GIBBSSAR Amendment 10

Instruction Sheet

The following instructional information is being provided to insert Amendment 10 into GIBBSSAR, the Gibbs & Hill Standard Safety Analysis Report. Please destroy the sheets removed and insert the new sheets as indicated below.

Remove (Front/Back)	Insert (Front/Back)
1.1-1/1.1-2	1.1-1/1.1-2
T1.8-1 Sh 3/T1.8-1 Sh 4	T1.8-1 Sh 3/T1.8-1 Sh 4
T1.8-1 Sh 9/T1.8-1 Sh 10	T1.8-1 Sh 8/T1.8-1 Sh 10
T1.8-1 Sh 13/T1.8-1 Sh 14	T1.8-1 Sh 13/T1.8-1 Sh 14
T1.8-1 Sh 15/T1.8-1 Sh 16	T1.8-1 Sh 14a/T1.8-1 Sh 15
	T1.8-1 Sh 15a/T1.8-1 Sh 16
3.1-11/3.1-12	3.1-11/3.1-12
3.1-14/3.1-16	3.1-15/3.1-16
3.2-1/3.2-2	3.2-1/3.2-2
T3.2-1 Sh 10a/T3.2-1 Sh 11	T3.2-1 Sh 10a/T3.2-1 Sh 11
3.5-7/3.5-7a	3.5-7/3.5-7a
3.6-3/3.6-3a	3.6-3/3.6-3a
T3.11-4 Sh 1/T3.11-4 Sh 2	T3.11-4 Sh 1/T3.11-4 Sh 1a
	T3.11-4 Sh 2
8-i/8-ia	8-i/8-ii
8-ii/-	8-iii/8-iv
8-iii/-	
8-iv/-	
8.1-1/8.1-2	8.1-1/8.1-2
8.1-3/8.1-4	8.1-3/8.1-4
8.1-5/8.1-6	8.1-5/8.1-5a
8.1-7/8.1-8	8.1-6/8.1-7
8.1-9/8.1-10	8.1-8/8.1-9
8.1-11/-	8.1-10/8.1-11
T8.1-1 Sh 1/T8.1-1 Sh 2	T8.1-1 Sh 1/T8.1-1 Sh 2
	T8.1-2 Sh 1/T8.1-2 Sh 2
	T8.1-2 Sh 3/T8.1-2 Sh 4
	T8.1-2 Sh 5/-
8.2-1/-	8.2-1/-
8.3-1/8.3-2	8.3-1/8.3-1a
8.3-3/8.3-4	8.3-2/8.3-3
8.3-5/8.3-6	8.3-4/8.3-5
	8.3-6/8.3-6a
8.3-7/8.3-8	8.3-7/8.3-8
8.3-9/8.3-10	8.3-9/8.3-9a
	8.3-9b/8.3-9c
	8.3-9d/8.3-10
8.3-11/8.3-12	8.3-11/8.3-11a
	8.3-12/8.3-12a
8.3-13/8.3-14	8.3-13/8.3-13a
	8.3-14/8.3-14a
8.3-15/8.3-16	8.3-15/8.3-15a
8.3-17/8.3-18	8.3-16/8.3-17
	8.3-18.8.3-18a

Remove
(Front/Back)

8.3-19/8.3-20
8.3-21/8.3-22
8.3-23/8.3-24
8.3-25/8.3-26
8.3-27/-
8.3-28/8.3-28a
8.3-29/8.3-30
8.3-31/-
8.3-31a/8.3-32
8.3-33/8.3-34

8.3-37/8.3-38
8.3-39/8.3-40
8.3-41/8.3-42
8.3-43/8.3-44
T8.3-4/T8.3-5

8.4-1/-
T8.4-1 Sh 1/T8.4-1 Sh 2
T8.4-1 Sh 3/T8.4-1 Sh 4
9.1-4/9.1-5
9.1-7/9.1-7a
9.1-10/9.1-10a

9.1-13/9.1-14

T9.5-1 Sh 1/T9.5-1 Sh 2
9.3-10a/9.3-11
9.3-12/9.3-13

9.4-9/9.4-9a
9.4-10/9.4-10a
9.4-11/9.4-11a
9.4-12/9.4-13
9.4-14/9.4-14a
9.4-15/9.4-16
9.4-16a/9.4-17
9.4-18/9.4-19
9.4-20/9.4-20a
9.4-21/9.4-22
9.4-23/9.4-23a
9.4-24/9.4-24a
9.4-25/9.4-25a
9.4-26/9.4-27
9.4-27a/9.4-28
9.4-28a/9.4-29

Insert
(Front/Back)

8.3-19/8.3-20
8.3-21/8.3-21a
8.3-22/8.3-23
8.3-24/8.3-25
8.3-26/8.3-27
8.3-27a/8.3-28
8.3-28a/8.3-29
8.3-30/8.3-31
8.3-31a/8.3-32
8.3-32a/8.3-33
8.3-34/-
8.3-37/8.3-38
8.3-39/8.3-40
8.3-41/8.3-42
8.3-43/8.3-44
T8.3-4/T8.3-5
T8.3-8/-
8.4-1/8.4-2
8.4-3/T8.4-1

9.1-4/9.1-5
9.1-7/9.1-7a
9.1-10/-
9.1-10a/-
9.1-13/-
9.1-14
T9.5-1 Sh 1/T9.5-1 Sh 2
9.3-10a/9.3-11
9.3-12/9.3-12a
9.3-13/-
T9.3-6/-
9.4-9/9.4-9a
9.4-10/9.4-11
9.4-11a/9.4-12
9.4-12a/9.4-13
9.4-14/9.4-15
9.4-16/9.4-16a
9.4-17/9.4-18
9.4-19/9.4-20

9.4-21/9.4-21a
9.4-22/9.4-23
9.4-23a/9.4-24
9.4-24a/9.4-25
9.4-25a/9.4-26
9.4-27/9.4-27a
9.4-28/9.4-28a
9.4-29/9.4-29a

Remove (Front/Back)	Insert (Front/Back)
9.4-30/9.4-31	9.4-30/9.4-31
9.4-31a/9.4-32	9.4-31a/9.4-32
9.4-33/9.4-34	9.4-32a/9.4-33
9.4-34a/9.4-35	9.4-34/9.4-34a
	9.4-35/-
T9.4-1/T9.4-2	T9.4-1/T9.4-2
T9.4-3/-	T9.4-3/-
T9.4-4 Sh 1/T9.4-4 Sh 2	T9.4-4 Sh 1/T9.4-4 Sh 2
T9.4-8 Sh 1/T9.4-8 Sh 2	T9.4-8 Sh 1/T9.4-8 Sh 2
T9.4-9 Sh 1/T9.4-9 Sh 2	T9.4-9 Sh 1/T9.4-9 Sh 2
T9.4-12/-	T9.4-12/-
9.5-1/9.5-2	9.5-1/9.5-2
	9.5-2a/-
9.5-7/9.5-8	9.5-7/9.5-7a
	9.5-8/-
9.5-23b/9.5-23c	9.5-23b/9.5-23b1
	9.5-23c/-
9.5-29/9.5-29a	9.5-29/9.5-29a
9.5-30/9.5-30a	9.5-29b/9.5-30
9.5-31/9.5-32	9.5-30a/9.5-31
9.5-32a/-	9.5-32/9.5-32a
	9.5-32b/9.5-32c
9.5-33/-	9.5-32d/9.5-33
T9.5-3 Sh 1/T9.5-3 Sh 2	T9.5-3 Sh 1/T9.5-3 Sh 2
T9.5-4/T9.5-5	T9.5-4/T9.5-5
	T9.5-9/-
	T9.5-10 Sh 1/T9.5-10 Sh 2
	T9.5-11 Sh 1/T9.5-11 Sh 2
	T9.5-12/-
T10.1-1/-	T10.1-1/-
10.2-17/10.2-18	10.2-17/10.2-18
10.2-18a/10.2-19	10.2-18a/10.2-19
10.3-7/-	10.3-7/-
10.4-5/10.4-6	10.4-5/10.4-5a
	10.4-6/-
10.4-11/10.4-12	10.4-11/10.4-12
10.4-15/10.4-15a	10.4-15/10.4-15a
10.4-29/10.4-30	10.4-29/10.4-30
10.4-31/10.4-31a	10.4-30a/10.4-31
	10.4-31a/-
T10.4-2 Sh 1/T10.4-2 Sh 2	T10.4-2 Sh 1/T10.4-2 Sh 2
T10.4-2 Sh 3/T10.4-3	T10.4-2 Sh 3/T10.4-3
T11.2-2/T11.2-3 Sh 1	T11.2-2 Sh 1/T11.2-2 Sh 2
	T11.2-2 Sh 3/T11.2-2 Sh 4

Remove (Front/Back)	Insert (Front/Back)
T11.2-3 Sh 2/-	T11.2-3 Sh 1/T11.2-3 Sh 2
	T11.2-3 Sh 3/T11.2-3 Sh 4
T11.2-5 Sh 1/T11.2-5 Sh 2	T11.2-5 Sh 1/T11.2-5 Sh 2
T11.2-5 Sh 3/T11.2-5 Sh 4	T11.2-5 Sh 3/T11.2-5 Sh 4
T11.2-5 Sh 5/T11.2-5 Sh 6	T11.2-5 Sh 5/T11.2-5 Sh 6
T11.2-5 Sh 7/T11.2-5 Sh 8	T11.2-5 Sh 7/T11.2-5 Sh 8
T11.2-5 Sh 9/T11.2-5 Sh 10	T11.2-5 Sh 9/T11.2-5 Sh 10
T11.2-5 Sh 11/T11.2-5 Sh 12	T11.2-5 Sh 11/T11.2-5 Sh 12
T11.2-5 Sh 12a/T11.2-5 Sh 13	T11.2-5 Sh 12a/T11.2-5 Sh 13
T11.2-5 Sh 14/T11.2-5 Sh 15	T11.2-5 Sh 14/T11.2-5 Sh 15
T11.2-5 Sh 16/T11.2-5 Sh 17	T11.2-5 Sh 16/T11.2-5 Sh 17
T11.2-5 Sh 18/T11.2-5 Sh 19	T11.2-5 Sh 18/T11.2-5 Sh 19
T11.2-5 Sh 20/T11.2-5 Sh 21	T11.2-5 Sh 20/T11.2-5 Sh 21
T11.2-5 Sh 22/T11.2-5 Sh 23	T11.2-5 Sh 22/T11.2-5 Sh 23
T11.2-5 Sh 24/T11.2-5 Sh 25	T11.2-5 Sh 24/T11.2-5 Sh 25
T11.2-5 Sh 26/T11.2-5 Sh 27	T11.2-5 Sh 26/T11.2-5 Sh 27
T11.2-5 Sh 28/T11.2-5 Sh 29	T11.2-5 Sh 28/T11.2-5 Sh 29
T11.2-6 Sh 1/T11.2-6 Sh 2	T11.2-6 Sh 1/T11.2-6 Sh 2
T11.3-2/T11.3-3 Sh 1	T11.3-2/T11.3-3 Sh 1
T11.4-1/T11.4-2 Sh 1	T11.4-1/T11.4-2 Sh 1

Remove (Front/Back)	Insert (Front/Back)
T11.4-2 Sh. 2/T11.4-2 Sh. 3	T11.4-2 Sh. 2/T11.4-2 Sh. 3
T11.4-2 Sh. 4/T11.4-2 Sh. 5	T11.4-2 Sh. 4/T11.4-2 Sh. 5
T11.4-2 Sh. 6/T11.4-2 Sh. 7	T11.4-2 Sh. 6/T11.4-2 Sh. 7
T11.4-2 Sh. 8/T11.4-2 Sh. 9	T11.4-2 Sh. 8/T11.4-2 Sh. 9
T11.4-2 Sh. 10/T11.4-2 Sh. 11	T11.4-2 Sh. 10/T11.4-2 Sh. 11
T11.4-2 Sh. 12/T11.4-2 Sh. 13	T11.4-2 Sh. 12/T11.4-2 Sh. 13
T11.4-2 Sh. 14/-	T11.4-2 Sh. 14/T11.4-2 Sh. 15
3/4 8-1/3/4 8-2	3/4 8-1/3/4 8-2
3/4 8-3/3/4 8-4	3/4 8-3/3/4 8-3a
	3/4 8-4/3/4 8-4a
	3/4 8-4b/3/4 8-4c
3/4 8-7/3/4 8-8	3/4 8-7/3/4 8-8
	3/4 8-8a/3/4 8-9
3/4 8-9/3/4 8-10	3/4 8-9a/3/4 8-10

Insert
(Front/Back)

Q010- 22/Q010- 23
Q010- 34/Q010- 35
Q010- 82/Q010- 83
Q010- 84/Q010- 85
Q010- 86/Q010- 87
Q010- 88/Q010- 89
Q010- 90/Q010- 91
Q010- 92/Q010- 93
Q010- 94/Q010- 95
Q010- 96/Q010- 97
Q010- 98/Q010- 99
Q010-100/Q010-101
Q010-102/Q010-103
Q010-104/Q010-105
Q010-106/Q010-107
Q040- 1/Q040- 2
Q040- 3/Q040- 4
Q040- 5/Q040- 6
Q040- 7/Q040- 8
Q040- 9/Q040- 10
Q040- 11/Q040- 12
Q040- 13/Q040- 14
Q040- 15/Q040- 16
Q040- 17/Q040- 18
Q040- 19/Q040- 20
Q040- 21/Q040- 22
Q040- 23/Q040- 24
Q040- 25/Q040- 26
Q040- 27/Q040- 28
Q040- 29/Q040- 30
Q040- 31/Q040- 32
Q040- 33/Q040- 34
Q040- 35/Q040- 36
Q040- 37/Q040- 38
Q040- 39/Q[illegible]
Q040- 41/[illegible]
Q040- 43/[illegible]
Q040- 45/Q04[illegible]
Q040- 47/Q040- 48
Q040- 49/Q040- 50
Q040- 51/Q040- 52
Q040- 53/Q040- 54
Q040- 55/Q040- 56
Q040- 57/Q040- 58
Q040- 59/Q040- 60
Q040- 61/Q040- 62
Q040- 63/Q040- 64
Q040- 65/Q040- 66

Insert
(Front/Back)

Q040- 67/Q040- 68
Q040- 69/Q040- 70
Q040- 71/Q040- 72
Q040- 73/Q040- 74
Q040- 75/Q040- 76
Q040- 77/Q040- 78
Q040- 79/-

FIGURES

Remove	Insert
3.6-1A	3.6-1A
3.6-1B	3.6-1B
3.7-8	3.7-8
3.7-9	3.7-9
3.7-10	3.7-10
3.7-11	3.7-11
3.7-12	3.7-12
3.7-14	3.7-14
6.2-25	6.2-25
8.3-2	8.3-2
8.3-3	8.3-3
8.3-4	8.3-4
8.3-5	8.3-5
8.3-6	8.3-6
8.3-7	8.3-7
8.3-8	8.3-8
8.3-9	8.3-9
8.3-10	8.3-10
8.3-11	8.3-11
9.1-3	9.1-3
9.1-3a Sh. 2	9.1-3a Sh. 2
9.2-1	9.2-1
9.2-2	9.2-2
9.2-4a Sh. 1	9.2-4a Sh. 1
9.2-5	9.2-5
9.2-6	9.2-6
	9.4-4
9.4-5	9.4-5
9.4-6	9.4-6
9.4-7	9.4-7
9.4-8	9.4-8
9.4-9	9.4-9
9.4-10	9.4-10 Sh. 1
	9.4-10 Sh. 2
9.4-12	9.4-12
9.4-13	9.4-13
9.4-14	9.4-14
9.4-15	9.4-15
	9.4-19
9.5-1B	9.5-1B
9.5-4	9.5-4
9.5-5	9.5-5
9.5-8	9.5-8
	9.5-9

FIGURES

Remove	Insert
10.1-1	10.1-1
10.1-4	10.1-4
	10.1-7
10.3-1	10.3-1
10.3-1a Sh. 2	10.3-1a Sh. 2
10.3-1b Sh. 2	10.3-1b Sh. 2
10.4-3	10.4-3
10.4-3a Sh. 1 & 2	10.4-3a Sh. 1 & 2
10.4-4	10.4-4

1. INTRODUCTION AND GENERAL DESCRIPTION OF PLANT

1.1 Introduction

This Gibbs & Hill, Inc. Standard Safety Analysis Report (GIBBSSAR) supports an application for preliminary approval of the standard plant design described herein. GIBBSSAR is submitted to the United States Nuclear Regulatory Commission (NRC) in accordance with the Code of Federal Regulations (CFR), specifically 10 CFR Part 50, Appendix O. GIBBSSAR follows NRC Regulatory Guide 1.70 (Standard Format and Content of Safety 1
Analysis Reports for Nuclear Power Plants, Revision 2, issued for comment by the NRC in September, 1975).

GIBBSSAR is intended to support a Utility-Applicant's construction permit application for a station of any number of units in either single or multiple layouts. The Utility-Applicant will incorporate, by reference, the GIBBSSAR design.

The standard plant design described in GIBBSSAR accommodates a large number of sites within the continental United States. The acceptable range of site-related design criteria is established in Chapters 2 and 3 of this report.

The nuclear steam supply system (NSSS) is a pressurized water reactor (PWR) supplied by the Westinghouse Electric Corporation. The containment is a steel-lined, reinforced-concrete, cylindrical structure with a hemispherical dome designed by Gibbs & Hill, Inc. (G&H).

Each generating unit is rated to operate at core power levels up to 3800 megawatts thermal (MWt); this corresponds to an electrical output of approximately 1335 megawatts electrical (MWe) at the generator terminals. However, the 10
radiological consequences of plant accidents are evaluated for a core power level of 4100 MWt. This power rating is used in the analyses of all postulated accidents that bear significantly upon 1
the acceptability of a site (per the criteria set forth in 10 CFR Part 100).

The interfaces between the systems described in GIBBSSAR and those of the NSSS vendor are identified in Section 1.8 and discussed in the applicable sections of this report. 1

The NSSS vendor's Reference Safety Analysis Report, RESAR-414, will be referred to as NSSS SSAR (Nuclear Steam Supply System Standard Safety Analysis Report). The NSSS SSAR applies in GIBBSSAR in all areas except where noted. Specific exceptions taken to RESAR-414 are listed in Table 1.1-1. Text pages and tables containing information specific to the Westinghouse NSSS SSAR, RESAR-414 will be printed in blue and marked with W-414, 6
and Westinghouse-414 respectively.

TABLE 1.8-1

DESIGN RESPONSIBILITY
(Westinghouse-414)

(Sheet 3 of 20)

System		W-414	G&H	U-A
d.	Combustible Gas Control in Containment (6.2.5):			
	Overall system design		x	
	Component design requirements		x	
e.	Containment Leakage Testing (6.2.6):			
	Overall system design		x	
	Component design requirements		x	
f.	Hydrogen Purge System (6.2.7):			
	Overall system design		x	
	Component design requirements		x	
g.	Containment Hydrogen Monitoring System (6.2.8):			
	Overall system design		x	
	Component design requirements		x	
	Piping layout and stress analysis		x	

TABLE 1.8-1

DESIGN RESPONSIBILITY
(Westinghouse-414)

(Sheet 4 of 20)

System		W-414	G&H	U-A
h.	Emergency Core Cooling System (6.3):			
	Overall system design	x		
	Component design requirements	x		
	Piping layout and stress analysis		x	
i.	Habitability Systems (6.4):			
	Overall system design		x	
	Component design requirements		x	
j.	Emergency Boration System:		Deleted	
7.	INSTRUMENTATION AND CONTROLS			
a.	Reactor Trip System (7.2)	x		
b.	Control Panel Layout and Design:			
	Main control board		x	
	Auxiliary shutdown panel		x	
	Diesel generator panel		x	

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TABLE 1.8-1

DESIGN RESPONSIBILITY
(Westinghouse-414)

(Sheet 9 of 20)

System	W-414	G&H	U-A	
Lighting systems (see subsection 9.5.3.)		x		
Lightning protection		x		
Computer		x		
Seismic instrumentation		x		
Electric space heaters		x		
Heat tracing		x		
9. AUXILIARY SYSTEMS				
a. New Fuel Storage (9.1.1):				
Overall storage system design		x		
Storage system component design requirements		x		10
new fuel storage racks			x	
b. Spent Fuel Storage (9.1.2):				
Overall storage system design		x		
Storage system component design requirements:				
spent fuel storage pool		x		
spent fuel cask storage pool		x		
spent fuel storage racks	x			

TABLE 1.8-1

DESIGN RESPONSIBILITY
(Westinghouse-414)

System		W-414	G&H	U-A
c.	Spent Fuel Pool Cooling and Cleanup System (9.1.3)			
	Overall system design		x	
	Component design requirements		x	
	Piping layout and stress analysis		x	
d.	Fuel Handling System (9.1.4):			
	Overall system design within containment	x		
	Overall system design within fuel handling building		x	
	Fuel handling system component design requirements			
	refueling cavity bridge	x		
	upender	x		
	fuel transfer tube and transfer car	x		

TABLE 1.8-1

DESIGN RESPONSIBILITY
(Westinghouse-414)

(Sheet 11 of 20)

System	W-414	G&H	U-A	
Spent fuel pool bridge	x			10
new fuel elevator	x			
130-ton fuel building crane		x		
spent fuel cask			x	
decontamination equipment			x	10
other fuel handling tools and equipment	x			
containment polar crane		x		10
e. Station Service Water System (9.2.1):				
Overall system design		x		
Component design requirements		x		
Piping layout and stress analysis		x		
f. Cooling System for Reactor Auxiliaries (9.2.2):				
Overall system design		x		
Component design requirements		x		
Piping layout and stress analysis		x		

TABLE 1.8-1

DESIGN RESPONSIBILITY
(Westinghouse-414)

(Sheet 12 of 20)

System		W-414	G&H	U-A
g.	Demineralized Water Makeup System (9.2.3):			
	Overall system design		x	
	Component design requirements		x	
	Piping layout and stress analysis		x	
h.	Potable and Sanitary Water Systems (9.2.4)			x
i.	Ultimate Heat Sink (9.2.5)			x
j.	Condensate Storage Facilities (9.2.6)		x	
k.	Water Treatment System (9.2.7)			x
l.	Plant Ventilation Chilled Water System (9.2.8)		x	
m.	Ventilation Safety Feature Chilled Water System (9.2.9)		x	
n.	Compressed Air Systems (9.3.1)		x	
o.	Process Sampling System (9.3.2):			
	Reactor plant sampling system design		x	
	Turbine plant sampling system design		x	

TABLE 1.8-1

DESIGN RESPONSIBILITY
(Westinghouse-414)

(Sheet 13 of 20)

System		W-414	G&H	U-A
p.	Equipment and Floor Drainage System (9.3.3)		x	
q.	Chemical and Volume Control System (9.3.4):			
	Overall system design	x		
	Component design requirements	x		
	Piping layout and stress analysis		x	
r.	Air-Conditioning, Heating, Cooling, and Ventilation Systems design		x	
s.	Air Conditioning, Heating, Cooling, and Ventilation Subsystem Design:			
	Control room area ventilation system (9.4.1)		x	
	Spent fuel pool area ventilation system (9.4.2)		x	
	Auxiliary and radwaste area ventilation systems (9.4.3)		x	
	Turbine building area ventilation system (9.4.4)		x	
	Engineered safety features ventilation system (9.4.5)		x	
	Containment ventilation system (9.4.6)		x	

TABLE 1.8-1

DESIGN RESPONSIBILITY
(Westinghouse-414)

(Sheet 14 of 20)

System		W-414	G&H	U-A
t.	Fire Protection System (9.5.1):			
	Overall system design		x	
	Component design requirements		x	
u.	Communications System (9.5.2):			
	Overall system design		x	
	Component design requirements		x	
v.	Lighting Systems (9.5.3):			
	Overall system design		x	
	Component design requirements		x	
w.	Diesel Generator Fuel Oil Storage and Transfer System (9.5.4):			
	Overall system design		x	
	Component design requirements		x	
	Piping layout and stress analysis		x	
x.	Diesel Generator Cooling Water System (9.5.5)		x	
	Overall system design		x		10

TABLE 1.8-1

DESIGN RESPONSIBILITY
(Westinghouse-414)

(Sheet 14a of 20)

System		W-414	G&H	U-A	
	Component design requirements			x	
y.	Diesel Generator Starting System (9.5.6)		x		10
	Overall system design		x		
	Component design requirements			x	

TABLE 1.8-1

DESIGN RESPONSIBILITY
(Westinghouse-414)

(Sheet 15 of 20)

System	W-414	G&H	U-A	
z. Diesel Generator Lubrication System (9.5.7)		x		
Overall system design		x		10
Component design requirements			x	
aa. Diesel Generator Combustion Air Intake and Exhaust System (9.5.8):				
Overall system design		x		10
Component design requirements			x	
10. STEAM AND POWER CONVERSION SYSTEM				
a. Turbine-Generator (10.2):				
Overall system design including turbine steam system		x		
Component design requirements		x		
Piping layout and stress analysis		x		

TABLE 1.8-1

DESIGN RESPONSIBILITY
(Westinghouse-414)

(Sheet 15a of 20)

System		W-414	G&H	U-A
b.	Main Steam Supply System (10.3):			
	Overall system design		x	
	Component design requirements		x	
	Piping layout and stress analysis		x	

TABLE 1.8-1

DESIGN RESPONSIBILITY
(Westinghouse-414)

(Sheet 16 of 20)

System		W-414	G&H	U-A
c.	Main Condensers (10.4.1):			
	Overall system design		x	
d.	Main Condenser Evacuation System (10.4.2):			
	Overall system design		x	
e.	Turbine Gland Sealing System (10.4.3):			
	Overall system design		x	
	Component design requirements		x	
	Piping layout and stress analysis		x	
f.	Turbine Bypass System (10.4.4):			
	Overall system design		x	
	Control system analysis	x		
	Component design requirements		x	
	Piping layout and stress analysis		x	

3.1.13 Criterion 13 - Instrumentation and Control

Instrumentation shall be provided to monitor variables and systems over their anticipated ranges for normal operation, for anticipated operational occurrences, and for accident conditions as appropriate to assure adequate safety, including those variables and systems that can affect the fission process, the integrity of the reactor core, the reactor coolant pressure boundary, and the containment and its associated systems. Appropriate controls shall be provided to maintain these variables and systems within prescribed operating ranges.

Discussion

G&H supplied instrumentation, control and power systems interface | 10
with appropriate NSSS vendor instrumentation and control systems to monitor significant variables in the reactor core, reactor coolant systems and containment structure over their anticipated range for all conditions to assure adequate safety. The installed instrumentation provides continuous monitoring, warning, and initiation of ESF. Refer to Chapter 7 and 8 for | 10
details.

For information on the instrumentation and controls within the NSSS vendor's scope, refer to Section 3.1 and Chapter 7 of the NSSS SSAR.

3.1.14 Criterion 14 - Reactor Coolant Pressure Boundary

The reactor coolant pressure boundary shall be designed, fabricated, erected and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.

Discussion

This criterion is within the scope of the NSSS vendor. Refer to Section 3.1 of the NSSS SSAR.

3.1.17 Criterion 17 - Electric Power Systems

An onsite electric power system and an offsite electric power system shall be provided to permit functioning of structures, systems and components important to safety. The safety function for each system (assuming the other system is not functioning) shall be to provide sufficient capacity and capability to assure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents.

The onsite electric power sources, including the batteries and the onsite electrical distribution system shall have sufficient independence, redundancy, and testability to perform their safety functions, assuming a single failure.

Electric power from the transmission network to the onsite electric distribution system shall be supplied by two physically independent circuits (not necessarily on separate rights-of-way) designed and located so as to minimize to the extent practical the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions. A switchyard common to both circuits is acceptable. Each of these circuits shall be designed to be available in sufficient time following a loss of all onsite alternating-current power supplies and the other offsite electrical power circuit, to assure that specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded. One of these circuits shall be designed to be available within a few seconds following a loss-of-coolant accident to assure that core cooling, containment integrity, and other vital safety functions are maintained.

Provisions shall be included to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss from the onsite electrical power supplies.

Discussion

Onsite and offsite electric power systems are provided, and designed with adequate independence, capacity, redundancy, and testability to assure the functioning of safety-related systems. Independence is provided for both systems by physical separation of components and cables, to minimize vulnerability of redundant systems to single credible accidents. For details of separation see Chapter 8.

Two independent offsite power sources are available on an immediate basis from two physically independent transmission line systems.

The primary offsite power source provides power through the station service transformers to the ESF buses. If this system fails, the alternate offsite power source immediately available provides power to the ESF buses through the main stepup and unit auxiliary transformers. Thus, a single component failure does not prevent power from being supplied to the ESF buses. See Section 8.2 for details.

The onsite ac source of electric power consists of two diesel generators; one connected and used exclusively for Train A, and one connected and used exclusively for Train B. One diesel generator is capable of supplying sufficient power for the operation of the minimum ESF required for the unit during a postulated LOCA. During a postulated LOCA, both diesel generators start automatically; if offsite power is also unavailable, then the generators will be automatically connected to their respective ESF buses. Safety-related loads are sequentially loaded onto the ESF buses whether the ESF Buses are powered from the onsite or offsite power source. 10

The two ESF buses and their associated diesel generators are arranged so that failure of a single component does not prevent the power supply systems from performing their function. See Section 8.3 for details.

Four dc batteries are provided in physically separated rooms, and each battery is adequate to supply the dc control power required for the ESF. Failure of a single component in this system does not impair control of the minimum ESF required to maintain the unit in a safe condition. See Table 8.3, Failure Mode Analysis.

3.2 Classification of Structures, Components, and Systems

This section classifies structures, systems, and components according to their importance in providing reasonable assurance that the plant can be operated without undue risk to the health and safety of the public.

For the seismic and safety classifications of the NSSS vendor's piping systems and their components, refer to the NSSS SSAR, Section 3.2.

3.2.1 Seismic Classification

Seismic design classification is in accordance with NRC Regulatory Guide 1.29, "Seismic Design Classification."

Table 3.2-1 lists all systems, other than those referenced above, which are important to plant safety and their classification according to NRC Regulatory Guide 1.29 and ANSI N18.2. The exceptions are the electrical power systems, which are listed in Section 3.10.

Seismic Category I structures, components, and systems are designed to withstand a safe shutdown earthquake (SSE) and operating basis earthquake (OBE) as discussed in Section 3.7, and other applicable load combinations as discussed in 10 CFR Part 100, Appendix A. All Safety Class 1, Safety Class 2, or Safety Class 3 components are classified as Seismic Category I. Seismic Category I structures are sufficiently isolated or protected from other structures to insure that their integrity is maintained.

Classification of instrumentation, piping and valves, ductwork and dampers, and associated supports, hangers, and restraints is consistent with the boundaries shown on the flow diagrams.

