.5 seconds later. The operators then close the main steam isolation valves 35 seconds after the reactor trip which trips the main FW pumps. With off-site power available, the startup FW pump starts in 50 seconds. The analysis also conservatively assumes AFW starts at 50 seconds to maximize the RCS cooldown and exacerbate the SG overfill. The analysis assumes the operators trip the RCPs 120 seconds after the reactor trip. The SUFP pump and AFW is secured 540 seconds (9 minutes) after the initiation of the event. The results of the analysis show that the indicated pressurizer water level goes off-scale low in 285 seconds and the SG water level goes off-scale high in 295 seconds in all four SGs. A time sequence of events is provided on Table 3-1. A plot of hot leg temperature, cold leg temperature, pressurizer pressure, indicated pressurizer water level and indicated steam generator water level versus time is provided on Figures 3A-E. As stated in Reference 1, operators have demonstrated that the main feedwater isolation valve can be closed before leaving the control room in time to preclude the indicated pressurizer water level going off-scale low or the indicated steam generator water level going off-scale high.

An equivalent typical RETRAN analysis performed for a licensing basis event analysis is described in Section 15.1.2 of the UFSAR, "Feedwater System Malfunctions Causing an Increase in Feedwater Flow." For this event, the following conditions are evaluated:

1. Accidental opening of one feedwater (FW) control valve at hot zero power conditions resulting in an increase of 225% of nominal flow to one steam generator (SG) with conservatively low FW temperature of 70° F.

2. Accidental opening of all four FW control valves at hot zero power conditions. One turbine driven feed pump is at run-out flow with a conservatively low FW temperature of 70° F.

3. Accidental opening of one FW control valve at hot full power conditions resulting in a step increase to 200% of nominal FW flow to one SG. The rod control system is either in automatic or manual mode.

4. Accidental opening of all FW control valves at hot full power conditions resulting in a step increase to 150% of nominal FW flow to all SGs. A 25 British Thermal Units per pound mass (Btu/lbm) FW enthalpy reduction is assumed. The rod control system is in manual mode.

The UFSAR further states that the zero power events are bounded by the full power cases and therefore not presented.

For the analysis presented in the UFSAR, a failure of one FW control valve is assumed resulting in increased FW flow to one steam generator. When the SG water level in the faulted loop reaches the high-high level setpoint, all FW isolation valves and FW control valves are automatically closed and the SG feed pumps are tripped. This prevents continued addition of FW. In addition, a turbine trip is initiated. Following turbine trip, the reactor will automatically trip due to turbine trip. The acceptance criterion for this event is that the DNBR remains above the safety analysis limit throughout the transient. The DNBR analysis uses the Revised Thermal Design Procedure methodology. A second but less limiting criteria discussed in the UFSAR is that fuel temperature remains below the fuel melting temperature. The analysis demonstrates this criterion is satisfied since the peak power does not exceed 118% power. A time sequence of events is provided on Table 15.1-1 of the UFSAR. A plot of nuclear power, DNBR, vessel average temperature, and pressurizer pressure temperature versus time is provided on Figures 15.1-1 and 15.1-2 of the UFSAR.

Table 3-2 provides a comparison of the key analytical inputs for the RETRAN analysis performed to support the fire hazards analysis licensing request and the equivalent typical RETRAN analysis performed for a licensing basis event described in the UFSAR.

4. Place SUFP in PTL

The RETRAN analysis performed to support the fire hazards analysis licensing request for evaluating the requirement to place the SUFP in PTL assumed a fire-induced spurious opening of a main feedwater isolation valve coincident with the operator initiated reactor trip when leaving the control room. The purpose of SUFP in PTL is to protect against the indicated pressurizer water level going off-scale low which would be a violation of Appendix R, Section III.L.2.b. In addition, the SG water level would go off scale high due to overfilling the SG. Overfilling the SG is considered a process variable outside what would be predicted for a normal loss of a-c power, which is a violation of Appendix R, Section III.L.1.

The RETRAN analysis assumes the operator trips the reactor followed by an automatic turbine trip 3.5 seconds later. The operators then close the main steam isolation valves 35 seconds after the reactor trip, which trips the main feedwater pumps. The main feedwater isolation valves to loops 2, 3, and 4 close at this time. The main feedwater isolation valve to loop 1 does not close due to a fire-induced spurious signal. With off-site power available, the SUFP starts in 50 seconds after the reactor trip. The analysis also conservatively assumes AFW

starts at 50 seconds after the reactor trip to maximize the RCS cooldown and exacerbate the SG overfill. The analysis assumes the operators trip the RCPs 120 seconds after the reactor trip. Results show that the indicated SG water level in loop 1 goes off scale high approximately 130 seconds after the reactor trip. The indicated pressurizer water level goes off-scale low 257 seconds after the reactor trip. A time sequence of events is provided on Table 4-1. A plot of hot leg temperature, cold leg temperature, pressurizer pressure, indicated pressurizer water level and indicated steam generator water level versus time is provided on Figures 4A-E. As stated in Reference 1, operators have demonstrated that the main feedwater isolation valve can be closed before leaving the control room in time to preclude the indicated pressurizer water level going off-scale low or the indicated SG water level going off-scale high.

The equivalent typical RETRAN analysis performed for a licensing basis event analysis is described in Section 15.1.2 of the UFSAR Section, "Feedwater System Malfunctions Causing an Increase in Feedwater Flow," which is discussed in Item 3 above. Table 3-2 provides a comparison of the key analytical inputs for the RETRAN analysis performed to support the fire hazards analysis licensing request and the equivalent typical RETRAN analysis performed for a licensing basis event described in the UFSAR.

Table 1-1

Time Sequence of Event For A Fire-Induced Spurious Opening of One Pressurizer PORV Coincident With Operator Initiated Reactor Trip

Time (sec)	Event
0	Reactor Trip
0	Turbine Trip
0	FW Isolation
0	MSIV Closure
0	Pressurizer PORV Opens
2	RCP Trip
61.5	SI Actuation
300	Operator Closes Pressurizer PORV Block Valves

Table 1-2

Comparison of Key Analysis Inputs for a Fire-Induced Spurious Opening of (1) One Pressurizer PORV Coincident With Operator Initiated Reactor Trip, and (2) Pressurizer Auxiliary Spray Valve Coincident With Operator Initiated Reactor Trip

PARAMETER	UFSAR CHAPTER 15.6.1 ANALYSIS ASSUMPTION	FIRE HAZARD ANALYSIS ASSUMPTION
Initial Power	Nominal full power plus instrument bias	Nominal full power (3853 MWt)
Initial RCS Average Temperature	High end of allowed operating band (593°F) plus instrument bias	Actual nominal (592°F)
Initial Pressurizer pressure	Nominal minus instrument bias	Nominal (2250 psia)
RCS flow	Best Estimate Flow	Best Estimate Flow
Moderator Temperature Coefficient	Most positive	NA (reactor trip occurs @ Time = 0)
Doppler Coefficient	Small (absolute value)	NA (reactor trip occurs @ Time = 0)

