Docket File
52-003

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 30, 1995

APPLICANT: Westinghouse Electric Corporation

PROJECT: AP600

SUBJECT: SUMMARY OF MEETING TO DISCUSS AP600 REACTOR SYSTEM DESIGN

The Nuclear Regulatory Commission (NRC) staff and representatives of Westinghouse Electric Corporation held a meeting in the Westinghouse office in Monroeville, Pennsylvania, on July 10 and 11, 1995, to discuss items relating to the AP600 reactor system design. This meeting was a continuation of discussions on the items documented in a letter to Westinghouse from NRC dated April 19, 1995. Attachment 1 is the list of meeting attendees. Attachment 2 includes handouts provided by Westinghouse during the meeting to clarify various discussions items.

Highlights of the discussion are summarized as follows:

Interfacing System LOCA:

Westinghouse will submit a WCAP report documenting its evaluation of AP600 systems interfacing the reactor coolant system for conformance to inter-system LOCA (ISLOCA) acceptance criteria. The content of the ISLOCA report was discussed. The staff requested that Westinghouse provide a calculation to show that with a design pressure of 900 psig, the normal RHR system will not rupture when subject to the RCS operating pressure.

ATWS analysis:

Westinghouse provided a response to the staff question related to the low steam generator level setpoint and signal delay of the diverse actuation system, and the passive residual heat removal (PRHR) actuation delay time assumed for the ATWS analysis. The staff also indicated that there might be a need for a request for exemption to 10 CFR 50.62 since the ATWS rule requires auxiliary feedwater or emergency feedwater actuation rather than the PRHR actuation.

CMT delay time:

The description of the core makeup tank valve opening delay time provided in revision 1 of the response to RAI 440.106 was discussed and found acceptable. The staff will look into how the valve actuation delay times are controlled in the technical specifications to ensure consistency or conservatism in the delay times assumed in the safety analysis.

CVS Design Change:

Westinghouse made a presentation on the design change of the setpoint and logic of the chemical and volume control system (CVS) for overfill protection. A new protection logic was added for the pressurizer overfill protection, i.e., the CVS makeup isolation valves will automatically close on a safeguards signal coincident with high-1 pressurizer level. For steam generator overfill protection, the CVS isolation will receive a signal from the protection and safety monitoring system (PMS) derived from either a high-2 pressurizer level or high steam generator level signal. These changes have been included in SSAR Revision 4 to Section 9.3.6, and Westinghouse will review Chapter 7, Instrumentation and Control, to assure it appropriately reflects the changes. Other design changes include reclassification of portions of the CVS inside containment to class D systems, and incorporation of remotely operated valves to isolate CVS from the normal residual heat removal system (RNS). Westinghouse indicated that Chapter 3 of SSAR will be changed to reflect the safety classification reduction in Revision 5.

Chapter 15 Design Basis Analysis:

The staff indicated that the Standard Review Plan requires for Chapter 15 design basis analyses that Condition II events should be analyzed without a single failure consideration to demonstrate the DNBR limit is not exceeded, and also be analyzed with a single failure consideration to meet the Condition III criteria. The staff also requested that Westinghouse provide the results of DNBR vs time for Condition II events.

A discussion was made on the use of non-safety-related equipment in the design basis analyses for certain events, e.g., use of turbine stop valves (TSVs) and branch line isolation valves in the steamline break (SLB) and steam generator tube rupture (SGTR) events, use of main feedwater (MFW) pump trip in the excessive MFW flow event, and use of pressurizer heater trip in the loss of MFW and SGTR events. Westinghouse presented a comparison between the existing plants and AP600 of the non-safety systems design and safety analyses. Many non-safety equipment in AP600 are improved over the existing plants. For example, the MFW control valve has a safety-related closing function, and the trip signals for the MFW trip, TSVs, control valves, and branch line isolation valves are provided by the PMS. The staff indicated that it is necessary to assure the leak tightness of the MSIV and turbine stop valves, and Westinghouse should determine whether or not leak requirements need to be included in the in-service testing, and whether the turbine stop valves, control valves and branch line isolation valves meet the technical specification screening criteria to be included in the plant technical specifications.

Boron Dilution:

Westinghouse has not provided a response to RAI 440.120 regarding a postulated boron dilution event. Westinghouse will look into the possibility of potential accumulation specific to AP600 design, and will provide an evaluation of consequences.

Fuel Assembly Design Change:

The staff inquired about Westinghouse's decision on a potential fuel assembly design change to address the vibration issue. Westinghouse will look into the status.

Open Item Tracking System:

The staff and Westinghouse went over the status of open items in the Open Items Tracking System database, and agreed on the status as indicated.

Original signed by
William C. Huffman, Project Manager
Standardization Project Directorate
Division of Reactor Program Management
Office Of Nuclear Reactor Regulation

Docket No. 52-003

Attachments: As stated

cc w/attachments:
See next page

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DATE	11/27/95		11/27/95		11/30/95					

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WESTINGHOUSE/NRC AP600
MEETING ATTENDEES
JULY 10 AND 11, 1995

NAME	ORGANIZATION
Andrea Sterdis	W AP600 Licensing
Terry Schultz	W AP600 Systems
Earl Novenstern	W Safety Analysis
John Butler	W Safety Analysis
Tim Rowell	W Safety Analysis
Mike Corletti	W Nuclear Safety
Tim Collins	NRC/DSSA/SRXB
Y. Gene Hsii	NRC/DSSA/SRXB

Attachment 1

HANDOUTS AND DRAFT RESPONSE INFORMATION

PRESENTED AT THE JULY 10 AND 11, 1995

WESTINGHOUSE/NRC AP600 MEETING

Attachment 2

Chapter 15 Deliverables

June 1995

Preliminary marked up sections of SSAR chapter 15, revision 4, covering the transient analyses of non-LOCA, steam generator tube rupture and large-break LOCA accidents:

15.0	Accident Analyses
15.1	Increase in Heat Removal from the Primary System
15.2	Decrease in Heat Removal by the Secondary System
15.3	Decrease in Reactor Coolant System Flow Rate
15.4	Reactivity and Power Distribution Anomalies
15.5	Increase in Reactor Coolant Inventory
15.6	Decrease in Reactor Coolant Inventory
Appendix 15A	Evaluation Models and Parameters for the Analysis of Radiological Consequences of Accidents
Appendix 15B	LOFTRAN Code Modification and Verification
Appendix 15C	AP600 WCOBRA/TRAC Vessel and Loop Models
Appendix 15E	Description of the WCOBTRA/TRAC Noding for the AP600 Long Term Cooling Analysis

Chapter 15 Deliverables

July 1995

Preliminary marked up sections of SSAR chapter 15, revision 5, covering the transient analyses of small-break LOCA accidents:

15.6	**Decrease in Reactor Coolant Inventory (parts)**
Appendix 15D	**Description of the NOTRUMP Noding for the AP600 Small Break LOCA Analysis**

Chapter 15 Deliverables

Currently in preparation

With the exception of Appendix 15A, sections relating to dose assessment have not yet been submitted.

15.1.5.4
15.3.3.3
15.4.8.3
15.6.2
15.6.3.3
15.6.5.3.3
15.7

Chapter 15 Overview

Incorporation of Reactor Systems Branch Open Items:

NRC Item #	Database Record #	SSAR Section # or Other Deliverable	Date of Deliverable
1.d	2223	15.0.1, 15.3.2	June 1995
1.f	2225	15.6.5.5.0	July 1995
1.h	2227	15.6.5.4C	July 1995
6.a.1	2242	15.6.3.1-2	June 1995
6.a.2	2243	15.6.3.3	Currently in preparation
6.a.4	2245	15.6.3.1-2	June 1995
6.a.6	2247	15.6.3.1-2	June 1995
7.c	2252	Proposed Response	July 10-11, 1995 (prelim)
7.d	2253	Proposed Response	July 10-11, 1995 (prelim)
8.c	2256	15.6.5.4C	July 1995
8.e	2258	15.6.5.4C	July 1995

Chapter 15 Overview

Incorporation of Reactor Systems Branch Open Items (cont):

NRC Item #	Database Record #	SSAR Section # or Other Deliverable	Date of Deliverable
14.b	2269	15.5.1-2	June 1995
		ERGs	Currently in preparation
21.a	2283	Rev. 1 RAI 440.106 Response	July 10-11, 1995 (prelim)
19	2281	SPES-2 Test Analysis Report*	
		NOTRUMP Preliminary Validation Report for SPES-2*	
		OSU Test Analysis Report*	
		NOTRUMP Preliminary Validation Report for OSU*	

* Deliverables scheduled for July 1995

NRC Item #	Database Record #	Description
7.c	2252	DAS Low SG level setpt/signal delay times used for ATWS
7.d	2253	" "

- ATWS analyses performed on best estimate basis.