In addition, certain systems designated as non-nuclear-safety-related, and whose failure could impair the function of an ESF system are designated Seismic Category I, and their safety classification is shown on the flow diagrams.

3.2.1.1 Seismic Category I Structures

The following structures are classified as seismic Category I:

a. Containment

b. Internal structure of containment

c. Auxiliary building (including control room, fuel handling area including spent fuel pool and fuel pool liners, and engineered safety features area) 10

3.2.1.2 Seismic Category I Lifting Devices

The following lifting devices are classified as seismic Category I:

a. Fuel handling area overhead crane

b. Polar bridge crane

c. Containment Fuel storage crane

d. Drumming storage area crane

Individual mechanical components other than the lifting devices detailed in this subsection, which are designed to remain functional during a SSE, are listed in Table 3.2-1.

3.2.2 System Quality Group Classification

The quality group classifications for each water and steam-containing pressure component are shown in Table 3.2-1. The components are classified according to their importance to safety as dictated by service and functional requirements and by the consequences of their failure. The quality group classifications are in accordance with NRC Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants."

The code requirements applicable to each quality group classification are identified in Table 3.2-2. The quality group classifications and the interfaces between classifications in a system with components of different classifications are indicated on the appropriate system flow diagrams.

TABLE 3.2-1 (Sheet 10a of 21)

CLASSIFICATION OF COMPONENTS, AND SYSTEMS

System Components	ANSI Classi-fication (Note 1)	Construction Codes and Standards (Note 2)	
Fire Protection System			
Fire protection booster pumps	3	g.3)	
System piping and valves (used as seismic Category I makeup supply to CCW and Safety Feature Chilled Water system and Spent Fuel Pool)	3	g.3)	10
System piping, valves, and hose stations (serving safety related equipment)	NNS	e.3), n, u	
Instrument Air System			
Air compressor	NNS	w	
Containment isolation valves	2	g.2)	
Air receiver	NNS	g.5)	5
System piping and valves (up to and excluding containment isolation valves)	NNS	e.3)	
Accumulators	NNS	g.5)	

TABLE 3.2-1 (Sheet 11 of 21)

CLASSIFICATION OF COMPONENTS, AND SYSTEMS 5

System Components	ANSI Classi-fication (Note 1)	Construction Codes and Standards (Note 2)	
Service Air System			
Air compressor	NNS	w	5
Containment isolation valves	2	g.2)	
Air receiver	NNS	g.5)	
Piping and valves (up to and excluding containment isolation valves)	NNS	e.3)	5
Floor Drainage System			
ESF building sump pumps	NNS	w	5
Piping and valves (pump discharges)	NNS	e.3)	
Service Water System			
Pumps	3	g.3)	
Piping and valves (required for the performance of those components for normal- and safety-function operation)	3	g.3)	
Strainers	3	g.3)	

Missiles generated by floods are not a design consideration as the PMF level generally is not higher than plant grade. In the 10
event the PMF level is higher than plant grade, protection from water borne missiles will be provided if needed and will be addressed in the Utility Applicant's SAR.

3.5.1.5 Missiles Generated by Events Near the Site

Accidental explosions near the site are site-related. The Utility-Applicant's SAR will identify locations of train, truck, ship or barge, industrial facilities, pipelines, and military facilities which may become sources of explosions and create significant loadings on structures. All Seismic Category I structures are designed for tornado loadings for Region I and associated missiles in accordance with Regulatory Guide 1.76, Ref. 2. (See subsection 3.5.1.4.) For any specific site, the adequacy of the Seismic Category I structures is verified for loadings caused by explosions near site in accordance with Regulatory Guide 1.91, Ref. 3.

3.5.1.6 Aircraft Hazards

This information is site-related and is presented in the 7
Utility-Applicant's SAR.

3.5.2 Systems to be Protected

All plant structures, systems, and components whose failure could lead to offsite radiological consequences or which are required to shut down the reactor and maintain it in a safe condition, assuming a single failure, are listed in Table 3.2-1.

In addition, the systems protected inside containment are listed in Table 3.5-11 systems outside containment required for safe
shutdown are all protected regardless of the missile source. 7

The safety-related system has redundancy and/or is protected against damage by internally generated missiles by a combination of barriers and physical arrangements. Only one internally generated missile is postulated at a time.

All safety-related NSSS and BOP systems are housed in seismic 6
Category I Structures which are designed to provide protection from tornado-generated missiles.

In general, reinforced concrete floors and internal compartment walls are used as barriers for protection of all essential components and systems against postulated missiles. For arrangement of floors and internal walls see Figures 3.8-1 to 3.8-3 (Structural Plant Arrangement): for general arrangement see Figures 1.2-3 through 1.2-10.

b. Fluid flow from a crack is based on a circular opening equal to that of the area of a rectangle, one-half pipe diameter in length and one-half pipe wall thickness in width.

c. The flow from the crack is assumed to result in an environment that wets all unprotected components within the compartment, with consequent flooding in the compartment and communicating compartments. Flooding effects are determined on the basis of a conservatively estimated time period required to effect corrective actions.

The following discussion is included to demonstrate how the RHR 7
and CCW system will be protected from high and moderate energy
line breaks, in the engineered safety features area of the 10
Auxiliary Building, in accordance with BTP APCSB 3-1.

The preliminary piping arrangement for the engineered safety 7
features area is shown on Figures 3.6-9 through 3.6-14 showing
the RHR and CCW piping and other safety related systems. 10

The RHR equipment, ie, pumps, heat exchangers, valves, and piping
are all located in comparments separated from other equipment, as 7
shown on the figures. There are two redundant trains of RHR and
CCW equipment, each physically separated from the other so that 10
the effects of a pipe break in one train will not affect the
operation of the other train. There are no high energy lines
located within the RHR compartments. The only high energy lines 7
located within the CCW compartments are the auxiliary feedwater
pumps discharge and the steam supply to the turbine driven AFW
pump. The only moderate energy lines located in the RHR rooms,
besides RHR piping, are the 20" component cooling water supply 10
and return for the RHR heat exchanger and 1" component cooling
water supply and return for the RHR pump lube oil cooler. The
only moderate energy lines located in the CCW compartments,
besides CCW piping, are the service water supply and return to
the CCW heat exchanger.

These compartment walls, along with other barriers and restraints, will be designed to provide protection of the RHR and CCW equipment from the dynamic effects of pipe rupture from high energy lines resulting from pipe whip and jet impignment.

Protection against the effects of an elevated
temperature/pressure/humidity environment associated with a break 7
of a high energy line will be provided by barriers between these
lines and the RHR and CCW equipment designed to direct water and
steam vapors away from these rooms. Piping falling into this 10

category are the main steam and feedwater lines running between the Containment and the Turbine Building & the steam lines going 10
to the turbine driven feedwater pumps. These barriers will also be water proofed as necessary, to prevent damage resulting from flooding.

There are no moderate energy lines in the safeguards area which would result in an elevated temperature/pressure/humidity environment.

Protection against the flooding affects of both high and moderate energy lines, will be as follows:(1)

<u>RHR Pump Room & Valve Room</u> A five foot curb will be provided at the entrance to these rooms and waterproofing will be provided up to this level to protect against a flood resulting from a break in a line outside the room. The flooding level is based on an analysis assuming a crack in the 30-inch component cooling water supply, the worse possible break in the engineering safety features area (except for feedwater break previously discussed). The flow rate through this crack was calculated, to be 2200 GPM and the rate of water rise 0.16 feet per minute. With a five foot curb this would allow sufficient time, over 30 minutes, for corrective action to be taken. Total floor area for flooding was calculated to be 2400 square feet. A crack of the moderate energy component cooling water piping located in the RHR pump compartment will result in a leak of less than 20 GPM. In 7
30 minutes the room will flood to a level of 6-inches. This level of flooding will not damage any safety related equipment. No liquid filled lines, other than RHR lines, are in the valve room. Protection of the RHR equipment in these compartments from a failure of RHR piping is not required since a redundant RHR train is available, and in accordance with BTP APCSB 3-1 a single failure of the redundant RHR train need not be assumed.

<u>RHR Heat Exchanger Compartment</u>-There is no safety related equipment in this compartment which can be damaged by flooding.

<u>RHR Valve Operating Room</u>-The entrance to this room is located above the flood level calculated previously and therefore no special provisions for water proofing are required.

(1) Except for steam and feedwater lines which have already been discussed above.

TABLE 3.11-4
(Sheet 1 of 2)

Environmental Conditions for Qualification Tests
for ESF Components Located Outside Containment

System	Components	Pressure (psig)	Temp. (F)	Relative Humidity (%) (5)	Integrated Rads Doses (Rads) (4) Gamma	Beta	Total Test Time Duration (Sec)	pH (5)	Notes	
Containment Spray	Valve Operators	atm	110	95	$4x10^6$	negli-	10^5-10^6	7.0	(1)	
	Pump Motors	atm	120	100	$4x10^6$	gible	10^5-10^6	7.0		
	Instrument Sensors	atm	120	95	$1x10^3$	negli-gible	10^5-10^6	7.0		8
Emergency Power	ESF Diesel Generator	atm	120	100	$1x10^3$	negli-	10^5-10^6	7.0	(1)	
	Valve Operators	atm	120	100	$1x10^3$	gible	10^5-10^6	7.0		
	Control Panels (local)	atm	120	100	$1x10^3$	negli-gible	10^5-10^6	7.0		
	ESF 6.9kV SWGR	atm	104	100	$1x10^3$	negli-	10^5-10^6	7.0		
	ESF 4.80kV SWGR	atm	104	100	$1x10^3$	gible	10^5-10^6	7.0		
	ESF transformers	atm	104	100	$1x10^3$	negli-	10^5-10^6	7.0		
	battery chargers	atm	104	100	$1x10^3$	gible	10^5-10^6	7.0		
	inverters	atm	104	100	$1x10^3$	negli-	10^5-10^6	7.0		
	batteries	atm	80	100	$1x10^3$	gible	10^5-10^6	7.0		
	Hot Shutdown Panel	atm	104	100	$1x10^3$	negli-	10^5-10^6	7.0		
	ESF dc SWGR	atm	104	100	$1x10^3$	gible	10^5-10^6	7.0		
	ESF ac-dc Distribution Panels	atm	104	100	$1x10^3$	negli-gible	10^5-10^6	7.0		
	ESF Motor Control Centers	atm	104	100	$1x10^3$	negli-	10^5-10^6	7.0		
	ESF Aux. Panel Board	atm	80	100	$1x10^3$	gible	10^5-10^6	7.0		
Aux. Bldg. Ventilation	ESF Fan Motors	atm	104	95	$4x10^4$	negli-	10^5-10^6	7.0		
	Instrument Sensors	atm	104	95	$4x10^4$	gible	10^5-10^6	7.0	(1)	
Auxiliary Feedwater	Pump motor assembly	atm	104	100	$4x10^4$	negli-		7.0	(1)	
	Sensors	atm	104	100	$4x10^4$	gible				
	Turbine driven AFW Pump, associated valve operators, controls, and instruments	atm	114	100	$4x10^4$	negli-gible		7.0	(1)	10
Service Water	Valve Operators	atm	120	95	$1x10^3$	negli-		7.0	(1)	
	Sensors	atm	120	95	$1x10^3$	gible		7.0	(1)	8

TABLE 3.11-4
(Sheet 1a of 2)

Environmental Conditions for Qualification Tests
for ESF Components Located Outside Containment

System	Components	Pressure (psig)	Temp. (F)	Relative Humidity (%) (5)	Integrated Rads Doses (Rads) (4) Gamma	Beta	Total Test Time Duration (Sec)	pH (5)	Notes
SG Feedwater	Control valve operator Pump controls	atm atm		100	$1x10^3$	negli- gible	100	7.0	(2)
Main Steam	Turbine driven AFW Pump steam supply valve operators			100	$1x10^3$	negli- gible	100	7.0	(2)

8

TABLE 3.11-4
(Sheet 2 of 2)

Environmental Conditions for Qualification Tests
for ESF Components Located Outside Containment

System	Components	Pressure (psig)	Temp. (F)	Relative Humidity (%) (5)	Integrated Rads Doses (Rads) (4) Gamma	Beta	Total Test Time Duration (Sec)	pH (5)	Notes
	Sensors Control Valve Operators			100	1x10^{3}	negli-gible	100	7.0	(2)
Component Cooling Water	Pump motor Control Valve Operators	atm atm	104	95	1x10^{3}	negli-gible	10^{5}-10^{6}	7.0	(1)
	Sensors	atm	104	95	1x10^{3}	negli-gible	10^{5}-10^{6}	7.0	
Control Room	Control board instruments and instrument racks	atm	80	60	1x10b3	negli-gible		7.0	(1)
Seismic Category I Portion of Fire Protec-tion	Booster Pump & motor assembly, valves & controls, sensors	atm	104	95	1x10^{3}	negli-gible		7.0	(1)
SFP Cooling	Valve controls, sensors	atm	120	100	4x10^{4}	negli-gible	10^{6}	7.0	(1)
Hydrogen Purge	Hydrogen detection	atm	120	100	4x10^{4}	negli-gible	10^{6}	7.0	(1), (3)

8

Note: 1. Environmental conditions listed are assumed to be the same for either LOCA or MSLB cases.

2. Conditions are based on MSLB - see Figure 3.11-2

3. System is NNS, non-seismic Category I, serving as a backup to the hydrogen recombiners.

4. Radiation doses as total for entire test time

5. Humidity and pH are held constant during the test

 1

8. ELECTRIC POWER

CONTENTS

10

TABLES

FIGURES

8.0 ELECTRIC POWER

8.1 <u>Introduction</u>

8.1.1 Utility Grid Description

This information is provided in the Utility-Applicant's SAR.

8.1.2 Onsite Electric System Description

The onsite electric system includes power supplies, distribution |1
equipment, and instrumentation and controls to supply power to
the unit auxiliary loads (normal and safety-related) during
startup, normal operation, and normal and emergency shutdown.
Connection of the generator to the unit output switchyard is made |10
via isolated-phase bus duct (generator main leads), load break
switch, and main step-up transformers.

Power to the unit 6900-V auxiliary bus systems is furnished through either the unit auxiliary or station service transformers.

Normally when the plant is in operation, the non-safety-related
auxiliaries are supplied from the main generator via the load
break switch, and two unit auxiliary transformers. The offsite |10
power supply via the station service transformers serves as a
backup source. The supply to the unit auxiliary transformers is
derived from a bus tap located between the load break switch and
the main step-up transformers by means of isolated-phase bus
duct.

Safety-related auxiliaries normally are supplied from the primary offsite power source via two separate and independent station service transformers. When the load break switch is open the back feed connection from the Unit output switchyard, via the main transformers and the unit auxiliary transformers, serves as the alternate offsite power source.

During startup and shutdown of the plant, the non-safety-related auxiliaries are powered from the alternate offsite power source via the main step-up and unit auxiliary transformers. After synchronizing the main generator with the alternate offsite power source, the load break switch is closed without interruption of power to the non-safety-related auxiliaries. The safety-related auxiliaries are continuously powered from the primary offsite power source. The station service and the unit auxiliary transformers are connected to the 6900-V bus system and provide two independent means of supply to the safety-related equipment from the offsite power systems without relying on the main generator.

The plant startup can also be achieved by supplying power to the Class IE and non-Class IE buses from the primary offsite power source via the station service transformers. Synchronization between the main generator and alternate offsite power source can be achieved either across the load break switch or a switchyard breaker. Following synchronization of the main generator to the alternate offsite power source the non-Class IE buses will be transferred (live) to the unit auxiliary transformers.

Upon a loss of all external ac power, station standby power sources consisting of two diesel generators are provided to satisfy the loading requirements of the ac Class IE loads. System redundancy precludes loss of all onsite power due to any single failure.

A third diesel generator, non-Class IE, is provided to satisfy the loading requirements of the ac non-safety-related essential loads.

Direct-current Class IE loads of the unit are supplied by four 10
independent and redundant 125-V Class IE battery systems. Direct-current loads that are not Class IE receive power through an independent non-Class IE 125/250-V battery system to protect the integrity of the 125-Vdc Class IE systems.

Alternating-current and direct-current Class IE loads of the unit are each divided into redundant load groups, each energized from an independent Class IE power supply. There is no
interconnections between redundant load groups. 10

Table 8.1-2 outlines the acceptance criteria for the electric power system.

8.1.3 Safety-Related Loads

The safety loads that require electric power to perform their safety functions are identified in Table 8.1-1. This table includes the safety load, safety functions performed, and type of electric power (ac or dc or both).

8.1.4 Design Criteria

The design bases, criteria, Regulatory Guides, standards, and other documents that are implemented in the design of the safety-related systems are listed below. These documents are described in Sections 3.1, 8.2 and 8.3. | 10

1. 10 CFR Part 50, Appendix A; General Design Criteria | 10
for Nuclear Power Plants, U.S. Nuclear Regulatory Commission, January 1, 1976 | 10

2. Regulatory Guide 1.6, Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems, U.S. Nuclear Regulatory Commission, March 10, 1971

3. Regulatory Guide 1.9, Selection of Diesel Generator Set Capacity for Standby Power Supplies, U.S. Nuclear Regulatory Commission, March 10, 1971

4. Regulatory Guide 1.12, Instrumentation for Earthquakes, U.S. Nuclear Regulatory Commission, April 1974

5. Regulatory Guide 1.22, Periodic Testing of Protection System Actuation Functions, U.S. Nuclear Regulatory Commission, February 17, 1972

6. Regulatory Guide 1.29, Seismic Design Classification, U.S. Nuclear Regulatory Commission, February, 1976 | 10

7. Regulatory Guide 1.30, Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electrical Equipment, U.S. Nuclear Regulatory Commission, August 11, 1972

8. Regulatory Guide 1.32, Use of IEEE Std 308-1974, Criteria for Class 1E Electric Systems for Nuclear Power Generating Stations, U.S. Nuclear Regulatory Commission, February, 1977 10

9. Regulatory Guide 1.40, Qualification Tests of Continuous-Duty Motors Installed Inside the Containment of Water-Cooled Nuclear Power Plants, March 1973. 10

10. Regulatory Guide 1.41, Preoperational Testing of Redundant Onsite Electric Power Systems to Verify Proper Load Group Assignment, U.S. Nuclear Regulatory Commission, March 16, 1973 10

11. Regulatory Guide 1.47, Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems, U.S. Nuclear Regulatory Commission, May 1973 10

12. Regulatory Guide 1.53, Application of the Single Failure Criterion to Nuclear Power Plant Protection Systems, U.S. Nuclear Regulatory Commission, June 1973 10

13. Regulatory Guide 1.62, Manual Initiation of Protective Actions, October 1973. 10

14. Regulatory Guide 1.63, Electric Penetration Assemblies in Containment Structures for Water-Cooled Nuclear Power Plants, U.S. Nuclear Regulatory Commission, May, 1977 10

10

15. Regulatory Guide 1.64, Quality Assurance 10
Requirements for the Design of Nuclear Power Plants, U.S. Nuclear Regulatory Commission, June 1976 10

16. Regulatory Guide 1.68, Preoperational and Initial 10
Startup Test Programs for Water Cooled Nuclear Power Plants, U.S. Nuclear Regulatory Commission, January 1977 10

17. Regulatory Guide 1.73, Qualification Tests of 10
Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants, U.S. Nuclear Regulatory Commission, January 1974

18. Regulatory Guide 1.75, Physical Independence of 10
Electric Systems, U.S. Nuclear Regulatory Commission, January 1975

19. Regulatory Guide 1.81, Shared Emergency and 10
Shutdown Electric Systems for Multi-Unit Nuclear Power Plants January 1975

20. Regulatory Guide 1.89, Qualification of Class 1E 10
Equipment for Nuclear Power Plants, U.S. Nuclear Regulatory Commission, November 1974

21. Regulatory Guide 1.93, Availability of Electric 10
Power Sources, U.S. Nuclear Regulatory Commission December 1974

22. Regulatory Guide 1.108, Periodic testing of Diesel Generator Units used as onsite Electric Power systems at Nuclear Power Plants, U.S. Nuclear Regulatory Commission, August 1977 and ERRATA issued in September 1977.

23. Regulatory Guide 1.118, Periodic Testing of Electric Power and Protection Systems June 1978.

24. Regulatory Guide 1.128, Installation Design and 10
Installation of Large Lead Storage Batteries for Nuclear Power Plants October 1978.

25. Regulatory Guide 1.129, Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Nuclear Power Plants February 1978.

26. Branch Technical Position (EICSB) 1, November 1975, Backfitting of the Protection and Emergency Power Systems of Nuclear Reactors. 10

27. Branch Technical Position (EICSB) 2, November 1975, Diesel - Generator Reliability Qualification Testing, U.S. Nuclear Regulatory Commission

28. Branch Technical Position (EICSB) 6, November 1975, Capacity Test Requirements of Station Batteries - Technical Specification, U.S. Nuclear Regulatory Commission 10

29. Branch Technical Position (EICSB) 7, November 1975, Shared Emergency Electric Power Systems for Multi-Unit Generating Stations. 10

30. Branch Technical Position (EICSB) 8, November 1975, Use of Diesel - Generator Sets for Peaking, U.S. Nuclear Regulatory Commission 10

31. Branch Technical Position (EICSB) 10, November 1975, Electrical and Mechanical Equipment Seismic Qualification Program, U.S. Nuclear Regulatory Commission 10

32. Branch Technical Position (EICSB) 11, November 1975 Stability of Offsite Power Systems, U.S. Nuclear Regulatory Commission 10

33. Branch Technical Position (EICSB) 15, November 1975, Reactor Coolant Pump Breaker Qualification, U.S. Nuclear Regulatory Commission 10

34. Branch Technical Position (EICSB) 17, November 1975, Diesel - Generator Protective Trip Circuit Bypasses, U.S. Nuclear Regulatory Commission 10

35. Branch Technical Position (EICSB) 21, November 1975, Guidance for Application of Regulatory Guide 1.47, U.S. Nuclear Regulatory Commission 10

36. Branch Technical Position (EICSB) 22, November 1975, Guidance for Application of Regulatory Guide 1.22, U.S. Nuclear Regulatory Commission 10

37. Branch Technical Position (EICSB) 27, November 1975, Design for Thermal Overload Protection for Motors of Motor Operated Valves, U.S. Nuclear Regulatory Commission 10

38. IEEE 279-1971, Criteria for Protection Systems for Nuclear Power Generating Stations 10

39. IEEE 308-1974, Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations 10

40. IEEE 317-1976, Electrical Penetration Assemblies in Containment Structures for Nuclear Power Generating Stations 10

41. IEEE 323-1974, Standard for Qualifying Class 1E Electrical Equipment for Nuclear Power Generating Stations (Basic Acceptance Criteria) 10

42. IEEE 334-1974, Standard for type Tests of Continuous-Duty Class 1E Motors for Nuclear Power Generating Stations 10

43. IEEE 336-1977, Installation, Inspection, and Testing Requirements for Instrumentation and Electric Equipment During the Construction of Nuclear Power Generating Stations 10

44. IEEE 338-1977, Trial-Use Standard Criteria for the Periodic Testing of Nuclear Power Generating Station Protection Systems 10

45. IEEE 344-1975, Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations 10

46. IEEE 352-1975, Guide for General Principles of Reliability Analysis of Nuclear Power Generating Station Protection Systems 10

47. IEEE 379-1977, Guide for the Application of Single Failure Criterion to Nuclear Power Generating Station Protection Systems 10

48. IEEE 380-1975, Definitions of Terms Used in IEEE Standards on Nuclear Power Generating Stations 10

49. IEEE 382-1972, Guide For Type Tests of Class 1 Electric Valve Operators For Nuclear Power Generating Stations 10

50. IEEE 383-1974, Standard for Type Tests of Class 1E Electric Cables, Field Splices and Connections for Nuclear Power Generating Stations 10

51. IEEE 384-1977, Trial-Use Standard Criteria for Separation of Class 1E Equipment and Circuits 10

52. IEEE 387-1977, Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations 10

53. IEEE 420-1973, Trial Use Guide for Class 1E Control Switchboards for Nuclear Power Generating Stations (ANSI N41.17) 10

54. IEEE 422-1977 Guide for the Design and Installation of Cable Systems in Power Generating Stations. 10

55. IEEE 450-1975, Recommended Practice for Maintenance, Testing, and Replacement of Large Stationary Type Power Plant and Substation Lead Storage Batteries

56. IEEE 484-1975, Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries 10

57. IEEE 494-1974, Standard Method for Identification of Documents Related to Class 1E Equipment and Systems for Nuclear Power Generating Stations 10

58. IEEE 497-1977 Trial-Use Standard Criteria for Post Accident Monitoring Instrumentation for Nuclear Power Generating Stations.

59. IEEE 577-1976 Requirements for Reliability Analysis in the Design and Operation of Safety System for Nuclear Power Generating Stations. 10

60. IEEE 603-1977 Trial-Use Standard Criteria for Safety Systems for Nuclear Power Generating Stations.

61. ANSI C37.20, Switchgear Assemblies, Including Metal Enclosed Bus (IEEE 27)

62. ANSI N45.2.11-1974, Quality Assurance Requirements for Design of Nuclear Power Plants 10

63. ANSI C57.12, General Requirements for Distribution, Power and Regulating Transformers. 10

64. IPCEA S-19-81 1969, "Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy." 10

65. IPCEA P - 46-426 1962, Power Cable Ampacities

66. IPCEA P-54-440 1975, Ampacities for Cables in Open Top Cable Trays.

67. NEMA SG 3-1971, Low Voltage Power Circuit Breakers

68. NEMA SG 4-1968, AC High Voltage Circuit Breakers 10

69. NEMA SG 5-1971, Power Switchgear Assemblies

70. NEMA SG 6-1974, Power Switching Equipment

71. NEMA TR1-1974, Transformers, Regulators and Reactors

72. NEMA MG-1-1972, Motors and Generators

73. NFPA NO. 70-1978, National Electrical Code 1978 Edition 10

74. NEMA VE 1-1971, Cable Tray Systems

75. Illuminating Engineering Society Lighting Handbook, 5th Edition, 1972

Additional standards, guides, recommended practices, and test procedures, for specific equipment are detailed in the equipment purchase specifications from among the publications of ANSI, IEEE, IPCEA, NEMA, NFPA, and others as required.

The extent of implementation of the design criteria for NSSS equipment is discussed in the NSSS SSAR.

8.1.5 Compliance

a. Compliance with Regulatory Guides 1.6, 1.9, 1.32, 1.75 and IEEE Standards 308, 344 and 387 |10

Class 1E electric systems are designed to comply with Regulatory Guides 1.6, 1.9, 1.32, 1.75 and IEEE 308, 344, and 387 as discussed in Section 8.3.

b. Compliance with Regulatory Guide 1.93

The reactor operation conforms to Regulatory Guide 1.93 as described in Technical Specification subsection 3/4.8.

c. Compliance with Regulatory Guide 1.63 and IEEE Standard 317

Electric penetrations are designed, tested and documented in accordance with IEEE 317 as augmented in Regulatory Guide 1.63 as discussed in subsection 8.3.1.2.6. |10

d. Compliance with Regulatory Guide 1.41

Preoperational testing of redundant onsite electric power systems conforms to Regulatory Guide 1.41.

e. Compliance with Regulatory Guide 1.22

The protection system is designed to permit periodic testing as required in accordance with Regulatory Guide 1.22.

f. Compliance with IEEE Standard 338

The periodic testing of the reactor trip systems and engineered safeguards feature actuation systems conforms to the requirements of IEEE 338.

g. Compliance with Regulatory Guide 1.30

The quality assurance program of Class 1E instrumentation and electric equipment satisfies the requirement outlined in Regulatory Guide 1.30.

h. Compliance with Regulatory Guide 1.29

Instrumentation and electric components designated as seismic Category I required for systems described in Regulatory Guide 1.29 are designated to withstand the effects of the SSE and remain functional.

i. Compliance with Regulatory Guide 1.81

Since the standard plant is designed to be independent of other units the Class 1E system satisfies the Regulatory Guide 1.81.

j. Compliance with Regulatory Guide 1.89 and IEEE Standard 323

All groups of Class 1E equipment are environmentally qualified in accordance with Regulatory Guide 1.89 and IEEE 323 using valid techniques as discussed in Section 3.11. |10

k. Compliance with Regulatory Guide 1.40

Qualification tests of continuous-duty motors installed inside the containment conform to Regulatory Guide 1.40.

l. Compliance with Regulatory Guide 1.47

Bypassed and inoperable status indication for Class 1E equipment conforms to Regulatory Guide 1.47.

m. Compliance with Regulatory Guide 1.53

The application of single failure criterion to plant protection systems conforms to Regulatory Guide 1.53. 10

n. Compliance with Regulatory Guide 1.62

The manual initiation of protective actions is designed in accordance with Regulatory Guide 1.62.

o. Compliance with Regulatory Guide 1.73

Qualification tests of electric valve operators installed inside the containment conform to Regulatory Guide 1.73.

The extent of implementation of Regulatory Guides for NSSS equipment is discussed in the NSSS SSAR.