Table 2-1

Time Sequence of Event For A Fire-Induced Spurious Opening of Pressurizer Auxiliary Spray Valve Coincident With Operator Initiated Reactor Trip

Time (sec)	Event
0	Reactor Trip
0	Turbine Trip
0	FW Isolation
0	Pressurizer Auxiliary Spray activated
2	RCP Trip
19	Low Low SG Level
21	AFW Actuation
146	SI Actuation
465	Pressurizer Level > 100%
600	Operator Action to Terminate Auxiliary Spray

Table 3-1

**Time Sequence of Events
For a Startup Feedwater Pump Spurious Actuation Scenario
with Feedwater Isolation Valves Open**

(Main Feedwater Isolation at 9 Minutes After Reactor Trip)

Time (Seconds)	Event	Notes
0	Reactor Trip	
3.5	Turbine Trip	
35	MSIVs Closed	Operator Action (includes 5 seconds for MSIV closure)
35	Main Feedwater Pumps Trip	
50	SUFP Starts	
50	AFW Starts	
120	RCPs Trip	Operator Action
285	Pressurizer Water Level @ 0%	
295	SG Water Level @ 100% NRS (narrow range span)	
540	AFW Flow Terminates	Operator Action
540	Feedwater Isolated	Operator Action
1315	Pressurizer Water Level > 0%	
2980	Max. SG Water Volume	$\approx$ 7401 ft^3

Notes:
1. AFW and SUFP stop 9 minutes after reactor trip.
2. Maximum SG water volume is ~7500 ft^3

Table 3-2

Comparison of Key Analysis Inputs for a Startup Feedwater Pump Spurious Actuation Scenario With Feedwater Isolation Valves Open

PARAMETER	UFSAR CHAPTER 15 ASSUMPTION	FIRE HAZARD ANALYSIS ASSUMPTION
Initial Power	Nominal full power plus instrument bias	Nominal full power (3853 MWt)
Initial RCS Average Temperature	High end of allowed operating band (593°F) plus instrument bias	Actual nominal (592°F)
Initial Pressurizer pressure	Nominal minus instrument bias	Nominal (2250 psia)
RCS flow	Best Estimate Flow	Best Estimate Flow
Reactivity Feedback	Maximum EOL	NA (reactor trip occurs @ Time = 0)
FW Temperature	Bottom of allowed operating band (390°F)	440°F prior to reactor trip 370°F after reactor trip

Table 4-1

Time Sequence of Events for a Spurious Opening of One Main Feedwater Isolation Valve

Time (Seconds)	Event	Notes
0	Manual Reactor Trip	Transient Starts
3.5	Turbine Trip	
35	Manual MS Isolation	All 4 MSIVs Closed Manual Operator Actions
35	Turbine Driven Main FW Pumps Trip	3 MFIVs Closed (Loop 1 Remains Open)
35	3 MFIVs Closed (Loop 1 Remains Open)	
50	AFW Pumps start	Flow to All SGs
50	Startup Feed Pump Starts	Flow to Loop 1 Only
120	All RCPs Trip	Manual Operator Actions
125	High-High SG Water Level	SG 1 > 98.3%NR
≈130	SG Water Level @ 100% NRS	
229	SG 1 Filled	SG Water Solid
257	Pressurizer Water Level < 0%	
265	Steamline 1 Filled	Steamline Water Solid. Liquid Release from SG PORV

Figure 1A Core Power vs. Time
Spurious Opening of One Pressurizer PORV
Coincident With Operator Initiated Reactor Trip

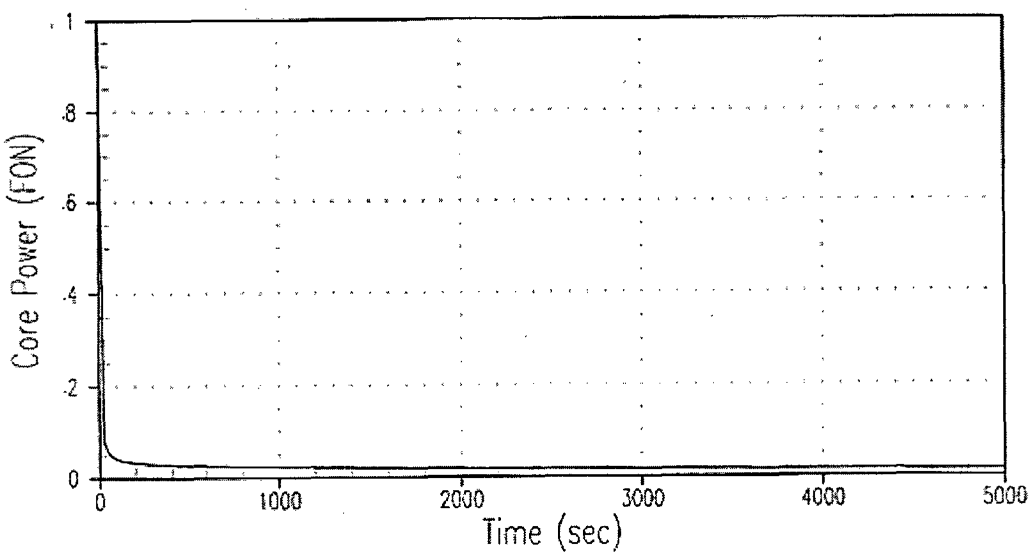


Figure 1B Pressurizer Pressure vs. Time
Spurious Opening of One Pressurizer PORV
Coincident With Operator Initiated Reactor Trip

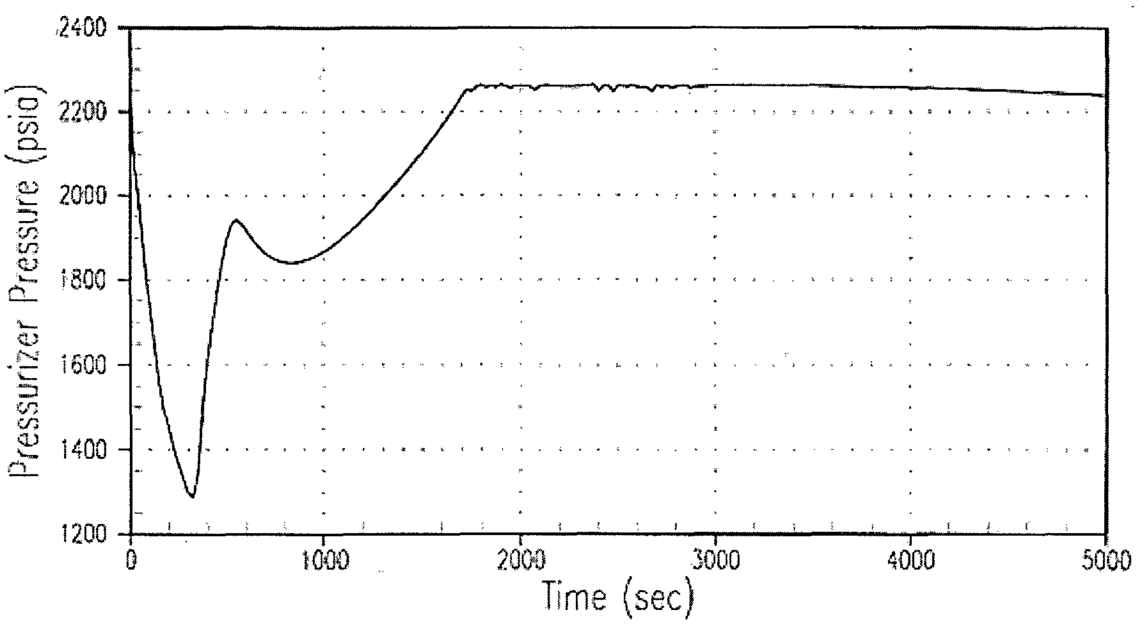


Figure 1C Hot Leg Temperature vs. Time
Spurious Opening of One Pressurizer PORV
Coincident With Operator Initiated Reactor Trip

