50-213

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

October 23, 1996

LICENSEE: Connecticut Yankee Atomic Power Company

FACILITY: Haddam Neck Plant

SUBJECT: SUMMARY OF SEPTEMBER 4, 1996, MEETING REGARDING SERVICE WATER LOADS

On Wednesday, September 4, 1996, a meeting was held at NRC Headquarters, between Connecticut Yankee Atomic Power Company (CYAPCO/licensee) and the NRC staff. The purpose of the meeting was to discuss the licensee's evaluation that concluded that loads on the service water (SW) system would be unacceptable following a loss-of-coolant accident (LOCA) or main steam line break (MSLB) accident with a concurrent loss of normal power (LNP) event. Attachment 1 is a list of meeting participants.

The meeting was organized into three areas: (1) a technical discussion on the LOCA/MSLB accident with a concurrent LNP event and its impact on the Haddam Neck SW and containment air recirculation (CAR) systems, (2) a technical discussion on the LOCA/MSLB event (no LNP) and its impact on the Haddam Neck SW and CAR systems, and (3) possible modifications at Haddam Neck to resolve the concerns.

The licensee began the meeting with a general description of the SW system and the line which feeds the CAR system. This included approximate lengths and elevation changes of piping runs, pipe size, interactions with other systems, heat exchanger size, and valve locations. The licensee then described the LOCA/MSLB accident with a concurrent LNP event analysis as it pertained to the SW and CAR systems. During the postulated event, the fans in the CAR units transfer heat to the stagnant SW system and create a significant steam void in the SW piping and in the tubes of the containment fan coolers. Upon restarting the SW pumps using the emergency diesel generators, the licensee concluded that the renewed SW flow would collapse the steam void and create a water hammer that could potentially cause piping and structural limits to be exceeded.

The licensee then described the same scenario except with no LNP event. However, during this postulated event, since SW flow continues to the CAR system and the throttle valves in each SW line tend to suppress boiling, steam voids in the SW piping and in the tubes of the containment fan coolers would only exist for a short period of time. Therefore, the licensee concluded that the steam voids would collapse before any significant water hammer could occur. Attachment 2 contains the slides the licensee used to describe this scenario.

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Finally, the licensee described a potential modification that would prevent the water hammer in the SW piping downstream of the CAR cooling coils from occurring in the first scenario. The design modification would include an accumulator that would have enough stored water to continue the flow of water through the SW system until the SW pumps are restarted off the emergency diesel generators. Attachment 3 diagrams the potential modification the licensee described.

(Original Signed By)

Stephen Dembek, Project Manager
Northeast Utilities Project Directorate
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket No. 50-213

Attachments: 1. Attendance List
2. Slides used in presentation
3. Diagram of potential modification

cc w/atts: See next page

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JZwolinski	JTappert
PMcKee	ALevin
SDembek	JGavula
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EJordan (JKR)	KManoly
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Mark Reinhart	ASerkiz
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OFFICE	NUPD:PM		PD2-2:LA		NUPD:D					
NAME	SDembek		LBerry		PMcKee					
DATE	10/22/96		10/22/96		10/23/96					

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MEETING BETWEEN CYAPCO AND

NRC STAFF REGARDING SERVICE WATER LOADS

SEPTEMBER 4, 1996

Name	Office
James Andersen	NRC/NRR/PM
John Fair	NRC/NRR/EMEB
Mark Reinhart	NRC/NRR/PDIII-1
Beth Wetzel	NRC/NRR/PM
James Tatum	NRC/NRR/SPLB
Tad Marsh	NRC/NRR/SPLB
George Hubbard	NRC/NRR/SPLB
Laura Dudes	C/NRR/SPLB
Bill LeFave	NRR/SPLB
John Tappert	NRR/PECB
Alan Levin	RC/NRR/SRXB
James Gavula	NRC/RIII/DRS
Gary Hammer	NRC/NRR/EMEB
Kamal Manoly	NRC/NRR/EMEB
Tony D'Angelo	NRC/NRR/PIPB
Al Serkiz	NRC/RES/GSIB
Everett Perkins	CYAPCO
Paul Mason	CYAPCO
Paul Rothe	Creare Inc.
Bob Fraser	NSPS
James Shapaker	NRC/NRR/PGCB

Attachment 1

CAR Fan Two-Phase Flow

Dr. Paul H. Rothe

Attachment 2

Creare

Service Water Cools Containment

- Cold River Water
- Pumped Through Gas-Liquid Heat Exchanger (CAR Fan)
- Throttled for Flow Control
- Hot Water Returned to River

Available for:

- Loss of Coolant Accident (LOCA)
- with Loss of Normal Power (LNP)