- Conservatively low DAS low SG level wide range setpoint assumed.

- DAS Low SG Level signal initiates:

    1. Rx trip
    2. Turbine Trip
    3. PRHR system actuation

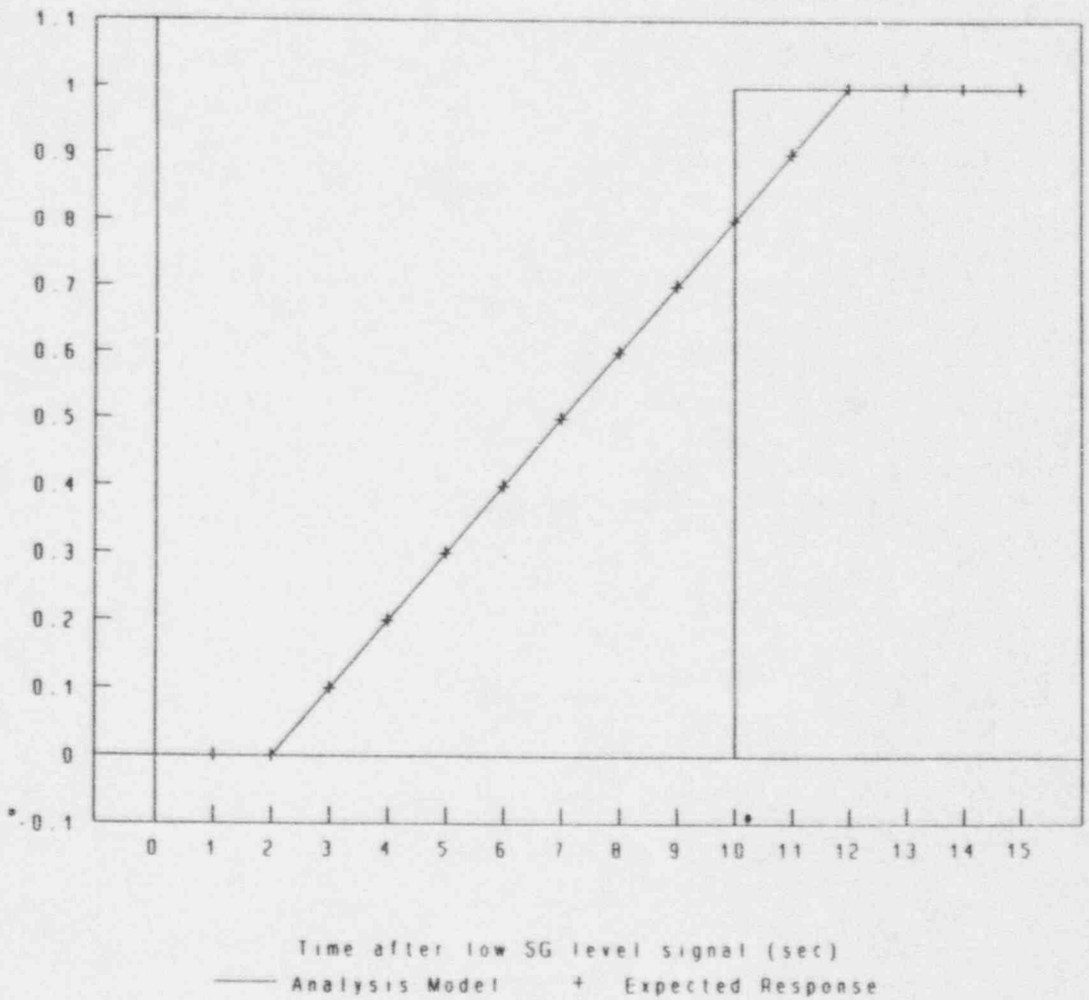
NRC Item #	Database Record #	Description
7.c	2252	DAS Low SG level setpt/signal delay times used for ATWS
7.d	2253	" "

1. Rx trip
   - Not credited

2. Turbine Trip
   - Analysis very sensitive to time of turbine trip
   - Conservatively long delay time assumed (4 seconds)

3. PRHR system actuation
   - Step function 10 seconds after setpoint reached assumed
   - Analysis underpredicts integrated PRHR flow
   - See Figure 1

Figure 1
PRHR Valve Opening Position
Analysis Model vs. Expected Response



NRC Item #	Database Record #	Description
21.a	2283	CMT valve opening delay times assumed in Ch. 15

Large Break LOCA:

Valve assumed to open linearly over 10 seconds
Consistent with best estimate methodology

Small Break LOCA:

Step function after maximum delay (20 seconds)
Minimizes CMT contribution to RCS make-up inventory

Non-LOCA:

Minimum delay 0 seconds
Maximum delay 20 seconds
Min/Max assumed depending on direction of conservatism

Response to AP600 Discussion Items 7.c and 7.d (Record Nos. 2252 and 2253)

Question

7.c It is said (item 8) that since a conservative low DAS wide range SG level analysis setpoint is assumed, no additional delay on this signal is assumed. How do you determine that overall result is still conservative as the DAS setpoint conservatism may not be large enough to compensate for omission of signal delay time? What are the actual DAS actuation setpoint and signal delay time?

7.d The PRHR HX valves are assumed to be fully open 10 seconds after the low wide SG level is reached. Does 10 seconds cover the signal delay and valve opening delay times.

Response

A conservatively low DAS wide range SG level setpoint was assumed in the analysis performed in response to RAI 440.26 (March 4, 1994). Upon receipt of the low SG level signal, a 4 second delay was assumed until turbine trip, and a 10 second delay was assumed until one of the two parallel PRHR valves was fully opened.

The LONF ATWS peak pressure is very sensitive to the time of turbine trip. The 4 second turbine trip delay includes signal processing time and is considered a conservatively long delay time. Thus, the conservatively low SG level setpoint and conservatively long turbine trip delay time result in a conservatively high peak pressure for the LONF ATWS transient analyzed. The LONF ATWS peak pressure is far less sensitive to the time the PRHR valve opens compared to the time of turbine trip. However, this will be discussed in more detail below.

The PRHR valve opening position assumed in the ATWS analysis is compared to the expected PRHR valve opening position in Figure 1 below. In Figure 1, $t=0$ is considered to be the time at which the low wide range SG level DAS setpoint is reached. In the ATWS analysis, the PRHR valve was assumed to fully open according to a step function 10 seconds after the low wide range SG level DAS setpoint was reached. The expected response would include a signal processing delay before the PRHR valve received the signal to open. The maximum signal processing delay is expected to be about 2 seconds. Upon receiving the actuation signal, the PRHR valve is expected to open linearly over 10 seconds.

As shown in Figure 1, the PRHR valve opening position was largely underpredicted from 2 to 10 seconds after the low wide range SG level DAS analysis setpoint was reached. From 10 to 12 seconds after this signal, the PRHR valve opening position was slightly overpredicted. Overall, the integrated response of the PRHR valve was clearly underpredicted in the ATWS analysis.

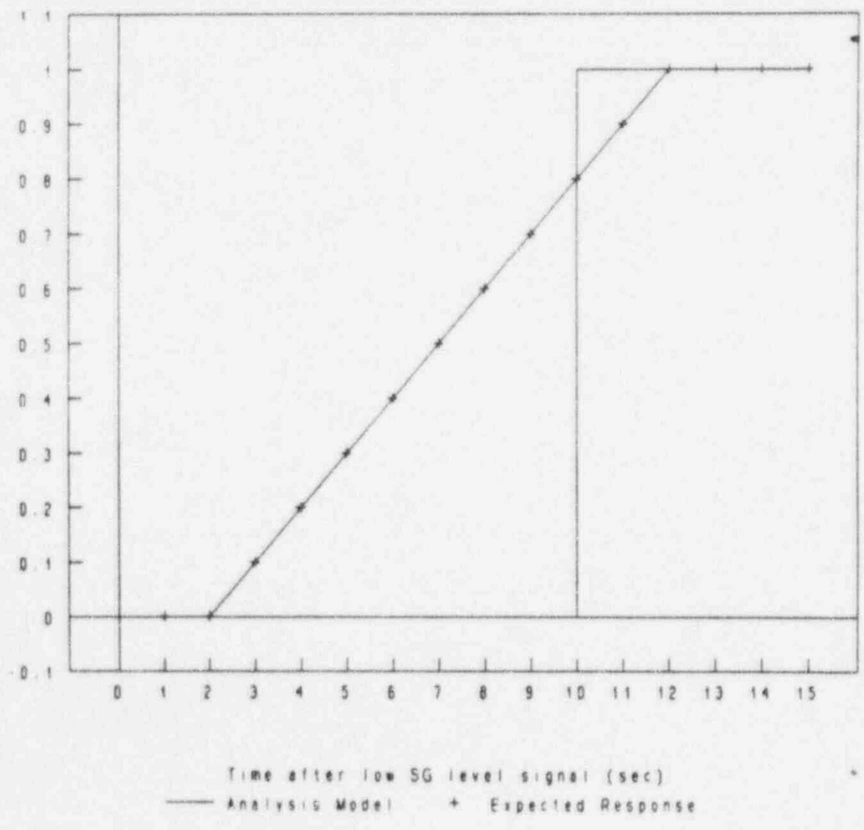
Response to AP600 Discussion Items 7.c and 7.d (Record Nos. 2252 and 2253)

There are two factors which make the extent to which the PRHR flow was underpredicted even greater.