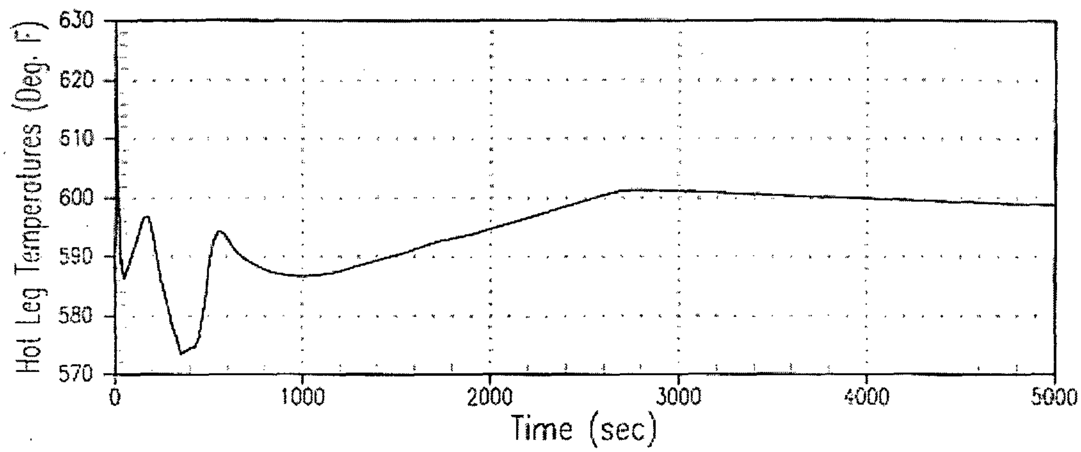
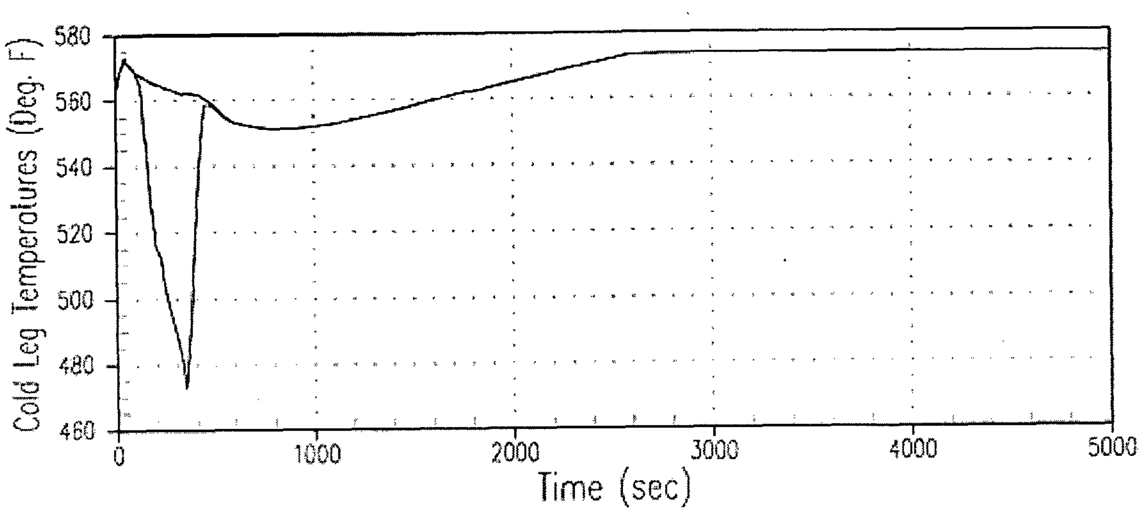


Figure 1D Cold Leg Temperature vs. Time
Spurious Opening of One Pressurizer PORV
Coincident With Operator Initiated Reactor Trip



Loop 1
Loop 2
Loop 3
Loop 4

Figure 2A Pressurizer Pressure vs. Time
Spurious Opening of Aux Spray Valve With Charging Flow

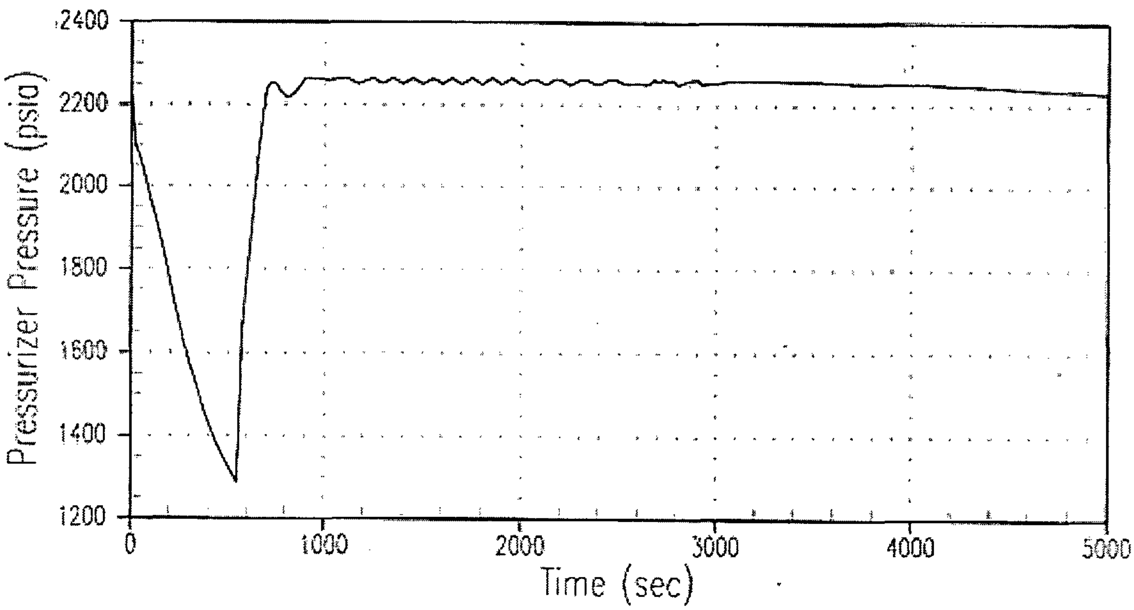


Figure 2B Indicated Pressurizer Water Level vs. Time
Spurious Opening of Aux Spray Valve With Charging Flow