Main Findings for CAR Fan Section

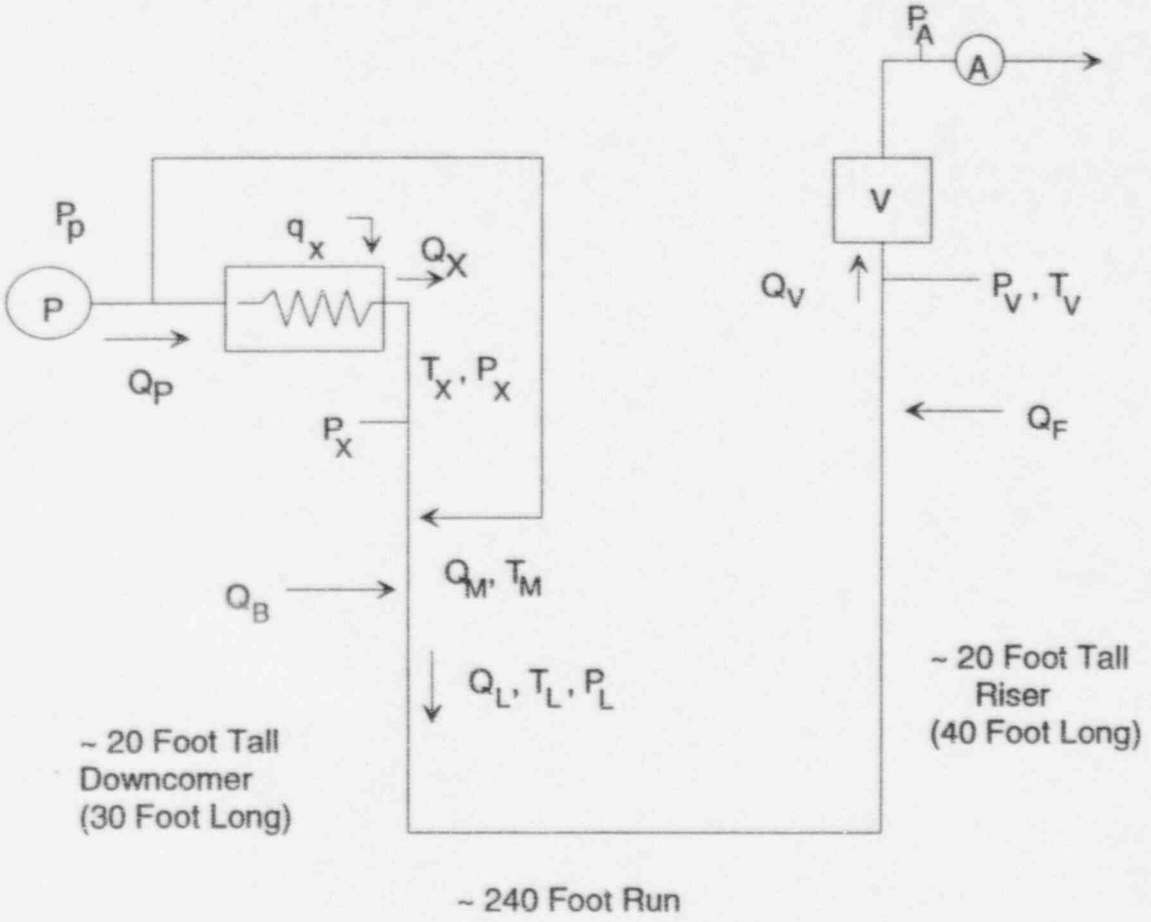
Overview -- 20 Hours

- Throttle Limits, Suppresses Boiling
- No Boiling in CAR Fan
- No Flashing at Throttle Inlet
- No Flashing in Line
- Flashing Discharge From Throttle