TABLE 8.1-1
(Sheet 1 of 2)

SAFETY LOADS AND FUNCTION

(Westinghouse-414) 1

Safety Load	Function	Power	
Safety injection pumps	Provide emergency core cooling	ac	
Centrifugal charging pumps	Provide borated water to primary coolant during main steam line break	ac	10
Residual heat removal pumps	Provide emergency core cooling and reactor heat removal during blackout	ac	1
Containment spray pumps	Provide cooling spray in containment following LOCA and main steam line break	ac	10
Service Water pumps	Provide cooling water for component cooling water heat exchangers, emergency makeup source to auxiliary feedwater system	ac	
Component cooling water system pumps	Provide cooling water to safety-related equipment	ac	1
Auxiliary feedwater pumps	Provide adequate water to steam generators in the event of a unit trip coupled with a loss of offsite power	ac	
Spent-fuel pool coolant pumps	Cool spent fuel	ac	
Hydrogen recombiner	Reduce hydrogen concentration in containment following DBA	ac	10
Emergency air conditioning and ventilation	Maintain safe operating ambient conditions for personnel and safety-related equipment	ac	1

TABLE 8.1-1
(Sheet 2 of 2)

SAFETY LOADS AND FUNCTION

(Westinghouse-414) 1

Safety Load	Function	Power	
Boron injection tank heaters, surge tank heaters, and heat tracing system	Prevent boric acid crystallization	ac	10 1 10
Motor-operated valves, small motors, fans and heaters associated with safety-related equipment	Ensure coordinated operation of safety-related systems	ac	1
Reactor trip system	Provide safe plant shutdown	ac and dc	
Engineered safety features actuation system	Provides for actuation of engineered safety features	ac and dc	10
Safety-related plant instrumentation	Provide safe reactor operation and postaccident shutdown	ac	
Instrument buses	Provide power to vital instrumentation and control equipment	ac	1
Shutdown control and instrumentation	Provide control to shutdown plant from outside of control room	ac and dc	
Instrument bus inverters	Provide power to vital instrument buses	dc	
Battery chargers	Provide charging to batteries	ac	

10

TABLE 8.1-2
(Sheet 1 of 5)

ACCEPTANCE CRITERIA FOR ELECTRIC POWER SYSTEM
(Westinghouse - 414)

Criteria	Offsite Power System	Onsite ac Power System	Onsite dc Power System
1. 10 CFR Part 50			
a. 10 CFR Part 50.34	x	x	x
b. 10 CFR Part 50.36	x	x	x
c. 10 CFR Part 50.55a	x	x	x
2. General Design Criteria, 10 CFR Part 50, Appendix A	x	x	x
3. Regulatory Guide			
1.6		x	x
1.9		x	
1.12		x	x
1.22		x	x
1.29		x	x
1.30	x	x	x
1.32	x	x	x
1.40		x	

10

TABLE 8.1-2
(Sheet 2 of 5)

ACCEPTANCE CRITERIA FOR ELECTRIC POWER SYSTEM
(Westinghouse - 414)

Criteria	Offsite Power System	Onsite ac Power System	Onsite dc Power System
1.41		x	x
1.47		x	x
1.53		x	x
1.62		x	x
1.63		x	x
1.64		x	x
1.68		x	x
1.70	x	x	x
1.73		x	
1.75		x	x
1.81		x	x
1.89		x	x
1.93	x	x	x

10

TABLE 8.1-2
(Sheet 3 of 5)

ACCEPTANCE CRITERIA FOR ELECTRIC POWER SYSTEM
(Westinghouse - 414)

Criteria	Offsite Power System	Onsite ac Power System	Onsite dc Power System	
1.100		x	x	
1.006		x		
1.108		x		
1.118	x	x	x	
1.128			x	10
1.129			x	
4. Branch Technical Positions (BTPs)				
EICSB 2		x		
EICSB 6			x	
EICSB 8		x		
EICSB 10		x	x	
EICSB 11	x			
EICSB 15		x		

TABLE 8.1-2
(Sheet 4 of 5)

ACCEPTANCE CRITERIA FOR ELECTRIC POWER SYSTEM
(Westinghouse - 414)

Criteria	Offsite Power System	Cnsite ac Power System	Onsite dc Power System
EICSB 17		x	
EICSB 18		x	
EICSB 21	x	x	x
EICSB 22		x	x
EICSB 27		x	x
5. IEEE Standards			
279-1971		x	x
308-1974	x	x	x
317-1972		x	x
323-1974		x	x
334-1974		x	
336-1971	x	x	x
338-1975	x	x	x
344-1975		x	x
352-1975		x	x

10

TABLE 8.1-2
(Sheet 5 of 5)

ACCEPTANCE CRITERIA FOR ELECTRIC POWER SYSTEM
(Westinghouse - 414)

Criteria	Offsite Power System	Onsite ac Power System	Onsite dc Power System
379-1972		x	x
380-1972	x	x	x
382-1972		x	
383-1974		x	x
384-1974		x	x
387-1972		x	
420-1975		x	x
450-1975			x
484-1975			x
494-1974		x	x

10

8.2 Offsite Power System

This section is provided in the Utility-Applicant's SAR.

8.2.1 Interface Requirements

The Gibbs & Hill Standard Nuclear Power Plant is designed to have two physically independent and separate offsite power sources. The primary offsite source provides power to the station service transformers. The alternate offsite source provides power via a backfeed connection from the unit output switchyard through the main transformers and the unit auxiliary transformers. This is as shown on the Simplified Main One Line Diagram, Figure 8.3-1. Both of the offsite sources may be in the same switchyard. Two independent circuits are required so that a failure of one circuit will in no way affect the other and result in the loss of both circuits. The Utility-Applicant's must perform a system stability analysis and the offsite power system must be capable of satisfying the following station power requirement:

a. Two independent power sources as described above

b. Steady state load of approximately (later) MVA

c. Nominal voltage (for station service transformers) as available for primary, 6.9 kV for secondary

d. Allowable voltage variation, assumed to be ±5 percent during normal operation 10

e. Nominal frequency, 60 Hz

The Utility Applicant must also perform an analysis to determine the frequency decay rate of the grid system. This frequency rate is required by RESAR-414, in setting of the reactor coolant pump underspeed trip set point.

8.3 Onsite Power Systems

8.3.1 ac Power Systems

8.3.1.1 Description

The onsite ac power systems consist of various auxiliary electrical systems designed to provide reliable electrical power to safety-related and non-safety-related station loads. Redundancy of systems and components ensures safe reactor 1 shutdown during an SSE or DBA, or both, and mitigates release of radioactive material to the environs. Figure 8.3-1 depicts the main one line of the electrical power distribution system. Figures 8.3-3 to 8.3-8 show the physical arrangement of major 10 Class 1E equipment and the separation of redundant power raceways. Power to the onsite Class 1E ac power distribution systems are furnished by one of the following systems: a main generator or an alternate offsite power source, primary offsite power source, or a standby power system (diesel generators).

a. Non-Safety-Related Distribution System

The unit distribution system uses voltage levels of 6900 V and 480 V for main power distribution. Bus arrangements, bus interconnections, transformer supplies, and power supplies are shown on Figure 8.3-1 Simplified Main One Line Diagram. The 10 non-Class 1E distribution system consists of eight 6900-V buses which furnish power to non-Class 1E loads. Transformation from 6900 V to 480 V provides the required power for the 480-V-auxiliaries and a 120/208-V lighting system. Power distribution at 480-V is accomplished through non-safety-related buses for the unit.

The unit auxiliary transformers are connected to the main generator via the load break switch. The supply for the primary winding of the unit auxiliary transformers is tapped between the load break switch and the low-voltage bushings of the main step-up transformers.

During startup of plant the load break switch is in the open position, the non-safety-related buses are powered from the 10 alternate offsite power source via the main and unit auxiliary transformers. The safety related buses are powered from the primary offsite power source via the station service transformers. The operator monitors the synchronizing system displays and when the main generator is in proper phase and voltage relationship with the alternate offsite power source, the load break switch will be manually closed by the operator without interruption of power to the non-safety-related buses. The bus supply breakers are not interlocked with the load break switch.

During normal plant operation, the non-safety-related buses are energized by the main generator through the load break switch and unit auxiliary transformers, and the safety related buses remain energized from the primary offsite power source. The load break switch is in a closed position.

a. In the event of a failure of the primary offsite power source the safety related buses will automatically fast-transfer to the main generator output.

b. In the event of a turbine trip, the load break switch will open automatically and isolate the main generator from the system. The nonsafety related buses will then remain energized via the backfeed connections from the alternate offsite power source through the main and unit auxiliary transformers. 10

c. In the event of an electrical fault in the generator protection zone, since the load break switch is not designed to interrupt fault current, it will remain closed and the main generator switchgear breaker will trip. The non-safety-related buses will automatically transfer to the primary offsite power source.

During a planned shutdown of the plant, the load break switch will be opened manually and the non-safety-related buses will remain energized via the backfeed connection from the alternate offsite power source through the main and unit auxiliary transformers. Safety related buses will remain energized from the primary offsite power source.

The capability of the load break switch to perform its required operational function will be demonstrated by qualification testing. The qualification testing program will show that the load break switch is able to perform its required operational functions reliably to assure that the requirements of General Design Criterion 17 are met.

10

The plant has two three-winding, three-phase, 60-Hz unit auxiliary transformers with secondary voltage of 6900-V. The secondary windings of each unit auxiliary transformer are connected to the 6900-V buses by means of metal-enclosed bus ducts as follows (see Figure 8.3-1, Class 1E bus supply circuit breakers in normal cubicle):

Transformer		Buses
TIA-1	x winding	1A1, 1A5, 1EA1
	y winding	1A2, 1A6
TIA-2	x winding	1A3, 1A7
	y winding	1A4, 1A8, 1EA2

Alternate locations for circuit breaker elements provide a means for maintaining power to the Class 1E buses; the details are described in subsection 8.3.1.1.b.

Switchgear for all the 6900-V buses is standard 500 MVA interrupting-capacity 7.2-kV class metal clad medium-voltage 10
switchgear. All circuit breakers are air-break type. Continuous current ratings are 1200 A for load feeder breakers. Incoming supply breakers for buses 1A1, 1A2, 1A3, and 1A4 are rated 2000 A continuous. Incoming supply breakers for reactor coolant pump buses are rated 1200 A continuous. The switchgear is metal clad with metal barriers between breakers. The 6900-V Class 1E switchgear and the 6900-V switchgear that energizes the non-Class 1E reactor coolant pumps are located in a seismic Category I structure, as shown in Figures 8.3-5 and 8.3-7, and are seismically qualified in accordance with the criteria discussed in Section 3.10. Two circuit breakers are connected in 10
series to feed each reactor coolant pump motor, as shown in Figure 8.3-1. The circuit

breakers conform to principal design criteria specified in IEEE 308-1974. 1

Each of the circuit breakers on reactor coolant pump buses 1A5, 1A6, 1A7, and 1A8 receives a trip signal in the event of an underspeed condition. The underspeed trip signal design is described in Section 7.2 of the NSSS SSAR. The frequency decay rates of the grid do not influence or prevent the full coastdown of the reactor coolant pumps under this condition. 10

Generally, motor loads exceeding 250 hp are rated 6600-V, and are connected to the 6900-V buses for across-the-line starting.

Dry-type transformers (6900 V to 480 V, three-phase, 60 Hz) are connected to a 480-V metal-enclosed switchgear (600-V-class) arranged as double-ended load centers. The switchgear is arranged in several independent station service distribution bus connections. Air-break circuit breakers are furnished with rated interrupting capability of 50,000 A. A bus tie between the buses provides service if one transformer is unavailable. The 480-V switchgear provides power to various motor control centers (MCC) and motors.

Generally, motors rated up to 100 hp are connected to MCC and larger motors are connected to 480-V switchgear.

The 118-Vac, single-phase, 60-Hz power, which is required for essential non-Class 1E loads is supplied by solid-state inverters IVIC-1, IVIC-2, and IVIC-3 as shown in Figure 8.3-1. Each inverter receives incoming normal power supply from either non-safety-related 480-Vac MCC 1B5-1 or 1B5-2, and a backup dc power supply from 125/250-V battery BT1D2-2 by means of an auctioneering-type circuit. The distribution panel RT1C1 provides an alternate source of regulated ac power to the 118-Vac buses during inverter maintenance periods. During blackout conditions, 480-Vac MCCs 1B5-1 and 1B5-2 receive power from a self-contained diesel generator 1G1 which ensures continuity of essential non-safety-related services.

Control power for all switchgear is obtained from the 125-Vdc systems. The 125-Vac systems are described in subsection 8.3.2. 10

b. Safety Related Distribution System

1) Power Supply Feeders

The primary offsite power source supplies power to the Class 1E buses through the station service transformers during all modes of operation of the unit, while the supply from the unit auxiliary transformers serves as a backup.

The station service transformer connection to the offsite substation is site-specific; however, it is independent of the connection to the main step-up tranformers from the unit output switchyard.

The plant has two three-winding, three-phase, 60-Hz station service transformers, each with secondary voltage of 6900-V. 10

The secondary windings of each station service transformer are connected to the 6900-V buses by means of metal-enclosed bus ducts as follows (see Figure 8.3-1, Class 1E bus supply circuit breakers in normal cubicle):

Transformer		Buses
T1A-3	x - winding	1A1, 1A5, 1EA1
	y - winding	1A2, 1A6
T1A-4	x - winding	1A3, 1A7
	y - winding	1A4, 1A8, 1EA2

10

The alternate offsite power source connections to Class 1E buses 1EA1 and 1EA2 are achieved through main step-up transformers T1-1 and T1-2, and the unit auxiliary transformers T1A-1 and T1A-2. The main step-up transformer secondary are connected to the unit output switchyard via an overhead transmission line, the length of which is site specific. 10

The secondary windings of each unit auxiliary transformer are connected to the 6900-V buses by means of metal-enclosed bus duct as follows (see Figure 8.3-1, 10
Class 1E bus supply circuit breakers in normal cubicle):

Transformer		Buses
T1A-1	x-winding	1A1, 1A5, 1EA1
	y-winding	1A2, 1A6
T1A-2	x-winding	1A3, 1A7
	y-winding	1A4, 1A8, 1EA2

Class 1E buses 1EA1 and 1EA2 of the unit can be supplied by two independent and reliable immediate-access offsite power sources, the first through the station service transformer and the second through the main step-up and 10
unit auxiliary transformers.

As noted previously and as shown in Figure 8.3-1, further flexibility of alternate power sources to Class 1E buses 1EA1 and 1EA2 can be achieved by relocation of various supply circuit breakers when either one station service transformer or one unit auxiliary transformer, or the proper combination of both transformers are out of service. The following paragraphs describe the planned relocation of these circuit breakers for the various postulated operating conditions.

When station service transformer T1A-3 is out of service, relocation of circuit breaker, item 8, to alternate cubicle, as shown in Figure 8.3-1 , enables station service transformer T1A-4 to supply power to Class 1E bus 1EA1 in addition to Class 1E bus 1EA2.

When station service transformer T1A-4 is out of service, relocation of circuit breaker, item 12, to alternate cubicle, as shown in Figure 8.3-1 , enables station service transformer T1A-3 to supply power to Class 1E bus 1EA2 in addition to Class 1E bus 1EA1.

When unit auxiliary transformer T1A-1 is out of service, relocation of circuit breaker, item 9, to alternate cubicle, as shown in Figure 8.3-1 , enables unit auxiliary transformer T1A-2 to supply power to Class 1E bus 1EA1 in addition to Class 1E bus 1EA2.

When unit auxiliary transformer T1A-2 is out of service, relocation of circuit breaker, item 13, to alternate cubicle, as shown in Figure 8.3-1, enables unit auxiliary transformer T1A-1 to supply power to Class 1E bus 1EA2 in addition to Class 1E bus 1EA1.

When one unit auxiliary transformer or one station service transformer is out of service, or proper combination of both are out of service, and after their associated circuit breakers have been relocated, the safety-related buses of the unit can be supplied by two independent and reliable immediate-access offsite power sources.

In addition to the two offsite sources described previously, the onsite standby diesel generators can supply power to Class 1E buses 1EA1 and 1EA2; refer to Subsection 8.3.1.1.c.

2) Busing Arrangement

Two independent and redundant 6900-V Class 1E buses are provided for the unit, each capable of supplying the minimum safety-related loads required to safely shut down the unit following a DBA. Each bus can be fed from two independent offsite power sources or from the diesel generator assigned to the bus.

Each Class 1E 6900-V bus supplies a double-ended load center (600 V class) through dry-type transformers (6900 V to 480 V, three-phase, 60 Hz) supplying 480-V, metal-enclosed switchgear. A bus tie between the bus sections of the double-ended load center provides continuity of service if one transformer is unavailable. Arrangement of buses is shown in Figure 8.3-1.

The voltage levels at the safety related buses will be optimized for the full load and minimum load conditions that are expected throughout the anticipated range of voltage variations of the offsite power source by the automatic operation of the on-load top charger of the Station Service and Unit Auxiliary Transformers. 10

To permit verification that bus voltage is within the suitable range during plant operation, voltages on the safety related 6900-V and 480-V buses are indicated in the control room.

3) Loads Supplied From Each Bus

The loads supplied from each independent and redundant 6900-V bus and 480-V load centers are shown in Table 8.3- 7. The loads supplied from each of the various motor control centers will be shown in the 10
Utility Applicant's FSAR.

4) Manual and Automatic Interconnections Between Buses, Buses and Loads, and Buses and Supplies

There are no manual or automatic interconnections between a Class 1E bus and its redundant counterpart. There is no way of connecting a load of one Class 1E bus to the redundant Class 1E bus. 10 Therefore, each Class 1E bus is completely independent of its redundant counterpart. The only time a Class 1E 6900-V bus is connected to more than one power source is after manual synchronization of one standby diesel generator to its related Class 1E bus. Paralleling of diesel generators is not possible due to electrical isolation and separation and administrative procedures which preclude testing more than one standby diesel generator at a time. Automatic transfer of a Class 1E 6900-V bus from the primary offsite power source to the alternate offsite power source is by sequential transfer fast transfer. 10

5) Interconnections Between Safety-Related and Non-Safety-Related Buses

There are no manual or automatic direct connections between any Class 1E (safety-related) bus and any non-Class 1E (non-safety-related) bus.

6) Redundant Bus Separation

All redundant buses are arranged to maintain electrical and physical isolation from each other in order to satisfy the single-failure criterion. Physical locations of these buses and related electrical distribution are shown in Figures 8.3-5 and 8.3-7. 10

The 6900-V and 480-V switchgear for the redundant safety-related loads are located in individual rooms in the seismic Category I auxiliary building. Each room contains only electrical equipment, thereby, minimizing exposure to mechanical, water, or fire damage caused by failure of equipment such as steam lines, waterlines, pumps and motors. Switchgear of redundant trains are further separated by placing the equipment on different floor elevations.

7) Equipment Capacities

All switchgear is adequately sized and coordinated to permit safe and reliable operation under normal, short circuit, and momentary current conditions.

The diesel generators are sized so that each set is capable of carrying the safety-related loads of its respective train for a DBA. 10

The estimated capacity of each diesel generator set and the estimated loads used to determine this capacity are given in Table 8.3-7. This estimated size will be revised, if required, as the detailed plant design progresses and depending on the manufacturer's standard sizes. The design and continuous rating applied is consistent with NRC Regulatory Guide 1.9 and IEEE 387.

Capacities of individual loads are determined on the basis of nameplate rating, pump pressure, and flow conditions or pump runout conditions. The basis of selection is noted in Table 8.3-1.

Interrupting capacity of switchgear, load center, MCCs, and distribution panels are selected on the basis of short-circuit calculations. Transformer impedances are selected to permit starting the largest motor on the bus without the voltage at the motor terminals dropping below 80 percent of the motor voltage rating, while still remaining within the interrupting and momentary capabilities of the breakers.

8) Automatic Loading and Stripping of Buses

The 6.9 kV Class 1E buses are normally fed from the primary offsite power supply through the Station Service Transformers.

In the event of a DBA the following significant operations are initiated:

a) The reactor is shutdown and the turbine generator is tripped 10

b) Tripping of the turbine generator will open the generator load break switch automatically.

c) All non-safety-related loads (non Class 1E) connected to the Class 1E busses are shed by the accident signal.

d) The diesel generator sets receive starting signals, however, the diesel generator circuit breaker remains open.

e) The safety related loads continue to operate and other safety related loads which are required for the safe shutdown of the plant are sequenced on in accordance with Table 8.3-1.

In the event of a DBA followed by the loss of the preferred offsite power source the following significant operations are initiated:

a) The reactor is shutdown and the turbine generator is tripped.

b) Tripping of the turbine generator will open the load break switch automatically. 10

c) All non safety related loads (non Class 1E) connected to the Class 1E buses are shed by the accident signal.

d) The diesel generator sets receive starting signals, however, the diesel generator circuit breakers remain open.

e) Automatic "fast transfer" of each 6.9 kV Class 1E bus to the corresponding unit auxiliary transformer will be initiated.

f) If the fast transfer is successfully completed safety related loads already operating continue to operate and the balance of safety related loads will be applied automatically in sequence in accordance with Table 8.3-1.

g) If the fast transfer is not completed, within the design time limit, then fast transfer is automatically blocked and the loads on the Class 1E busses, except those permanently connected will be automatically shed by either of the bus undervoltage protection schemes.

h) After load shedding is completed and if the alternate offsite power source is available automatic "slow transfer" (dead bus) is initiated.

i) If "slow transfer" is successfully completed the safety related loads will be applied automatically in sequence in accordance with Table 8.3-1.

j) In the event the "slow transfer" is not completed, within the design time, then the "slow transfer" is automatically blocked. After blocking the slow transfer and when the diesel generators have attained rated speed and voltage (approx 10 seconds from receipt of accident signal) and if there is no voltage on the 6.9 kV Class 1E buses, the diesel generator breakers will close automatically and the loading of the diesel generators will follow the sequence in accordance with Table 8.3-1.

In the event of a DBA concurrent with the loss of both offsite power sources the following significant operations are initiated: 10

a) The reactor is shutdown and the turbine generator is tripped.

b) Tripping of the turbine generator will open the load break switch automatically provided no fault currents are present.

c) All the non safety related loads (non Class 1E) connected to the Class 1E busses are tripped by the accident signal.

d) The diesel generator sets receive starting signals, however, the diesel generator circuit breakers remain open.

e) The loads on the Class 1E busses, except those permanently connected will be shed by either of the bus undervoltage protection schemes.

f) When the diesel generators have attained rated speed and voltage and if there is no voltage on the 6.9 kV Class 1E buses, the diesel generator breakers will close automatically and the loading of the diesel generators will follow the sequence in accordance with Table 8.3-1.

In the event of a loss of the preferred offsite power source without a DBA the following significant operations are initiated:

a) The diesel generator sets receive starting signals, however, the diesel generator circuit breakers remain open.

b) Automatic "fast transfer" of each 6.9 kV Class 1E bus to the corresponding unit auxiliary transformer will be initiated.

c) If the transfer is successfully completed no further operations are necessary.

d) If the fast transfer is not completed within the design time limit, than fast transfer is
automatically blocked and the loads on the Class 1E 10
busses will be automatically load shed by either of the bus undervoltage protection schemes.

e) After load shedding is completed and if the alternate offsite power source is available automatic "slow transfer" (dead bus) is initiated.

f) If "slow transfer" is successfully completed the loads will be applied automatically in sequence in accordance with Table 8.3-2.

g) In the event the slow transfer is not completed within the design time then the "slow transfer" is automatically blocked. After blocking the slow transfer and when the diesel generators have attained rated speed and voltage and if there is no voltage on the 6.9 kV Class 1E busses, the diesel generator breakers will close automatically and the loading of the diesel generators will follow the sequence in accordance with Table 8.3-2.

In the event both offsite power sources are lost without a DBA the following significant operations are initiated:

a) The reactor is shutdown and the turbine generator is tripped.

b) Tripping of the turbine generator will open the load break switch automatically provided no fault currents are present.

c) The diesel generator sets receive starting signals, however, the diesel generator circuit breakers remain open.

d) The loads on the Class 1E busses, except those permanently connected will be load shed by either of the bus undervoltage protection schemes.

e) When the diesel generators have attained rated speed and voltage and if there is no voltage on the 6.9 kV Class 1E busses, the diesel generator breakers will close automatically and the loading of the diesel generators will follow the sequence in accordance with Table 8.3-2. 10

In the event of a loss of the alternate offsite power source, main step-up and unit auxiliary transformers back feed not available, without a DBA the following significant operations are initiated:

a) Turbine, reactor and main generator trip.

b) Load break switch opens provided no fault currents are present.

c) The diesel generator sets receive starting signals, however, the diesel generator circuit breaker remains open.

d) Automatic "fast transfer" of each 6.9 kV non Class 1E bus (normal busses) to the preferred offsite power source is initiated. 6.9 kV Class 1E busses remain energized from the preferred offsite power source.

e) If the transfer is successfully completed plant shutdown proceeds with all auxiliary loads still available.

f) If the fast transfer is not completed within the design time limit, then fast transfer is automatically blocked and the loads on the 6.9 kV non Class 1E busses will be automatically shed by the bus undervoltage relays.

g) The loads on the Class 1E busses, which are being supplied by the preferred offsite source, continue to operate and any additional loads required for safe shutdown are sequenced on in accordance with Table 8.3-2.

Voltage conditions on the 6.9 kV Class 1E busses are monitored by two systems of undervoltage protection. One system senses a low or total loss of voltage and a second system which senses a sustained voltage 10
degradation of bus voltage. Each system consists of three voltage sensors connected in a two out of three coincidence scheme on each bus. The resultant output will incorporate a time delay to prevent spurious trips due to momentary voltage distrubances. Setpoints for the voltage sensors and time delay relays will be determined by analysis of the voltage requirement characteristics of the safety related equipment for all onsite distribution voltage levels. The time delay, including suitable margin, will not exceed the maximum time delay assumed in the Utility Applicant's FSAR accident analysis and will not result in a failure of any safety system component due to extended operation at a degraded voltage condition.

When the diesel generator is supplying power to the 6.9 kV Class 1E busses load shedding is automatically blocked during the sequencing cycle and is automatically reinstated at the completion of the sequencing cycle. Indication of the load shed blocking status will be provided in the control room. Details of this design will be provided in the Utility Applicant's FSAR.

9) Safety-Related Equipment Identification

Safety related equipment identification is discussed in Subsection 8.3.1.3.

10 Instrumentation and Control

Control of the 6900-kV Class 1E supply breakers is from | 10
the control room where voltmeters, ammeters, frequency meters, synchroscopes, control switches, and controls are available as required by the operator. Control of the supply breakers is also available at the switchgear, but synchronizing control is only provided in the control room. Control of each supply breaker from the control room is dependent on the remote-local control switch in the switchgear being in the remote position. To close a circuit breaker requires operation of two switches; the first, the synchronizing two position (off, sync) switch, and the second, the control four position (pull out, trip, neutral, close) switch. | 1

With power to the Class 1E buses supplied from the primary offsite source and with the alternate offsite source available, the normal position of the control switches is "remote" for the switchgear remote-local control switch and "off" and "auto" for the control room synchronizing and control switches respectively. 10
respectively. With this configuration the system automatically responds to the transfer scheme which provides continued operation of the Class 1E buses in the event of loss of either or both offsite sources.

Control of the 6900 volt feeder breakers and the 480-V 1
main breakers is from the control room. Synchronizing 10
control is not required. These breakers are controlled by four-position (pull out, trip, neutral, close) 1
control switches.

Control power for the Class 1E circuit breakers is from two of the four Class 1E 125-Vdc batteries.

11) Electric Circuit Protection System

Electric circuit protection is provided to prevent damage to equipment, maintain operational continuity, and reduce the safety hazard to plant personnel. Fast-acting relays respond to overloads, undervoltage, or faults on feeders or buses so that corrective action can be initiated to isolate the affected equipment, 10
transfer loads, or start the onsite diesel generators.

Determination of relays that have operated is indicated by signal targets on the individual relays. Relay protection is also provided on each feeder and transformer. Class 1E motors are connected to 6900-V or 480-V Class 1E switchgear buses and, in general, are each provided with alarms in the control room on overcurrent to alert the operator. The feeder circuit breaker trips on a short-circuit fault. If the feeder circuit breaker fails to clear, backup protection is 10
provided by the automatic tripping of the incoming breaker. Smaller motors are connected to the combination starters, where short-circuit protection is provided by circuit breakers and overload protection by thermal relays. Thermal relays associated with Class 1E motor-operated valves alarm only, the alarms are located in the control room; thus meeting the requirements of 10
Branch Technical Position (EICSB) 27. However, overload

protection will be provided by the branch circuit protective device for the safety related motor operated 10
valves inside the containment.

The unit auxiliary and station service transformers are protected by differential relays and overcurrent backup relaying. Faults within the differential relay zone of the unit auxiliary transformer cause the unit to trip and the unit output breakers in the unit output switchyard to open. The non-Class 1E 6900-V buses fast transfer to the primary offsite power source. A fault
within the differential zone around either station 10
service transformer opens the high-voltage breakers in the primary offsite power source substation. The 6900-V Class 1E buses automatically transfer to the alternate offsite power source through the unit auxiliary transformers with no loss of operation.

All protective devices are coordinated to isolate a fault or abnormal condition as quickly as possible without damaging or interfering with the effective operation of the rest of the system.

Only conventional protective relays of reliable designs with well-defined and proven theory of operation and operating characteristics will be selected for Class 1E application.

Relay settings are based on calculation which takes into 10
account manufacturer's tolerances.

Acceptance tests and calibration tests for each relay will be performed in accordance with manufacturer's recommendation. Periodic testing is performed on each relay to verify proper relay operation.

12) System Testing and Surveillance

Circuit design incorporates test provisions to periodically monitor the operational capability of the safety-related Class 1E systems during power operation. Initially, all safety-related equipment is tested to verify compliance with performance specifications after final assembly and during the startup testing phase.

The diesel generators are tested prior to plant startup to demonstrate their capability to satisfy design requirements. The following tests are administered to certify the adequacy of the units for the intended service:

a) Starting tests

b) Load acceptance tests

c) Rated load tests

d) Design load tests

e) Load rejection tests

f) Electrical tests

g) Functional tests

The suitability and qualification testing program of each diesel generator unit of the standby power system is confirmed in accordance with IEEE 387-1972 and NRC 1
Regulatory Guide 1.9. If the diesel generator sets are of a type or size not previously used as standby emergency power sources in nuclear powerplant service, reliability qualification testing for the diesel generator sets is performed in accordance with Branch Technical Position (EICSB) 2.

Manual starting of each diesel generator from the control room is incorporated into the design to permit periodic testing. During testing, the diesel generator is manually synchronized to its bus after reaching rated voltage and frequency. Automatic sychronizing is not used. An accident signal occurring during periodic testing of a diesel generator automatically overrides the test mode and places the diesel generator in the emergency mode.

Periodic testing of the diesel generators is scheduled to verify their continued capability and availability to perform their design function. The schedule of diesel generator tests are described in subsection 16.3/4.8.1.1.2.

Functional testing of the interlock to prevent load-shed during sequencer operation will be performed at least once every eighteen months during shutdown in conjunction with the testing of the diesel generators. 10

Provisions are incorporated to allow testing and calibration of both 6.9-kV Class 1E bus undervoltage protection systems during plant operation.

13) Systems and Equipment Shared Between Units

No electrical Class 1E systems and equipment are shared between units.

c. Onsite Standby Electric Power Sources

The onsite standby ac power source is an independent onsite automatically starting system designed to furnish reliable and adequate power for safety-related loads to ensure safe plant shutdown and standby when preferred and alternate offsite power sources are not available.

Two independent diesel generators are provided, each capable of sequentially starting and supplying the minimum power requirements required for a DBA. The diesel generators are electrically and physically independent.

The standby power diesel generator sets are used to provide emergency power, and are not used for peaking or other nonemergency service; therefore, the system is in accordance with Branch Technical Position (EICSB) 8.

Diesel generators and associated equipment are located in a
seismic Category I building as shown in Figure 8.3-5. The 10
building structures protect the diesel generators and associated 1
equipment against SSE, tornadoes, missiles, fire and flood.
Within the protected structures, separation and protection 10
against these phenomena are achieved by means of a seismic Category I partitioning wall between the two diesel generators.

1) Starting Initiating Circuits

Each diesel generator set automatically starts upon receiving any one of the following signals:

a) Undervoltage on its respective safety related bus

b) Sustained degradation of voltage on its respective safety-related bus

c) High containment pressure

d) Low pressurizer pressure 10

e) Excessive cooldown signal

f) Manual actuation from the control room

g) Undervoltage and protective relay trip signal on the primary offsite source or alternate offsite source.

Figure 8.3-2 shows start signals a), b), f), and g); signals c) through f) are shown in the applicable NSSS SSAR.