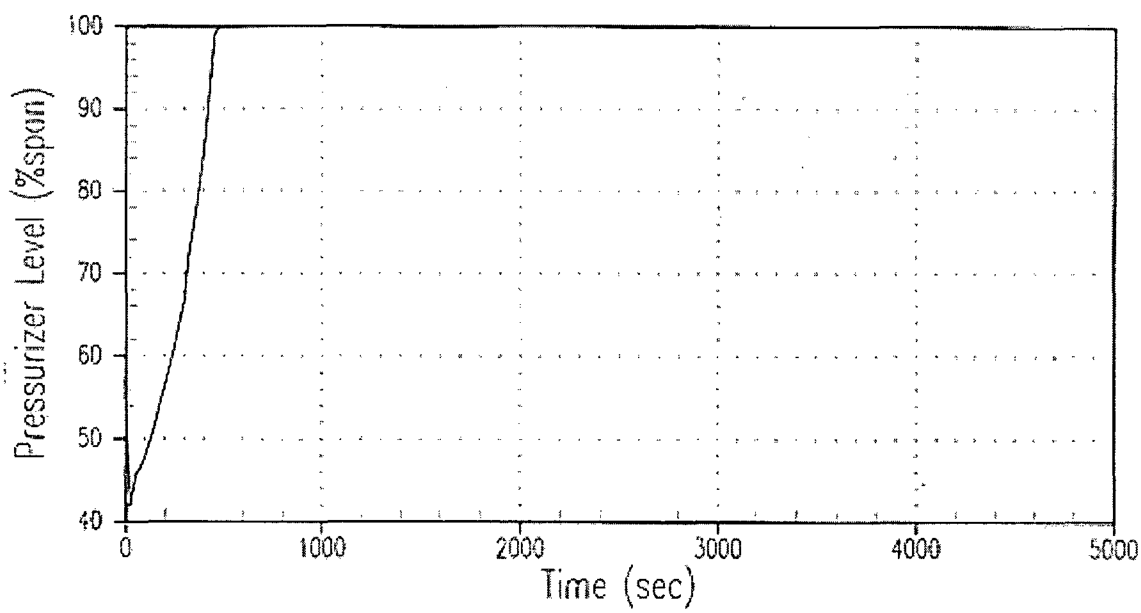


Figure 2C Hot Leg Temperature vs. Time
Spurious Opening of Aux Spray Valve With Charging Flow

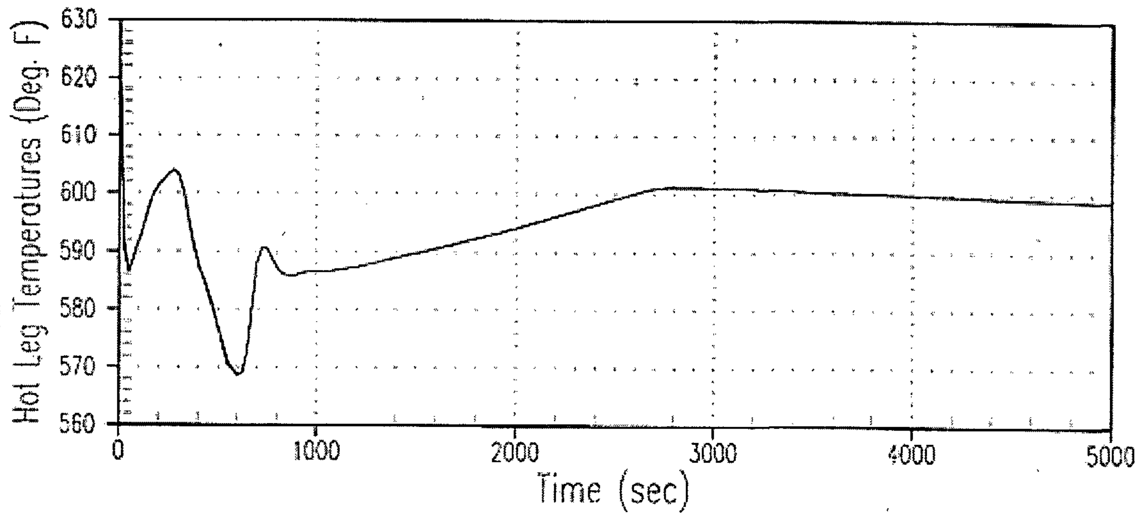


Figure 2D Cold Leg Temperature vs. Time
Spurious Opening of Aux Spray Valve With Charging Flow

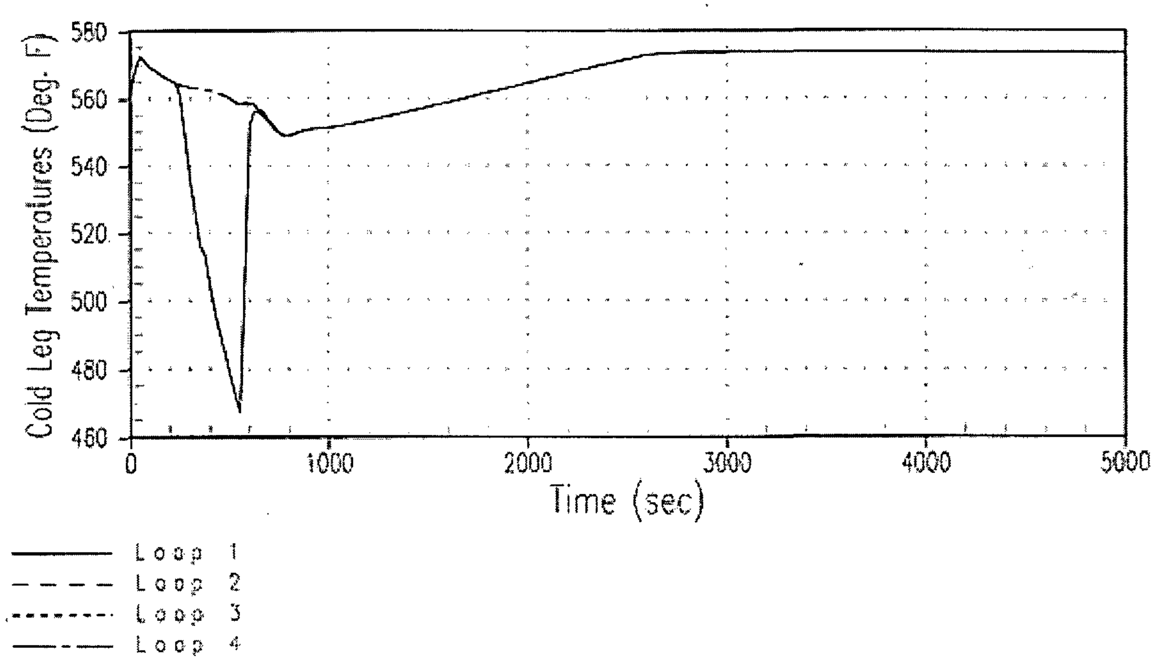


Figure 2E Pressurizer Auxiliary Spray Flow vs. Time
Spurious Opening of Aux Spray Valve With Charging Flow