1. The flow resistance of the valve decreases as it opens. However, the valve resistance is only a small fraction of the total PRHR system flow resistance. Flow through the PRHR system will approach full flow soon after the valve begins to open, then only marginally increase until the valve is full open at 10 seconds. As a result, the curve of the expected PRHR flow vs. time during valve opening approaches full flow asymptotically. Thus, the extent to which the PRHR flow was underpredicted in the ATWS analysis is even greater than the extent to which the PRHR valve position was underpredicted.

2. A conservatively low wide range SG level DAS setpoint was chosen in the ATWS analysis. Thus, the expected time of the DAS signal is earlier than that predicted in the ATWS analysis

Figure 1
PRHR Valve Opening Position
Analysis Model vs Expected Response



Question 440.106

Section 6.3.2.5.3 of the SSAR states that for those valves that reposition to initiate safety-related system functions, the valve repositioning times are less than the times assumed in the accident analyses. It further states that it is acceptable for the CMT injection to be delayed several minutes due to high initial steam condensation rate.

a. The proposed Technical Specifications do not provide a definitive requirement regarding the valve repositioning time. For example, Surveillance Requirement 3.5.2.4 specifies verification of the CMT inlet and outlet isolation valves to be operable every 92 days without defining the valve repositioning times or what constitute operability of the valves. Describe how the valve delay times are controlled in the TSs and how surveillance is made to ensure the actual delay times are shorter than assumed in the safety analysis?

b. Describe how the CMT injection delay time is accounted for in the safety analysis and what verification is performed to ensure that this is a conservative value.

Response:

Upon review of Rev. 0 of the AP600 SSAR, Question 440.106 was generated by NRC. The Rev. 0 Westinghouse response to Question 440.106 was subsequently provided based on the Technical Specifications and analyses supporting Rev. 0 of the SSAR. Based on Rev. 0 of the SSAR, the Rev. 0 response to Question 440.106 still stands with one exception: In non-LOCA analyses supporting Rev. 0 of the SSAR, a long delay of 20 seconds was used in cases where a maximum delay time was conservative, as opposed to the 10 second delay stated.

Since the issuance of the Rev. 0 response to Question 440.106, several design changes were made and the Chapter 15 events were reanalyzed in support of the SSAR, Rev. 4. As a result of discussions with NRC since the submittal of Rev. 0 of the SSAR, there are also some differences between the Rev. 0 and Rev. 4 SSAR analyses with respect to CMT injection delay times assumed. This Rev. 1 response to Question 440.106 addresses part b of Question 440.106 based on the analyses which support SSAR, Rev. 4.

b. In the AP600 SSAR Chapter 15 safety analyses, three sources of delay in the injection of CMT inventory are considered:

- Electronic signal delay; time from plant parameter exceeding setpoint to when valve actuation signal is generated.
- Valve opening delay; time from when valve receives actuation signal to when valve completes its operation. Minimum, maximum and nominal stroke times are defined. These times are used as appropriate in the different safety analysis.
- CMT steam condensing related delays; time from when steam enters the CMT (after the cold voids) until the CMT achieves full injection flow. This delay only occurs when the top of the CMT is not heated by water recirculation prior to steam entering the CMT from the cold legs. Note that during this delay time the CMTs provide injection at a reduced rate.

The electronic signal delay is taken to be 1.2 seconds. This delay applies to LOCAs where a CMT actuation signal is generated by a containment high pressure or a pressurizer low pressure signal. It also applies to non-LOCAs where the CMT actuation is generated by a pressurizer low pressure, a cold leg low temperature or a SG low pressure signal.

The CMT discharge valve is modeled in the large break LOCA SSAR analysis to open linearly over a ten second time span, which is the nominal opening time of this valve. This assumption models CMT flow delivery in a best estimate manner consistent with the overall methodology applied to the large break LOCA analysis.

For the small break LOCA SSAR analyses, the CMT valve opening delay is modeled assuming a step function after the signal response and valve stroke delay. The maximum delay (20 seconds) for valve stroke time is used to minimize the CMT contribution to RCS make-up inventory in the initial stage of the LOCA transient, when the minimum mass inventory condition for the limiting Section 15.6.5.4 B small break LOCA occurs.

The CMT valve opening delay is modeled in non-LOCA analysis assuming a step function after the signal response and valve stroke delay. A short delay (0 seconds) or a long delay (20 seconds) for valve stroke time is used depending upon the conservative direction for the event being analyzed. For example, the steam line break event used a conservatively long delay to minimize the amount of boration contributed by the CMT. Conversely, analysis of the spurious "S" signal event used a conservatively short delay time.

The CMT steam condensing delay is accounted for in the thermal hydraulic models of the CMT. The CMT models account for the possibility of steam condensing delay mechanistically. They model the heating of the top portion of the CMT water before a steam bubble can form and the CMT can begin to drain. In many events there will be no steam condensing delay either because no steam enters the CMT (as in non-LOCA events) or because the CMTs initially recirculate hot water from the cold legs before the cold legs void and steam enters the CMTs (as in smaller LOCAs). There are some events (such as larger LOCAs) where the cold legs void quickly, and the water in the top of the CMTs is cold when steam flows up from the voided cold legs. In this situation, the steam entering the CMT condenses in the liquid until a bubble forms at the top of the CMT. During this heatup period the CMT injection is reduced relative to its full capability. These CMT models have been verified against the CMT test results as documented in References 1 and 2, and these mechanistic models were used in the LOCA analyses to support the SSAR, Rev. 4..

SSAR Revision: NONE

<u>References</u>

440.106-1 "AP600 NOTRUMP Core Makeup Tank Preliminary Validation Report", MT01-GSR-001, October 28, 1994.

440.106-2 "WCOBRA/TRAC Core Makeup Tank Preliminary Validation Report", MT01-GSR-003, February 28, 1995.

AP600 CVS Safety Classification Reduction

Michael M. Corletti
AP600 Systems Engineering
July 11, 1995

Chemical & Volume Control System Functions

AP600

- **Provide RCS purification**
  - High pressure purification loop inside containment
- **Provide RCS inventory control**
  - Makeup pumps operate automatically on pressurizer level
- **Maintain RCS boron concentration**
  - Makeup pumps provide blended makeup from BAT and DWS at desired concentration
- **Provide hydrogen addition for RCS chemistry control**
  - High pressure injection line used for batch addition of hydrogen