2) Starting Mechanism And System

Each diesel generator is capable of attaining rated voltage and frequency and can be fully loaded within a time consistent with the requirements of the ESF under accident conditions. Generator reactances and characteristics of the static exciter and voltage regulator are coordinated to provide satisfactory starting and acceleration of sequenced loads. The exciter-regulator system design ensures rapid voltage recovery when starting large motor loads. Voltage drops do not exceed the limits established in NRC Regulatory Guide 1.9. 10

Starting of the diesel engines is accomplished by a compressed air system consisting of independent and redundant air compressors, receivers, and solenoid valves. Each of the redundant receivers has sufficient compressed air storage for five starts. Section 9.5 presents a more detailed description of the starting mechanism.

Fast starting and load acceptance is facilitated by maintaining engine temperature by heating and forced circulation of cooling water and lube oil. In addition, the units are located in heated rooms.

3) Tripping Devices

The diesel generator protection systems initiate automatic and immediate protective actions to prevent or limit equipment damage and allow restoration of the equipment upon correction of the trouble.

Excluding accident conditions, tripping of the diesel generators occurs for any of the following reasons:

a) Low lube oil pressure

b) Engine overspeed

c) Lube oil high temperature 10

d) High crankcase pressure

e) Generator differential

f) Generator overcurrent with voltage restraint

g) Reverse power flow

h) High cooling water temperature

i) High generator bearing temperature

j) Loss of excitation

k) Generator negative sequence 10

l) Generator ground

m) Generator field trip

With the exception of items b) and e), these trips are bypassed when the diesel generators start due to a SIAS which is consistent with Branch Technical Position (EICSB) 17. The possibility of the diesel generator protective devices tripping the diesel is precluded under accident conditions by bypassing these trip 10
signals.

The possibility of diesel generator protective devices not tripping the diesel, when required, is minimized by selecting devices with high reliability based on operating experience and testing. Only generator differential relays that have a high degree of field-proven reliability are used.

4) Interlocks and Permissives 10

Interlocks are provided to ensure safe and proper 1
operation of the electrical systems: and the following are typical applications:

a) To lock out all possible sources of energy to a bus if a fault exists on the bus

b) To prevent automatic closing of the diesel generator breakers if voltage is present on the associated Class 1E bus with the diesel generator control switch in the automatic mode

c) To prevent closing of a diesel generator breaker until the diesel generator achieves rated voltage and frequency

d) To prevent paralleling both battery chargers associated with each 125-Vdc system

5) Load Shedding Circuits 10

For a discussion of load shedding circuits of the onsite standby diesel generators, see Subsection 8.3.1.1,b.,8.

6) Testing

For a discussion of testing of the onsite standby diesel generators, see Subsection 8.3.1.1,b.,12 and 16, 3/4.8.1. 10

7) Fuel Oil Storage and Transfer Systems

For a discussion of the fuel oil storage and transfer system of the onsite standby diesel generators, see Section 9.5.

8) Cooling and Heating Systems 10

For a discussion of cooling and heating systems of the onsite standby diesel generators, see Section 9.5.

9) Instrumentation and Control System and Alarms

10

Automatic control of the diesel generators and Class 1E
loads requiring sequencing is provided. Manual control 10
of the diesel generators and safety-related systems is available locally and in the main control room. Arrangement of control circuitry maintains the required redundancy compatible with the related power circuit.

Control power is obtained from redundant 125-V dc systems. Train A loads receive power from battery
BT1ED1 and Train B loads from battery BT1ED2. See 10
Figure 8.3-1.

The dc power from the station batteries is required by each diesel generator for controls, alarms, protective relays, air-starting solenoid valves, and, if required, generator field flashing. These loads are estimated and tabulated in Table 8.3-4 and will be finalized in the
Utility Applicant's FSAR. 10

Instrumentation is provided to continually monitor the status of the safety-related systems. Diesel generator status is indicated and alarmed in the control room. If running, automatic shutdown of a diesel generator is also annunciated.

The following instrumentation is provided to monitor the operability of the diesel generators:

a) Voltmeters

b) Ammeters

c) Frequency meters

d) Varmeters

e) Wattmeters

f) Running time meters

g) Tachometer

Instrumentation and alarms for the diesel generator cooling, starting, lubricating, and ventilating systems are discussed in Section 9.5. 10

The following indicating or alarm devices for the onsite standby power system are provided locally and in the control room. 10

a) Bus voltage, current, and frequency

b) Circuit breaker position lights

c) Diesel generator power flow and starting status

d) Battery voltage

e) Protective relaying operational alarms

Each condition that renders a diesel generator incapable of responding to an automatic emergency start signal is alarmed separately in the control room. A separate alarm point engraved "Auto Start Blocked" is initiated in addition to the alarm window identifying the abnormal condition. Conditions that block automatic emergency start are as follows:

10

Condition	Annunciator Wording
Local mode selector switch not in "Auto" position	Mode Switch-Off Auto
Controls not reset from a previous trip	Controls Not Reset
Loss of AC or DC control power	Control Power Not Available
Insufficient starting air pressure	Starting Air Pressure Low
Insufficient fuel oil pressure	Fuel Oil Pressure Low
Valves in improper position which is not monitored by by other instrumentation	Valve Position Off Normal

In addition a "Diesel Generator Trouble" alarm is provided which is initiated for any malfunction not included in the above list. 10

Each Diesel Generator local panel contains an annunciator which identifies the origin of any trip or malfunction.

11) Prototype Qualification Program

For a discussion of the prototype qualification program see Subsection 8.3.1.1,b.,12.

d. Safety Related Systems

1) Motor Size

Motor size for the individual loads are determined on the basis of nameplate rating, pump pressure, and flow conditions or pump runout conditions. Basis of selection of motor size for the purpose of determining the preliminary size of the onsite standby diesel generator is noted in Table 8.3-1.

2) Minimum Motor Accelerating Voltage

The minimum voltage required for Class 1E motors to accelerate their connected load is 80 percent of motor voltage rating.

3) Motor Starting Torque

The selection of motor staring torque of the safety-related motors is based on speed-torque curves, wk^2 factor, expected voltage at terminals of motor, and acceleration time requirements.

4) Minimum Motor Torque Margin

In accordance with the loading sequence established in Tables 8.3-1 and 8.3-2, specified acceleration times require that the motors achieve rated speed within 5 seconds or less. The minimum design margin of motor torque over the pump load torque, at 80 percent of motor rated voltage, is 20-percent minimum for the range | 2
between standstill and breakdown torque speed for the BOP motors.

5) Motor Insulation

Motor insulation is selected on the basis of ambient temperature and expected temperature rise based on the worst loading conditions. In most cases, the motors have Class B insulation.

6) Temperature Monitoring Devices Provided in Large Horsepower Motors

Temperature-monitoring devices are provided for those motors that are 100 hp or more.

7) Interrupting Capacity of Switchgear, Load Centers, Control Centers, and Distribution Panels

Interrupting capacity is as described in Section 8.3.1.1.b.7. | 10

8) Electric Circuit Protection

For electric circuit protection, see subsection 8.3.1.1,b.,11.

9) Grounding

High impedance grounding of the standby diesel generator neutral limits the ground fault current to low values which allows continuous operation with a single phase to ground fault in the onsite standby power system. A ground fault is alarmed in the control room.

Motors are grounded to ensure tripping of ground fault current protective relay where applied and to ensure 1
personnel protection.

Panels, racks, control boards, switchgear, MCCs are grounded to ensure personnel protection. 1

8.3.1.2 Analysis

The onsite ac and dc electric systems conform to GDC, Regulatory Guides, and other applicable criteria, as listed in subsection 8.1.4.

8.3.1.2.1 Compliance with GDC 17, Electric Power Systems

The electric power system design complies with GDC 17 Electric Power Systems.

The first immediate offsite power circuit access to the safety-related buses is from the primary offsite power source substation through station service transformers. In the event of failure of the primary offsite power circuit, the safety-related buses are powered from the main generator via the load-break switch and unit auxiliary transformers. If the main generator is not available (load-break switch in open position), then the alternate immediate offsite power circuit access to the safety-related buses is from the unit output switchyard through the main and unit auxiliary transformers. The primary and alternate offsite systems are physically independent circuits from offsite transmission networks; each is continuously available.

Two independent diesel generators and their distribution systems are provided to supply power to the redundant safety related loads. Each diesel generator and its distribution system are 10
designed and installed to provide a reliable source of redundant onsite-generated ac power, and is capable of supplying the safety-related loads assigned to the Class 1E buses which it serves.

Four independent 125-V dc batteries and their distribution systems supply power to the redundant dc systems. Each battery and its distribution system are designed and installed to provide a reliable source of redundant onsite dc power, and are capable of supplying the safety-related loads assigned to the safety-related bus which they serve.

Redundant parts of the ac and dc systems are physically and electrically independent to the extent that a single event or single electrical fault does not cause a loss of power to extend beyond the particular safety load group.

8.3.1.2.2 Compliance with GDC 18, Inspection and Testing of Electric Power Systems

The electric power systems are designed to permit inspection and testing of all important areas and features, especially those which are safety-related and do not normally operate.

The ESF electrical system is designed to permit:

1) Inspection and testing during equipment shutdown, of wiring, insulation, connections and assess continuity 10
of the systems and condition of components

2) Periodic testing, during normal plant operation, of 10
the operability and functional performance of the Class 1E systems, including actuation devices, protective relays, ESF loads, sequencing circuitry, and buses.

The periodic testing of the diesel generator and batteries (onsite power system) is described in technical specification subsection 3/4.8. Plant design also provides testing capability for other Class 1E equipment as required by IEEE 308-1974. 10

8.3.1.2.3 Compliance with Regulatory Guide 1.6

The design complies with the provisions of Regulatory Guide 1.6.

The electrically powered safety loads (ac and dc) are separated into redundant load groups such that loss of any one group will not prevent the minimum safety functions from being performed. 10

Each Class 1E ac bus has access to two offsite power sources and an onsite standby power source. Two diesel generators are provided, each connected exclusively to its respective Class 1E

IMAGE EVALUATION
TEST TARGET (MT-3)

6″

MICROCOPY RESOLUTION TEST CHART

IMAGE EVALUATION
TEST TARGET (MT-3)

6″

MICROCOPY RESOLUTION TEST CHART

ac bus. There is no automatic or manual tie between redundant Class 1E ac buses.

The safety related dc loads are separated into four independent 10
load groups; each load group is energized by its exclusive
battery and two battery chargers (one spare). The
battery-charger combination has no automatic or manual connection
to any other redundant dc load group.

10

8.3.1.2.4 Compliance with Regulatory Guide 1.9

The design complies with the provisions of Regulatory Guide 1.9

Diesel generator ratings are based on the continuous load demand required at any one time. This rating exceeds the sum of the conservatively rated loads. Motor loads are estimated based on nameplate rating, pump runout conditions, or estimated flow-pressure conditions. A conservative motor efficiency is assumed as shown in Table 8.3-1 and 8.3-2.

Sequencing large loads at five-second intervals ensures that 1 large motors have reached rated speed and that the voltage and frequency are stabilized before the succeeding loads are applied.

8.3.1.2.5 Compliance with Regulatory Guide 1.32

The design complies with the provisions of Regulatory Guide 1.32.

The first offsite power circuit access to the safety-related buses is from the primary offsite power source substation through station service transformers. In event of failure of the primary offsite power circuit, the safety-related buses are powered from the main generator via the load-break switch and the unit auxiliary transformers. If the main generator is not available (load-break switch in open position), the alternate immediate offsite power circuit access to the safety-related buses is from

the alternate offsite power source in the switchyard through the main step-up transformer and unit auxiliary transformers. Therefore, each Class 1E bus has immediate access to the two offsite power sources available from the primary and alternate 10
offsite transmission networks.

Each battery charger is sized to supply the combined steady-state loads and the charging capacity to restore the battery from the designed minimum-charge state to the fully charged state under all modes of plant operation.

8.3.1.2.6 Compliance with Regulatory Guide 1.63

In reference to position C1, the electrical penetration assembly is designed to withstand, without loss of mechanical integrity, the maximum current versus time conditions permitted by backup protective devices or conductor fusing characteristics.

The electrical distribution for power and control circuits incorporates coordinated circuit design which selects penetrations with thermal capability greater than the thermal capability of the associated externally connected field cabling. This approach ensures that in the unlikely event of two failures 1
of circuit protection devices, the externally connected field conductors fail before the penetration conductor or penetration seal.

Electrical penetrations are not currently available with self-fusing characteristics. Circuit breakers or fuses used for circuit overload protection preclude compliance with the requirements of IEEE 279-1971. 1

Power and control circuits incorporate backup protective devices that are provided as follows:

1) For three phase power circuits, see subsection 8.3.1.1.b.11 10

2) Single phase and dc circuits; either two circuit breakers or one circuit breaker and a set of fuses are used in series. In this case one of four overcurrent devices, when actuated, isolates the fault from the energy source.

3) The protection ensures that both primary and backup protective devices operate for the same fault in a coordinated manner.

4) The circuit design will only comply with IEEE 279-1971 in the aspect that the protective devices| 1
are redundant. Circuit independence and physical separation are limited in that both protective devices are in series in the same circuit.

5) The protective devices are connected in series for penetration circuits, as opposed to the channelized protection systems specified in IEEE 279-1971.| 1
Consequently, the capability of online testing, bypassing, and manual initiation, as stated in paragraphs 4.10, 4.11, and 4.17 of IEEE 279-1971 are not| 1
possible.

8.3.1.2.7 Compliance with Regulatory Guide 1.75 and IEEE 384-1974| 1

The design complies with the provisions of Regulatory Guide 1.75 and IEEE 384-1974. | 1

Complete physical separation of the redundant protective and safety-related equipment, cables, raceways, and internal wiring is achieved by one of the following: the use of separate rooms or floors; appropriate distance; the use of barriers in a room.

All safety-related equipment, exposed raceways, cables, and internal wiring are identified by distinct color markers so that the plant personnel will be able to distinguish, without resorting to any reference material, Class 1E circuits from redundant Class 1E counterparts and Class 1E systems from non-Class 1E circuits.

Separate cable-spreading areas located above and below the control room are provided, one for each safety-related train and two protection channels.

8.3.1.2.8 Compliance with Regulatory Guide 1.93

As described in technical specification subsection 3/4.8, the power operation is initiated and continued without restriction only when the limiting conditions for operation (LCO) are met. If the LCO are not met, the power operation is restricted in accordance with Regulatory Guide 1.93.

8.3.1.2.9 Compliance with IEEE 308-1974 1

All aspects of the electrical station design comply with IEEE 308-1974. 1

Class 1E electrical equipment is designed to satisfy the functional requirements under conditions produced by the design basis events listed in IEEE 308-1974. 1

Separation, redundancy, and independence of components eliminate the possibility of a common mode failure. All Class 1E equipment is located in Seismic Category I structures and is qualified in accordance with IEEE 344-1975, as supplemented by Branch 1
Technical Position (EICSB) 10. Seismic design of electrical equipment is discussed in Section 3.10.

Surveillance of Class 1E systems demonstrate their readiness to perform intended safety functions. Availability and operability of these systems are monitored by periodic testing.

8.3.1.2.10 Failure Mode Analysis

Verification that the safety-related ac systems satisfy the single failure criterion is demonstrated by the failure mode analysis given in Table 8.3-3 where component failure and the effects of failure are noted.

8.3.1.2.11 Equipment Operation in Hostile Environments

Wherever possible, electrical equipment is located to avoid, or minimize, the effects of hostile environments during all modes of plant operation. With the exception of the containment atmosphere, the environment in all areas of the plant containing Class 1E equipment is approximately the same as in conventional powerplants. Expected radiation levels outside of containment are low, having little or no effect on equipment performance. All Class 1E equipment is specified to perform its intended function under the maximum expected environmental conditions at the equipment locations. Specifications include radiation, temperature, pressure, and humidity requirements, as well as margin.

Electrical equipment required to operate inside containment during and after an accident is capable of functioning under the conditions discussed in Section 3.11 and tabulated in 10
Table 3.11-2.

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Equipment operation is not impaired by the cumulative effects of radiation released during the accident and radiation released during long term normal operation. For steam line breaks or a LOCA, the equipment is designed to function for the required duration and to perform its safety function. The required duration constitutes the length of time required for operation of safety-related equipment which permits safe shutdown of the plant and prevents significant release of radioactive material to the environment. This time interval varies for specific items of equipment, depending on equipment function.

See Section 3.11 of the NSSS SSAR for tests performed on safety equipment supplied by the NSSS vendor. Valve motor operators and cables not supplied by the NSSS vendor are tested by the manufacturer to verify performance capability under accident conditions. Type tests of valve motor operators are required, conducted, and documented in accordance with IEEE 382-1972 and 1
Regulatory Guide 1.73. All Class 1E cables are tested, and the tests are documented as outlined in IEEE 383-1974. 1

The heating and ventilation systems of safety-related structures are discussed in Section 9.4.

8.3.1.3 Physical Identification of Safety-Related Equipment

Safety-related electrical equipment is uniquely numbered so that identification as safety equipment is evident. In addition, color-coded nameplates conspicuously identify the equipment as safety-related.

Cable and cable tray identification is accomplished by distinct color markings at intervals not exceeding 15 feet, at junctions, points of entry to and exit from enclosed areas, and at each end. These raceways are marked prior to the installation of their cables.

Cables installed in these raceways are marked by a distinct color marking at intervals not to exceed 5 feet to facilitate visual verification that the cable installation is in conformance with separation criteria. In addition, color coding of the cables enables plant personnel to distinguish, without having to resort to any reference material, between Class 1E and non-Class 1E equipment and circuits, between non-Class 1E systems associated with different redundant Class 1E systems, and between redundant Class 1E systems. The following is a list of equipment and cable and raceway color codings of separation routings of Class 1E and non-Class 1E electrical systems (see the NSSS SAR for 10
identification of equipment supplied by the NSSS vendor):

Subsystem Name	Color	
Reactor Protection Ch I Actuation Train A Battery I	Red	
Associated cables routed with Train B	White-Black stripe	10
Battery II Reactor Protection Ch II Actuation Train B	White	1
Associated cables routed with Train A	Red-Black stripe	10
Reactor Protection Ch III Battery III	Blue	
Reactor Protection Ch IV Battery IV	Yellow	1

Non-Class IE	Galvanized (cable trays) Black (cable)

8.3.1.4 Independence of Redundant Systems

Separation between redundant Class 1E systems is based on the potential hazards in the particular area so that even in the event of a single failure, the design still provides a sufficient number of circuits and equipment to accomplish protective functions during any design basis event.

Separation of equipment is achieved either by distance, separate rooms, or barriers. Possible effects of pipe whip and/or jet impingment on redundant safety related equipment or system are considered in determining the separation.

Possible effects of non-safety-related equipment on safety-related equipment are also considered in determining the adequate separation of components.

The QA program discussed in Chapter 17 ensures compliance with 1
established criteria. Class 1E equipment and circuits are clearly identified on documents and drawings in accordance with IEEE 494-1974. The electrical cable system for the Class 1E system is described in the succeeding subsections. Cable 1
installations for redundant systems are in conformance with IEEE 384-1974 as augmented by Regulatory Guide 1.75. 1

8.3.1.4.1 Cable Voltage Grouping

Cables in raceways are grouped on the basis of function and voltage. Independent raceways are provided as follows:

a. 6900-V power

b. Low voltage power

c. Control (control cables and cables for intermittent 10
duty, e.g., valve operators, are not restricted to one layer and may occupy the same raceway.)

d. Instrumentation 10

In a vertical stack of trays, the highest voltage level is on top with lower trays descending in voltage level with instrumentation at the lowest level whenever feasible.

e. Nuclear Instrumentation | 10

The minimum separation from the NIS conduits and containment penetration assemblies to electrical noise sources such as power sources of 118Vac, and above shall be two feet. The minimum separation from 6.9 kV shall be six feet.

8.3.1.4.2 Cable Routing Separation

Power, and control and instrumentation cables are installed in trays and rigid steel conduits. The cable tray system conforms to NEMA VE1-1971, Cable Tray Systems.

Wherever feasible, redundant circuits are routed at different floor elevations or on opposite sides of rooms or spaces. Redundant circuits are installed in separate cable trays, conduits, ducts, and penetrations. Separation of tray systems is as follows:

8.3.1.4.2.1 Cable-Spreading Areas

Separate cable-spreading areas located above and below the control room are provided, one for each Class 1E train and two protection channels. Neither cable-spreading area contains high-energy equipment (i.e. switchgear, transformers, rotating equipment) or potential sources of missiles or pipe whip.
Minimum separation between redundant Class 1E channels, or
between Class 1E and non-Class 1E trays in the cable-spreading 10
areas is 1-foot horizontal* and 3 feet vertical.**

Where termination arrangements preclude maintaining this
separation, totally-enclosed raceways, barriers, or tray covers 10
are used as discussed in Regulatory Guide 1.75.

The 6900-V and 480-V power cables are not routed in the cable-spreading area. Power supply feeders to instrument and control room distribution panels are installed in enclosed raceways.

In addition to the fire barriers, used only if adequate physical separation cannot be obtained, fire detection and fire protection
systems are provided as discussed in subsection 9.5.1. Alarms 10
located in the control room give operators early warning of fire.

8.3.1.4.2.2 General Plant Areas

In plant areas where hazards are limited to failures or faults internal to the electric equipment or cables, minimum spacing between redundant cable trays separated horizontally* is 3 feet | 10
and 5 feet between those separated vertically.** If minimum spacing is unattainable, a fire barrier is provided in accordance with IEEE 384-1974. | 1

*(measured from the side rail of one tray to the side rail of the adjacent tray)

**(measured from the bottom of the top tray to the top of the side rail of the bottom tray).

8.3.1.4.2.3 Hostile Environments

In general Class 1E wiring systems will not be routed through an area where there is potential for accumulation of large quantities of oil or other combustible material. If such routing is unavoidable, only one system of redundant cables is allowed in any such area, and the cables are protected by flame retardant material as discussed in Section 9.5.1. In areas containing potential missiles, physical arrangement or protective barriers preclude simultaneous loss of more than one redundant system. | 1

8.3.1.4.2.4 Electrical Penetration Areas

Separate penetrations are provided for 6900-V power, 480-V power, control, and instrumentation cables of each Class 1E train and protection channel. The design objective is maximum possible separation between Class 1E trains, and between any large piping penetrations and Class 1E trains to minimize damage from steam or waterline ruptures. Protection from the main steam and feedwater lines is provided by means of reinforced concrete walls or floors. Electrical penetration areas located on different floor elevations provide adequate physical separation between redundant circuits. In cases where redundant instrumentation channels will be routed on the same elevation, and in the same general area, the redundant channels will be located on opposite sides of the areas, if feasible. Minimum separation distance between individual penetration nozzles is 6 foot centerline to centerline

Location and separation of penetrations are shown in Figure 8.3-3.

8.3.1.4.2.5 Cable Tray Crossover Areas

In cases where redundant trays cross over each other in areas where only electrical equipment is located, there is a minimum vertical separation of 15 inches (free air space). Fire 10
protection requirements are in accordance with Section 9.5.1.

8.3.1.4.3 Seismic Requirements

Cable trays, supports, and ducts carrying Class 1E circuits meet Seismic Category I requirements. In addition, trays and supports carrying non-Class 1E circuits that could jeopardize the integrity of Class 1E circuits or other safety related equipment are also designed to meet seismic requirements.

8.3.2 dc Power Systems

8.3.2.1 Description

The dc systems provide dc and ac (inverters) energy for plant control and instrumentation and emergency lighting under all modes of plant operation, including loss of all ac power sources, until these sources are restored. Safety-related loads are supplied by four redundant 125-Vdc systems designed to operate without interruption during and after a DBA, an SSE, or a tornado. These systems are classified Class 1E, seismic Category I, and as such, their design requirements conform to IEEE 308-1974, IEEE 344-1975, IEEE 384-1974, IEEE 450-1975,
IEEE 484-1975, and NRC Regulatory Guides 1.6, 1.32, 1.75, and 1
1.93. Figure 8.3-1 depicts the main arrangement for the station dc systems.

The dc systems are comprised of four independent and redundant Class 1E 125-V systems and one 125/250-V battery system. Each Class 1E 125-V system consists of one battery, one main distribution bus with air circuit breakers, two static battery chargers, local distribution panels, and feeders.

Battery BT1ID1 feeds distribution panel 1ED1-1 and inverter 1V1PC-1 which supplies channel I and train A load requirements. Battery BT1ED3 feeds distribution panel 1ED3-1 and inverter 1V1PC-3 which supplies channel III load requirements. Battery BT1ED2 feeds distribution panel 1ED2-1 and inverter
1C1PC-2 whch supplies channel II and Train B load requirements. 10

Battery BT1ED4 feeds distribution panel 1ED4-1 and inverter 1V1PC-4 which supplies channel IV load requirements. | 10

See Tables 8.3-4 and 8.3-5. There are no bus ties between the dc systems. Battery chargers for each independent dc system are fed from 480-V MCCs which are supplied power through 480-V double-ended unit substations from 6.9-kV Class 1E buses 1EA1 and 1EA2. Battery chargers for batteries BT1ED1 and BT1ED3 have connections to bus 1EA1, and battery chargers for batteries BT1ED2 and BT1ED4 have connections to bus 1EA2. The assignment of sources of control power for all switchgear is shown in Table 8.3-8. 10

Independence and separation for each Class 1E dc system are maintained. This precludes a single failure from causing loss of more than one Class 1E system. There is no connection of non-Class 1E loads to these Class 1E systems. The objective is to supply only Class 1E loads from these systems.

To supply non-class 1E loads, a 125/250-Vdc system is provided that is completely independent of the Class 1E 125-V systems. This non-Class 1E system consists of two 125-V batteries, connected to provide 125/250-V supply, three 125-V battery chargers, and the main distribution bus with air circuit breakers, motor starters, and feeders.

Two chargers are provided for normal operation of non-Class 1E batteries BT1D1-1 and BT1DT1-2; the third charger is a spare. 10

The loads on the 125/250-Vdc system essentially consist of the following:

a. 250-V turbine-generator emergency bearing oil pump

b. 250-V turbine-generator emergency hydrogen seal oil pump

c. 250-V feedwater turbine emergency oil pumps

d. Control power for non-safety-related switchgear

e. Non-emergency lighting and distribution panels 10

f. Non-safety-related BOP instrumentation and plant computer inverters

Each Class 1E 125-V battery is located in a separate, seismic Category I room of the auxiliary building (Figure 8.3-5 and 8.3-7). In addition to providing protection against an SSE, the walls of these rooms act as fire and missile barriers to maintain the integrity of the redundant systems. The battery chargers and 10 distribution boards associated with a particular battery are located in a room, adjacent to the battery room, of similar construction. 10

Separation of batteries from associated equipment negates the effect of any corrosive fumes emanating from the batteries, maintaining a high degree of system reliability and availability. All battery rooms are ventilated to remove gases produced during charging operations. Battery room ventilation systems are 10
described in Section 9.4.8.2.

A separate room is provided in the electrical building to house the non-safety-related 125/250-V system batteries.

a. Station Batteries

All batteries are lead-acid type, designed for continuous float duty. The Class 1E batteries are mounted on corrosion-resistant steel racks with high-impact noncombustible spacers between cells and cell clamps to prevent shifting and to facilitate maintenance, while permitting the batteries to function during an SSE. These Class 1E 125-V batteries and battery racks are seismic Category I components seismically qualified as referenced in Section 3.10.

The batteries are maintained in a nominal fully charged condition, and have sufficient capacity to carry essential loads continuously for a minimum of 4 hours without battery chargers. The batteries will be connected to their respective buses under all modes of operation. No operator action is required to maintain battery power on the buses. Complete loss of offsite power concurrent with the loss of all standby diesel generator power is not considered credible. In the event that all 10
preferred sources are lost, ac power to the chargers is furnished immediately by the diesel generators; therefore, the 4-hour criterion is conservative. A preliminary load estimate for the 125-V batteries is given in Tables 8.3-4 and 8.3-5.

It is expected that loads will be modified as the design details are finalized. Final load sizes and battery capacities will be given in the Utility Applicant's FSAR. 10

Battery instrumentation consists of dc ammeters (in the battery leads) and voltmeters, ground detection, and undervoltage relays on the dc buses. Ground detection and undervoltage conditions are annunciated in the control room.

b. Battery Chargers

Each Class 1E 125-V battery system has two redundant battery chargers to permit charger maintenance without degrading system integrity. The solid-state chargers float the battery on the bus and supply the dc load demand up to maximum charger capacity, maintaining the battery in a fully charged condition.

Each charger has sufficient capacity to restore the battery from the design minimum charge of 1.75-V per cell to its fully charged state in 12 hours while supplying its largest steady-state loads. The chargers will have the capacity for periodic battery 10
equalizing charges.

Input power to the chargers associated with the Class 1E 125-V systems is obtained through independent 480-V, three-phase ac feeds from safety-related Class 1E MCCs. Battery chargers associated with battery BT1ED1 are supplied from 480-V MCCs 1EB1-1 and 1EB3-1 as indicated in Figure 8.3.1. These MCCs are powered from Class 1E 480-V switchgears 1EB1 and 1EB3, respectively. Arrangements of power supplies for the chargers associated with battery BT1ED3 are similar.

Battery chargers associated with battery BT1ED2 are supplied from 480-V MCCs 1EB2-1 and 1EB4-1 as indicated in Figure 8.3-1. These MCCs are powered from Class 1E 480-V switchgears 1EB2 and 1EB4, respectively. Arrangements of power supplies for the chargers associated with battery BT1ED4 are similar.

There are no combinations of ac power sources from redundant trains feeding the two chargers associated with a particular safety-related battery system. If the preferred ac power sources are unavailable, the standby diesel-generators will provide the required ac power.

Each charger is automatically regulated and equipped with a dc voltmeter, dc ammeter, ac failure, battery charger high voltage relay and battery low voltage relays. Malfunction of a charger annunciates in the control room and trips the charger main breaker; charger main breaker status is indicated in the control 10
room and alarms for an off-normal position indication. Protection is incorporated to prevent the ac supply source from becoming a load on the battery caused by power feedback resulting from the loss of ac power to the charger.

8.3.2.3 References

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8.3.3 Fire Protection for Cable Systems

8.3.3.1 Cable Derating and Cable Tray Fill

Established cable ampacities are based on IEEE publication S-135 (IPCEA P-46-426), AIEE-IPCEA Power Cable Ampacities for Copper or Aluminum Conductors, and manufacturer's standards.