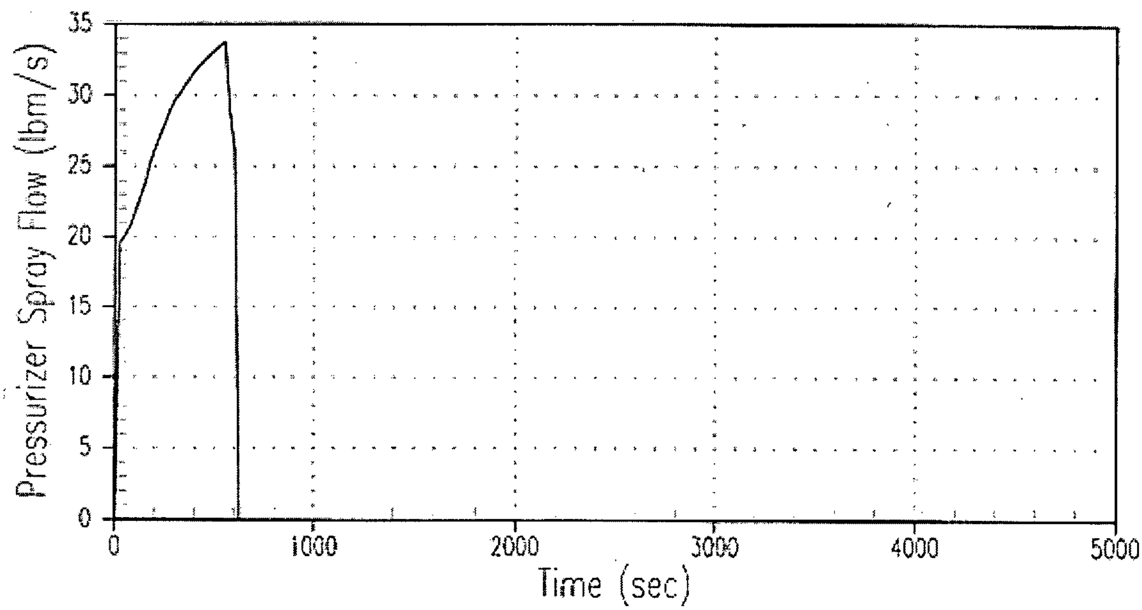


Figure 2F Safety Injection Flow vs. Time
Spurious Opening of Aux Spray Valve With Charging Flow

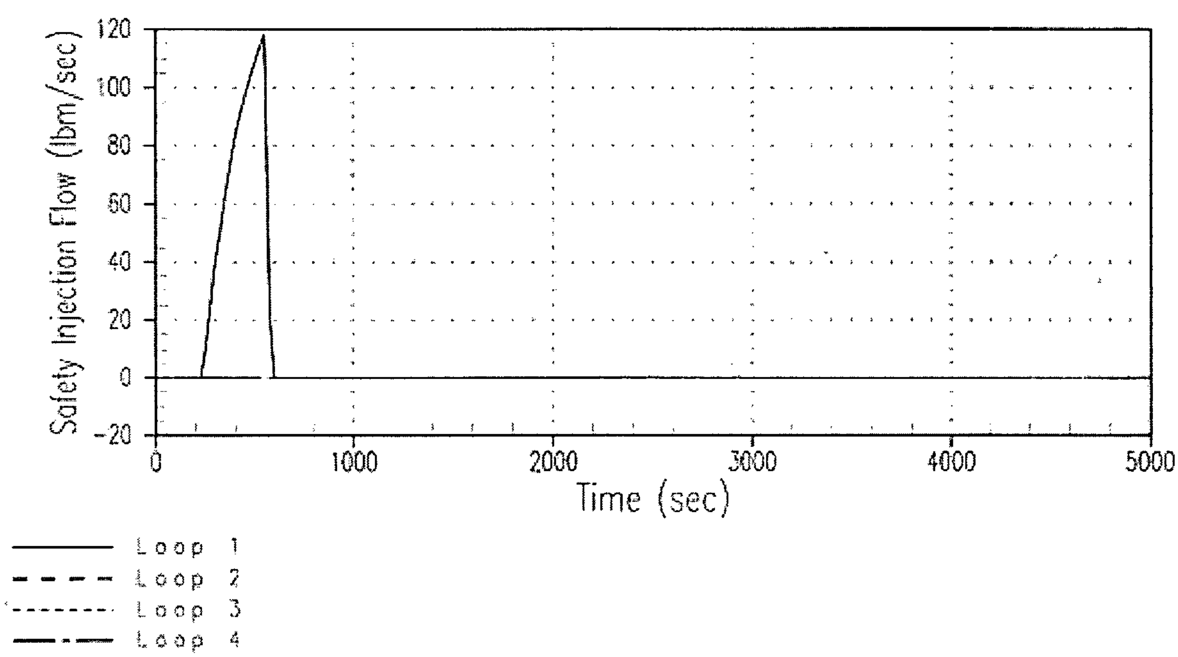


Figure 3A Hot Leg Temperature vs. Time
Main FWIV Open With Startup Feedwater Pump

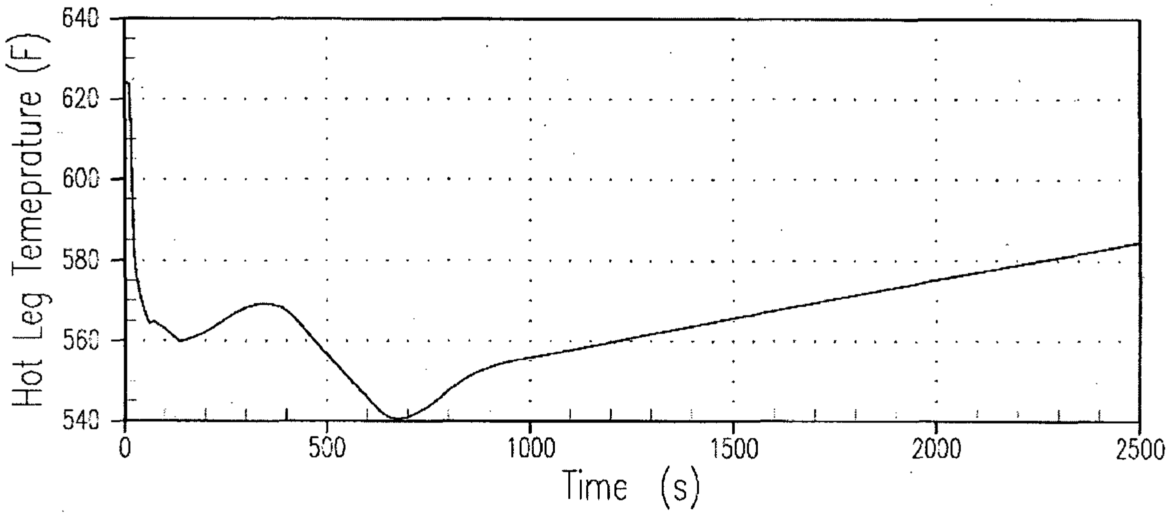


Figure 3B Cold Leg Temperature vs. Time
Main FWIV Open With Startup Feedwater Pump