CVS Design Change

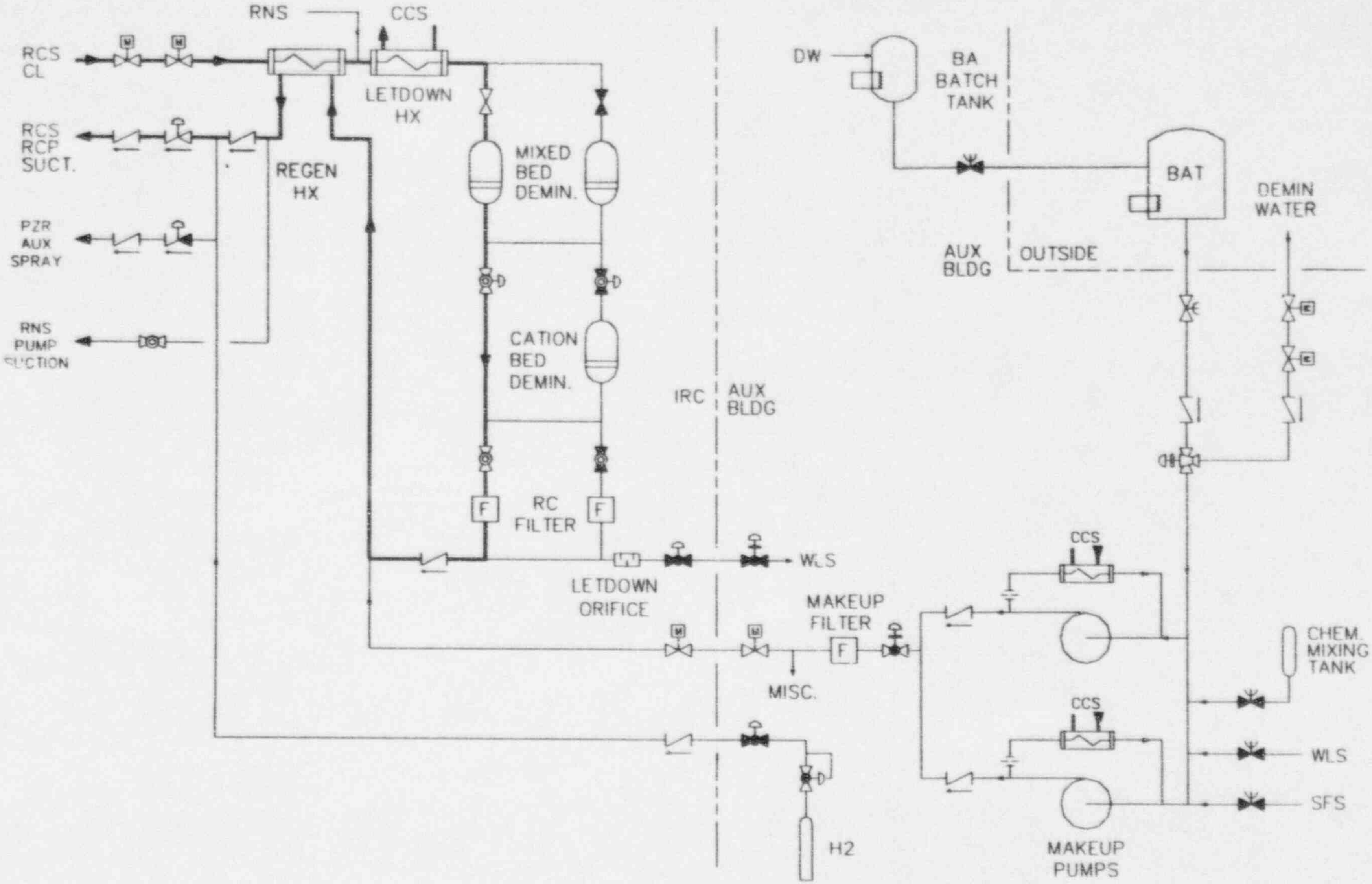
- **Reclassify portions of CVS inside containment**

- **AP600 Nuclear Safety Classification and Seismic Requirement Methodology Document (GW G1 010)**
  - Portions of CVS inside containmemt meet criteria for Class D systems
  - SSAR Section 3.2

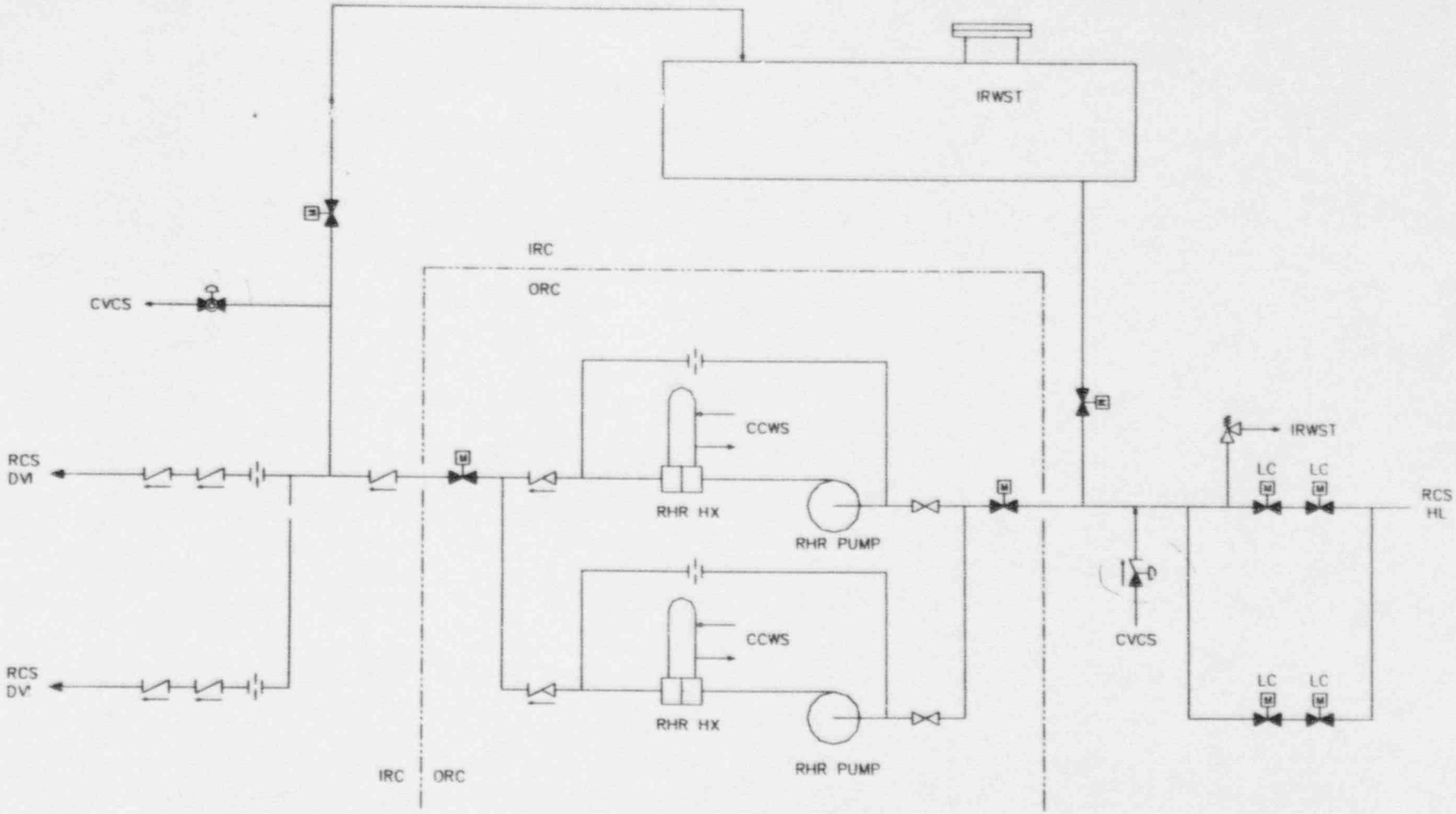
- **Nonsafety-related portions of CVS are isolated during an accident**
  - Purification stop valves close on an 'S' signal or low pressurizer level
  - Letdown containment isolation valves
  - Makeup line containment isolation valves

- **Incorporation of remotely operated valves to isolate CVS from RNS**
  - For shutdown alignment only
  - Containment isolation
  - Human factors

Chemical and Volume Control System



Normal RHR System



AP600 USE OF NONSAFETY EQUIPMENT IN DBA

T. L. SCHULZ
AP600 SYSTEMS ENGINEERING
JULY 11, 1995

AP600 USE OF NONSAFETY EQUIP

AP600

- **Current Plant Approach**
  - Use nonsafety-related equipment to mitigate DBAs
  - NRC allows this for steam / feedwater isolation

- **AP600 Approach**
  - Reduce use of nonsafety equipment
    - Balance safety benefits with adverse effects of adding equipment
      - Increased plant unavailability / trips
      - Congested plant arrangement
        - Reduced maintainability / reliability
        - Increased ORE
  - Where nonsafety-related equipment used
    - Provide partial safety-related capability
      - Provide PMS actuation
      - Use appropriate inservice testing, Tech Spec, ITAAC
    - Require additional failure tolerance

USE NONSAFETY EQUIPMENT

AP600

	Current Plants	AP600
1. Steam Line Isol	- MSIV (S)	- MSIV (S)
	- Turb Stop valve (SN)	- Turb Stop valve (SN)
	- Branch Isol valve (SN)	- Branch Isol valve (SN)
2. Main Feed Isol	- MFIV (S)	- MFIV (S)
	- MFCV (SN)	- MFCV (S)
	- MFW pump trip (SN)	- MFW pump trip (SN)
3. Pzr Heater Trip	- one breaker (N)	- three breakers (SN)
4. RCP Trip	- one breaker (N)	- one breaker (N)
		- two breakers (S)
5. Pzr Vent	- two Pzr PORV (N)	- two ADS stage 1 val (S)
6. SG PORV	- redundant SG PORV (N)	(not required for DBAs)