Considerations for determining cable size are as follows:

a. Normal and emergency load currents

b. Short-circuit heating capacity

c. Voltage regulation

d. Load factor of 100 percent

e. Grouping derating

f. Load diversity

Ampacities of cables installed in trays are derated in accordance with the appropriate derating factors given in IPCEA P-46-426 and IPCEA P-54-440. 10

Cable tray fill criteria limit the sum of the cross-sectional areas of control cables to a maximum of 40 percent of the usable cross section of the tray. Cable tray fill criteria for powre cables will be according to "calculated depth of cables in tray, inches" of IPCEA P-54-440. In the case of medium-voltage and 600-V power cables larger than AWG No. 4/0, a minimum separation of one-quarter of the diameter of the larger cable is maintained; 10 for this case, fill may exceed the "calculated depth of cables in tray" but is limited to a single-cable layer.

8.3.3.2 Fire Detection and Protection

A detailed description of the fire protection and detection systems in areas of heavy cable concentration is given in subsection 9.5.1.

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8.3.3.3 Fire Barriers and Separation Between Redundant Trays

Fire barriers and separation between redundant trays are discussed in subsection 8.3.1.4.

8.3.3.4 Fire Stops at Penetrations in Walls and Floors

Cable and cable tray penetrations through fire-rated walls and floors and all other types of cable ways or conduits are provided with fire stops. The fire stops prevent fires from spreading along raceways and are rated with sufficient time to maintain the integrity of the floor or wall and to provide time to bring fire-fighting equipment into service. The fire stops are tested by a recognized laboratory, in accordance with ASTM E119, Fire Tests of Building Construction and Materials (including the hose stream test).

Design criteria considerations for fire stops are as follows:

a. Gas tightness

b. No reaction between the materials used and cable insulation jackets

c. Minimal poisonous gases or fumes developed during installation or during a fire

d. No expansion which might injure insulation or jacketing during installation and operation

e. Provision for the installation of additional cables

f. Heat dissipation

g. Temperature rise during curing of material within acceptable limits

h. Cable ampacity consistent with the requirements of the penetration

i. Where sleeve penetrations are used beneath control boards or other panels, all voids are plugged with a nonflowing fire-resistant material after the cables are installed.

j. If the sleeves are installed in metal plates in the floor, the plates are coated with a fire-resistant compound. All fasteners are similarly protected to prevent failure.

k. The finished floor penetrations do not contain open wells into which debris can fall and accumulate.

l. Where a metal enclosure functions as a fire barrier, penetrations into the enclosure are provided with a fire stop.

m. Where radiation is a consideration, shielding material is used.

Vertical runs of cable trays in plant areas are provided with horizontal fire stops at every fire-rated floor penetration.

Horizontal runs of cable trays in plant areas are provided with vertical fire stops at every fire-rated wall penetration. Vertical runs of cable trays in cable chases or shafts are provided with horizontal fire barriers at every fire-rated floor or fire-rated wall penetration. (See Figures 8.2-4 through 8.2-11 for wall locations and elevations.)

A list of materials used and their characteristics will be provided in the Utility Applicant's FSAR. The materials used 10
will be in accordance with the criteria listed for fire stops.

Quality assurance procedures used to verify that the penetration fire stops and seals have been properly installed are in accordance with Section 17.1 and NRC Regulatory Guide 1.30.

To ensure that fire stops and seals are properly installed, a 1
portable carbon dioxide extinguisher is activated at the seal, and a visual inspection is performed to see if there is any leakage.

Scheduled tests of fire stops and seals are performed; to qualify as having passed the test described in the previous paragraph, there shall be no leakage.

The administrative procedures and controls followed when it becomes necessary to breach a complete fire stop of seal or to add or to remove cables are in accordance with Section 17.1.

Scheduled visual inspections are performed to identify open or deteriorated fire stops and seals.

TABLE 8.3-4

ESTIMATED 125-Vdc BATTERY LOAD REQUIREMENTS
BT1ED1 AND BT1ED2 | 10

(Westinghouse-414)

Load Description	Amperes Required Per Time Intervals After Loss of ac Power		
	0-1 Min.	1-239 Min.	239-240 Min.
Annunciators and indicating lamps	15	15	15
Instrument bus inverters	102	102	102
Diesel generator panel	2	2	2
Diesel generator field flashing	70	-	-
Solenoid valves	20	-	-
Breaker operations	100	-	75
Relay operations	10	10	10
Miscellaneous	10	10	10
Total amperes/interval	329	139	214

| 10 (Diesel generator field flashing)

| 10 (Total amperes/interval)

TABLE 8.3-5

ESTIMATED 125-Vdc BATTERY LOAD REQUIREMENTS
BT1ED3 AND BT1ED4 | 10

(Westinghouse-414)

Load Description	Amperes Required Per Time Intervals After Loss of ac Power		
	0-1 Min.	1-239 Min.	239-240 Min.
Annunciators and indicating lamps	15	15	15
Instrument bus inverters	72	72	72
Relay operations	10	10	10
Miscellaneous	10	10	10
Total amperes/interval	107	107	107

TABLE 8.3-8

ASSIGNMENT OF CONTROL POWER SOURCES FOR SWITCHGEAR

Source of Control Power (125 Vdc)	Classification	Switchgear Type (Bus Nomenclature)		
		6.9 kV	480 V	Reactor Trip Switchgear
Battery BT1ED1	Actuation Train A Reactor Protection Channel I	1EA1 1A5*, 1A7*	1EB1, 1EB3	RT-I1, RT-I2,
Battery BT1ED2	Actuation Train B Reactor Protection Channel II	1EA2 1A6*, 1A8*	1EB2 1EB4	RT-II1, RT-II2
Battery BT1ED3	Reactor Protection Channel III	-	-	RT-III1, RT-III2
Battery BT1ED4	Reactor Protection Channel IV	-	-	RT-IV1, RT-IV2
Battery BT1D1-1	Non-Safety Train C	1A1, 1A3, 1A5, 1A7	1B1, 1B3, 1B1A, 1B3A, 1B5	-
Battery BT1D1-2	Non-Safety Train C	1A2, 1A4, 1A6, 1A8	1B2, 1B4, 1B2A, 1B4A	-

* The reactor coolant pump motor feeder breaker is equipped with a back-up trip coil actuated by pump under speed trip

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8.4 Interface Information

Electrical interface requirements with the Utility-Applicant are described in subsection 8.2.1. The onsite dc electric system is designed on the basis of four Class 1E batteries and their respective distribution. The cable routing system is designed on the basis of the routings defined in subsection 8.3.1.3, Physical Identification of Safety-Related Equipment, wherein both a reactor protection channel and an actuation train are in the same routing; a difference in potential of the circuits is the only basis for the separation requirement.

The GIBBSSAR/RESAR-414 interface requirements that are listed below correspond to the same items listed in RESAR-414, Section 8.3.1.2

1. The AC electrical power supply system are separated into two redundant load groups or electrical power trains.

2. Each of these two electrical power trains has access to both a preferred and a standby power supply as described in Section 8.3.1.1. Therefore the Class 1E bus in each of the 10 two electrical power trains, has access to an off-site power source and one emergency diesel generator.

3. Each of the two emergency diesel generators is sized to provide all the electrical power required to operate the engineers safeguards equipment assigned to the corresponding electrical power train. These diesel generators start automatically on receipt of an engineered safeguards actuation signal ("S" signal) independent of the availability of off-site power.

4. In the event that off-site power is available following the accident, the emergency diesel generators are not connected to the respective Class 1E buses in each electrical power train. With off-site power available, all equipment operating prior to the accident continues to operate. The safeguards equipment associated with each power train is sequentially started.

5. In the event that a loss of off-site power occurred coincident with or subsequent to the postulated accident, the two emergency diesel generators are automatically started and connected to the respective Class 1E buses when a loss of voltage is sensed. They will be designed to accept a

sequential loading of all the assigned safeguards equipment within 10 seconds after receipt of the "S" signal.

6. This temporary loss of voltage associated with the loss of off-site power terminates the operation of all dependent equipment and only the required engineered safeguards equipment will be sequentially started and loaded on the corresponding diesel generators.

7. In regards to the on-site emergency standby electrical power systems frequency and voltage variations of a transient nature (i.e., not steady state) meet the requirements of Regulatory Guide 1.9, 1971.

8. The 6900 V and 480 V Class 1E buses provide sufficient voltage to start Class 1E motors. The minimum starting voltage for Class 1E motors is 80 percent of the motor rated voltage at the motor terminal.

9. Means will be provided through limited operator actions to manually transfer residual heat removal suction isolation valves 9000A, 9001B to the alternate Class 1E power supplies. 10

10. The GIBBSSAR design takes exception to the RESAR-414 requirement to provide redundant Class 1E power sources, through manual switch over to the positive displacement charging pump. As described in RESAR Section 9.3.4.2.5, the poisitive displacement charging pump is used for hydrotesting the Reactor Coolant System but is capable of providing sufficient flow for reactor coolant pump seal injection during the abnormal conditions when both centrifugal charging pumps are inoperable. This pump is supplied from the Train A Class 1E bus.

In addition to the criteria described above, GIBBSSAR also complies with the following requirements required by the NRC in the "Report to the Advisory Committee on Reactor Safeguard by the Office of Nuclear Regulation in the Matter of Westinghouse Electric Corporation Reference Safety Analysis Report RESAR-414", July 1978.

a. Four redundant and independent Class 1E 120 volt vital buses are provided. Each vital bus has the capability of being powered from either a Class 1E ac bus or a Class 1E dc bus via an inverter.

b. Four redundant and independent Class 1E batteries are provided to conform to the redundancy required for the safety-related systems and components. 10

TABLE 8.4-1

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9.1.2.2 Facilities Description

The spent-fuel pool is designed to store spent-fuel assemblies underwater for a suitable decay period after their removal from the reactor. The shielding for operating personnel and removal of decay heat generated by the spent-fuel assemblies is provided by borated water.

Spent-fuel facilities consist of a transfer canal, a spent-fuel pool, in-containment spent-fuel pool, a spent-fuel-cask-loading pit and cask decontamination area. All structures in contact with borated water are lined with austenitic stainless steel plates. The design parameters of the spent-fuel storage area are shown in Table 9.1-2.

There are drainage grooves at the pool liner interface which, when isolated sequentially, help locate liner leakages. The exact location of the leak can be determined by pressurizing an individual groove with air. All components are separated from each other by sealed gates which allow independent adjustments in water levels of various areas.

All components immersed in borated water are made of austenitic stainless steel. Spent-fuel pool instrumentation is described in Chapter 7.

The spent-fuel pool requires periodic makeup to maintain its design level. A low-level alarm alerts the operator to the need to initiate makeup to restore the water level to initial elevation.

The normal source of makeup water is the demineralized water system via the spent fuel pool cooling water pump. If the normal source is not available, an alternate source is the refueling 10
water storage tank via the refueling water purification pump. The seismic Category I makeup source is taken from the Fire Protection System, as discussed in Section 9.5.1. The design of the makeup sources is in accordance with the requirements of Regulatory Guide 1.13, Fuel Storage Facility Design Basis. The pool water periodical local sampling and manual additions of boric acid will ensure required boron concentration during makeup by demineralized water. 10

Ventilation of the fuel-handling area is described in Section 9.4.2.

9.1.2.3 Safety Evaluation

The spent-fuel pool is designed to store spent-fuel in a safe manner and to limit potential offsite exposure.

a. The spent-fuel pool is located inside the fuel-handling building, a seismic Category I structure, to withstand all the effects of natural phenomena described in Chapters 2 and 3. It is designed in accordance with the requirements of Regulatory Guide 1.29, Seismic Design Classification and with Regulatory Guide 1.13, Fuel Storage Facility Design Basis. 2

b. The spent-fuel pool is designed in accordance with the applicable requirements of General Design Criterion 61.

c. The fuel-handling building and the spent-fuel pool are designed to withstand the effects of external missiles and internally generated missiles, pipe whip, and jet impingement forces associated with pipe breaks, so that the safety functions will not be precluded.

The integrity of the pool liner is monitored continuously using pool level instrumentation. Small leaks are detected by spent-fuel pool monitoring grooves. The performance of the spent-fuel pool makeup system can be tested during plant operation. Provided level alarms are to warn operating personnel 2 of drop in pool level and with radiation monitoring to alarm if excessive levels of radiation occur.

A minimum shielding cover of 10.5 feet of borated water on top of the spent-fuel elements is maintained at all times during fuel storage and fuel-handling.

Fuel-handling building ventilation safety evaluation is discussed in Section 9.4.

Spent-fuel pool cooling and cleanup system safety evaluation is discussed in subsection 9.1.3.3.

All penetrations into the fuel pool are at least 11 feet above the top of the fuel assemblies, and equipped with siphon breakers to prevent unplanned drainage of the spent-fuel pool during normal operation and following an accident.

d. Spent-fuel elements are stored in racks with a minimum center-to-center spacing sufficient to ensure that a Keff of

The cleanup function is accomplished by the purification loops and the spent-fuel pool skimmer loop.

9.1.3.1 Design Bases

The design bases for the spent-fuel pool cooling and cleanup systems are:

a. The temperature of the spent-fuel pool is maintained below 120 F when one-third of a core is stored, and below 150 F if two and one-third of a core are stored - item e of Table 9.1-3 - with one of the two cooling loops in operation. For further details see Table 9.1-3

b. The cooling system design temperature depends on CCW supply temperature of 105 F and decay heat production of spent fuel. 1

c. The clarity of spent-fuel pool water is maintained at a level sufficient to facilitate visual observation during fuel-handling operations.

d. Filtration and ion exchange capability are provided to remove suspended radionuclides. 1

e. The cooling portion of the system is classified seismic Category I and Safety Class 3, and the cleanup portion is classified nonnuclear safety. 1

f. Design of the SFPCS is in accordance with the applicable requirements of General Design Criteria 2, 4, 5, 44, 45, 46, 61, and 63, Regulatory Guides 1.13 and 1.29, and NRC Branch Technical Position APCSB 3-1. 1 10

9.1.3.2 System Description

The SFPCS consists of two redundant loops, each containing one pump and one heat exchanger. Residual heat is removed by component cooling water. The SFPCS is in operation continuously and the spent-fuel pool pumps are supplied by two different emergency power buses if a loss of offsite power occurs. A second pump is automatically started in case of failure of the first pump, since both are sized to handle flow to one heat exchanger only. 1

Spent fuel is removed from the reactor core during the refueling sequence and is then placed in the spent-fuel pool where it is stored until shipped offsite to a reprocessing facility.

When the SFPCS is in operation, water is drawn from the spent-fuel pool by the spent-fuel pool cooling water pump, pumped through the tube side of the heat exchanger, and returned to the pool. The suction line, which is protected by a strainer, is located at an elevation 4 feet below the normal water level; the return line terminates at an elevation 6 feet above the top of

9.1.3.4 Inspection and Testing Requirements

All components of the spent-fuel pool cooling and cleanup system are in either continuous or intermittent use during normal operation. Inspection and performance testing is done in accordance with the normal plant maintenance program.

9.1.4 Fuel Handling System

The servicing of the pressurized water reactor nuclear system includes the refueling of the reactor core. This operation is provided by means of the fuel handling system, which handles the nuclear fuel and asociated equipment in a safe and effective way from the time it reaches the plant until it leaves the plant after post-irradiation cooling.

9.1.4.1 Design Bases

The design bases for the NSSS supplied components are presented in the NSSS SSAR, subsection 9.1.3.1 The overhead crane provided in the fuel handling building will meet the intent of NRC Regulatory Guide 1.104. The containment polar crane will meet the intent of NRC Regulatory Guide 1.104 if the Westinghouse topical report regarding a vessel head drop is found unacceptable by the NRC. Exceptions taken to Regulatory Guide 1.104, if any, will be discussed following acceptance of the Westinghouse topical report by the NRC. 10

9.1.4.2 System Description

This subsection is presented in the NSSS SSAR, subsection 9.1.3.2. 1

a. Refueling Procedure

This subsection is presented in the NSSS SSAR, subsection 9.1.3.2.1. 1

b. Component Description

1) The NSSS supplied components are presented in the NSSS SSAR, subsection 9.1.3.2.3 and listed in GIBBSSAR Table 1.8-1. 6

2) The fuel handling structure design and fuel handling procedures limit accidental free fall of the spent fuel cask to 27 feet. The cask is designed to 2

withstand a free drop through a distance of 30 feet in accordance with the Department of Transportation regulations contained in 49 CFR Part 173, and 10 CFR Part 71, Appendix B. 2

3) A fuel building overhead crane, sized to handle a spent fuel cask, is provided in the fuel handling building. Its

c. The cask lifting rig uses a double yoke concept shown in Figure 9.1-4. The cask is lifted using four trunnions located 90 degrees apart. Any failure of one portion of the system results in the other taking over its full load duties. 1

The location of the spent fuel cask loading area was determined on the basis of the requirement for sufficient distance between the spent fuel storage pool and the transfer path of the spent fuel shipping cask. The postulated drop of the cask on the wall between the cask loading area and the decontamination area with 1
subsequent tipping or rolling is limited with consequences to the cask loading area as shown in Figure 9.1-5. 2

No safety related equipment will be damaged.

The design safety evaluation of the NSSS fuel storage and 2
handling equipment is presented in the NSSS SSAR, 1
Subsection 9.1.3.3.1

9.1.4.4 Inspection and Testing Requirements

The inspection and testing requirements for the NSSS supplied components are presented in the NSSS SSAR, subsection 9.1.4. The fuel building overhead crane will meet the intent of the inspection and testing requirements of NRC Regulatory Guide 1.104. The containment polar crane will meet the inspection and testing requirement of NRC regulatory guide 1.104 if the Westinghouse topical report regarding a vessel head drop 10
is found unacceptable by the NRC. Exceptions taken to regulatory guide 1.104, if any, will be discussed following acceptance of the Westinghouse topical report by the NRC.

It is assumed that the cranes are fully loaded and operating at maximum speed when they are analyzed for SSE. 6

9.1.4.5 Instrumentation Requirements

The system instrumentation and controls, and the adequacy of safety-related features to meet the single-failure criterion are presented in both the NSSS SSAR, subsection 9.1.3.5, and in GIBBSSAR subsections 9.1.2.3 and 9.1.4.2. 1

9.1.5 Interface Requirements

The interface requirements for the fuel storage and handling systems are described in Table 9.1-5. 1

Design of the fuel building overhead crane and containment polar crane will meet all applicable codes and standards as follows:

a) Crane Manufacturers Association of America (CMAA); Specification 70

b) American Society for Testing and Materials (ASTM)

c) American Gear Manufacturers Association (AGMA)

d) Antifriction Bearing Manufacturers Association (AFBMA)

e) American Institute of Steel Construction (AISC) 10

f) American National Standards Institute (ANSI)

g) American Welding Society (AWS)

h) National Fire Protection Association (NFPA)

i) National Electrical Manufacturers Association (NEMA)

j) Occupational Safety and Health Act (OSHA)

k) Instrument Society of America (ISA)

l) Institute of Electrical and Electronics Engineers (IEEE)

m) Code of Federal Regulations - 10 CFR Part 50

Detailed specifications of cranes will be provided and vendor's compliance with the intent of Regulatory Guide 1.104 will be included in the Utility Applicant's Final Safety Analysis Report.

TABLE 9.1-5
(Sheet 1 of 2) | 1

FUEL STORAGE AND HANDLING SYSTEMS-INTERFACE REQUIREMENTS
(Westinghouse-414)

Interface Items	RESAR-414 Reference	GIBBSSAR Reference	Comments	
Sampling of RWST after makeup from the RMWS	Appendix 9A.1	Figure 6.2-25	Local sampling is provided.	
Spent fuel pool cooling and cleanup system	Appendix 9A.2, 9A.3	Section 9.1.3	G&H scope of supply	
New fuel racks uplift force	Appendix 9A.4	Section 9.1.1.1		
Electrical requirements of refueling equipment	Appendix 9A.4	NA	To be addressed in the FDR	10
Air requirements of refueling equipment	Appendix 9A.4	Section 9.3.1.1		10 1
Water require- ments of refueling equipment	Appendix 9A.5	Section 9.2.3		
Spent fuel pit (boron concen- tration)	Appendix 9A.5	Table 9.1-3		10
Layout, dimen- sions, supports, tolerances, and erection require- ments of the manipulator crane	Appendix 9A.7	NA	To be addressed in the FDR	10

TABLE 9.1-5
(Sheet 2 of 2) 1

FUEL STORAGE AND HANDLING SYSTEMS-INTERFACE REQUIREMENTS
(Westinghouse-414)

Interface Items	RESAR-414 Reference	GIBBSSAR Reference	Comments
CVCS values to be locked shut during refueling	Section 9A	Table 9.3-6	10
Mechanical and structural requirements for the fuel transfer system	Appendix 9A.11	NA	To be addressed in the FDR
General Design Criteria and Regulatory Guides	Table 9A-1	Section 9.1.2.1, 9.1.3.1	

9.3.3.2 System Description

Segregation of drain headers is provided for each level of the auxiliary building and containment (as described in Section 11.2).

Collection and transfer of liquids from the building lower levels are facilitated by sump pumps, sumps, and drain collection tanks. Redundant full capacity sump pumps are provided at each transfer point in the drainage system. Ultimately, all drains are directed to the waste-processing system.

a. Floor Drainage of Areas Containing ESF Equipment

ESF floor drain pumps are located on the lower elevation of the section of the auxiliary building which contains the ESF equipment. The pumps are divided into two redundant trains; each is located in an area separated from its backup train by watertight walls to prevent total flooding of one area from interfering with the operation of pumps located in the other area.

Each ESF equipment train area is provided with its own sump. The collection sumps are equipped with two 100-percent-capacity sump

pumps which transfer floor drainage into the low activity waste collection tank. The component cooling water drain tank compartment is provided with a sump and a sump pump. The sump is 2
normally aligned for discharge to the component cooling water surge tank.

b. Floor Drainage of Auxiliary Building

Auxiliary building drainage is designed so that upper floors drain directly to the low activity waste collection tank. The drains from the lowest floor are routed to a sump and pumped to 2
the low activity waste collection tank.

Floor drains from the laundry and hot showers are routed to the laundry and hot shower tanks.

All storage tank areas are provided with the necessary waterproofing (curbs or water-tight compartments) to prevent leakage into other areas and damage to safety related components 10
if a tank break occurs.

Floor drains from the water-tight compartments have a 10
locked-closed manually operated gate valve, located within each compartment and operated, if a tank break occurs, from above the expected water level in the compartment.

9.3.3.3 Safety Evaluations

Compartments which contain ESF pumps, recycle holdup tanks, and waste tanks are designed to seismic Category I requirements. For further classification of structures see Section 3.2.1. 6

Continued operation of the system is not required for plant safety. The containment portion of this system is prevented from 6
operating during a LOCA by automatic closure of the containment drain piping isolation valves on a containment isolation Phase A signal.

The main piping headers have a minimum diameter of 4 inches. Header size is sufficient to preclude total flooding of the piping and to ensure that the lines are not pressurized or 1
ruptured.

Two 50 gpm sump pumps per train are provided in the lowest elevation of the ESF area of the Auxiliary Building to 6
accommodate drains without flooding adjacent areas.

Each sump is equipped with two pumps; either one can handle the design leakage rate.

The leakage is postulated to occur as a result of a gross flange gasket failure or a severely damaged pump seal.

All piping in the safety features area of the Auxiliary Building is designed to seismic Category I requirements, therefore pipe rupture in the safety features area caused by the SSE is not postulated. 10

The auxiliary building floor drainage system is designed to accommodate normal expected leakages without localized flooding.

If an accident occurs, i.e., ruptures of tanks or cracks in large piping, total flooding of the auxiliary building is prevented by the following:

a. Operator's action to isolate affected system. No credit for operator action is taken for 30 minutes following a high-level alarm in the sumps or low activity waste collection tanks 10

b. An arrangement of floor drains which will ensure that an increased number of floor drains are used as the flooding expands 1

These two actions ensure that deep flooding of a building floor will not occur. 1

Overflow or drainage of a tank will be detected by the high-low level alarm instrumentation displayed in the control room.

After a tank failure, the operator manually opens the valve to initiate the processing of the water in the compartment. Because of administrative controls placed on this valve, the possibility of inadvertently leaving this valve open is not considered to be credible. Access to the compartment is not allowed until the contents have decayed to acceptable levels. 10

9.3.3.4 Tests and Inspections

Leaktightness and flowpaths are tested prior to initial operation of the system. Pumps and level controls are adjusted for maintenance of proper sump levels.

9.3.3.5 Instrumentation Applications

Each ESF area sump has high- and low-level alarms and sump-water-level indication in the control room to indicate that water is entering the sump. In addition, the operational status of the sump pumps is indicated. Based on this information and the design flow of the sump pumps, the operator can determine the approximate leakage inflow to each sump.

If the leakage inflow from one train to the sump is sufficient to keep the pump running for more than 30 minutes without a decrease in sump water level, the operation is switched to the redundant safety feature train and the leaking train is isolated.

The auxiliary building sumps have high- and low-level alarms; the operational status of the sump pumps is indicated in the control room.

The containment sump pump discharge line has a flow totalizer to indicate total flow as a factor in containment overall leakage control. (See Section 7.6.1.2.)

All sump pumps operate automatically; start and stop of a pump is controlled by sump level.

References:

1. Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water, Steam-and Radioactive-Waste-Containing components of Nuclear Power Plants," Revision 1.

2. ANSI N18.2, "Nuclear Safely Criteria for the Design of Stationary Pressurized Water Reactor Plants; 1973. | 1

3. ASME B&PV, Section III, Class 3. | 1

9.3.4 Chemical and Volume Control System | 6

Refer to NSSS SSAR.

Interfaces with the NSSS SSAR CVCS system are addressed in Table 9.3-6. | 6

9.3.5 Standard Liquid Control System (BWRs)

This section is not applicable to the standard plant.

TABLE 9.3-6
CVCS INTERFACE REQUIREMENTS
(Westinghouse-414)

The interface requirements of RESAR-414 Section 9A are satisfied as follows:

a. CVCS components are located in the Auxiliary Building and maintained above 65 F and furnished with redundant temperature indicating alarms.

b. The piping layout in the Utility-Applicant's SAR will run the 4 inch letdown line long enough to contain the specified volume and subsequently delay time required for decay of N_{16}. 6

c. The volume control tank vent and safety valve discharge lines are located in the tank compartment to shield radioactive gas released from the tank.

d. Steam for the CVCS batching tank is provided by the auxiliary steam system. See GIBBSSAR Figure 10.3-1. Steam is provided at a pressure of 50 psig. Average capacity is 280,000 Btu/hr of steam.

e. Instrument air is provided for the CVCS air-operated valves from the instrument air system. See Figure 9.3-1.

f. Gas space sampling for volume control tank is provided for and shown in Figure 9.3-2.

g. Makeup for the RWST is provided from the Reactor Makeup Water 10
Storage Tank. A local sample connection on the RWST provides for 6
the testing of boron concentration. See Figures 9.2-6 and 10
6.2-25. Makeup to the RCS from RWST is prevented during supply 6
from RMWST to RWST by means of an interlock between the valve 10
supplying the RWST from the RMWST and the discharge valve on the
RWST to the RCS.

h. Samples from various points of Boron Recycle system are piped to a sample sink. See Figure 9.3-2. 6

i. CCW for the boron thermal regeneration system chiller units is designed for 105 F.

j. CVCS valves 110B, 111B, 8339, 8355, and 8361 will be locked shut during the refueling operation 10

Fans are rated and tested in accordance with the standards of the Air Moving and Conditioning Association (AMCA) (1).

HEPA filters and iodine adsorber are tested periodically during plant operation, in accordance with NRC Regulatory Guide 1.52, using the test methods contained in ANSI N101.1 (2) and ANSI N510 (9). Filter units are arranged to facilitate cell replacement.

Heating and cooling coils are tested as per ARI Standard 410 (12) Ductwork and filters are tested in accordance with ANSI 510 (9) and industry standards.

Redundant standby equipment is operated on a cyclic basis to assure the availability of the equipment.

9.4.2 Fuel-Handling Area Ventilation System

9.4.2.1 Design Bases

The fuel-handling area ventilation system which is part of the controlled access ventilation system is designed to provide 10
ventilation and conditioned air to the spent fuel pool area and other fuel-related areas in the auxiliary building. The system provides safe ambient conditions for operating equipment and personnel during normal plant operation. Pertinent design conditions are presented in Tables 9.4-1, 9.4-2 and 9.4-7. 6

A slight negative pressure is maintained by pressure controls during normal operation, refueling, loss of offsite power, following a LOCA or following a fuel handling accident to prevent the release of radioactive gaseous effluent to the environment. During normal operation, exhaust air is channeled through the controlled access filter units (CAFU). During all other listed modes of operation, exhaust air is drawn through the Engineered Safety Feature filter units (ESFU). These units are redundant and powered from the Class IE electrical bus.

Auxiliary cooling units are used to maintain the safety-related 10
fuel pool cooling system pump rooms below the maximum ambient temperature allowed by the equipment design. The auxiliary cooling units, which are interlocked to the pumps, are supplied with water from the safety-related chilled water system (see Figure 9.4-5), or with component cooling water or service water depending on site conditions. The fuel pool cooling system pumps are not required for safe shutdown of the reactor and are not immediately required to maintain the fuel pool temperature below

the boiling point (see Section 9.1.3.3), and are tripped upon receipt of a safety injection signal, or loss of offsite power. 10

The operation of the auxiliary cooling units is automatically restored when the fuel pool cooling pumps are manually loaded rather than automatically sequenced onto the emergency diesel 6
generators within 11.08 hrs. See Section 9.1.3.3. 10

HVAC equipment is designed to operate in and to maintain the required ambient conditions. The supply and exhaust ventilation 6
units are

a part of the controlled access area ventilation systems as shown in Figure 9.4-6. 10

Tritium concentration buildup and dispersion throughout the fuel-handling area is prevented by a local network of supply and exhaust ducts at the spent fuel pool, as shown schematically in Figure 9.4-8. The fuel pool area ventilation system is designed 6 to reduce operator dose as a result of the evaporation of irradiated water; it prevents the contamination of fuel pool water by entrapping dirt and other particulate matter that might otherwise settle on the water surface. Fresh air is supplied over the pool and exhausted from all sides of the pool by exhaust ducts located near the pool surface.

Pipe type duct work is embedded in the walls of the fuel pool, with exhaust registers at approximately 6-foot centers and 6 inches above the water surface. Air delivered by the CASU (supply air outlets are located above the refueling crane approximately 25 ft high) is drawn downward over the surface 10 through the exhaust registers. This arrangement floods the occupied spaces with contaminant-free air, thus minimizing personnel exposure to contaminated air.

The concentration of airborne radioisotopes throughout the area during fuel handling operation is maintained below the maximum permissible concentration (MPC) levels specified in 10 CFR Part 20.

The CAFU and ESFU provide sufficient redundancy in equipment and power supplies for the system to sustain a single active component failure without loss of function. Instrumentation and controls which incorporate visual as well as audible alarms are provided; these enable the operator to continuously monitor system performance and manually switch to standby units when required.

All exhaust air is passed through charcoal iodine adsorber beds and HEPA filters prior to discharge through the plant ventilation discharge duct.