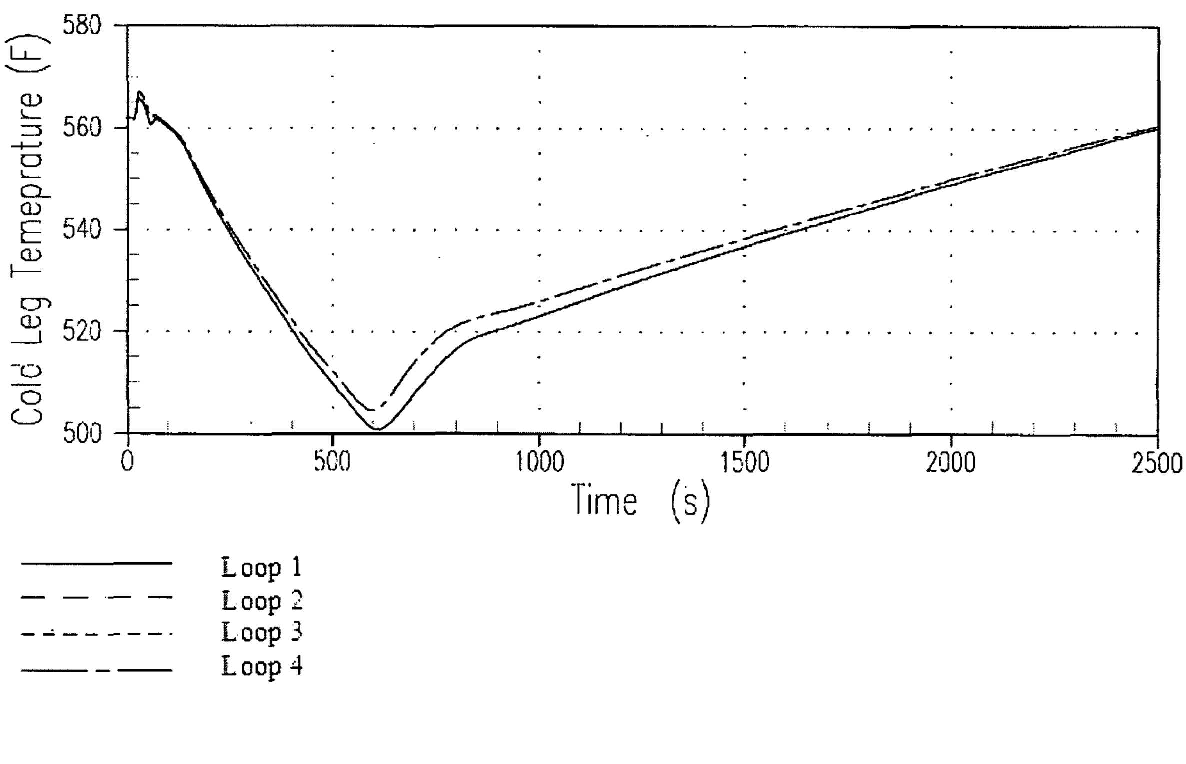


Figure 3C Pressurizer Pressure vs. Time
Main FWIV Open With Startup Feedwater Pump

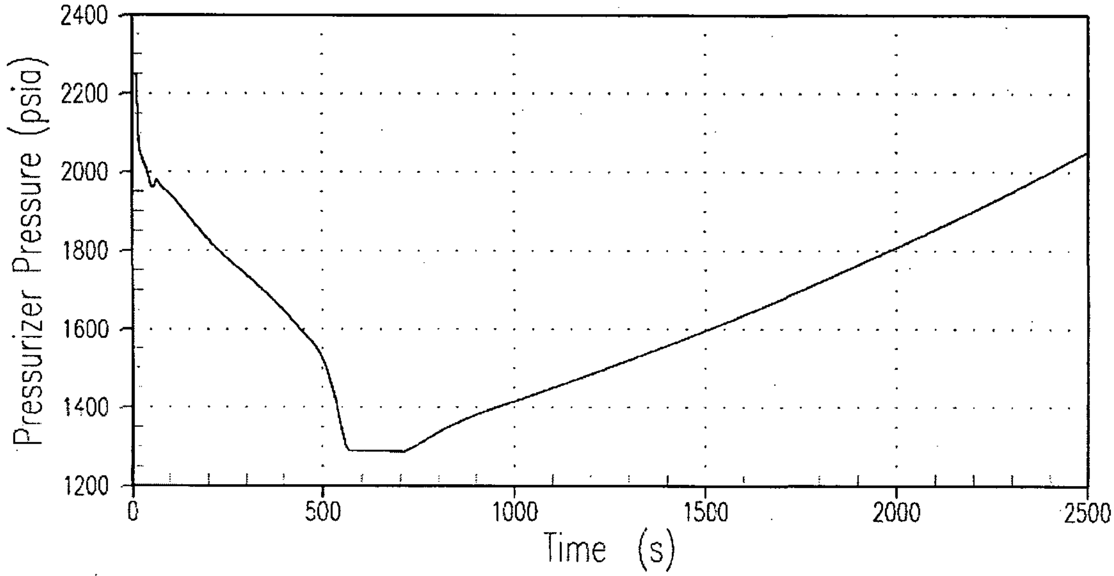


Figure 3D Indicated Pressurizer Water Level vs. Time
Main FWIV Open With Startup Feedwater Pump

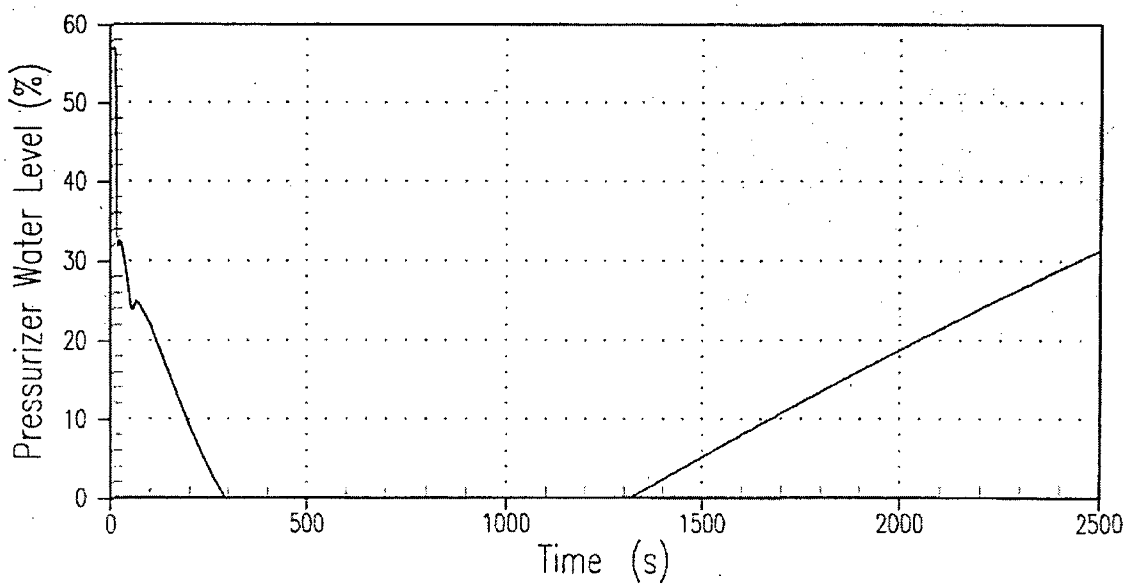


Figure 3E Indicated Steam Generator Water Level vs. Time
Main FWIV Open With Startup Feedwater Pump