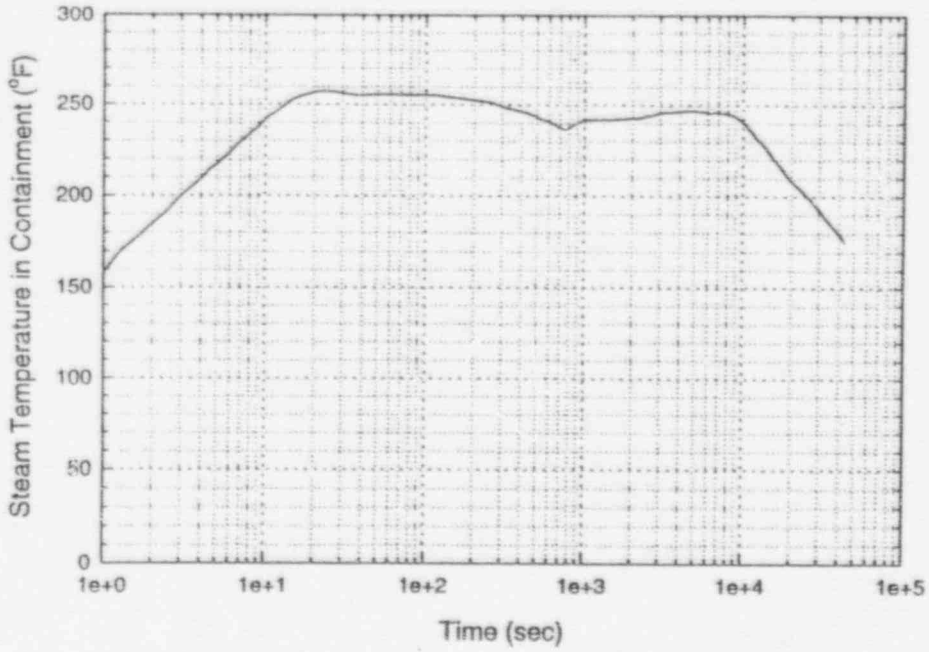
Microview-- 100 Seconds

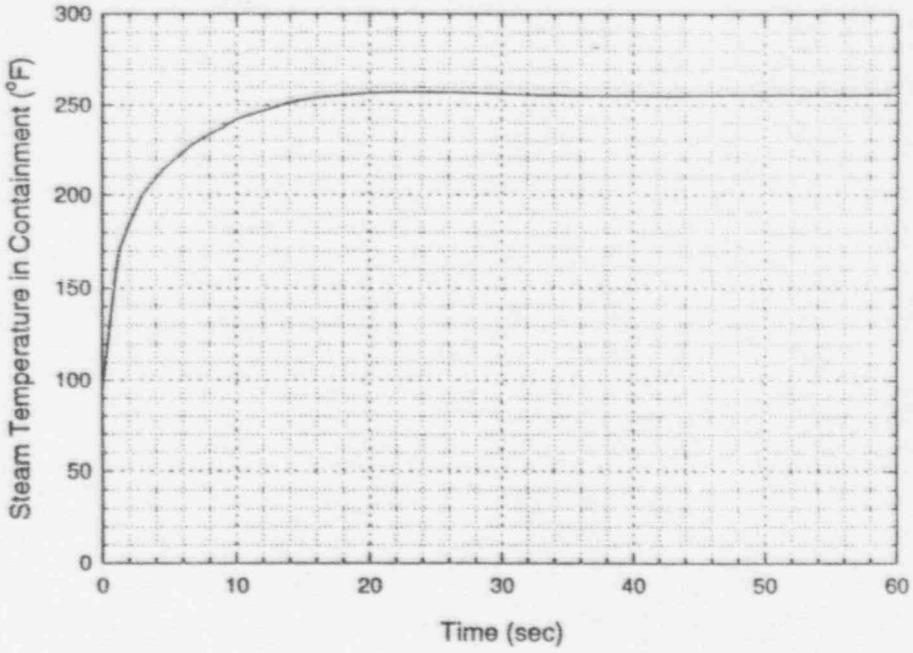
- LOCA - A Void Builds, Slowly Collapses
- LOCA/LNP - Same