(S) - Safety, (SN) - Partial Safety, (N) - Nonsafety

AP600 USE NONSAFETY EQUIP

- **AP600 Use of Nonsafety-Related Equipment vs Event**

Cond. - Event	Turb Stop Valve Trip	Branch Line Val	MFW Pump Trip	Pzr Heater Trip
II - RCS Mass Addition	-	-	-	yes
II - Loss MFW	-	-	-	yes
II - Loss Offsite Power	-	-	-	-
II - SG Depressurize	yes	yes	-	-
II - Excessive MFW	-	-	yes	-
III - Small LOCA	-	-	-	-
III - Loss RCS Flow	-	-	-	-
IV - Large SL Break	yes	yes	-	-
IV - SGTR	yes	yes	-	yes
IV - Large LOCA	-	-	-	-
IV - Control Rod Ejection	yes	yes	-	-

Pressurizer Overfill

Prepared by Tim Rowell

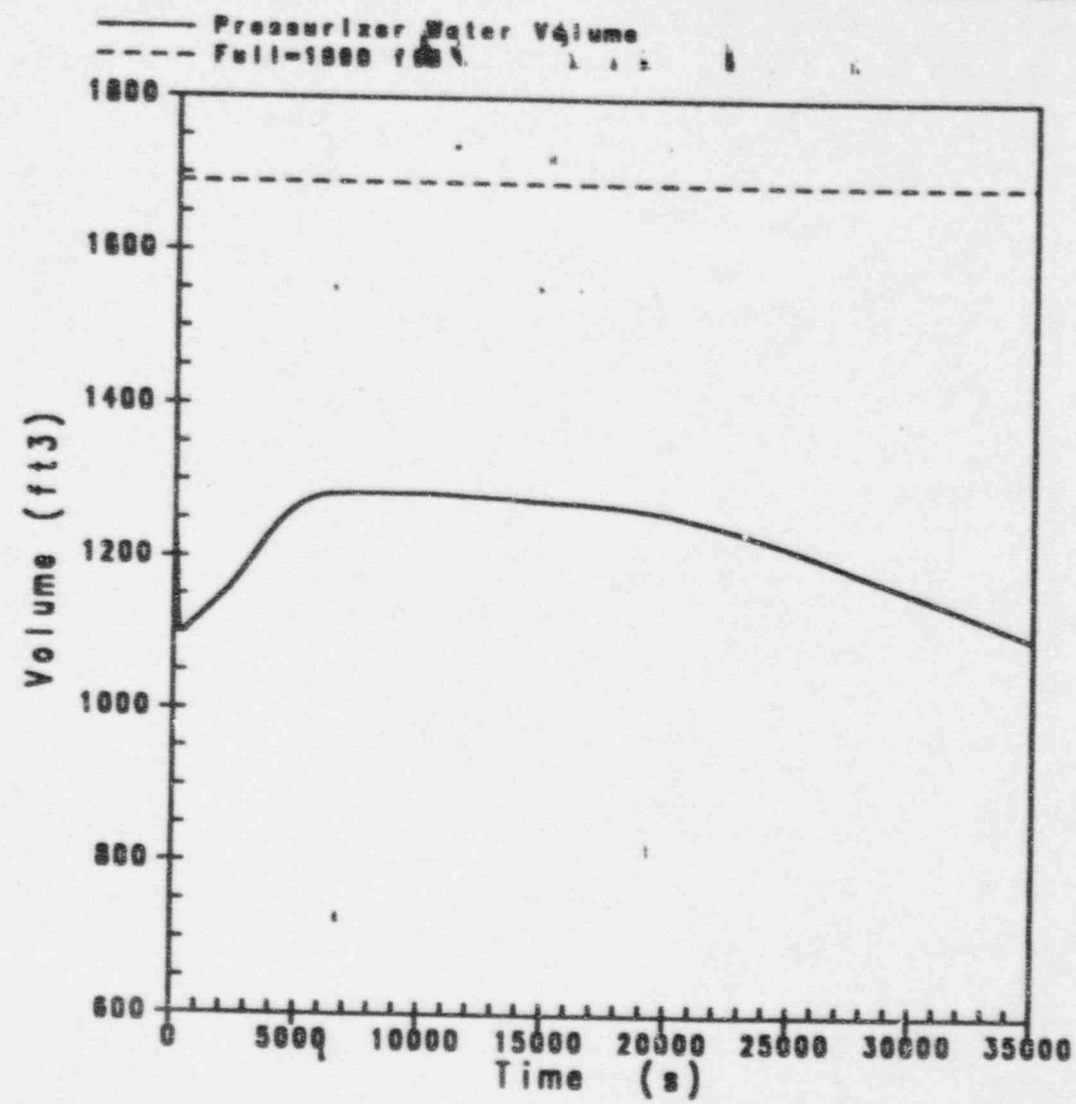
Design Changes

1. Larger pressurizer (1300 $ft^3 \Rightarrow$ 1600 ft^3)
2. Safety-related signal to isolate CVS pumps on "S" signal.

Analysis Results

(SSAR, Rev. 4 Mark-up submitted June, 1995)

- Spurious "S" signal event has substantial overfill margin.
- CVS malfunction event is more limiting.

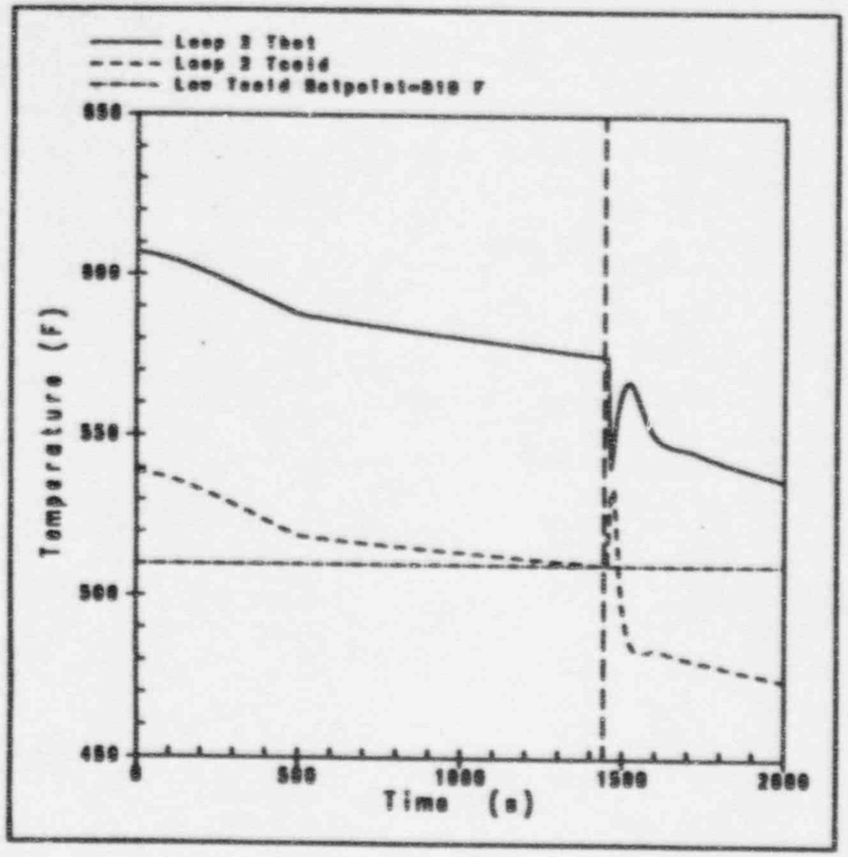


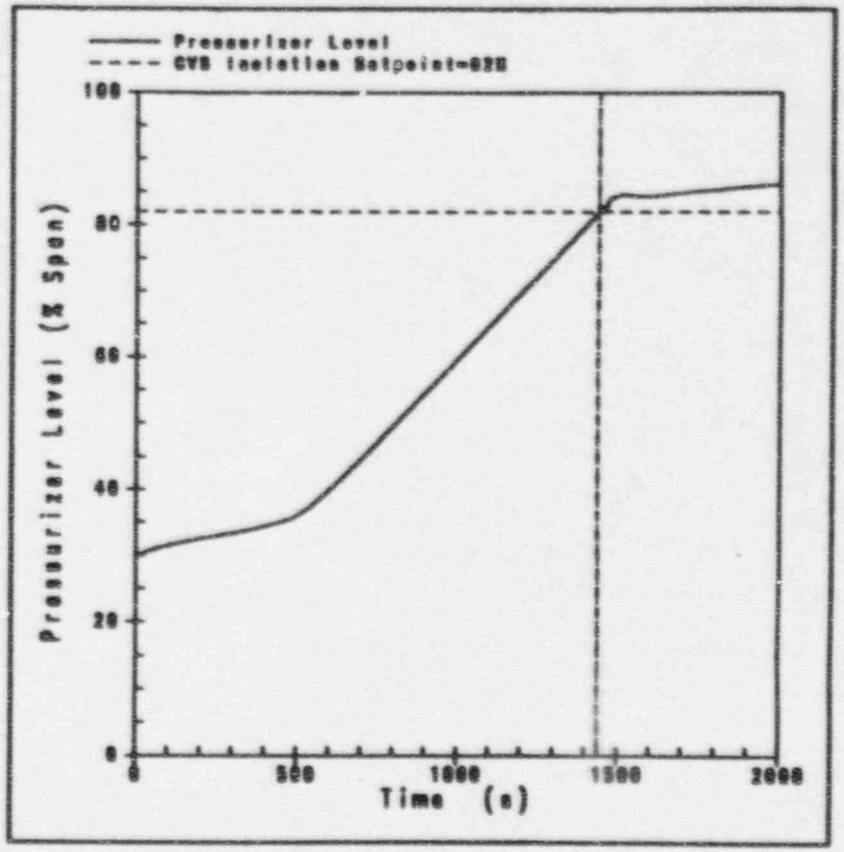
Pressurizer Water Volume
Full-1800 ft3
Volume (ft3)
1800
1600
1400
1200
1000
800
600
0
5000
10000
15000
20000
25000
30000
35000
Time (s)