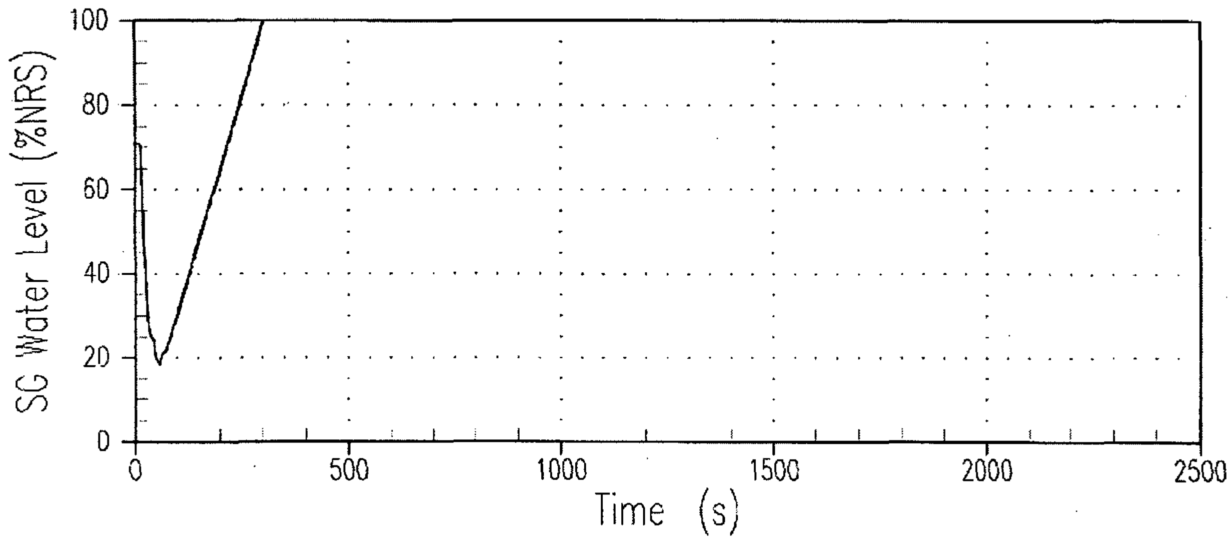


Figure 4A Hot Leg Temperature vs. Time
Spurious Opening of One Main Feedwater Isolation Valve

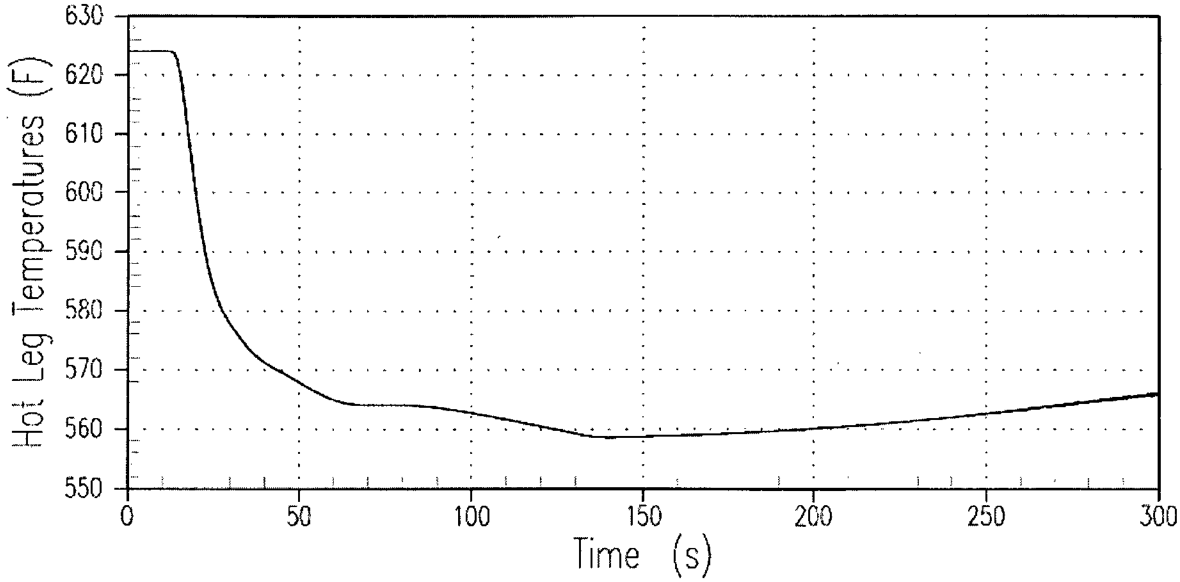


Figure 4B Cold Leg Temperature vs. Time
Spurious Opening of One Main Feedwater Isolation Valve