Variables for Transient Analysis



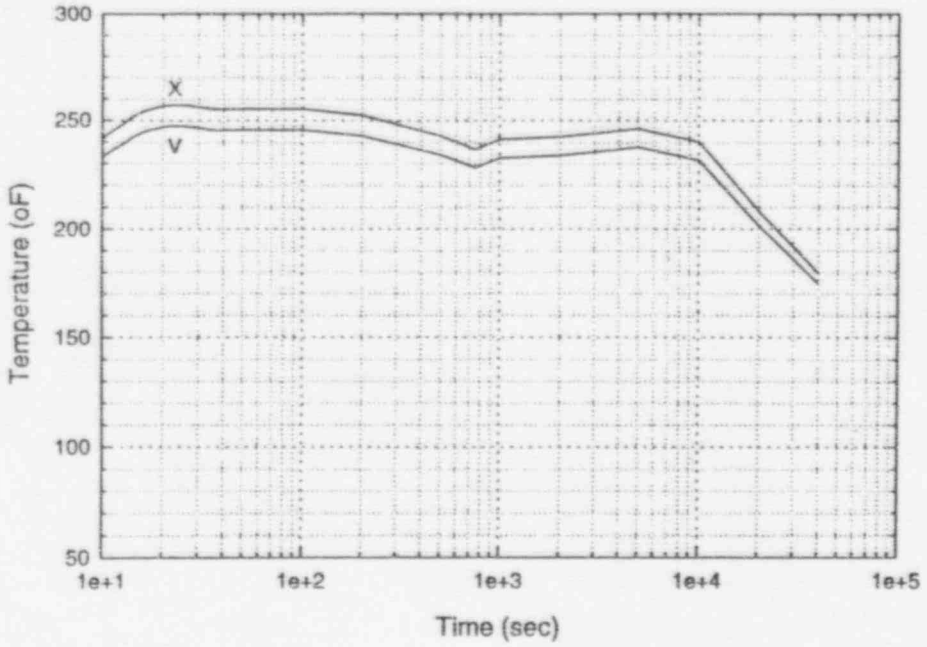
Steam Dew Point Temperature

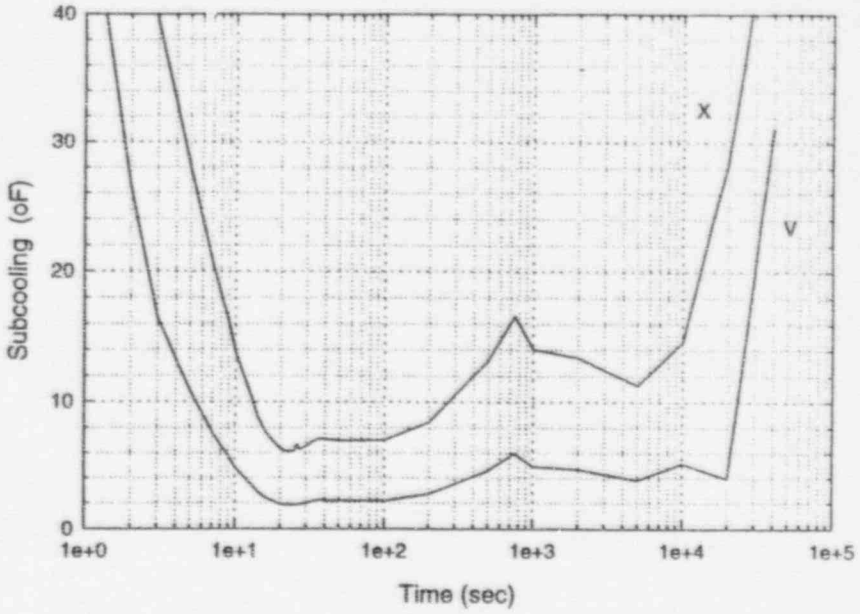




Creare

Water Temperature and Subcooling at Valve Inlet V and CAR fan Outlet X to the day post LOCA





Calculations for Motor Heat Only, River at 95°F

	Creare Calculations	CY APCO Results	NOTE
CAR fan Inlet ** P **			
Pressure (psia)	40.06	40.29	
Temperature (°F)	95	95	Specified
Flow Rate (gpm)	578.1	579.6	
CAR fan Exit ** X **			
Pressure (psia)	24.16	24.27	
Temperature (°F)	95	95	
Flow Rate (gpm)	543.6	544.9	
Motor Cooler Stream ** M **			
Temperature (°F)	100		
Flow Rate (gpm)	34.6	34.65	
Service Water Line ** L **			
Pressure (psia)	23.70	24.26	
Temperature (°F)	95.3	95.3	
Flow Rate (gpm)	578.1	579.55	
Valve Inlet ** V **			
Pressure (psia)	12.83	12.93	
Temperature (°F)	95.3	95.3	
Flow Rate (gpm)	578.1	579.55	
Valve Exit ** A **			
Pressure (psia)	8.75	8.75	Specified

Calculations for LOCA, River Water at 95°F

	Creare Calculations	CY APCO Results	Note
CAR fan Inlet ** P **			
Pressure (psia)	49.25		
Temperature (°F)	95	95	Specified
Flow Rate (gpm)	497.2		
CAR fan Exit ** X **			
Pressure (psia)	38.13	38.7	
Temperature (°F)	256	256	
Flow Rate (gpm)	467.5	449	
Subcooling (°F)	6.7		
Motor Cooler Stream ** M **			
Temperature (°F)	100		
Flow Rate (gpm)	29.7	28	
Service Water Line ** L **			
Pressure (psia)	37.81	38.7	
Temperature (°F)	246.3	246.8	
Flow Rate (gpm)	497.2	477	
Subcooling (°F)	15.9		
Valve Inlet ** V **			
Pressure (psia)	29.56	30.7	
Temperature (°F)	246.3	246.8	
Flow Rate (gpm)	497.2	477	
Subcooling (°F)	2.1		
Valve Exit ** A **			
Pressure (psia)	irrelevant (choked)	8.7	Specified

Values of Subcooling ΔT Sub

Time	Line 151			Line 154		
	X	L	V	X	L	V
0	142.6	141.3	110.7	134.2	132.7	111.5
10	13.8	22.0	4.8	9.1	17.2	5.4
20	6.4	15.6	1.9	2.7	11.9	2.4
40	7.1	16.3	2.2	3.3	12.4	2.7