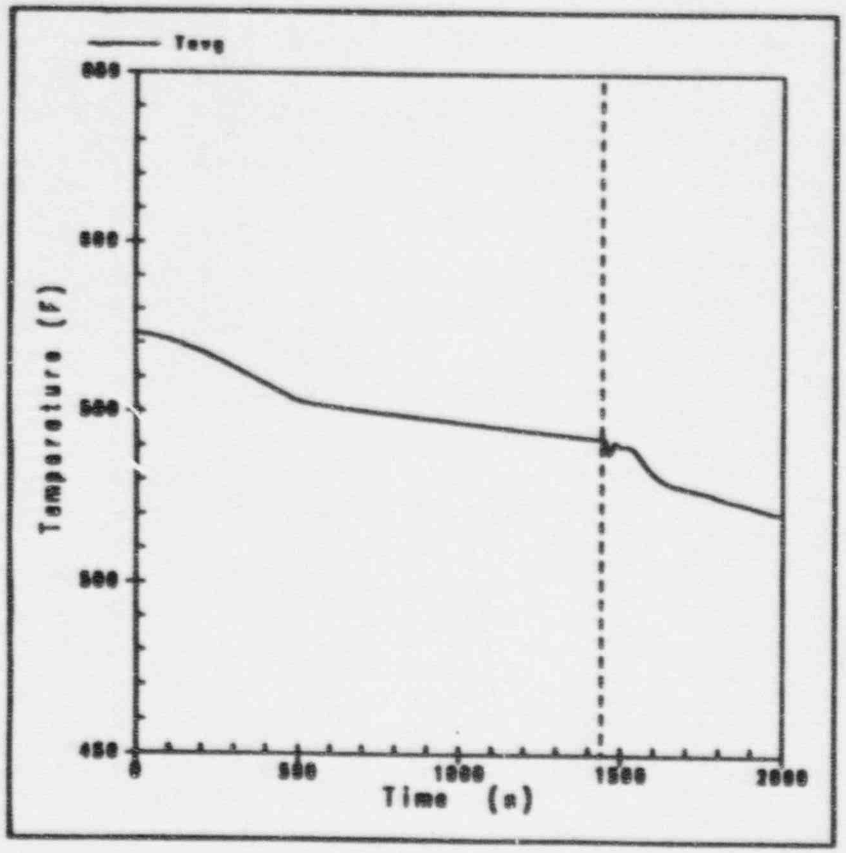
CVS Malfunction

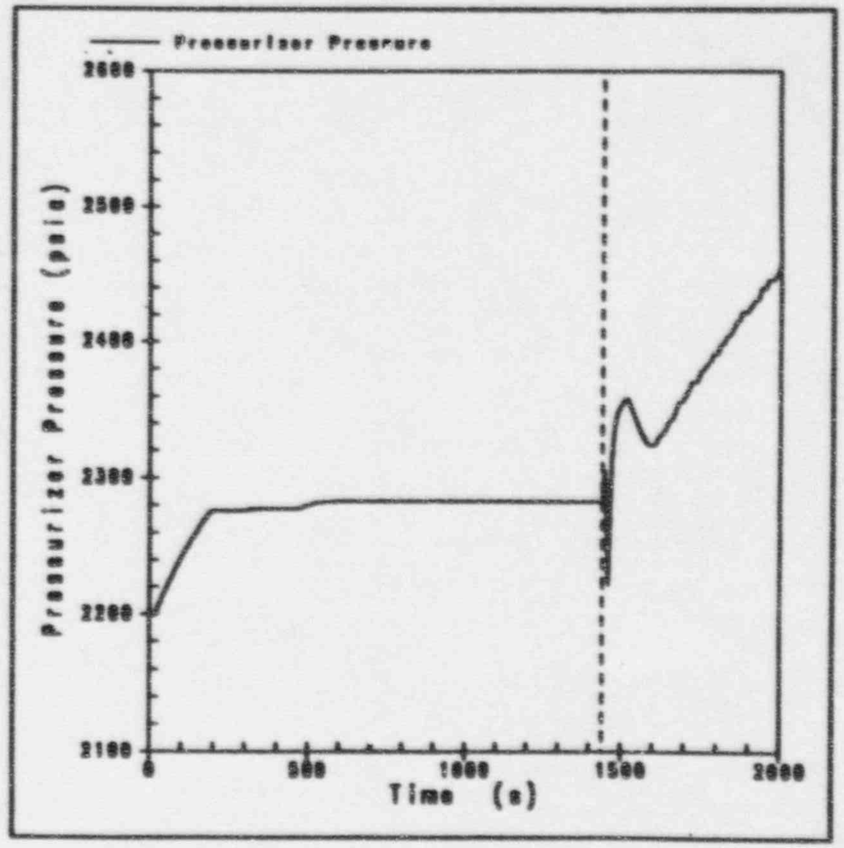
Conditions were chosen such that the Low Tcold "S" signal is reached at the same time the safety-related high pressurizer level CVS isolation setpoint is reached.

- **Minimum reactivity feedback, maximum boron worth.**
- **Minimum initial pressurizer level.**
- **Pressurizer sprays operable.**
- **CVS boron concentration ~47 ppm higher than RCS.**


Loop 2 Thot
Loop 2 Tcold
Low Tcold Setpoint=510 F
Temperature (F)
Time (s)
650
600
550
500
450
0
500
1000
1500
2000


Pressurizer Level
CVS Isolation Setpoint=82%
Pressurizer Level (% Span)
Time (s)
100
80
60
40
20
0
500
1000
1500
2000


Tavg
Temperature (F)
650
600
550
500
450
0
500
1000
1500
2000
Time (s)


Pressurizer Pressure
Pressurizer Pressure (psia)
2600
2500
2400
2300
2200
2100
0
500
1000
1500
2000
Time (s)

Assessment

Setpoints which affect these key factors:

- **Low T-cold setpoint**

  Analysis setpoint = 514°F - 4°F (unc) = <u>510°F</u>

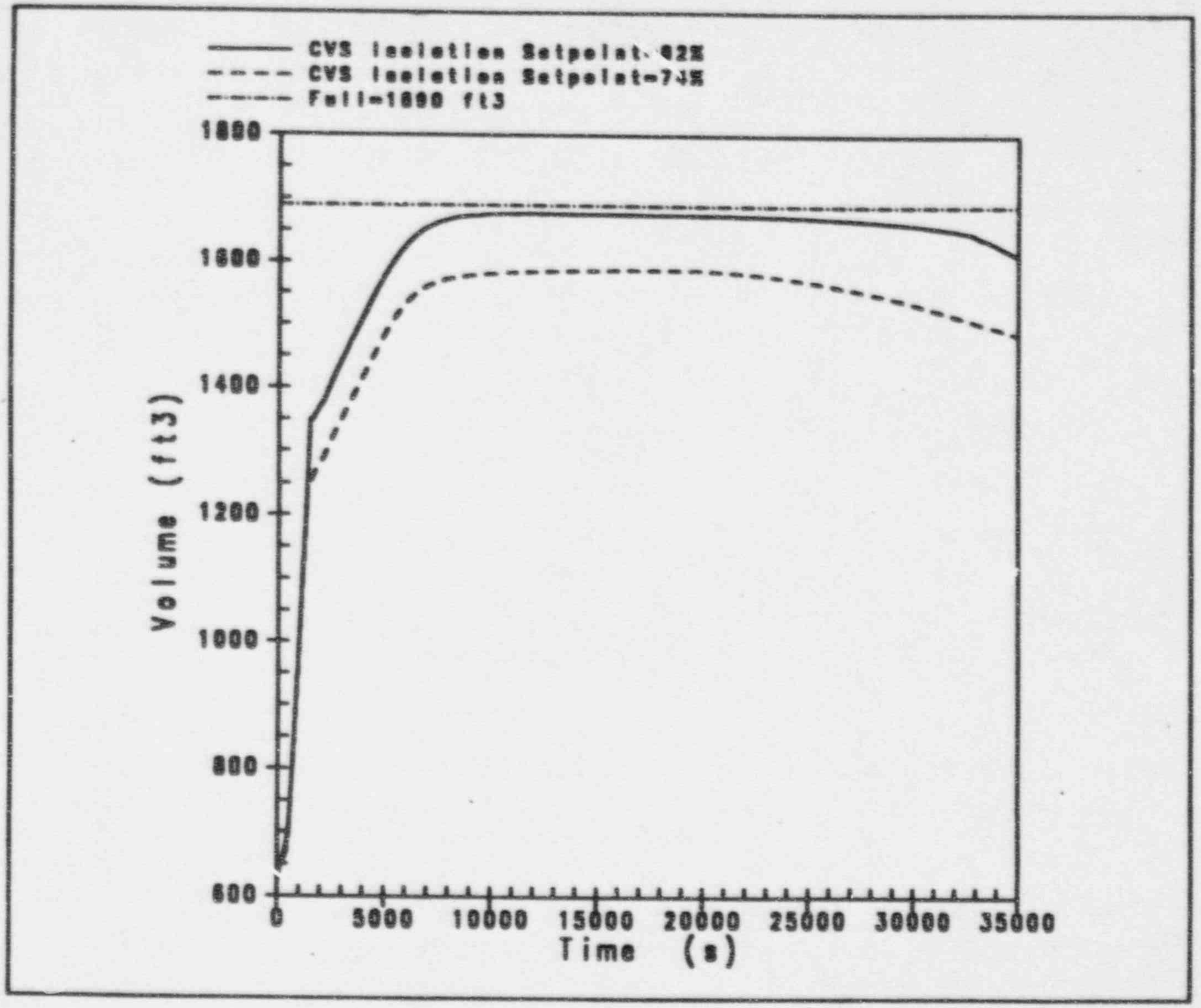
- **High pressurizer level CVS isolation setpoint**

  Analysis setpoint = 75% + 7% (unc) = <u>82% span</u>

Design Change

Lower high pressurizer level CVS isolation setpoint to 67%.

Analysis setpoint = 67% + 7% (unc) = 74% span


CVS Isolation Setpoint 92%
CVS Isolation Setpoint=74%
Full=1690 ft3
Volume (ft3)
1800
1600
1400
1200
1000
800
600
0
5000
10000
15000
20000
25000
30000
35000
Time (s)

CVS Malfunction

Preliminary Cases:

Note significant core ΔT at time of Low T-cold "S" signal.
With lower ΔT, lower Tavg at time of "S" signal.
Also, sprays keep pressure < 2300 psia.

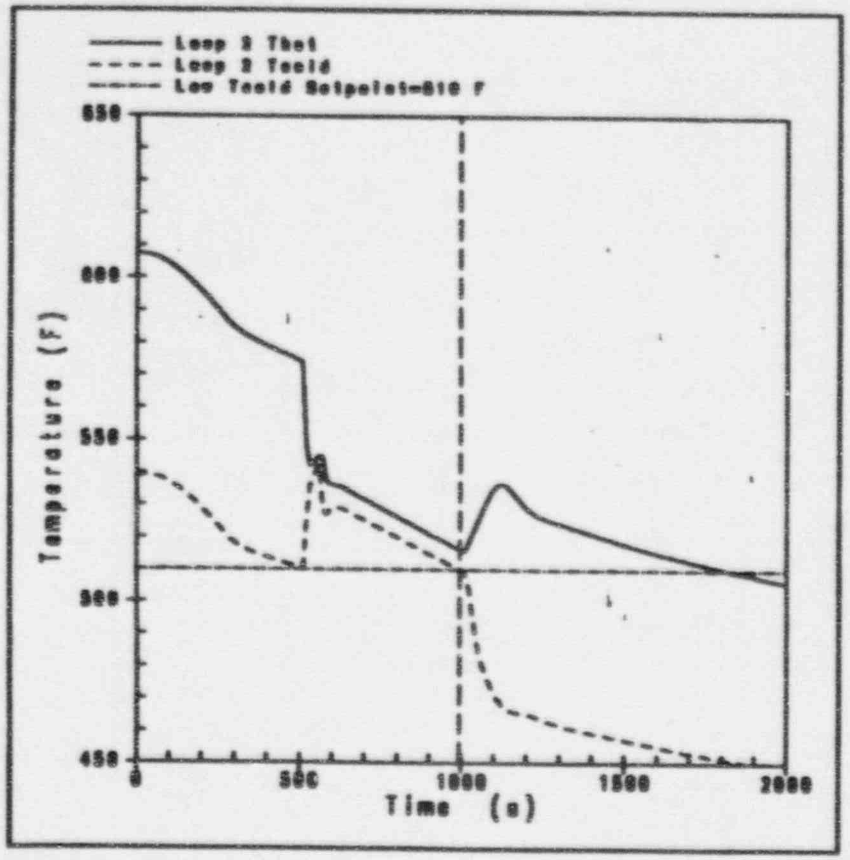
More Limiting Case:

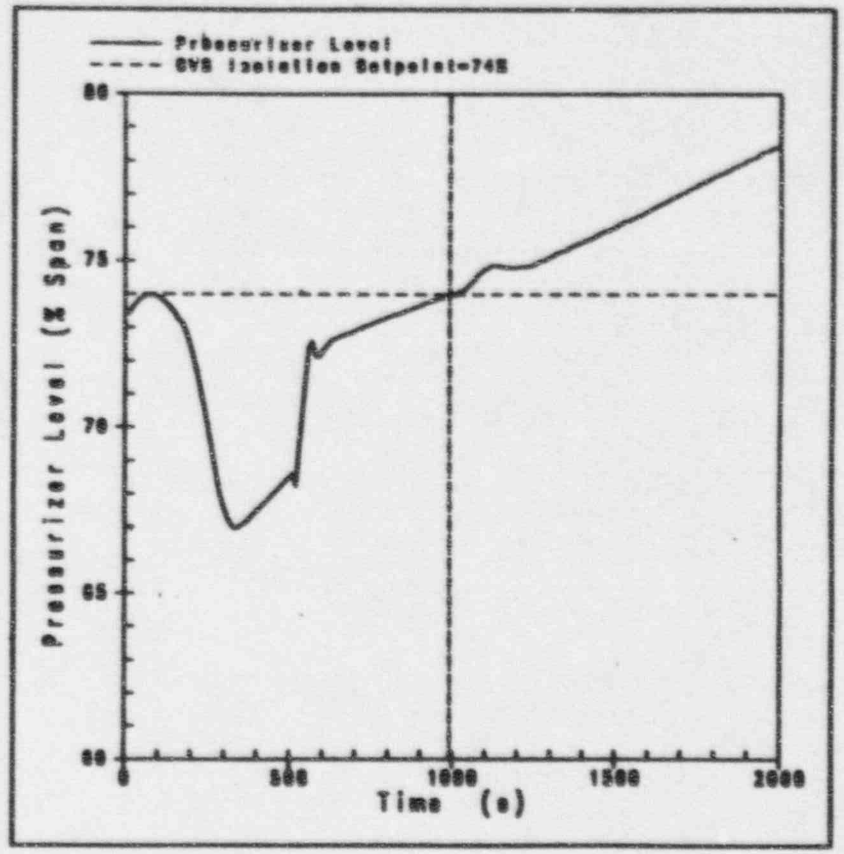
At time of "S" signal:
- Lower ΔT
- Lower Tavg
- Higher pressure