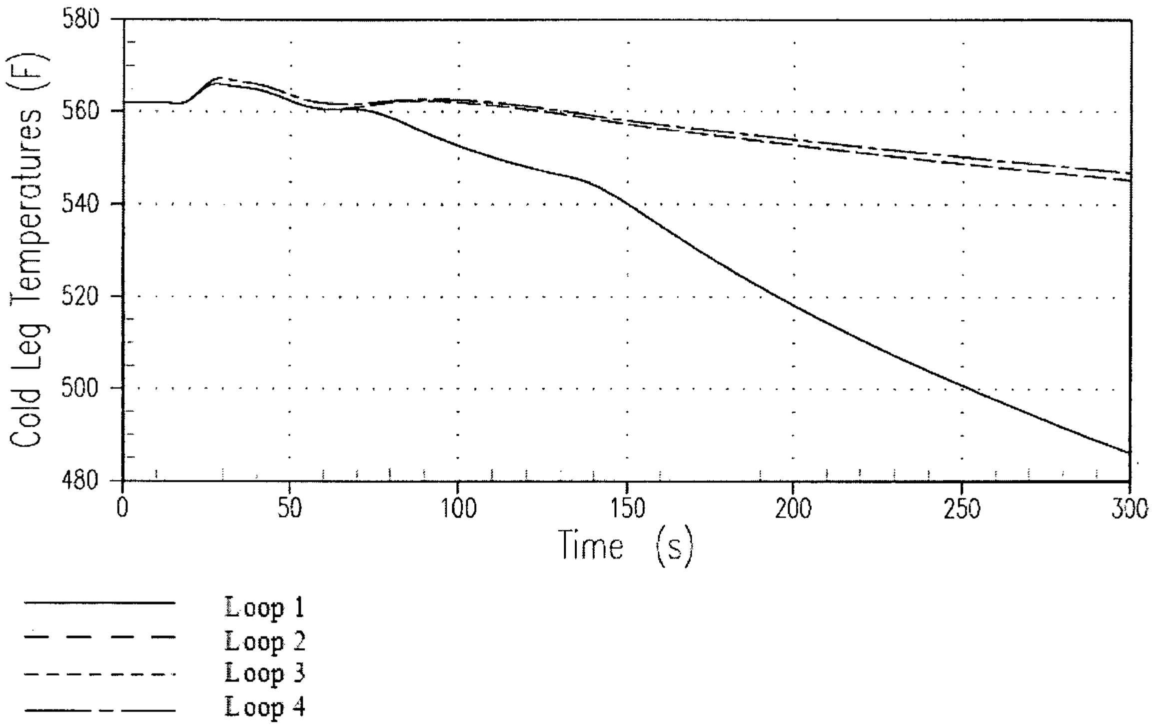


Figure 4C Pressurizer Pressure vs. Time
Spurious Opening of One Main Feedwater Isolation Valve

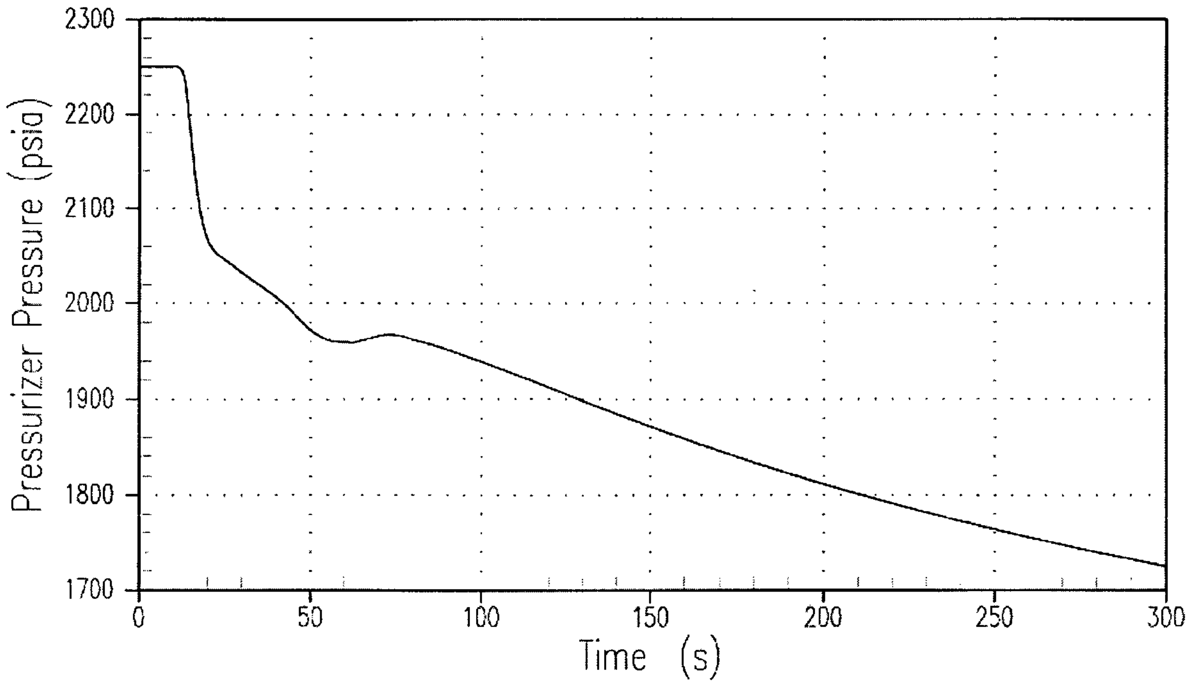


Figure 4D Indicated Pressurizer Water Level vs. Time
Spurious Opening of One Main Feedwater Isolation Valve

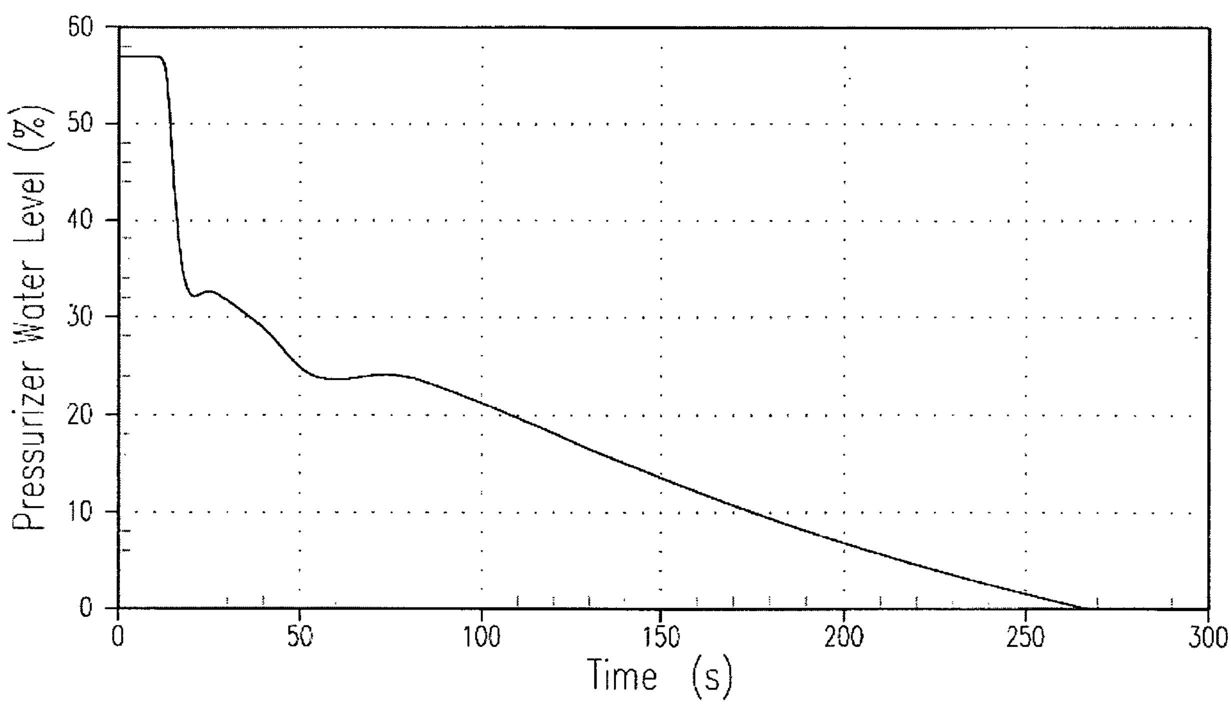


Figure 4E Indicated Steam Generator Water Level vs. Time
Spurious Opening of One Main Feedwater Isolation Valve