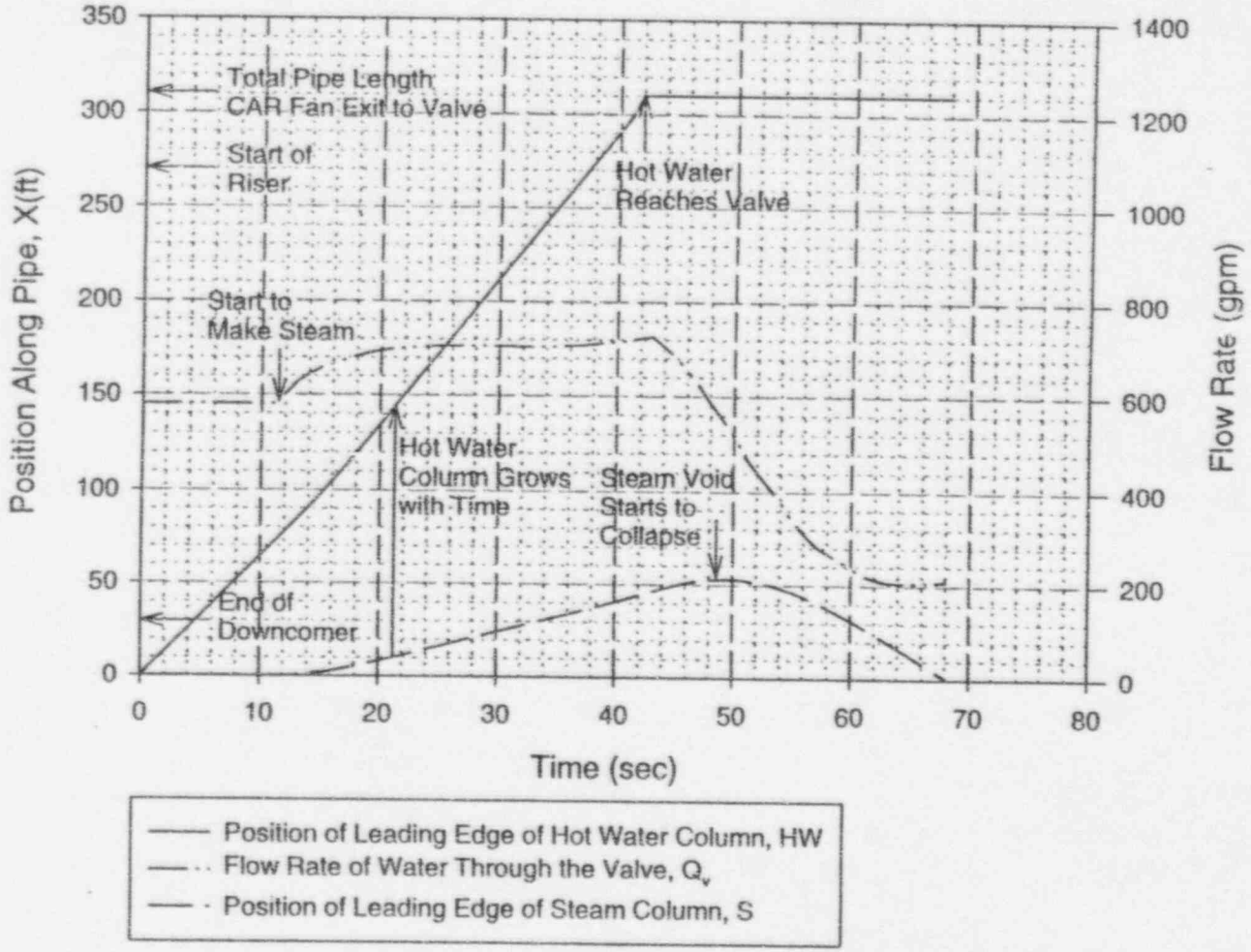
Sensitivity to Valve Pressure Recovery Factor

Valve Pressure Recovery Factor, F_L	Valve Flow Rate Q_V (gpm)	Valve Inlet Pressure P_V (psia)
0.85	497.2	29.56
0.75	491.5	30.48
0.65	483.3	31.77
0.55	471.0	33.66
0.45	451.5	36.52
0.35	419.0	40.99