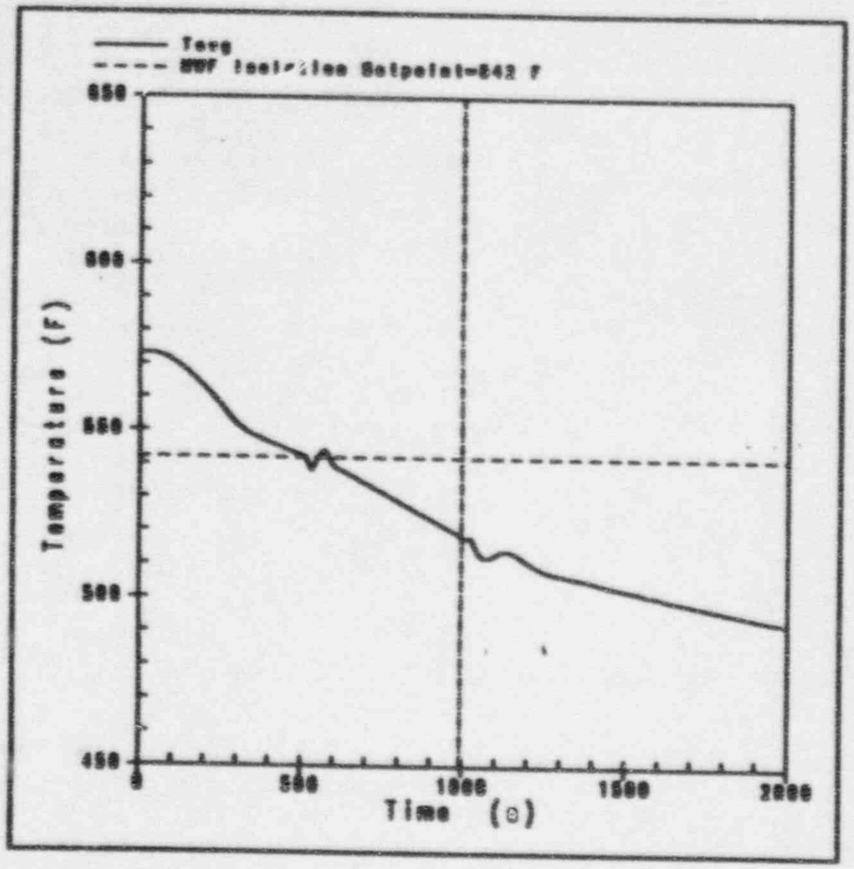
SSAR Analysis

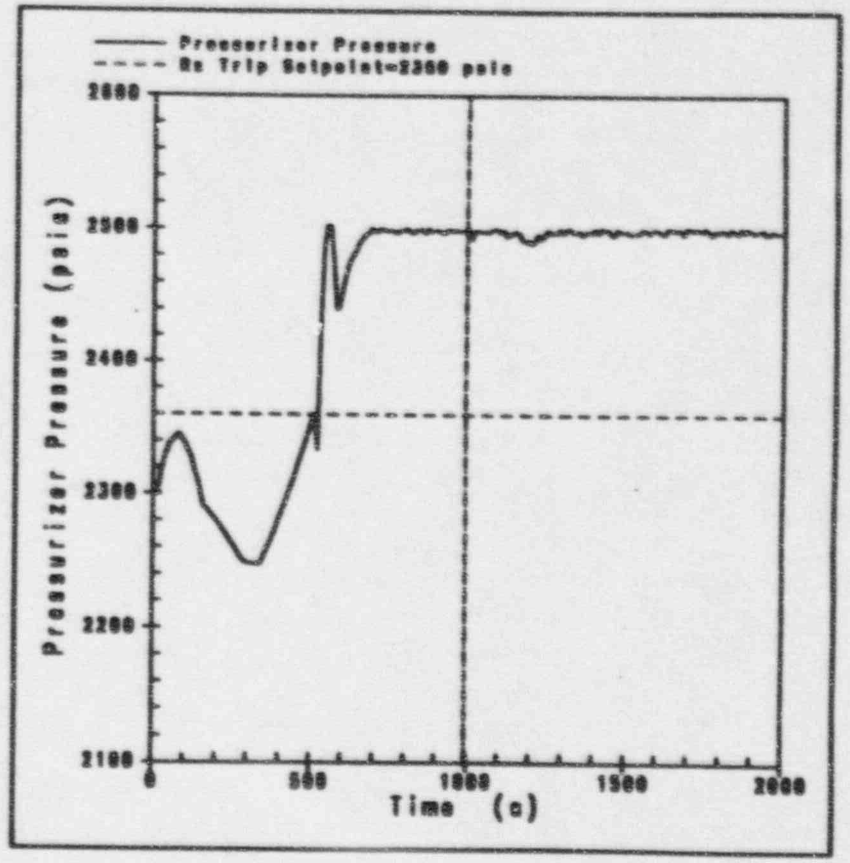
(SSAR, Rev. 4 Mark-up submitted June, 1995)

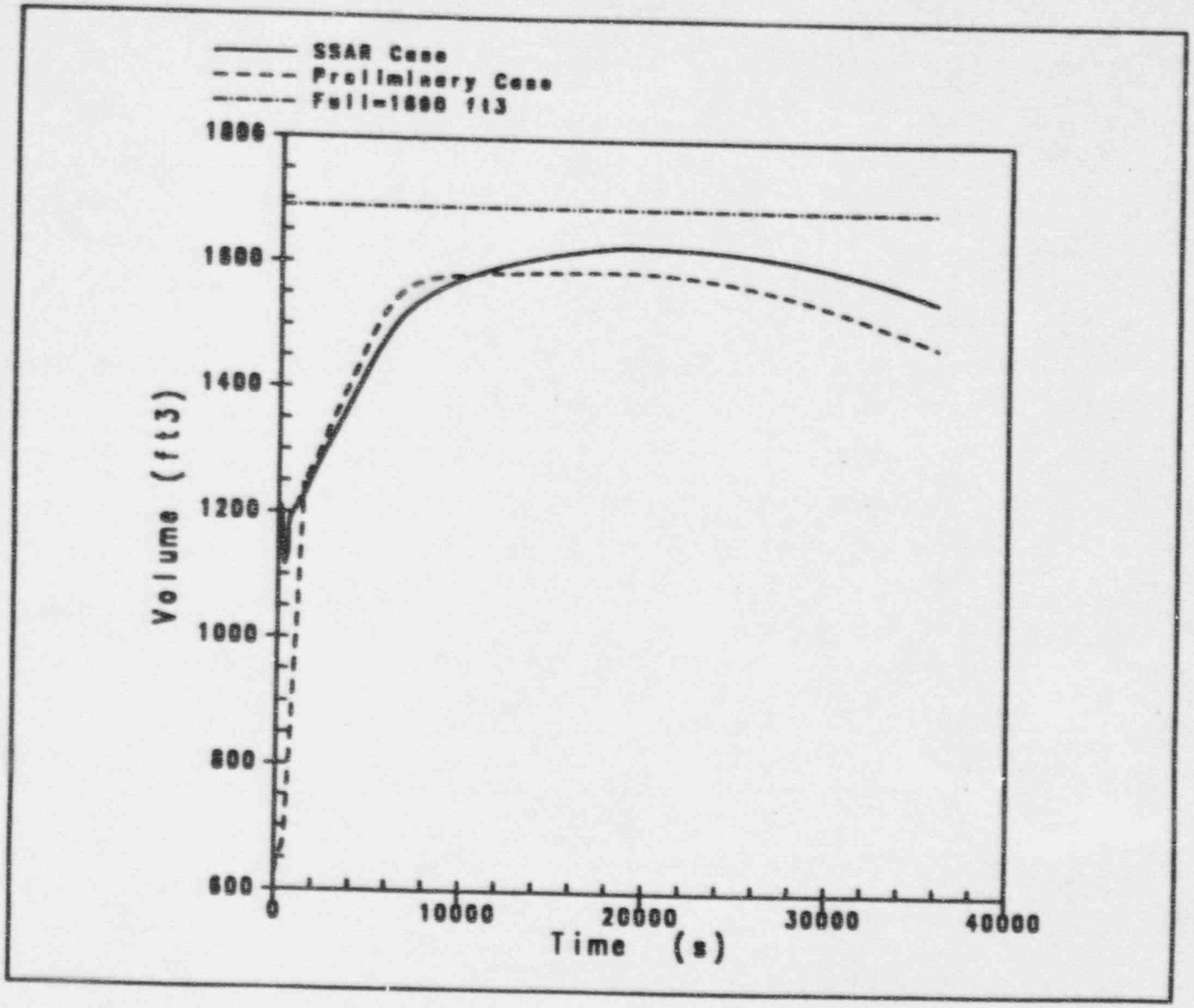
- Pressurizer sprays assumed to be inoperable.
- Rx trip on high pressurizer pressure.
- PRHR actuation on Low SG level coincident w/low SFW.
- CMT actuation and CVS isolation on Low T-cold "S".


Loop 2 Thot
Loop 2 Tcold
Low Tcold Setpoint=510 F
Temperature (F)
650
600
550
500
450
0
500
1000
1500
2000
Time (s)


Pressurizer Level
SVS Isolation Setpoint=74%
Pressurizer Level (% Span)
80
75
70
65
60
0
500
1000
1500
2000
Time (s)


Tavg
650
600
550
500
450
0
500
1000
1500
2000
Time (s)
Temperature (F)


Pressurizer Pressure
2600
2500
2400
2300
2200
2100
0
500
1000
1500
2000
Time (s)
Pressurizer Pressure (psia)


SSAR Case
Preliminary Case
Full-1690 ft3
1800
1600
1400
1200
1000
800
600
0
10000
20000
30000
40000
Volume (ft3)
Time (s)