10

The CAFU's and the ESFU's are designed to meet the requirements of regulatory guides 1.140 and 1.52 respectively and data for each element of filter are shown in Tables 9.4-4 and 9.4-5. The CAFU and ESFU filter unit details are shown in Figures 9.4-17 and 9.4-2.

Mist eliminators are provided in the spent fuel pool exhaust to remove moisture in the exhaust air, that exists due to evaporation of high-temperature fuel pool water. The evaporate is routed by a drain system to the suction side of the fuel pool skimmer pump which returns it to the fuel pool or to a hot drain. 10 In addition, care is taken not to impair the visibility for underwater observation by employing the following:

a. Maintain a low sweep velocity over the spent fuel pool surface to prevent ripple propagation

b. Supply sufficient heated air manually set to avoid 10 saturation of the air at the spent fuel pool surface

9.4.2.2 System Description

The fuel handling area ventilation system is shown schematically in Figure 9.4-7 and 9.4-8. The controlled access supply system (CASS) delivers filtered and tempered outside air to each floor of the fuel-handling area through a duct distribution system. 10 Each Controlled Access Supply Unit (CASU) consists of a roughing filter, heating and cooling coils, and a 100-percent-capacity fan. (See Figure 9.4-6.) Chilled water from the plant ventilation chilled water system shown in Figure 9.4-9, or 6 component cooling water or service water depending on site conditions is supplied to the cooling coils. The cooling water supply to these coils is maintained by the plant ventilation chilled water system only during normal operation. The CASU and associated ductwork are NNS.

The exhaust system ductwork branches to all areas within the fuel-handling area. Exhaust air is discharged to the atmosphere through the plant ventilation discharge duct via the CAFU or the ESFU during a fuel handling operation. The modular filter units shown in Figures 9.4-6, 9.4-2 and 9.4-17 are connected in parallel to the discharge plenum. Each module is also connected 10 to a common suction plenum which contains branches for the auxiliary building, safeguards area, containment and the condenser vacuum pump as well. Two of the filter units are classified as Engineered Safety Feature filter units (ESFU) and are maintained on a standby mode. However, the housing of all the modules, suction plenum, and the exhaust ductwork leading to the plenum are all Nuclear Safety Class 3 and

Seismic Category I to avoid inplant release of radioactivity as well as damage to other equipment during a DBE. Train oriented motor operated dampers powered from the Class 1E electrical buses, in the common suction plenum of the exhaust allow the fuel-handling area exhaust to be routed through the ESFU during refueling or spent fuel handling operations. The filter units which are train oriented and powered from the Class 1E buses, are separated in two equipment rooms separated by a heavy concrete wall enabling separation of redundant modules in accordance with NRC Regulatory Guide 8.8. The filter units which are designated ESFU will remain on standby during the normal plant mode of operation, and only operate 10 hours a month in accordance with Regulatory Guide 1.52, when not used during fuel handling operations. In this manner the NRC Regulatory Guide 1.52 requirement C.6.b of testing the iodine removal efficiency of the 10
ESFU after 720 hours of operation will not be attained during a year of reactor operation, and the ESF modules can be tested annually together with the CAFU.

The filter unit design incorporates the guidelines of NRC Regulatory Guides 1.52 and 1.140, and the recommendations of ERDA 76-21. Specific problems in previously designed units as shown in WASH-1234 were also considered.

The CAFU and fans are designed for normal operation only and the components comprising the units are as follows, in sequential order: prefilter, HEPA filter, iodine absorber and HEPA filter. Moisture separators and electric heaters are not used since the relative humidity of the exhaust air does not exceed 70 percent (see Figure 9.4-3). The ESFU units differ from the normal units only in that the prefilter has been replaced by moisture separators and electric heater in order to maintain the same standard size of the other CAFU. All filter units are furnished with preset temperature detectors in the absorber section which automatically initiates a water deluge to prevent auto ignition of the charcoal.

Prior to spent fuel-handling or refueling operations, the 6
fuel-handling area exhaust is routed through the ESFU by manually aligning the necessary dampers. (See Figure 9.4-6.) Each of the two ESFU is capable of handling 50 percent of the required 10
ventilation flow. If a fuel-handling accident occurs,

at least one unit is capable of maintaining the fuel-handling
area at a slight negative pressure. One CASU is stopped and the 10
supply damper is closed by manual operation.

9.4.2.3 Safety Evaluation

The fuel-handling area ventilation system conforms to the
Regulatory Position established in NRC Regulatory Guide 1.13 and
the exhaust portion is ANSI Safety Class 3 and Seismic 10
Category I.

The system complies with the environmental and components design
criteria, the qualification testing provisions, and the
applicant's understanding of the intent of system design criteria
promulgated in NRC Regulatory Guides 1.52 and 1.140, which is 10
shown in Table 6.5-1. Even if the system fission-product removal
features failed to function properly, the exclusion boundary
doses resulting from a postulated fuel-handling accident would
still be well below the exposure guidelines of 10 CFR Part 100.
(See subsection 15.7.4 for an analysis of a postulated
fuel-handling accident.)

During an abnormal condition, as the spent fuel pool water
temperature increases, from the normal operating temperature of
120 F, the evaporation rate from the pool also increases, because
the temperature of the ventilation air is kept at or below 115 F
is required to eliminate fog. A water temperature above 130 F
raises the relative humidity of exhaust air above 70 percent. To
protect the iodine adsorber and HEPA filters from above
70 percent relative humidity (which decreases the efficiency of
filters), it is necessary to remove moisture from the air prior 10
to entering the filter units (see Table 9.4.5). For this purpose
mist eliminators are provided in the exhuast and also in the
ESFU. The water drainage from the exhaust mist eliminators is
returned to the pools, or to a hot drain, thus limiting the
tritium concentration in the exhaust air.

Alarms are provided in the main control room to alert the
operator for equipment malfunction and to facilitate the startup
of standby units. Radiation levels are monitored continuously,
by area monitors (see Section 12.3.4) and Figure 12.3-4. 10

The system is sized to maintain the concentrations of airborne
radioisotopes, during fuel-handling operations below the
MPC levels specified 10 CFR Part 20, Appendix B, and to maintain
the area radiation levels as low as is reasonably achievable 10
(ALARA) in accordance with NRC Regulatory Guide 8.8. To minimize

the release of airborne contaminants to the outside ambient during a fuel-handling accident, ESFU 10 are provided and will be in operation prior to any spent fuel-handling. 10 For a discussion of a fuel-handling accident, see Section 15.7.4.

The exhaust filter units are physically separated and protected from pipe whip.

The fuel-handling area ventilation system is designed with sufficient redundancy in all active components and with a modular filter unit approach. The ventilation failure mode incorporates 10 manual switching from an inoperative fan to the available standby fan. During a periodic filter change, the airflow is temporarily reduced, but not interrupted; thus preferred airflow patterns can still be maintained throughout the fuel-handling area per Regulatory Guide 8.8. The scheduling of the filter change is such that it does not interfere with refueling operations.

The auxiliary building houses the fuel-handling area ventilation equipment and is a seismic Category I structure; the air inlet 10 structure is designed to seismic Category I requirements and to withstand the tornado loads and tornado-related missile conditions described in subsection 3.3.2. However, the air supply duct leading to the CASU is not Seismic Category I. The instrumentation and control requirements are discussed in Section 7.3.

9.4.2.4 Inspection and Testing Requirements

See subsection 9.4.1.4.

9.4.3 Auxiliary (Controlled Access Area) and Radwaste Areas Ventilation System

9.4.3.1 Design Bases

The auxiliary building (controlled access area) and radwaste areas ventilation system is designed to maintain suitable and safe ambient conditions for operating equipment and personnel during normal plant operation.

In addition, a slight negative pressure, by pressure control, 10 with respect to the environs is maintained either during normal operation, a loss of offsite power or following a DBA by operating at least one ESFU of the controlled access ventilation system. This reduces the radioactive effluent released to the environment to permissible levels. The dissipation of heat from the

charging pumps and the CASU and CAFU/ESFU equipment rooms is 10
accomplished by using supplementary auxiliary cooling units consisting of a cooling coil and a fan mounted in a housing which maintain these rooms below the maximum permissible temperature. HVAC equipment is designed to operate in and to maintain the required ambient conditions. The supply and exhaust ventilation filtration units are a part of the modular arrangement for the controlled access area ventilation system as shown in Figure 9.4-6.

Ambient temperatures throughout the building are maintained below 104 F during normal operation. During loss of offsite power and LOCA safety related equipment rooms are kept below 104 F. Other system design conditions are presented in Tables 9.4-1, 9.4-2 and 9.4-7. 6

The ductwork layout is arranged so that under normal operation in areas where airborne radioactivity may be present, airflow is directed from areas of low activity toward areas of high activity per Regulatory Guide 8.8. 10
The waste gas evaporator and waste gas compressor areas are provided with direct exhaust duct connections to the exhaust filter units, while the supply air originates from the surrounding areas of lesser possible radioactivity.

Filters and demineralizers, as well as gas decay tanks are located in separate closed compartments; flexible hose duct connections are provided for attachment to a manifold in the 10
exhaust systems when it is necessary to ventilate these compartments. The compartments are not ventilated unless personnel access is required. The compartments can then be loaded manually and individually onto the ventilation system. The airflow quantities are adequate to ensure that the concentration of radioisotopes in all areas, including the radwaste area, is below the MPC specified in Appendix B to 10 CFR Part 20.

The auxiliary building can be maintained at a slight negative pressure during abnormal conditions as described in 10
Section 9.4.2.1.

The system is provided with sufficient redundancy in equipment and power supplies to sustain a single active component failure without loss of function. Redundant safety-related fans are powered from redundant Class IE electrical buses. (See 10
Section 8.3 for buses description)

The CAFU/ESFU equipment room auxiliary cooling units are supplied with chilled water from the Nuclear Safety Related Chilled Water system Figure 9.4-5 while the remaining non-safety class auxiliary cooling units are supplied with chilled water from the 10 plant ventilation chilled water system (Figure 9.4-9) during normal operation and loss of offsite power. The NNS cooling units are not required to operate during LOCA since the charging pumps are not required for a plant shutdown following a LOCA. The pump room auxiliary cooling unit is interlocked so that it starts simultaneously with the equipment it serves.

The system is provided with sufficient instrumentation to enable the operator to continuously monitor the system performance and manually switch to the standby units when required.

Differential pressure measurement equipment is provided to ensure that a slight negative pressure with respect to the environs is maintained in the building; this prevents outward leakage of unfiltered contaminated air to the environment.

Exhaust air is passed through iodine adsorber beds; its activity is monitored prior to discharge to the atmosphere. The estimated annual radioactivity released from this source is discussed in section 11.3. Radioactivity is monitored by area monitors (See Section 12.3.4). 10

9.4.3.2 System Description

The auxiliary building (controlled access area) and radwaste areas ventilation system is shown schematically on Figure 9.4-10 6 sheets 1 and 2. The air supply system delivers filtered and tempered outside air to each floor of the auxiliary building through a duct distribution system. Two CASU of the controlled access ventilation system are utilized for ventilation of the auxiliary building (controlled access area) and radwaste areas.

The CASU and the operation is described in Section 9.4.2.2. The exhaust system duct work branches to all areas within the auxiliary building.

10

Exhaust air is passed through the CAFUs and discharged to the atmosphere through the plant ventilation discharge duct. The CAFU is described in Section 9.4.2.2. Four CAFUs are required to handle the auxiliary building air during normal operation. During any abnormal condition, the exhaust is passed through the ESFU with the CASUs shut down in order to maintain a negative pressure in the building. 10

9.4.3.3 Safety Evaluation

The exhaust portion of the auxiliary building ventilation system is ANSI Class 3 and Seismic Category I. The reliability and safety of the auxiliary building (controlled access area) and radwaste areas ventilation system is ensured by the following features: 10

a. The modular arrangement as shown on Figure 9.4-6, with redundant capacity and redundant power supplies, enables the system to sustain a single active failure without loss of function. 6 10

b. The charging pump and CASU auxiliary cooling units are supplied with chilled water from the plant ventilation (non-safety) chilled water system. These pumps are not required following a LOCA. 10

c. The CAFU/ESFU auxiliary cooling units are supplied with chilled water from the safety-related chilled water system since the ESFU are in operation following a LOCA.

d. Instrumentation and controls which incorporate audible and visual alarms in the control room facilitate continuous monitoring of system performance and alert the operator in the event of system malfunction.

e. Standby units can be remotely actuated from the control room. 10

f. Fail modes for isolation valves and dampers are set so that their failure does not render the system inoperable. Motor operated dampers are powered from the Class 1E busses. 10

g. The supply system component hangers are designed for seismic Category I loadings to negate the possibility of these components interfering with the operation of safety-related components, although the system is non-nuclear safety. 10

h. Exhaust air will be passed through iodine adsorber beds prior to its discharge. Data concerning iodine adsorbers is presented in Table 9.4-5. | 10

i. The auxiliary building (controlled access area) and radwaste areas ventilation system complies with the environmental and | 10 components design criteria, the qualification testing provisions, and the applicant's understanding of the intent of the system's design criteria promulgated in NRC Regulatory Guide 1.52, which is shown in Table 6.5-1.

The auxiliary building and radwaste areas ventilation system (controlled access ventilation system) supply and exhaust units are located in the auxiliary building at elevation 146 feet, 6 inches as shown in Figure 1.2-4. The instrumentation and control requirements are discussed in Section 7.3. 10

9.4.3.4 Inspection and Testing Requirements

See subsection 9.4.1.4.

9.4.4 Turbine Building Area Ventilation System

9.4.4.1 Design Bases

The turbine building ventilation system is designed to maintain suitable and safe ambient conditions for operating equipment and personnel during normal plant operation. Fresh outside air is delivered through a system of intake louvers. The air is delivered at each level of the turbine building. The air is either recirculated or rises to the ceiling of the turbine room, where it is exhausted to the atmosphere through roof exhausters. Multiple fans provide flexibility of operation and system balance. Steam supplied from the auxiliary boiler provides heat 2
during a unit shutdown in winter. System design conditions are presented in Tables 9.4-1, 9.4-2 and 9.4-7. The turbine building 6
ventilation system is shown in Figure 9.4-11.

9.4.4.2 System Description

Adjustable louvers provide weather protection and flow control of air. System balance is set and maintained by adjusting dampers on the roof exhausters and the makeup louvers. The steam for unit heaters is extracted from the auxiliary steam system when the unit is in operation, or from the electric auxiliary boiler when the unit is shut down.

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The exhaust fans are located on the roof of the building. For summer design conditions, a flow rate of approximately 1,460,000 ft³/min (with a discharge temperature of 115 F) is used.

For winter design conditions, a recirculated flow rate of approximately 146,000 ft³/min (with a discharge temperature of 80 F) is used.

9.4.4.3 Safety Evaluation

The reliability of the turbine building ventilation system is ensured by the following features: 1

a. The use of multiple fans (total of which is one more than required for normal operation), with excess capacity and multiple power supplies, enables the system to sustain a single active component failure without loss of ventilation.

b. Instrumentation and controls incorporating audible and visual annunciation facilitate continuous monitoring of system performance and alert the operator for system malfunctions.

c. There is no treatment of the turbine building exhaust air, since the discharge from the vacuum pumps during normal plant operation is routed to the plant vent stack via the controlled access area systems filtration units. 2 (See subsections 10.4.2.2 and 9.4.2.) The vacuum pump discharge is monitored for radioactivity (see subsection 10.4.2.3). See Section 7.3 for instrumentation and controls. 10

9.4.4.4 Inspection and Testing Requirements

Shop inspection and testing are performed for all moving equipment, heating coils, and controls.

The system is initially tested and adjusted for proper flow paths, flow capacities, heating and cooling capacities, and mechanical operability. 10

Fans are rated and tested in accordance with the standards of AMCA. (1). Coils are tested as per ARI Standard 410 (12). Ductwork is tested in accordance with industry standards. 10

Redundant standby equipment is operated on a cyclic basis to assure availability of the equipment.

9.4.5 Engineered Safety Features Area Ventilation System

9.4.5.1 Design Bases

The engineered safety features area ventilation system is designed to maintain suitable and safe ambient conditions for operating equipment and personnel during normal plant operation.

In addition, the building is kept at a slight negative pressure 10
with respect to the environment either during a loss of offsite
power or following a LOCA, by operating the ESFUs and tripping
the CASU thus reducing the radioactive effluent released to the
environment to permissible levels. The removal of heat during
these periods is accomplished by using auxiliary cooling units
which maintain the safety-related equipment rooms below the 5
permissible maximum temperature (104 F). Ventilation equipment
is designed to operate in and to maintain the required 10
conditions. The supply and exhaust ventilation units are a part
of the controlled access area ventilation systems, described in
Section 9.4.2 and shown in Figure 9.4-6.

Temperatures throughout the building are maintained below 104 F 10
during all modes of operation. Other system design parameters are presented in Tables 9.4-1, 9.4-2 and 9.4-7.

The system is provided with sufficient redundancy in equipment and power supplies to enable it to sustain a single active component failure without loss of function.

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The supply and exhaust air quantities are sized on the basis of providing ventilation of the area rather than cooling of the safety related equipment in the area due to the intermittent operation of the equipment. To remove the large quantities of heat which are rejected from the safety-related equipment following a DBA, each of the compartments in which this equipment is located is supplied with cool air from auxiliary cooling units. Each auxiliary cooling unit is powered from the same Class 1E electrical bus as the equipment it serves. Also, each unit is connected in such a way as to start simultaneously with the equipment it serves. The auxiliary cooling units are supplied with chilled water from the safety related chilled water system shown in Figure 9.4-5. The chilled water supply is interlocked with the fan during normal testing or operation of the equipment. In case of an emergency, override assures continuous water supply to all auxiliary units. 10

The system is provided with sufficient instrumentation to enable the operator to continuously monitor the system performance and manually switch to the standby units when required.

Exhaust air is passed through iodine adsorber beds and its activity is monitored prior to discharge to the atmosphere, as 2
shown on Table 9.4-5. Area monitors continuously monitor the 10
radiation levels (see Section 12.3.4 and Figures 12.3-1 and 12.3-2).

9.4.5.2 System Description

The safety features area ventilation system is shown schematically in Figure 9.4-7. The safety features area main air 6
supply system delivers filtered and tempered outside air to each floor of the safety feature area through a duct distribution system. The supply unit is discussed in Section 9.4.2.2. 10

The supply and exhaust system ductwork branches to all areas within the safety feature area. The exhaust unit is discussed in Section 9.4.2.2. 10

Auxiliary cooling units, each comprised of a water coil and fan section, are provided for all compartments which contain safety feature equipment. 10

The cooling units are operated in conjunction with the equipment, served through interlocks. 10

9.4.5.3 Safety Evaluation

The exhaust system, cooling units and Safety Features Chilled Water System are of seismic Category I and ANSI Safety Class 3 design. The supply system supports are designed to seismic Category I criteria, in order to prevent the damage to this system and thus interfering with the operation of safety-related components. 10

The reliability and safety of the safety feature area ventilation system is ensured by the following features: 1

a. The modular arrangement as shown on Figure 9.4-6 (with excess capacity and redundant power supplies) enables the system to sustain a single failure without loss of function. 10

b. Each safety-related equipment room has a 100-percent-capacity cooling unit to remove the heat dissipated by the equipment. Auxiliary cooling units are supplied with chilled water from one of two independent and separate chilled water systems. Each chilled water system and the auxiliary cooling units it serves are powered from the same Class 1E electrical bus.

c. Instrumentation and controls which incorporate audible and visual alarms in the control room facilitate continuous monitoring of system performance and alert the operator if the system malfunctions.

d. Safety related fans are automatically started upon receipt of a loss of offsite power or LOCA signal. 5

e. Chilled water is supplied to all auxiliary units during an emergency by an override signal to open all valves. Failure modes for isolation valves and dampers are set so that their failure does not render the system inoperable. 10

f. Exhaust air is passed through iodine adsorber beds prior to its discharge. Data concerning the iodine adsorbers is presented in Table 9.4-5.

g. All compartments containing ECCS equipment are furnished with isolation dampers in the supply system to prevent backflow. In case of a DBA and subsequent operation of the ECCS, the 10 compartments are isolated, the ventilation system is shut down, except for the ESFUs that provide a slight negative pressure 10 within the auxiliary building, and the auxiliary cooling units operate on a recirculation basis and provide cooling of the ECCS equipment.

Any contaminated air will be vented through the CAFU. 10

The safety features area ventilation system part of the controlled access ventilation system, is located in the auxiliary building at elevation 146 feet, 6 inches, as shown in Figure 1.2-4. The instrumentation requirements and control of the system are discussed in section 7.3.

9.4.5.4 Inspection and Testing Requirements

See subsection 9.4.1.4.

9.4.6 Containment Ventilation Systems

The containment ventilation systems as shown in Figure 9.4-12 6
consist of the containment air recirculation and cooling, CRDM cooling, neutron detector well cooling preaccess filtration, containment pressure relief, and containment purging systems. These systems are not required for operation following a LOCA. The systems are designed in accordance with the interface data requirements presented in Table 9.4-9. Specific data for the varicus systems are presented in Table 9.4-8.

9.4.6.1 Design Eases

a. Containment Air Recirculation and Cooling System

The containment air recirculation and cooling system maintains containment ambient temperature at or below 120 F and relative
humidity between 20 and 70 percent during normal plant operation. 3

The containment air recirculation and cooling system is designed to remove all heat generated by equipment within the containment,
with the exception of the reactor coolant pump motors which are 10
cooled separately by the Component Cooling Water System (or
service water), depending on site related conditions. 5

The system operates following a loss of offsite power, and provides mixing of fresh air during refueling and shutdown, but it is not operative following a DBA. Postaccident cooling is provided by the containment spray system (see subsection 6.2.2).

b. CRDM Cooling Units 10

The CRDM cooling system maintains temperatures within the CRDM shrouds in accordance with the NSSS SSAR. Specific data concerning this system will be presented in the Utility-Applicant's SAR.

c. Neutron Detector Well Cooling

Neutron detector well cooling units prevent neutron detectors 10
from exceeding their temperature limitations. (See Table 9.4-2.) These units also provide cooling for reactor shield wall concrete and nozzle supports. Two 100-percent-capacity cooling units are provided for redundancy and cooling water is provided by the plant ventilation chilled water system.

The system also works in conjunction with the containment purge supply and exhaust system to control the radioactivity in the reactor cavity during maintenance and refueling.

d. Containment Preaccess Filtration

The need for safe, periodic, or emergency access to the containment necessitates the use of containment preaccess filtration. This filtration system provides air circulation and
air filtering within the containment area. Containment preaccess 10
filtration equipment reduces the concentration of fission product particulate activity in the containment atmosphere prior to personnel entering the containment or containment purging. The reduced level of airborne particulate permits access to the containment for brief time intervals during reactor power or hot shutdown operations without containment purging. MPC level and required time period of unit operation prior to entry will be presented in the Utility-Applicant's SAR.

e. Containment Purge Supply and Exhaust

Containment purge supply and exhaust equipment satisfies the prerequisites for safe prolonged access to the containment following shutdowns. The use of this system will be restricted to cold shutdown operations. During all other operations, the systems containment isolation valves will remain closed.
Tempered fresh air is supplied and circulated throughout the 3
containment. Ventilation equipment is designed to maintain containment temperature above 60 F during the winter season.
Exhaust air is passed through the controlled access filter units 10

(CAFU) and discharged into the atmosphere through the plant ventilation discharge duct. The rate of release ensures that the offsite concentration of radioactive material is within the limits of 10 CFR Part 20. A discussion of the estimated annual 10 radioactivity discharges from purging is presented in Section 11.3.

f. Containment Pressure Relief

The containment pressure relief system is designed to prevent an increase in the containment positive pressure above the maximum permitted during normal operation, and per branch technical 10
position CSB 6-4.

9.4.6.2 System Description

a. Containment Recirculation

During normal operation, air in the containment is recirculated and maintained at or below 120 F. Four cooling units are provided, each sized for 33-1/3 percent of the normal duty cooling load. Fans are provided with a connection to the Class 1E electrical buses to preclude loss of cooling due to loss of offsite power. The cooling medium is water provided from the plant ventilation chilled water supply during normal operation and loss of offsite power. Instruments are provided to 10
continuously monitor air temperature and pressure within the containment during all phases of reactor operation.

The cooled air is distributed throughout the containment by the supply ductwork. No return ductwork is provided; the warm air rises through various openings in the floors and returns to the Suction side of the fan coil units.

b. Control Rod Drive Mechanism Ventilation System

The CRDM ventilation system will be supplied by Westinghouse and 5
designed in accordance with the interface requirements listed in RESAR-414 Section 9A.11.

c. Neutron Detector Well Cooling

The neutron detector well and nozzle support cooling system is a closed loop system provided to effect cooling of the neutron detector well and nozzle supports while limiting the concentration of radioactive Argon in the containment atmosphere. During normal operation, the reactor cavity is isolated from the containment atmosphere by use of a cavity seal ring. The cavity seal ring is positioned over the gap between the reactor vessel 2
flange and the reactor cavity concrete. Reactor cavity seal shims are provided on the cavity concrete to raise the seal ring to the level of the reactor after thermal expansion of the reactor takes place. The thickness of the shim is designed to

match the thermal expansion of the reactor vessel. Clamping devices anchor the cavity seal ring in place to prevent leakage.

During refueling, the reactor vessel cools and its size is reduced to the level of the cavity concrete. The cavity seal ring is now used without the seal shims to isolate the reactor cavity. The clamping devices again anchor the ring and form a water tight seal for the refueling process. 2

The reactor vessel is therefor isolated from the containment
atmosphere in the reactor cavity with the exception of the
reactor head and CRD mechanism. The air is cooled and directed
up around the reactor from the underside of the vessel. Part of 2
the air cools the neutron detectors and part is directed to the
nozzle and reactor vessel supports. The air is returned to the
fan via duct work embedded in the concrete. Two
100-percent-capacity fan-cooled units are provided. Each unit
consists of a fan, cooling coil, and inlet and outlet dampers.
Both units are connected to the Class IE electrical bus to
preclude loss of cooling if a loss of offsite power occurs.
However, the units are automatically tripped on receipt of a LOCA
signal - instrumentation continuously monitors air temperature in 10
the area of the neutron detection instrumentation.

The system is connected to and is used in conjunction with the
containment purge system to lower the level of radioactivity in
the reactor cavity prior to periodic maintenance. 2

d. Containment Preaccess Filtration

Preaccess filtration equipment is operated prior to reactor
shutdown for containment access. Air inside the containment is
recirculated by two 50-percent-capacity fan and filter units.
Each unit includes fan, roughing filter, two HEPA filters, and
iodine adsorbers. Both units are required to operate for
designed iodine removal. The equipment is designed to remove
fission product iodine gas, as well as radioactive particles, to
permit prompt access to the containment. Air is discharged at
the suction side of the containment recirculation system which
supplies the air through ductwork and guarantees proper mixing.
The minimum total air flow required is 30,000 ft³/min. The 3
assigned decontamination efficiency of the filtration equipment
for both elemental and organic iodides is 90 percent.
Temperature detectors and a deluge system permit flooding of the
charcoal adsorber beds in case of a fire. Filters are designed
as per NRC Branch Technical Position ETSB No. 11-2. Data 10
concerning preaccess filtration equipment are presented in
Tables 9.4-4, 9.4-5 and 9.4-8. 3

e. Containment Purge Supply and Exhuast

The purge supply and exhaust units are part of the controlled access area ventilation systems (see Figure 9.4-6). Description of each system is as follows: 10

1) Containment Purge Supply

Fresh air is passed through CASU and discharged near the recirculation supply fans in the containment, or in the neutron detector well below the reactor vessel. 10

One CASU is required. 10

2) Containment Purge Exhaust

Exhaust air is drawn through the CAFU and released to 10
the atmosphere via the plant ventilation discharge duct.

Two CAFUs are required. Both fans are required to
maintain design purge rate. The air is monitored before
discharge to the environment to limit the concentration
of contaminants as required by 10 CFR Part 20. The
purge isolation valve is designed to close automatically
on detection of high radiation levels, as indicated in 3
Table 12.3-1.

f. Containment Pressure Relief

The containment pressure relief system is designed to alleviate
containment pressure increases caused by temperature or humidity
transients during startups or air leakage from pneumatic
instruments during power operations. The system is manually
operated from the control room. A high containment pressure 3
alarm, located in the control room, alerts the operators to
pressures exceeding normal operating limits. The alarm has a set
point dictated by maximum pressure permitted within the
containment during normal operation.

The pressure relief line, as shown in Figure 9.4-12 and 9.4-18 is 10
connected to the containment purge exhaust system. The exhaust
air is decontaminated by the CAFU prior to being discharged to
the plant ventilation discharge duct.

Both pressure relief containment isolation valves automatically
close if high radiation is detected as discussed in Section 12.3
or on a phase A isolation signal, as discussed in 3
subsection 6.2.4 and Section 7.3. The isolation valves have a
maximum size of 8 inches and are designed to close within
5 seconds (including instrumentation delays) per branch technical 10
position CSB 6-4. Debris are prevented from affecting valve
closure by the use of a heavy gauge 1/4-inch mesh screen and a
150-lb-class tee at the inlet of

the inner containment isolation valve. This method prevents both entrapment and direct impingement of debris on the valve internals. The valve and actuator design basis include consideration of buildup of containment pressure for the LOCA break spectrum and relief line flows as a function of time up to and during valve closure.

The piping and ductwork downstream of the pressure relief valves will be designed to contain the escaping air and steam and will route the release to the CAFU. This will prevent any safety related equipment required to function following a LOCA from 10
being affected by the escaping mass.

The system design will ensure, that in the event of a LOCA, the radiological consequences will not exceed 10 CFR Part 100 limits. 3

Additional requirements for the design of the system isolation valves are presented in subsection 6.2.4.

9.4.6.3 Safety Evaluation 3

The reliability and safety of the containment ventilation systems is ensured by the following features: 1

a. Redundancy in equipment and power supplies enables the systems to sustain a single active component failure without total loss of function.

b. Instrumentation and controls which incorporate audible and visual alarms in the control room facilitate continuous monitoring of the system performances and alert the operator for system malfunctions.

c. Standby units can be remotely actuated from the control room.

d. Failure modes for isolation valves and dampers are set so that their failure does not render the system inoperable.

e. The exhaust systems outside the containment are of seismic Category I and of ANSI Safety Class 3 design.

f. The containment isolation valves for the containment pressure relief and purge systems are of seismic Category I and ANSI Safety Class 2 design. 3

g. The systems inside the containment are seismic Category I except for the fans and coils.

h. Exhaust air is passed through iodine adsorber beds prior to its discharge. 3

See Section 7.3 for discussion on instrumentation. 10

9.4.6.4 Inspection and Testing Requirements

Inspection and testing of the ventilation system components are discussed in subsection 9.4.1.4. The containment purge and pressure relief system isolation valves testing and inspection requirements are discussed in subsection 6.2.4. In addition, the pressure relief containment isolation valves are tested to determine the availability of the isolation function and the leak rate during reactor operation.