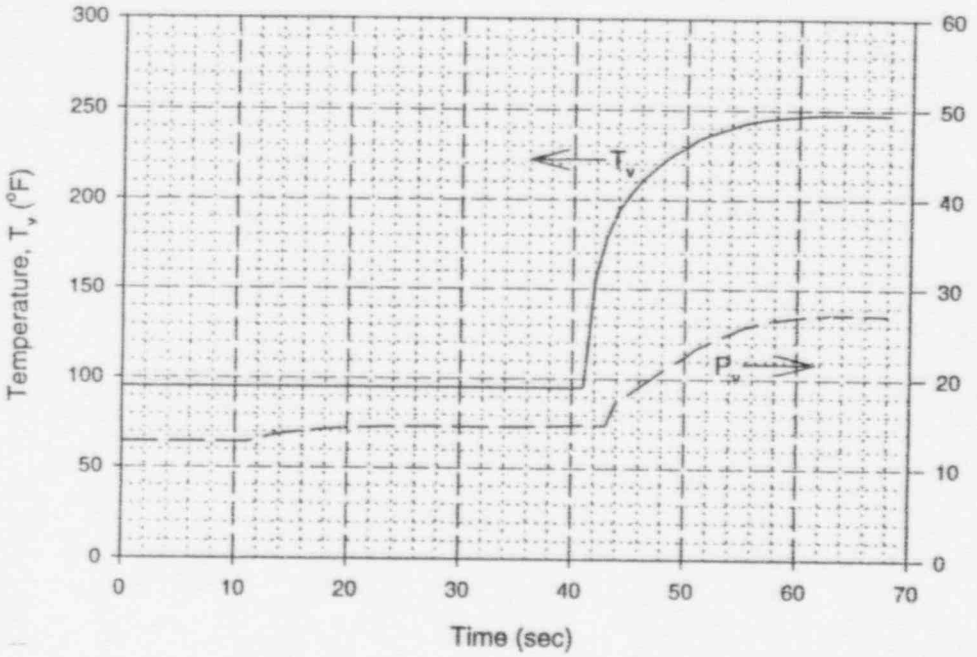
The Thermal Wave

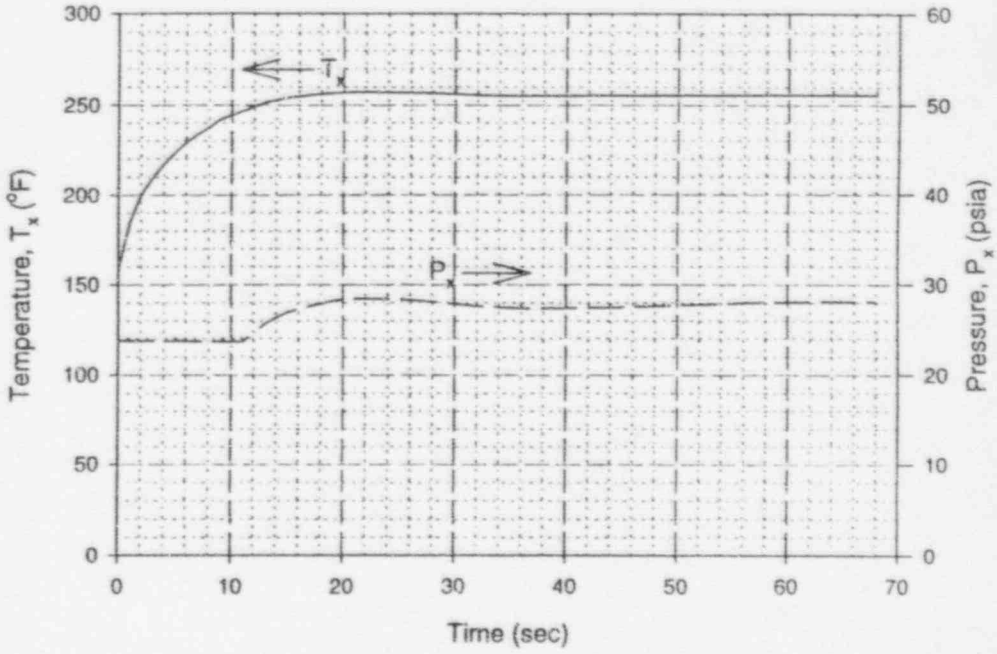
Stage 0	Cold Water Flowing in CAR Fan Section LOCA Transient Heats CAR Fan
Stage 1	Boiling Onset in About 12 Seconds Line Fills with Hot Water
Stage 2	Line Flow Increases by 30% Void Grows Pushing Out Water Hot Water Replaces Cold Downcomer Voids
Stage 3	Hot Water Reaches Throttle Void Enters Run
Stage 4	Thermal Profile Passes at Throttle Throttle Chokes Throttle Flow Declines Onset of Void Collapse
Stage 5	Void Slowly Collapses Hot Water From CAR Fan Fills Void
Stage 6	Throttle Inlet Pressurizes Stable Choked Flow is Achieved CAR Fan Outlet is Subcooled, No Boiling

Transient Motion of Interfaces



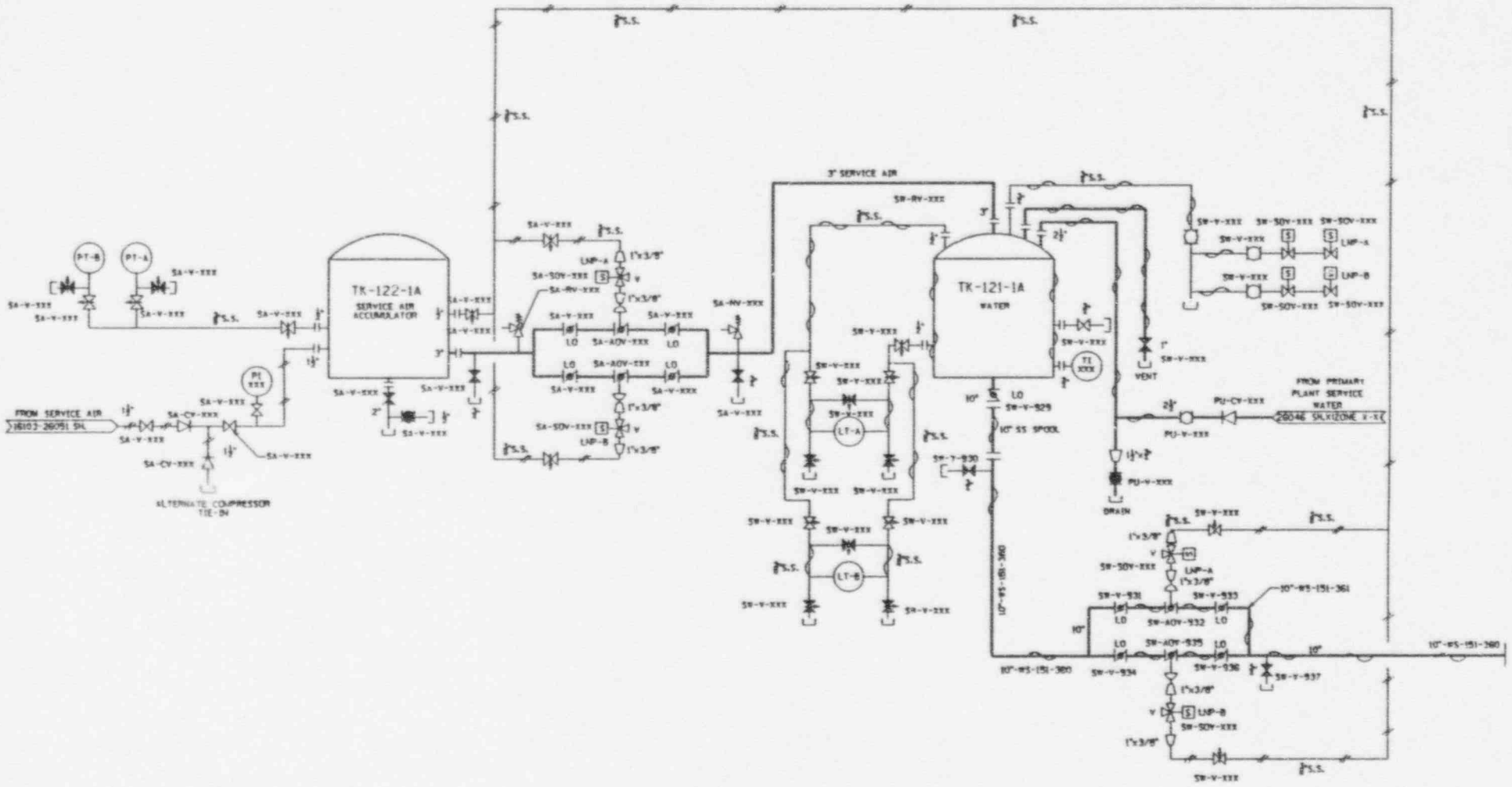
Thermodynamic Transient at Valve V and CAR Fan Outlet X



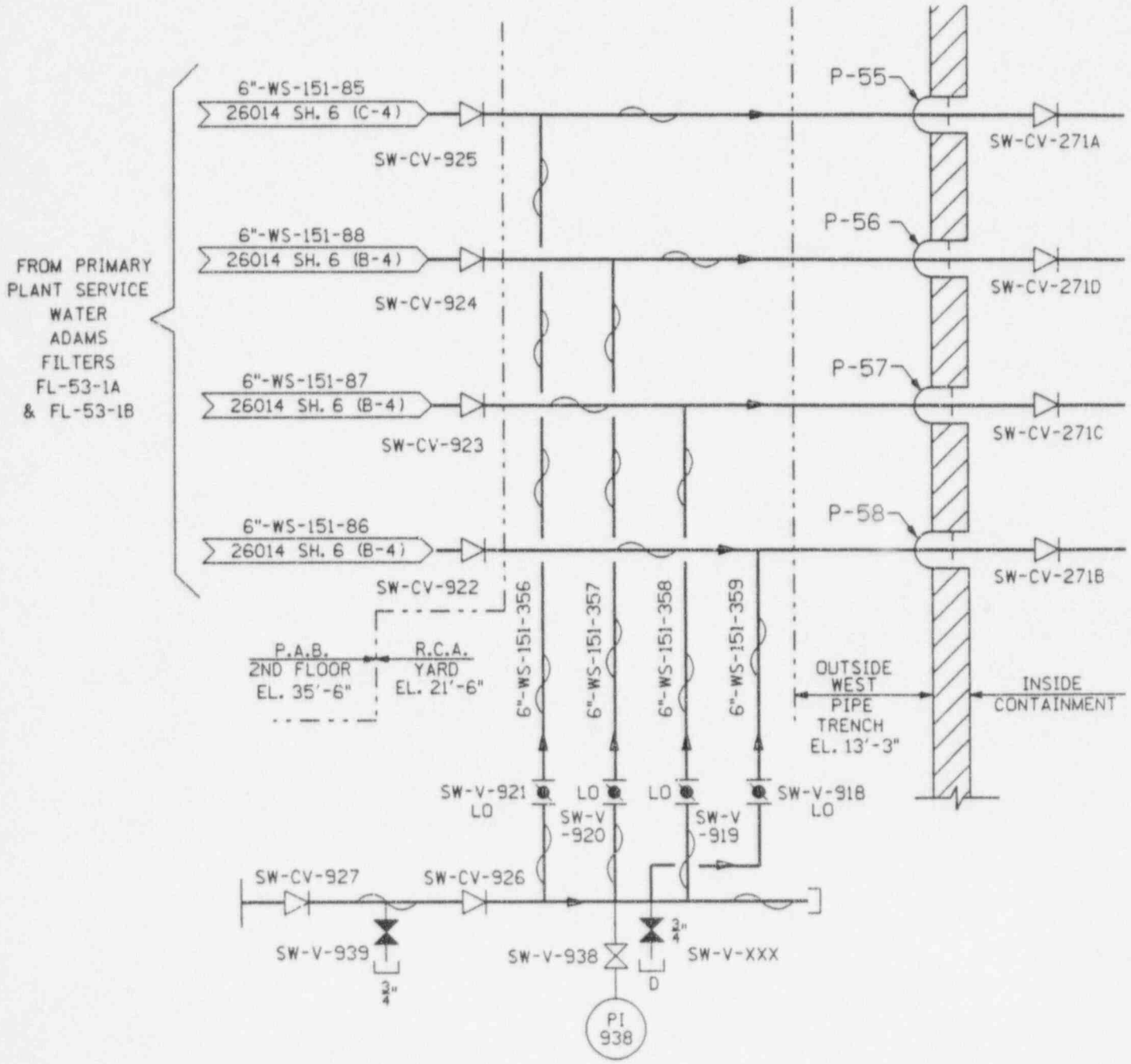


Margins

1. Maximum CAR Fan Heat Transfer
   - No Degradation
   - No Thermal Inertia
2. Multiphase Flow Regime
   - Segregated Flow Treated
     (No Issue If Bubbly Flow in the Run)
3. No Steam Condensation on Pipe
4. Loss of Downcomer Head Neglected