9.4.7 Service Water Intake Structure Ventilation System

9.4.7.1 Design Bases

The service water intake structure ventilation system is designed to maintain suitable ambient conditions for personnel and equipment during normal plant operation, scheduled shutdowns, and anticipated operational transients.

Ambient conditions are maintained below 104 F during normal operation and below 120F during accident conditions. The minimum ambient temperature is maintained above 50F. The system is provided with sufficient redundancy in equipment and power supplies (as shown in the following) to enable it to sustain a single active component failure without loss of function. 10

a. Supply units are equipped with two fans and cooling coils employing service water as the cooling media, each having 100-percent capacity. 10

b. The fans are powered from independent Class 1E electrical buses to preclude any loss of cooling or heating in the event of a loss of offsite power or following a LOCA. The system components are of seismic Category I and ANSI Safety Class 3 design, to ensure system availability for safe shutdown of the reactor during accident conditions. 10

9.4.7.2 System Description

The service water intake structure ventilation system is shown
schematically in Figure 9.4-13. Sufficient air for heat 6
dissipation is supplied from outside air louvers designed to
seismic Category I requirements to the equipment space. (See 6
Table 9.4-11 for service water intake structure ventilation
system interface requirements.) The supply unit consists of a
roughing filter, heating coil, cooling coil, and two

100-percent-capacity fans. Exhaust air is discharged to the atmosphere through air louvers of seismic Category I design.

The ambient temperature during the winter months and during shutdown is maintained by recirculation through the supply unit and electric heaters located within the supply unit.

Temperature during the summer months is maintained by air cooling as long as the site ambient temperature remains below 104 F. If the temperature increases, supplementary cooling units employing service water as the cooling media becomes operational to 10
maintain 104 F.

9.4.7.3 Safety Evaluation

The reliability and safety of the service water intake structure ventilation system is ensured by the following features: 1

a. Redundancy in equipment and power supplies enables the system to sustain a single active component failure without loss of function.

b. Instrumentation and controls which incorporate audible and visual alarms in the control room facilitate continuous monitoring of system performances and alert the operator for system malfunctions.

c. Standby units are automatically energized following failure of the functional unit.

d. Failure modes for isolation valves and dampers are set so that their failure does not render the system inoperable.

e. The system is of seismic Category I and ANSI Safety Class 3 design.

The service water intake structure is a seismic Category I structure; the air inlet and exhaust louvers and ductwork are designed to seismic Category I requirements and to withstand the tornado loads and tornado-related missile conditions described in subsection 3.3.2.

9.4.7.4 Inspection and Testing Requirements

See subsection 9.4.1.4.

9.4.8 Miscellaneous Ventilation Systems

9.4.8.1 Diesel Generator Building

The diesel generator building ventilation system is designed to
maintain suitable and safe ambient conditions for operating
equipment and personnel during normal plant operation. In
addition, the system ensures suitable operating conditions 1
following a DBA. Each diesel generator compartment is supplied
with 3-33 1/3 percent capacity exhaust fans which are manually
started when the generators are in operation. A third, auxiliary
diesel generator is served by two 50 percent capacity units which
are also manually started when the generator is in operation.
Additionally, 1-100 percent capacity exhaust fan serves each
compartment and is operated continuously irrespective of the 2
diesel generator functional status. Both exhaust fans also serve
the auxiliary diesel generator during normal operation. The
equipment that serves each main diesel generator compartment is
located in or above the compartment it exhausts. No redundancy
is provided, since the diesel generators themselves are
redundant. The system is of Seismic Category I and ANSI Safety
Class 3 design. Figure 9.4-14 shows the system schematically. 6

Maximum ambient temperatures are maintained below 104 F for 1
normal plant operation and below 120 F during operation of the 10
diesel generators. A minimum temperature of 50 F is maintained 1
during all modes of operation.

Exhaust fans are sized to provide adequate ventilation for personnel and dissipation of auxiliary equipment heat emissions during plant and diesel generator operations. Each of the diesel generator compartments is equipped with air exhaust units to dissipate the large quantities of heat which are rejected from the diesel generator following diesel starting. Each exhaust unit is automatically energized from the Class 1E electrical bus following the starting of the diesel generator it serves.

Electric unit heaters are provided to maintain the minimum ambient temperature within each compartment when the diesels are not in operation.

Monitoring of the conditions in the diesel generator rooms is accomplished with the following control room instrumentation:

a. Diesel generator room high temperature alarm 2

b. Ventilation system fan motor tripped alarms

9.4.8.2 Uncontrolled Access Area - Auxiliary Building

The uncontrolled access area ventilation system, shown
schematically in Figure 9.4-14, consists of redundant inlets,
filters, cooling and heating coils, shutoff dampers and four
50 percent capacity supply fans, and four 50 percent capacity 10
exhaust fans providing 100 percent capacity for each electrical
train. The system is designed to maintain the area ambient
temperature below 104 F in summer and above 50 F in winter.
Modulating dampers located in both the air inlets and the air
exhausts provide a slight positive pressure for the uncontrolled
access areas to prevent the in leakage of radioactivity from
controlled access areas. The system contains provisions for 2
recirculation during winter operation in order to reduce heating
and cooling requirements. The system is of seismic Category I
ANSI safety-class 3 design and in accordance with the single 10
component failure criteria requirement.

The uncontrolled access area ventilation provides ventilation to
the Class 1E switchgear rooms, cable spreading rooms, battery
rooms, inverters, and electrical penetration areas containing
Class 1E equipment. Chilled water supplied to the uncontrolled
access ventilation cooling coils from independent and separate
safety-related chilled water systems enables the ventilation
system to maintain the required ambient temperatures during all
modes of operation. (See Figure 9.4-5.) 6

The battery rooms are provided with separate exhaust systems.
Each room has an exhaust duct and two 100 percent capacity fans
that discharge the exhaust air to the roof. The cooled air is
supplied by the uncontrolled access area supply system and
recooled by a coil placed inside the duct in order to maintain
the ambient temperature at 75±5 F during all modes of operation.
The system is of seismic Category I and ANSI safety Class 3 10
design and has 100 percent redundancy to sustain a single active
component failure. The redundant fans are started manually from
the control room upon initiation of a loss of ventilation alarm.
Hydrogen concentration monitors are not required in the battery
rooms. The uncontrolled access ventilation system provides a
sufficient number of room air changes, such that the hydrogen gas 2
concentration is maintained below explosive limits during normal
plant operation.

If a LOCA or loss of offsite power occurs, the battery room 2
exhaust fans are automatically loaded onto the safety-related 10
diesel generator bus to provide sufficient ventilation and
adequate dispersion of hydrogen gas. 2

Recirculation of the uncontrolled access exhaust ensures a minimum temperature of 50 F for winter operations. 1

The uncontrolled access area ventilation equipment is located in the auxiliary building at elevation 100 feet, 6 inches and 150 feet, 6 inches adjacent to the control room HVAC system. The air intake is in the wall exposed to the outside; the intake louvers and inlet ducts are designed to seismic Category I requirements and to withstand the previously referenced tornado conditions. The exhaust is discharged through roof structures which are designed to withstand tornado loads and tornado generated missiles. 2

9.4.8.3 Electrical Building, Health Physicist Office, and Service Area 10

The electrical building ventilation and air conditioning system is shown in Figure 9.4-15. Two 50 percent capacity air cooled A/C units will provide conditioned air to the offices and service area, normal switchgear area, non-safety related battery rooms, central alarm station, guards room, and throughout the entire building. A combination of recirculation and once-through ventilation is employed during the various seasons in order to conserve power. The offices and service area will be maintained at an ambient temperature of approximately 75 F and 50 percent relative humidity. The battery room, guard room and the remaining area at El. 135 ft-6 in. will be maintained at 80 F and 50 percent relative humidity. The normal switchgear area will be designed for a maximum ambient temperature of 104 F. The exhaust from the air conditioned, potentially radioactive areas, is ducted to the auxiliary building ventilation system and is passed through the controlled access area exhaust filters. Two 100 percent capacity exhaust fans are provided for exhausting the battery area in order to remove the hydrogen contents within the rooms. In addition, two 50 percent capacity fans will be used for the toilet and locker exhaust. The system is not required to operate following a LOCA or during a loss of offsite power.

9.4.8.4 Main Steam and Feedwater Area

The main steam and feedwater area ventilation is shown schematically in Figure 9.4-7. Approximately 2000 cfm of air 10
from the atmosphere is introduced into this area by a fan located in the turbine building. This air, plus the air present in the room is cooled by four auxiliary cooling units supplied from the non-safety related chilled water system. Air is exhausted at all times from this area to the turbine building by the over-pressure caused from the supply fan. The system is designed to keep the area ambient temperature below 120 F in summer and above 50 F in winter. Provision for recirculation of ventilation air is made for winter operation. The system is not required to operate following LOCA or during a loss of offsite power.

9.4.9 Plant Ventilation Discharge Duct

9.4.9.1 Design Basis

The plant ventilation discharge duct is designed to aid in the dispersion of gaseous effluents exhausted by the controlled access ventilation system during normal operation. (See Figure 9.4-6.) |6

9.4.9.2 System Description

The plant ventilation discharge duct is the release point of the controlled access area ventilation systems. The duct is located adjacent to the southeast side of the containment.

The design parameters for the plant ventilation discharge duct are the following:

a. Height of Release

The release point is approximately 77 feet 3 inches below the top of the containment and at least 68 feet 6 inches above other adjacent structures. 6 The release point is at the springline of the Containment. 10

b. Discharge Temperature

As shown in Table 9.4-2, the minimum indoor design condition is 50 F. The temperature of the outside air is site related; therefore the temperature difference between the gaseous effluent discharge and the outside air is also site related. Information concerning outdoor design conditions (Table 9.4-1) will be presented in the Utility Applicant's SAR.

c. Effluent Discharge Quantity

The quantity of gaseous effluent exhausted via the plant vent stack is as follows:

1)	Normal operation, ft^3/min (maximum)	120,000	3
2)	Refueling, ft^3/min (maximum)	150,000	2
3)	Loss of offsite power, ft^3/min (maximum)	30,000	3
4)	LOCA, ft^3/min (maximum)	30,000	

d. Plant Vent Stack Size and Shape

The plant ventilation discharge duct is rectangular in construction. The free inside area depends on the gaseous effluent discharge rate, with a converging section at the discharge point. The converging section is designed to create a dischage velocity of 3000ft/min, based on the normal operation discharge quantity, and to provide good dispersion.

9.4.9.3 Safety Evaluation

The plant discharge duct is designed to seismic Category I and as 6 such no failure is anticipated. The duct is designed as non-nuclear safety above the exhaust equipment roofline. 10

9.4.10 References

The following documents were used in the the preparation of this Section:

(1) Air Moving and Conditioning Association (AMCA), Test Code for Air Moving Devices, 210-67, 300, 211.

(2) American National Standards Institute, ANSI N101.1-1972, Efficiency Testing of Air-Cleanin~ Systems Containing Devices for Removal of Particles.

(3) American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Guide and Data Handbooks, Vols. I to IV, 1970-1972.

(4) American Air Filter Topical Report, AAF-TR-7101, Design and Testing of Fan Cooler Filter Systems for Nuclear Application, February 20, 1972.

(5) American Filter Institute (AFI).

(6) National Bureau of Standards (NBS).

(7) ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers) Standard 52-68, "Method of Testing Air Cleaning Devices used in General Ventilation for Removing Particulate Matter, Section 9".

(8) American National Standards Institute, ANSI N509-1976, "Nuclear Power Plant Air Cleaning Units and Components".

(9) American National Standard Institute, ANSI N510-1975, "Testing Nuclear Air Cleaning Systems". 6

(10) ERDA 76-21 "Nuclear Air Cleaning Handbook" (ORNL - NSIC - 65 Rev. 1).

(11) 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

(12) 10 CFR Part 50, Appendix A, General Design Criterion 4, "Environmental and Missile Design Bases."

(13) 10 CFR Part 50, Appendix A, General Design Criterion 5, "Sharing of Structures, Systems, and Components."

(14) 10 CFR Part 50, Appendix A, General Design Criterion 19, "Control Room."

(15) 10 CFR Part 50, Appendix A, General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment."

(16) 10 CFR Part 50, Appendix A, General Design Criterion 64, "Monitoring Radioactivity Releases."

(17) Branch Technical Positions APCSB 3-1, "Protection Against Postulated Piping Failures in Fluid Systems 6
Outside Containment," attached to Standard Review Plan 3.6.1, and MEB 3-1, "Postulated Break and Leakage Locations in Fluid System Piping Outside Containment," attached to Standard Review Plan 3.6.2.

(18) Regulatory Guide 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations be as Low as is Reasonable Achievable", Revision 2.

(19) Regulatory Guide 1.13, "Fuel Storage Facility Design Basis."

(20) Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste Containing Components of Nuclear Power Plants," Revision 1.

(21) Regulatory Guide 1.29, "Seismic Design Classification," Revision 1.

(22) Regulatory Guide 1.52, Rev. 2 "Design, Testing, and 10
Maintenance Criteria for Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants."

(23) Regulatory Guide 1.78 "Assumptions for Evaluating the Habitability of a Nuclear Power Plant Control Room 6
During a Postulated Hazardous Chemical Release".

(24) Regulatory Guide 1.95, "Protection of Nuclear Power
Plant Control Room Operators Against An Accidental 6
Chlorine Release."

(25) Regulatory Guide 1.140, "Design, Testing, and
Maintenance Criteria for Normal Ventilation, Exhaust 10
System Air Filtration and Adsorption Units of Light
Water-Cooled Nuclear Power Plants."

(26) Wash 1234 "Engineered Safety Features Air Cleaning
Systems for Commercial Light-Water-Cooled Nuclear Power 6
Plants."

(27) 10 CFR Part 100, "Reactor Site Criteria". 10

(28) 10 CFR Part 20, Appendix B, "Concentration in Air 10
and Water Above Natural Background". 6

(29) Air-Conditioning and Refrigeration Institute (ARI), 10
for forced - Circulation Air - Cooling and Air Heating, 6
Coils, 410.

TABLE 9.4-1 1

EXTERNAL ENVIRONMENTAL DESIGN CONDITIONS

Maximum Summer Design, F DB	110 F
Summer design temperature, F WB	79 F
Winter design temperature, F DB	-15 F
Latitude	Will be provided in the Utility Applicant's SAR. 10
Elevation	Will be provided in the Utility Applicant's SAR.
Average wind velocity	Will be provided in the Utility Applicant's SAR.

The design temperatures were based on data abstracted from ASHRAE Handbook of Fundamentals using 1 percent design for the summer and 99 percent design for the winter.

TABLE 9.4-2

DESIGN CONDITIONS - INDOORS
(NORMAL OPERATION, LOSS OF OFFSITE POWER, AND LOCA)

Air-conditioned areas (control room)	summer	75F ±5 F, 50% relative humidity ±10%	10
	winter	75F ±5 F, 50% relative humidity ±10%	10
Air-conditioned areas (office and service area)	summer	75F ±5 F, 50% relative humidity ±10%	10
	winter	75F ±5 F, 50% relative humidity ±10%	10
Non-air-conditioned area (auxiliary, safety features area, fuel handling, and electrical buildings)	summer winter	104 F maximum 50 F minimum	10
Containment building CRDM shroud (air temp)		120 F maximum - 60 F minimum 120 F inlet*	
Neutron detector well		135 F normal 175 F maximum (excursions)	10
Main Steam and feedwater area, Diesel generator area, Station service water pumphouse, tank enclosure, and turbine buildings	summer winter	120 F maximum 50 F minimum	10
Battery rooms	summer winter	75 F ±5 75 F ±5	10

*For outlet temperature see NSSS SSAR.

TABLE 9.4-3

EQUIPMENT LINEUP FOR
CONTROL ROOM AIR-CONDITIONING SYSTEM
MODES OF OPERATION

Mode	Dampers Open*	Fan On*	Dampers Closed	Dampers Modulated**	
Normal Operation	1, 7, 21 29, 32	7, 1, 9	5, 11, 13, 15 19, 25, 27, 2, 4, 6, 8, 12, 14, 16, 18, 22 24, 28, 30, 31	3	8 10 8 10
Emergency Recirculation	15, 19, 21, 27	1,3	1, 3, 5, 7, 11, 13, 29, 31, 2, 4, 6, 8, 12, 14, 16, 18, 22 24, 28, 30, 32	25	
Emergency Pressurization	5, 15 19, 21, 27	1, 3, 5	1, 3, 7, 11, 29 31, 2, 4, 6, 8, 12, 14, 16, 18 22, 24, 28, 30 32	13, 25	8
Emergency Ventilation	1, 11, 15, 19, 21, 29, 32	1, 3, 7 9	5, 7, 13, 27, 2, 4, 6, 8, 12, 14, 16, 18, 22, 24, 28, 30, 31	3, 25	10

SEE subsection 9.4.1.2 for overpressure requirements

*Components normally function

NOTE: Fan inlet flow control dampers 9, 10, 17, 20 compensate for filter conditions.

TABLE 9.4-4
(SHEET 1 of 2)

FILTER DESIGN REQUIREMENTS
PER NRC REGULATORY GUIDES 1.52 REV. 2 and 1.140 | 10

Prefilters

Efficiency at rated air velocity	40 percent minimum per ASHRAE STD 52	3
Initial (clean) resistance at rated air velocity	0.16 inch water	3
Maximum (dirty), resistance at rated air velocity	1.0 inch water	
Dust-holding capacity at rated air velocity	175 gr/ft^2 minimum of AFI test dust	3

HEPA Filters

Air flow capacity/ cartridge	1000 ft^3/min minimum	
Filtration efficiency DOP** tests	0.03% penetration on DOP Challenge per ANSI N510 and NRC Regulatory Guide 1.52 Rev. 1	3
Air flow resistance	1.0-inch water maximum clean filter at rated capacity	3
	4.0-inch water maximum dirty filter at rated capacity	

*Air Filter Institute
National Bureau of Standards

**Dioctyl Phthalate

TABLE 9.4-4 1
(SHEET 2 of 2)

FILTER DESIGN REQUIREMENTS
PER NRC REGULATORY GUIDES 1.52 REV. 2 and 1.140 10

<u>Iodine Adsorbers</u>

Material	Impregnated activated charcoal meeting the requirements of Table 2, NRC Regulatory Guide 1.52 Rev.-1
Initial Efficiency	In accordance with NRC Regulatory Guide 1.52 Rev-1, Table 2, Test 5 2
Minimum contact time	0.25 sec. per 2 inches
Adsorber bed thickness	4.0 inches
Assigned decontamination efficiencies for elemental and organic iodides	3
ESF	99 percent, per Regulatory Guide 1.52
Non-ESF	90 percent, per Regulatory Guide 1.140 10
Minimum weight of carbon	250 lb per 1000 ft^3/min air

TABLE 9.4-8
(SHEET 1 of 3)

CONTAINMENT VENTILATION SYSTEMS DESIGN PARAMETERS

<u>Containment Air Recirculation and Cooling Unit</u>

Number installed	four	
Number required to operate	three	
Type coil	chilled water	
Heat removal capacity, Btu/hr (each)	(later)	
Fan capacity, ft^3/min (each)	65,000	10
Conditions Temperature, F (containment)	120 maximum	
Total pressure, psig	atmospheric	
Cooling media	plant ventilation chilled water or component cooling water or service water	

TABLE 9.4-8
(SHEET 2 of 3)

CONTAINMENT VENTILATION SYSTEMS DESIGN PARAMETERS

Neutron Detector Well Unit

Number installed	two	
Number required to operate	one	
Type coil	chilled water	
Heat removal capacity, Btu/hr (each)	344,700	10
Fan capacity, ft³/min (each)	approx. 10,500	
Temperature, F	135 (possible excursions to 175)	
Cooling media	plant ventilation chilled water	

TABLE 9.4-9
(SHEET 1 of 2)

CONTAINMENT VENTILATION SYSTEMS INTERFACE REQUIREMENTS
(Westinghouse - 414) | 2

	RESAR-414 Table 9.4-1 Requirements	G&H Design	
Vessel Annulus & Detector Well Cooling System 8hr Excursions)	135 F avg. 175 F max.	135 F avg. 175 F max.	10
CRDM Shroud System Exhaust Fans	120 F inlet 39 F rise 56,000 SCFM	120 F inlet 39 F outlet 56,000 SCFM	10
Containment Building System	120 F max.	120 F max.	

Piping	NSSS Heat Release Estimate (Btu/hr)	Heat Removed By Ventilation (Btu/hr)	3
Reactor Coolant System	148,800	148,800 - Note (2)	10
Other Piping	40,000	40,000	
Equipment			
Reactor Vessel			
Above Seal	17,000	17,000	
Below Seal	125,000	125,000	
Reactor Coolant Pumps	5,537,700	701,800 - Note (1)	10
Steam Generators	1,150,200	1,150,200 - Note (3)	
Pressurizer	171,500	171,500 - Note (3)	
Control Rod Drive Mechanisms	2,334,000	2,334,000	

TABLE 9.4-9
(SHEET 2 of 2)

CONTAINMENT VENTIIATION SYSTEMS INTERFACE REQUIREMENTS
(Westinghouse - 414) 2

	NSSS Heat Release Estimate (Btu/hr)	Heat Removed By Ventilation (Btu/hr)	
Pressurizer Relief Tank	42,800	42,800	10
Primary Concrete Shield	17,000	17,000	1
Regenerative Heat Exchanger	34,500	34,500	
Excess Letdown Heat	400	400	10
Subtotal A	9,618,900	4,783,000	
+15% Contingency	11,061,700	5,500,500	

	Heat Removed By Ventilation (Btu/hr)	
		3
Main Steam Piping	270,000	
Feedwater Piping	270,000	
Incore Instrumentation	18,000	
Rod Position Indicator	18,000	
R.C. Drain Tank Pumps	17,000	
R.C, Drain Tank Heat Exchanger	12,000	
R.C. Drain Tank	12,000	
Electrical Equipment	20,000	
CRDM Fan Load	230,000	
Containment Recirculation Fans	496,400	
Subtotal B	1,363,400	
Subtotal B + Contingency	1,500,000	
Subtotal A + Contingency	5,800,000	
Subtotal B + Contingency	1,500,000	5
Total	7,300,000	

Note (1) - Additional 4,835,900 Btu/hr are removed by the motor water coolers shown in Figure 9.2-4.

Note (2) - Includes hotlegs, crossovers, and cold legs. 10

Note (3) - Includes supports.

TABLE 9.4-12

TOXIC GAS AND SMOKE DETECTORS 6

Detector Type:	Chlorine*	Other Toxic** Gases	Ionization Smoke Detector***
Detection Capability:	1ppm of air by Volume	**	N/A (see Note 1) 10
Seismic Category:	I	I	I

* This detector will isolate the control room HVAC system by closure of damper within four seconds of detector trip. The system will automatically switch to the recirculation mode of operation. 6

** Other toxic gas detectors required by site-specific conditions will be discussed in the Utility-Applicant's SAR. These detectors will meet the requirements of Regulatory Guide 1.78.

*** This detector will alarm in the control room and isolate the control room HVAC within four seconds. The operator will evaluate the need to manually perform any system re-alignment required. 10

Note 1: Note applicable since the ionization detector design cannot be related to an established volume of smoke within the air.

9.5 Other Auxiliary Systems

9.5.1 Fire Protection

The overall fire protection program was developed utilizing the defense in depth concept. The fire protection system deals with fire prevention, fire detection and suppression, and fire extinguishing techniques. The fire protection system is designed to balance these factors. These factors are applied to construction methods, selection of materials, plant general arrangement, and evaluation of fire effects. Further considerations, such as employee safety, effects on the environment and property protection have also been incorporated in the overall fire protection program.

The fire protection program applies to equipment, procedures and plant personnel utilized in effecting fire protection and prevention as it relates to plant design. The fire hazards evaluation quantifies potential fire hazards throughout the plant is terms of combustible heat release loading. Subsequently, the fire protection and detection systems are designed based on this heat release loading and the nature of the combustible material in the area, as well as on the criticality of equipment and combustibles in adjacent fire areas. A summary of this information is presented in tabular form and provided in Table (later). 8

The Gibbs & Hill, Inc. Standard Nuclear Power Plant fire protection program is in general compliance with the criteria provided by Standard Review Plan 9.5.1 and NRC Branch Technical Position ASB-9.5-1, Rev. 2.

An overall fire protection system description is provided in sections 9.5.1.1 through 9.5.1.5. Section 9.5.1.6 provides the details which indicate the extent of conformance with Standard Review Plan 9.5.1 and NRC Branch Technical Position ASB 9.5-1, Rev. 2.

9.5.1.1a Design Bases

The following are design functions of the fire protection system:

a. To minimize the possibilities of fire starting in any area of the plant

b. To provide quick-acting fire detection and suppression systems for use in the event of a fire.

c. To minimize the possibility of personnel injury and equipment damage. 8

d. To minimize the effects of fire to essential safety-related components of the plant.

The fire protection booster pumps are also used as part of the seismic Category I makeup supply to the CCW surge tank, the 10 safety feature chilled water expansion tanks, and the spent fuel pool.

9.5.1.1b Identification of Fires

The overall fire protection is based on evaluation of potential fire hazards which can affect the safety-related structures. Fires that can directly or indirectly affect emergency safety features (ESF) equipment and structures are postulated to occur at the location of stored combustible material and are directly related to the quantity of combustible material.

Safety related systems, structures, components and equipment are separated from each other either by 3-hour fire barriers (with openings having protection consistent with this rating), or by equivalent and adequate spatial clearance. Fire areas are provided based on the amount of combustible material present and 8 provide adequate isolation of redundant safety related systems and components.

9.5.1.1c Fire Characteristics

The intensity of fire depends on the material and combustibility of the burning surface area.

Activated charcoal has an ignition temperature of approximately 340 C. When used in an adsorber filter, activated charcoal is encased in a steel or sheet metal enclosure. The incidence of fire with normal airflow is considered unlikely. Combustion products are mainly carbon, carbon dioxide, and carbon monoxide. Charcoal fires in relatively still air burn slowly with a low spreading intensity and little smoke.

Oil fires burn rapidly with high intensity and smoke. Fires involving hydraulic oils are kept to a minimum by use of high-flashpoint fluids and where possible synthetic hydraulic oils. Lubricating and diesel fuel oil fires are surface burning 8
fires, which produce smoke and unburned fumes.

9.5.1.2 System Description

a. General Description

Water for the fire protection system is site specific. A discussion of the fire water source will be provided in the Utility-Applicant's SAR.

The water supply system is designed based on the largest anticipated water demand of any sprinkler or deluge system in the plant for 2 hours, plus 750 gpm for hose streams. The fire protection system water flow diagrams are provided on 8
Figures 9.5-1a, 9.5-1b and 9.5 (later).

Two equal capacity fire protection pumps, one motor-driven and one diesel engine-driven is provided. A jockey pumps is provided to maintain full system water pressure at all times. The fire protection pumps are located outside the primary plant. As a minimum the fire suppression system shall be capable of delivering water to hose streams located near equipment and components required for safe shutdown following an SSE. These areas are supplied with fire water to the hose stations from a seismic Category I source by the fire protection booster pumps.

Because the fire protection booster pumps are used as part of 10
the seismic Category I makeup supply to the CCW surge tank, the safety feature chilled water expansion tanks, and the spent fuel pool, they are designed to Safety Class 3 and seismic Category I requirements, as shown on Figure 9.5-1B.

b. Fire Suppresion Components

Fire protection consists of the following:

1) Sprinkler water systems located in various areas of the 8
plant equipped with alarm check valves and an annunciator in the control room

2) Deluge water systems located in various areas of the plant equipped with water motor alarms and an annunciator in the control room

3) Readily accessible portable extinguishers located throughout the various buildings to meet specific area requirements

4) Fire hose stations located throughout the various buildings

5) An automatic fixed hal n extinguishing system is used in the plant computer ro . 8

6) Approved yard fire hydrants are providec for overall area protection of the plant structures.

c. Fire Detection Components

Fire and smoke detection devices include:

1) Ionization smoke detectors

2) Thermal Detectors

3) Flame detectors

4) Combination of items 1, 2 and/or 3.

The fire detection system is provided with backup onsite power supply for operation in the event of loss of normal onsite power. The type of detectors provided throughout the plant are comparable with combustible material located in the specified fire areas.

9.5.1.3 System Evaluation 8

Analysis of the potentially adverse effects of the fire protection and the fire detection system are evaluated as follows:

a) Fire Detection

A fire detection system is provided to ensure that a single failure in one zone will not incapacitate the detectors in an adjacent detection zone. Primary and secondary power sources shall be provided for the fire detection systems. Fire detection system control and annunciation is addressed in the Utility Applicant's SAR.

b) Pipe Rupture

Ruptures in Fire Protection System piping are indicated in the control room by the starting of the main fire protection pumps without fire detection anunciation, automtic supression system alarms, hose stream actuation alarms or usage of yard fire hydrants. See the failure mode and effects analysis provided in Table 9.5-7.

3) Two 100 percent capacity pumps, one ac motor driven and
one diesel engine driven pump are provided. Each pump
is rated at 2500 gpm. The day tank fuel supply for the
diesel driven fire pumps is provided adjacent to the 8
engine driven pump. A 3 hour fire barrier separates the
fuel supply from the pump. The fire water pumps shall
comply with the requirements of NFPA 20, "Standard for
the Installation of Centrifugal Fire Pumps." One ac
motor driven jockey pump is provided to maintain system
pressure.

Two 100 percent capacity fire protection booster pumps
are provided. These Safety Class 3, seismic Category I
pumps provide water to the piping and hose stations 10
serving safety related equipment.

4) The fire protection water supply system is site specific and is addressed in the Utility-Applicant's SAR.

5) The fire protection system water supply design basis is discussed in section 9.5.1.6.5b(1).

6) Fire hydrants are located a maximum of 250 feet apart on the main yard loop. Fire hydrants permit protection of onsite locations of fixed or transient combustibles. Hose houses and equipment are provided in accordance with NFPA 24, "Outside Protection".

Threads compatible with those used by the local fire
department are utilized on the hydrants, hose couplings 8
and standpipe risers. Thread size and type is addressed
in the Utility Applicant's SAR.

c) Water Sprinkler and Hose Standpipe Systems

1) Hose stations and sprinkler systems have connections to the main yard piping which ensure that neither a passive or an active failure in a line will impair both the primary and secondary fire suppression systems. Piping and fittings meet the requirements of ANSI B31.1, "Power Piping." Each sprinkler and standpipe system is provided with an approved isolation valve.

Safety related equipment which does not represent a fire hazard and could be damaged by water, is protected against such damage through the use of water shields or baffles. 8

2) Design of control and sectionalizing valves in the fire protection system ensures that they are sufficiently monitored to indicate valve position. Electrical supervision of the valves conforms to NFPA 26 Code requirements. Electrical supervision signals are indicated in the control room.