Attachment 3


FROM PRIMARY PLANT SERVICE WATER ADAMS FILTERS FL-53-1A & FL-53-1B
6"-WS-151-85
26014 SH. 6 (C-4)
SW-CV-925
6"-WS-151-88
26014 SH. 6 (B-4)
SW-CV-924
6"-WS-151-87
26014 SH. 6 (B-4)
SW-CV-923
6"-WS-151-86
26014 SH. 6 (B-4)
SW-CV-922
P-55
P-56
P-57
P-58
SW-CV-271A
SW-CV-271D
SW-CV-271C
SW-CV-271B
P.A.B.
2ND FLOOR
EL. 35'-6"
R.C.A.
YARD
EL. 21'-6"
6"-WS-151-356
6"-WS-151-357
6"-WS-151-358
6"-WS-151-359
OUTSIDE
WEST
PIPE
TRENCH
EL. 13'-3"
INSIDE
CONTAINMENT
SW-V-921
LO
LO
SW-V
-920
LO
SW-V
-919
SW-V-918
LO
SW-CV-927
SW-CV-926
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3/4"
SW-V-938
3/4"
SW-V-XXX
D
PI
938

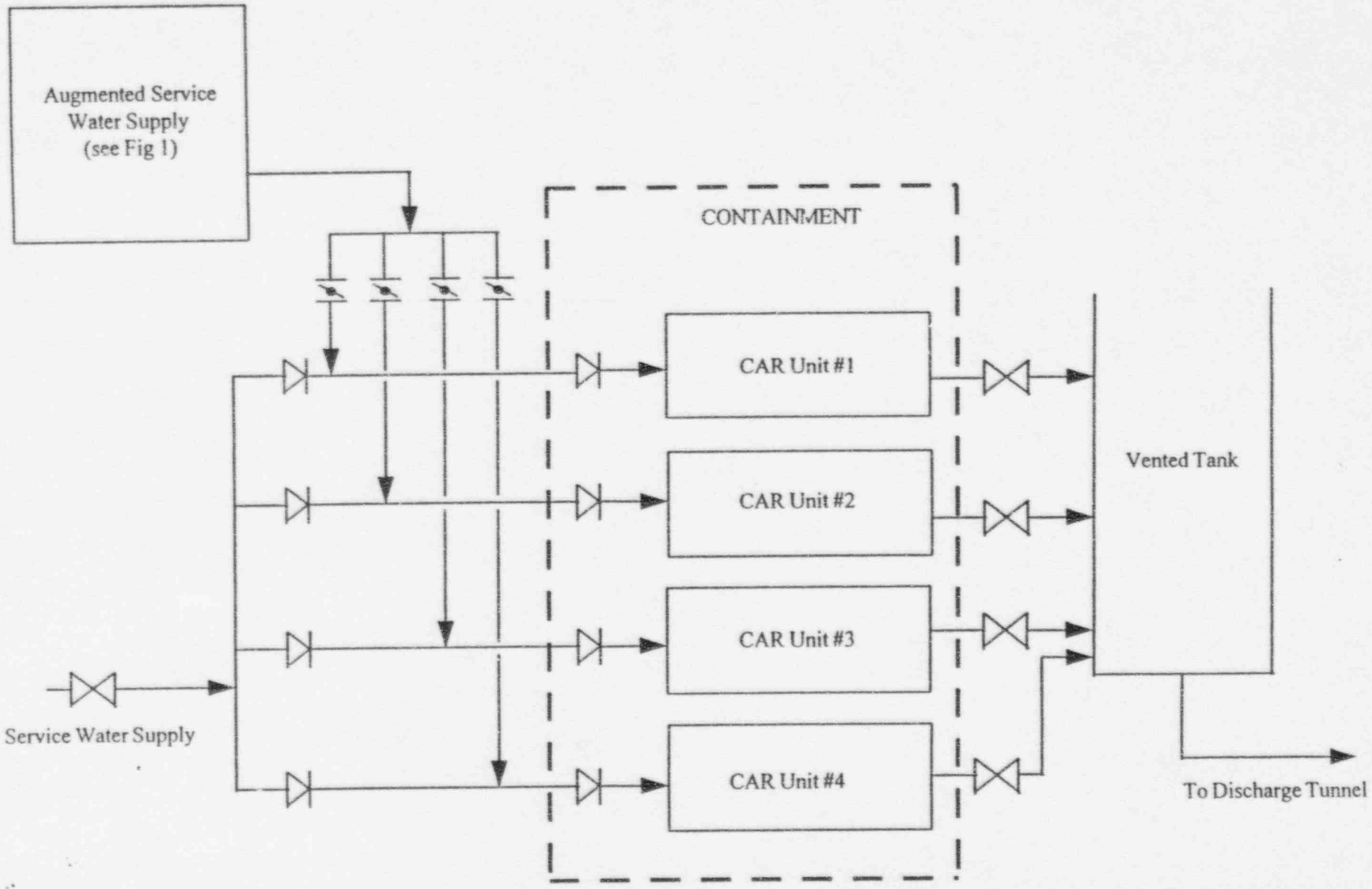

Figure 1: PRIMARY OPTION