3) Fixed water spray systems conform to the requirements of NFPA 13, "Standard for Installation of Sprinkler Systems," and NFPA 15 "Standard for Water Spray Fixed Systems".

4) Interior hose stations are able to reach any and all locations that contain safety related equipment which may be exposed to a potential fire hazard. Standpipes and hose systems are designed and installed according to the requirements of NFPA 14, "Standpipe and HoseSystems."

Fire hose stations have been located to facilitate ease of access to any given fire area as denoted by Table (later). Sufficient hose stations and backup equipment have been provided to preclude physical blockage of a particular hose station. 8

Fire protection piping and hose stations located in or near areas containing safety related equipment required for safe shutdown following an SSE is seismic Category I and performs their intended design function following an SSE.

5) The proper type of hose nozzles to be utilized in each fire area are based on the hazard analysis. This item is addressed as plant design proceeds.

6) Foam fire suppression systems are addressed in the Applicant's SAR

d) Halon Suppression Systems

Fixed automatic halon suppression systems are used in the plant computer room.

e) Carbon Dioxide Suppression Systems

Fuel oil required for recharging the fuel oil storage tanks for an indefinite period of operation in excess of 7 days will be 1
normally brought in by tank truck. However, railroad tank cars can be brought in on the plant's railroad spur.

The single failure analysis is provided in Table 9.5-2.

9.5.5 Emergency Diesel Generator Cooling Water System

The emergency diesel generator cooling water system is designed to provide a heat-removal medium for the station emergency diesel generators and it consists of two systems: a diesel engine jacket water subsystem and a jacket water to cooling water heat exchanger subsystem. The emergency generator cooling water 1
system is shown in Figure 9.5-4.

9.5.5.1 Design Bases

The various components are sized to remove the maxium heat produced by the diesel generator sets using service, water as a 10
cooling medium. Essential system components are designed to seismic Category I requirements and to withstand the worst anticipated environmental phenomernon.

This system is designed to meet the requirements of 10 CFR Part 50, GDC 2, 4, 5, 44, 45, and 46, NRC Regulatory Guides 1.26 and 1.29.

The jacket water heat exchanger design parameters are shown in Table 9.5-3. The design bases for the diesel generators cooling water system are:

a. The temperature of the diesel engine is maintained below the maximum design value for all modes of operation. The diesel engine jacket is kept warm by a standby electric heater during 10
the standby periods.

b. The redundant emergency diesel generator cooling water systems are separated and do not share any components.

c. System components and piping have sufficient physical separation or shielding to protect the system from missiles and from jet impingement caused by cracks or breaks in 10
moderate-energy piping. There is no high-energy piping in this area.

d. System components are classified as ANSI Safety Class 3 6
and are designed in accordance with ASME B&PV Code Section III, Class 3, seismic Category I, as detailed in Table 3.2-1. However, when a component is commercially unavailable as ASME Class 3 design, the component will be of the highest 16
commercial quality available from the chosen manufacturer, see Table 9.5-10.

e. Failure of non-seismic Category I structures and components would not affect the safety related function of the 6
system.

f. Diesel engine cooling water protective devices are bypassed in the event of emergency operation.

9.5.5.2 System Description

The jacket water subsystem is an integral part of the diesel engine, and consists of the diesel engine jacket water heat exchanger, surge tank, an engine jacket water system stand-by electric heater, an engine driven jacket water pump, and a motor driven auxiliary pump.

The jacket water subsystem is provided with the following instrumentation and alarms on the local diesel generator panels.

a. Low-level and high-level surge tank.

b. Low-temperature jacket water in 10

c. Low-temperature jacket water out

d. High-temperature jacket water in

e. High-temperature jacket water out

f. Low jacket water pressure in

g. Low jacket water pressure out

h. Service water temperature in

i. Service water temperature out

j. On-off temperature control for the jacket water heater

k. Auxiliary jacket water pump on-off control to ensure continuous water circulation through the engine on loss of the engine driven pump.

A general diesel trouble alarm which includes pressure, temperature, and coolant system level alarms (which are annunciated separately on the local diesel generator panel) is provided in the Control Room. In the unlikely event of a failure in one diesel cooling system, the backup diesel generator is available for immediate emergency use.

Jacket water temperature is maintained constant by the use of an automatic three-way valve which is thermostatically operated. Vents at high ponits in the system ensure that no air is trapped in the system. Leakage in the jacket water cooling system can 10
result in a high jacket water temperature alarm; the operator then switches to the redundant diesel generator.

To prevent degradation of system cooling performance and of the materials utilized, the jacket water cooling system is periodically cleaned and flushed during planned maintenance.

The surge tank contains a sufficient volume of water and is located to maintain the NPSH required by the pump for seven days of continuous operation at maximum rated load.

9.5.5.3 Safety Evaluation

The systems is designed in accordance with the requirements of NRC Regulatory Guide 1.26, 1.29 and ANSI N18.2

The emergency diesel generator cooling water system is located inside the auxiliary building and is not affected by the design maximum flood, tornado and tornado missiles.

System design permits the control room operators to monitor component leak tightness. Rapid decrease in the water level in the surge tank or a level rise in the emergency diesel generator compartment sumps indicate abnormal system leakage and the operator will switch to the redundant diesel generator for plant operation.

If a mechanical failure of the engine-driven jacket water pump occurs, there is a redundant motor driven auxiliary pump to ensure continuous water circulation through the engine. 10

The engine jacket water contains antifouling compounds to prevent organic fouling and corrosion inhibitor to prevent corrosion.

Anti-freeze protection will be described in the Utility-Applicant's SAR. 1

An analysis of the ability of the system to meet the single failure criteria is shown in Table 9.5-4. 10

9.5.5.4 Inspection and Testing Requirements

Design of the system allows periodic inspection and testing in accordance with requirements of Chapter 16

9.5.6 Diesel Generator Starting System

The emergency diesel generator starting system is an air-powered system designed to provide engine starting power and it is shown in Figure 9.5-5.

9.5.6.1 Design Bases

Redundant starting air systems are provided for each diesel generator set. Starting signals are listed in Section 8.3.1.1b. The starting system is designed to meet the requirements of 10 CFR Part 50, Appendix A, General Design Criteria 2, 4 and 5 and NRC Regulatory Guides 1.26 and 1.29. The system is designed to seismic Category I requirements and to withstand the worst anticipated environmental phenomena described in Sections 3.3., 3.4 and 3.5. 10

9.5.6.2 System Description

Each diesel is supplied with an air injection type starting system. Each engine is provided with an air compressor, redundant air receivers, piping, and valves and a starting appartus. Each of the redundant starting systems is capable of cranking a cold diesel engine five times without recharging the receiver. Each cranking cycle duration is approximately three seconds or two to three engine revolutions.

Two air supply lines are provide, each having redundant solenoid starting valves. One valve passes enough air to start the diesel engine, thus ensuring a sufficient supply of starting air if one valve fails to operate. Each of the two air receivers for each diesel engine is capable of independently starting the engine. In addition, if one engine fails to start the redundant emergency diesel generator will provide the plant emergency power. Each receiver also has a valve to permit periodic blowdown of accumulated moisture and foregin material.

The lines from the air receiver to the engine are sloped such that any contaminants present in the lines will collect at a low 10
point prior to connection to the engine. To minimize fouling of the starting air valves with contaminants, drains are provided on the air receivers to collect water and oil carryover. Strainers located downstream of the receivers and designed to collect contaminats.

Periodic running of the diesel engine, and blowdown of the strainers and lowpoints will minimize the build-up of contaminants in the starting air system.

Instrumentation is provided to monitor the operation of the system. On low receiver pressure, redundant pressure elements actuate an alarm in the diesel generator room and a trouble alarm in the Control Room.

Cleanliness of strainers is monitored and alarmed by means of differental pressure across the strainers.

Emergency diesel generator air starting compressor, air receiver, and design parameters are to be specified by a diesel generator manufacturer.

9.5.6.3 Safety Evaluation

The system is designed in accordance with the requirements of NRC Regulatory Guide 1.26 and ANSI N18.2, Safety Class 3. The system is designed to seismic Category I requirements. The components in the system will be designed to comply with applicable ASME B&PV Code Section III, Class 3, as shown in Table 3.2-1. However, when a component is commercially unavailable as ASME Class 3 design, the component will be of the highest commercial quality available from the chosen manufacturer. See Table 9.5-10.

The emergency diesel generator air starting compressor is located inside the Auxiliary Building and is not affected by the design maximum flood, tornado or tornado missiles. 10

Essential portions of the system are housed within seismic Category I structures and are protected from the effects of jet impingement caused by cracks in moderate-energy piping. There is no high energy piping in this area. The failure mode and effects analysis presented in Table 9.5-5 demonstrates the ability of the system to perform its design function while subjected to a single failure.

9.5.6.4 Inspection and Testing Requirements

Design of the system allows periodic inspection and testing in accordance with the requirement of Chapter 16.

9.5.7 Diesel Engine Lubrication System

Each diesel engine lubrication system is designed to provide adequate engine lubrication under all operating conditions, including full-load operation. The system is internal to the diesel engine. The flow diagram and the component design parameters will be presented in the Utility Applicant's FSAR. Figure 9.5-9 shows a typical diesel generator lubrication system.

9.5.7.1 Design Bases 10

The diesel generator lubrication system will be designed to meet the requirements of 10 CFR Part 50, General Design Criteria 2, 4, and 5 and NRC Regulatory Guide 1.26 and 1.29.

9.5.7.2 System Description

A typical diesel generator lube oil system is shown in Figure 9.5-9. The diesel generator has one main lube oil pump that is engine driven and an auxiliary pump (motor-driven) that is capable of automatically supplying lube oil if the engine-driven pump fails. The main pump is equipped with an integral relief valve and draws oil from the sump through a coarse suction strainer. The lube oil travels through the pump, cooler, and then through the strainer to the engine. The lube oil system is supplied with the following instrumentation and alarms on the local diesel generator panel.

a. Lube oil sump, low level alarm

b. Lube oil sump low temperature alarm

c. High temperature, lube oil in alarm

d. High/low temperature, lube oil out alarm

e. Hight differential pressure, lube oil strainer alarm 10

f. Low pressure engine oil alarm

g. Low pressure engine oil trip alarm

h. High pressure crankcase trip alarm

i. An auxiliary lube oil pump on-off control actuated by lube oil pressure

j. An on-off temperature control for the lube oil heater

k. Local flow indication

When an alarm sounds on the Diesel Room Control Panel a "DIESEL GENERATOR TROUBLE" signal will also sound in the control room.

The lubrication oil system is cooled by jacket water. The design of the lubrication oil cooler and lubrication design requirements will be based on parameters established by the Diesel Generator Manufacturer. The jacket water system is cooled by service water.

The required oil quality as specified by the engine manufacturer is maintained by automatically filtering and straining the oil as it is circulated in the engine.

The engine crankcase is protected from overpressurization by the following design features. The system is equipped with alarms and trips initiated by high oil temperature and/or pressure, which shutdown the diesel generator if operating limits as specified by the engine manufacturer are exceeded. The lubrication oil system trips are blocked by the safety injection actuation signal. The lubrication oil sump, and the lubrication oil strainer are vented.

When the engine is not operating, a motor-driven auxiliary pump draws oil from the sump, passes it through an electrically heated bypass filter, and the engine lubricating system. This ensures continuous pre-lubrication of the engine and standby heating of the oil.

9.5.7.3 Safety Evaluation 10

The system is designed in accordance with the requirements of NRC Regulaory Guide 1.26 and ANSI Standard N18.2, Safety Class 3. The diesel generator lube oil system is designed to seismic Category I requirements.

The components in the system are designed to the requirements of the ASME B&PV Code, Section III, Class 3. However, when a componet is commercially unavailable as ASME B&PV Code, Section III, Class 3 design, the component will be of proven equivalent quality. See Table 9.5-10.

Low oil pressure to the main header is alarmed by a pressure switch. Oil pressure is indicated by a pressure gauge locally. Another pressure switch trips the engine on low lube oil pressure (if no safety injection actuation signal is present).

The volume of lubrication oil in the sump is sufficient to ensure continued operation under emergency conditions. A redundant diesel generator unit is provided to meet the single-failure criterion, should a failure of the diesel generator lube oil system necessitate the stoppage of a diesel generator unit.

Both the high lube oil temperature and the low lube oil pressure monitoring systems have separate alarm and trip switches, since a failure of these components could result in an engine malfunction being undetected.

The diesel generator lube oil system is housed in a seismic Category I structure. Failure of non-seismic components outside this structure does not affect this system. This structure also protects the system from the maximum flood, tornado or tornado missiles. A single failure analysis of the diesel generator lubrication system is presented in Table 9.5-9. 10

9.5.7.4 Inspection and Testing Requirements

Design of the system aloows preiodic inspection and testing in accordance will the requirements of Chapter 10.

9.5.8 Diesel Generator Combustion Air Intake and Exhaust System

The emergency diesel generator combustion air intake and exhaust system supplies combustion air of reliable quality and sufficient quantity to the diesel engines, and exhausts the products of combustion from the diesel engine to the atmosphere and is shown in Figure 9.5-8. 10

9.5.8.1 Design Bases

a. The redundant emergency diesel generator combustion air intake and exhaust systems are separated and do not share any components.

b. The essential portions of the system are housed in a seismic Category I structure and are protected from flood, tornado or tornado missiles. Components have sufficient separation or shielding to protect the system from missiles and from jet impingement caused by cracks in moderate-energy piping. There is no high energy piping in this area. 10

c. The Diesel Generator Air Intake and Exhaust System is classified as ANSI Safety Class 3 and designed to Seismic Category I requirements. System components will be designed to 6
comply with the ASME B&PV Code, Section III, Class 3. However, when a component is commerically unavailable as ASME Class 3 design, the component will be of the highest commercial quality available from the chosen manufacturer, such that no degradation of engine function will be experienced when the diesel generator set is required to operate continuously at the maximum rated 10
power output (See Table 9.5-10).

9.5.8.2 System Description

A typical emergency diesel generator combustion air intake and exhaust system consists of an intake pipe that brings outside combustion air to the diesel and an exhaust pipe that discharges combustion gases to the environment. Both intake and exhaust pipes are designed for maximum diesel generator ratings and for continuous operation.

The intake system consists of a filter, silencer, flexible connection, adapter for connection to turbocharger intake, air intake duct connection, and interconnecting piping. The filter is of the dry type and can be cleaned during operation, if necessary. The filter and silencer are located inside the diesel generator area of the Auxiliary Building. The flexible connection compensates for thermal expansion and absorbes vibrations. The turbocharger consists of a gas turbine driven compressor. Air coolers and heaters are provided to cool or heat the discharge air from the compressor when required. 10

The exhaust system consists of the outlet adapter for the turbocharger gas turbine outlet, a flexible connection to provide vibration isolation and compensate for themal expansions, a muffler to reduce exhaust gas sound level, exhaust duct connection, and interconnected piping. The system is provided with the following instrumentation:

a. Intake air filter low pressure alarm

b. Turbocharger inlet and outlet low pressure alarm

c. Turbocharger gas turbine inlet low pressure alarm

d. Turbocharger gas turbine outlet high pressure alarm

e. Air cooler and heater high - low temperature alarms

f. Air cooler and heater temperature indicators

g. Turbocharger gas turbine inlet temperature alarm

h. Turbocharger gas turbine inlet and outlet temperature indicators

i. Cylinder exhaust gas temperature direct-reading pyrometer 10

Pressure and temperature alarms from redundant pressure and temperature switches are provided at the local panel. High and low temperature indication is provided on the engine control panel. A general trouble annunciation is provided in the control room. Cylinder exhaust temperature is indicated on the engine control panel in the diesel generator room. Sufficient intake airflow is provided to ensure operation under emergency conditions. A more complete description of the system will be provided in the Utility Applicant's SAR.

9.5.8.3 Safety Evaluation 1

The location of the intake and exhaust are such that dilution or contamination of the intake air by exhaust air or other gases that may incidentally or accidentally be released on site is minimized. There are no intake or exhaust louvers or control devices that may block the air or exhaust gas flow. The air intakes and exhausts are protected by labyrinth shielding arrangements. These arrangements protect the intake and exhaust from:

a. possible clogging during normal operation, including standby, from atmospheric conditions such as heavy or freezing rain, dust storms, ice and snow

b. damage by tornado missiles

The normal air intake for each diesel generator is approximately 30 percent greater than the air intake required for combusion at 100 percent load. This 30 percent higher flow capacity means that a large quantity of smoke and extraneous gas such as carbon 10
dioxide and nitrogen would be required to cause significant dilution of the diesel combustion air before effecting the diesel generator performance.

A redundant diesel generator unit is provided to meet the single failure criterion if a failure of the Diesel Generator Combustion Air Intake and Exhaust System necessitates the stoppage of a diesel generator unit. A failure mode and effects analysis is given in Table 9.5-11.

9.5.8.4 Inspection and Testing Requirements

The emergency diesel generator combustion air intake and exhaust system is tested periodically in accordance with the requirements of Chapter 16. System design allows visual inspection of components.

TABLE 9.5-3
(Sheet 1 of 2)

EMERGENCY DIESEL GENERATOR JACKET WATER SYSTEM
HEAT EXCHANGER DESIGN PARAMETERS

Quantity	two	10
Type	tubes and shell fixed head	
Maximum heat transferred, Btu/hr	18×10^{6} (3)	10
Shell side fluid	service water	
Flow, gpm each	1350 (3)	10
Temperature in F	100 (1)	
Temperature out F	116 (3)	10
Design pressure, psig	100	
Tube side fluid	engine jacket water	
Flow, gpm	See Note 3	
Temperature in F	See Note 3	1
Temperature out F	See Note 3	
Design pressure psig	100	
Code - thermal design	TEMA Class R	
Pressure retaining parts	ASME B & PV Code Section III, Class 3	
Materials of construction	See Note 2	1

TABLE 9.5-3
(Sheet 2 of 2)

EMERGENCY DIESEL GENERATOR JACKET WATER SYSTEM
HEAT EXCHANGER DESIGN PARAMETERS 1

Notes:

1. Service water temperature is site dependent. It is assumed that site water is available at 100 F. 1

2. Materials selection depends on the water quality and its source, which is to be specified after site location.

3. Dependent upon diesel-generator manufacturer selected by the Utility Applicant. This information will be presented in the Utility-Applicant's SAR. 10

TABLE 9.5-4

FAILURE MODE AND EFFECTS ANALYSIS OF DIESEL GENERATOR COOLING WATER SYSTEM

Item on 1EG1	Function	Failure Mode	Cause of Failure	Effects on Subsystem	Method of Failure Detection	Effect on System
Engine driven jacket water pump	Pumps jacket water	No output	Mechanical failure	Cannot pump water	High water temperature	None; motor driven auxiliary pump is available.
Motor driven auxiliary pump	Pumps jacket water	No output	Mechanical failure; loss of power; motor failure	Cannot pump water	High water temperature	None; 1EG2 is available.
Jacket water heat exchangers	Heat sink for diesel service and jacket water systems	a. Leaks	Cracks, corrosion	Temperature rises	High water temperature	None; 1EG2 is available.
		b. No flow	Blockage	Temperature rises	High water temperature	
Engine jackets transfer lines	Transports water	a. No flow	Blockage	Cannot transfer water	High water temperature	None; 1EG2 is available.
		b. Leakage	Cracks and corrosion			
Standby electric heater	Heats water for standby readiness	No output	Loss of power	Fails to heat water	Low water temperature	None; 1EG2 is available.

10

Diesel Generator No. 1 = 1EG1

Diesel Generator No. 2 = 1EG2

TABLE 9.5-5

FAILURE MODE AND EFFECTS ANALYSIS OF DIESEL GENERATOR STARTING SYSTEM FOR 1EG1

Item Description	Function	Failure Mode	Cause of Failure	Effects on Subsystems	Method of Failure Detection	Effect on System
Air lines	Transports air	No flow	Blockage, cracks, corrosion	No start	Low air receiver pressure	None: Second subsystem or 1EG2 is available.
Manifold	Delivers air	No flow	Blockage	No start	Low air receiver pressure	None: 1EG2 is available.
Compressor	Refill air receiver	No air being supplied	Loss of power	No refilling of air receiver	Air compressor failure to start automatically signal, low air air receiver pressure	None: All receivers are available. 1EG2 is available.
Air receiver	Stores air for five starts	Loss of air	Leaks, ruptures	No starting air	Low air receiver pressure	None: second air receiver is available. 1EG2 is available.

10

1EG1 = Diesel Generator 1

1EG2 = Diesel Generator 2

TABLE 9.5-9

FAILURE MODE AND EFFECTS ANALYSIS OF DIESEL GENERATOR LUBRICATION SYSTEM

Item Description	Function	Failure Mode	Cause of Failure	Method of Method of Failure Detection	Effect on System
Diesel 1EG1 engine-driven pump	Pumps lube oil	Pump failure	Mechanical	Low oil pressure	None: Auxiliary pump (motor-driven) and 1EG2 are available
Transfer lines and valves	Transports lube oil	1. No flow	1. Blockage	1. Low oil pressure	None: 1EG2 is available.
		2. Leakage	2. Cracks or corrosion	2. Low oil pressure	
Lube oil cooler	Cools oil	1. Leaks oil or water	1. Cracks or corrosion	1. Low oil pressure	None: 1EG2 is available.
		2. No heat transfer	2. Blockage	2. High oil temperature	
Filter/Heater	Cleans and warms oil	1. Fails to heat	1. Loss of power	1. Low oil temperature	None: 1EG2 is available.
		2. Fails to clean	2. Clogs	2. High or low oil pressure	
Strainer	Cleans oil	Clogged element	Particulate matter in oil	High pressure drop drop across strainer	None: 1EG2 is available.

10

1EG1 = Diesel Generator 1

1EG2 = Diesel Generator 2

TABLE 9.5-10 (Sheet 1 of 2)

DIESEL GENERATOR EQUIPMENT QUALITY CLASSIFICATION

System and Component	ANSI Safety Class	Applicable Code	Code Class	Seismic Category	Quality Assurance	GIBBSSAR Reference Section	Remarks
Diesel generator set	Note 1	IEEE 387	-	I	Note 4	9.5.4	
Diesel fuel storage tank	3	ASME III	3	I	Note 4	9.5.4	
Diesel generator fuel oil Day tank	3	ASME III	3	I	Note 4	9.5.4	
Diesel fuel oil transfer pump	3	Mfrs Stds	Note 2	I	Note 4	9.5.4	
Diesel generator fuel oil transfer strainer	3	ASME III	3	I	Note 4	9.5.4	
Diesel generator fuel booster pump	3	Mfrs Stds	Note 2	I	Note 4	9.5.4	Integral with diesel generator 10
Diesel generator engine driven fuel pump	Note 1	IEEE 387	-	I	Note 4	9.5.4	Integral with diesel generator
Diesel fuel filter	Note 1	IEEE 387	-	I	Note 4	9.5.4	Integral with diesel generator
Jacket water heat exchanger	3	ASME III	3	I	Note 4	9.5.5	
Motor driven auxiliary jacket water pump	3	ASME III	3	I	Note 4	9.5.5	
Engine driven jacket water pump	Note 1	IEEE 387	-	I	Note 4	9.5.5	
Diesel generator startup air receiver	3	ASME III	3	I	Note 4	9.5.6	
Diesel generator startup air compressor	Note 1	Mfrs Stds	-	I	Note 4	9.5.6	

TABLE 9.5-10 (Sheet 2 of 2)

DIESEL GENERATOR EQUIPMENT QUALITY CLASSIFICATION

System and Component	ANSI Safety Class	Applicable Code	Code Class	Seismic Category	Quality Assurance	GIBBSSAR Reference Section	Remarks
Diesel generator startup air dryers and aftercooler	Note 1	Mfrs Stds	-	I	Note 4	9.5.6	
Motor driven auxiliary lube oil pump	3	Mfrs Stds	Note 2	I	Note 4	9.5.7	
Engine driven lube oil pump	Note 1	IEEE 387	-	I	Note 4	9.5.7	
Lube oil strainer	3	ASME III	3	I	Note 4	9.5.7	
Lube oil cooler	3	ASME III	3	I	Note 4	9.5.7	
Intake air filters and silencers	Note 1	IEEE 387	-	I	Note 4	9.5.8	
Exhaust silencer	Note 1	IEEE 387	-	I	Note 4	9.5.8	
Piping and valves on the engine	Note 1	IEEE 387	-	I	Note 4	9.5.4-9.5.7	
Piping and valves off the engine	3 NNS	ASME III ANSI B31.1	3 -	I Note 3	Note 4 Note 5	9.5.4-9.5.7 9.5.4-9.5.7	

10

Notes

1. This equipment is not included in the scope of ANSI N18.2, but is covered by IEEE 387.
2. This equipment is not commercially available as ASME B&PV Code, Section III, Class 3; however the equipment is constructed to quality standards equivalent to ANSI Safety Class 3.
3. Seismically qualified by analysis.
4. Meets quality assurance requirements of 10 CFR Part 50, Appendix B.
5. Meets certain portions of the quality assurance criteria set forth in 10 CFR Part 50, Appendix B.

TABLE 9.5-11
(Sheet 1 of 2)

FAILURE MODE AND EFFECTS ANALYSIS OF DIESEL GENERATOR 1EG1
(COMBUSTION AIR INTAKE AND EXHAUST SYSTEM)

Item Description	Function	Failure Mode	Cause of Failure	Effects on Subsystems	Method of Failure Detection	Effect on System
Intake air pipes and flexible hose	Pipe air to the engine	a. Rupture	Crack, corrosion	Loss of outdoor intake air	High exhaust gas temperature	None: 1EG2 available
		b. Low flow	Blockage	Loss of adequate air	High exhaust gas temperature	None: 1EG2 available
Intake air filter	Cleans intake air	Fails to clean	Blockage	Loss of adequate clean intake air	High exhaust gas temperature	None: 1EG2 available 10
Air intake silencer	Reduce intake air sound level	a. Rupture	Crack, corrosion	Loss of outdoor intake air; excessive noise	Excessive noise	None: 1EG2 available
		b. Low flow	Blockage	Loss of adequate intake air	High exhaust gas temperature	None: 1EG2 available
Turbocharger	Provide combustion air	No air being supplied	Loss of compressor or turbine	No flow	Stopping of engine, high exhaust gas temperature	None: 1EG2 available
Turbocharger air cooler	Cools intake air	Leaks	Cracks or corrosion	Loss of adequately-cooled air	Loss of engine output	None: 1EG2 available

TABLE 9.5-11
(Sheet 2 of 2)

FAILURE MODE AND EFFECTS ANALYSIS OF DIESEL GENERATOR 1EG1
(COMBUSTION AIR INTAKE AND EXHAUST SYSTEM)

Item Description	Function	Failure Mode	Cause of Failure	Effects on Subsystems	Method of Failure Detection	Effect on System	
Exhaust gas pipes and flexible hose connection	Pipe exhaust gas to the outside of plant	a. Rupture	Crack, corrosion	Exhaust gas inside the Engine Room	Excessive noise	None: 1EG2 available	
		b. Low flow	Blockage	Cannot transport exhaust gas adequately	Excessive noise, loss of engine output	None: 1EG2 available	10
Muffler	Reduce exhaust air sound level	a. Rupture	Crack, corrosion	Excessive noise	Excessive noise	None: 1EG2 available	
		b. Low flow	Blockage	Cannot transport exhaust gas adequately	Stopping of engine	None: 1EG2 available	

1EG1 = Diesel Generator 1
1EG2 = Diesel Generator 2

TABLE 9.5-12

DESIGN PARAMETERS FOR EMERGENCY DIESEL GENERATOR TO BE PROVIDED IN THE UTILITY APPLICANT'S SAR

Fuel Oil Transfer Pumps	
Capacity TDH Motor Size	Depend on the diesel Generator flow rate per Cylinder as specified by manufacturer
Jacket Water System Heat Exchanger	10
Shell Side:	
Flow	Manufacturer dependent
Temperature in	Site dependent
Temperature out	Manufacturer dependent
Tube Side:	
Flow Temperature in Temperature out	Manufacturer dependent
Materials of Construction	Dependent on water quality at a particular site

TABLE 10.1-1
MAJOR STEAM AND POWER CONVERSION EQUIPMENT
SUMMARY DESCRIPTION - 3817MWt 10
(Westinghouse -414)

Steam Generator		
Steam flow rate (total 4 steam generators)	16.86 x 10^6 lb/hr	
Feedwater inlet temperature	436 F	
Steam outlet temperature	556.3 F	10
Steam outlet pressure	1100 psia	
Steam Quality	99.75 percent	6
Turbine Generator (Westinghouse)		
Steam flow rate to turbine generator	15.27 x 10^6 lb/hr	
Throttle inlet pressure	1075 psia	10
Throttle enthalpy	1187.5 Btu/lb	
Guaranteed output expected	1,334,512 kW	
Power factor	.90	
Hydrogen pressure	75 psig	
Turbine Generator (Allis-Chalmers)		
Steam-to-turbine generator	15.18 x 10^6 lb/hr	
Throttle inlet pressure	1075 psia	10
Throttle enthalpy	1187.5 Btu/lb	
Guaranteed output	1,312,087 kW	
Power factor	0.90	
Hydrogen pressure	60 psig	
Turbine Generator (General Electric)*		
Steam-to-turbine generator	15.20 x 10^6 lb/hr	
Throttle inlet pressure	1075 psia	
Throttle enthalpy	1187.5 Btu/lb	
Guaranteed output	1,330,802 kW	10
Power factor	.90	
Hydrogen pressure	75 psig	

*Based on 3800 MWt

10.2.3.6 In-Service Inspections

To detect disc flaws leading to brittle failure at the design speed, the following periodic inspections and tests are performed:

a. Once each month

1) Overspeed trip - oil trip test

2) Low-vacuum trip

3) Low-bearing oil pressure trip

4) Electrical overspeed trip

5) Thrust bearing trip

6) Low electrohydraulic fluid trip

7) Extraction nonreturn valves

b. Once every six months 10

1) Overspeed emergency trip by overspeeding the unit

2) Remote trip

3) Initial pressure regulator

4) Auxiliary governor (overspeed protection controller)

c. Once each startup 10

1) Check the overspeed protection controller.

A small percentage of the fuel elements may exhibit small pinholes or cracks over the lifetime of the station allowing the diffusion of radioactive fission products from the fuel into the reactor coolant.

2) Visually check to be sure governor and intercept valves close.

d. Main steam stop and control valves, reheat stop valves, and reheat intercept valves will be exercised at least once a week by closing each valve and observing by the valve position indicator that it moves smoothly to the fully closed position. At least once a month, this examination will be made by direct observation of the valve motion.

e. At approximately 3-1/3 year intervals, during refueling or maintenance shutdowns, coinciding with the inservice inspection schedule required by Section XI of the ASME Code for reactor components, at least one main steam 10 stop valve, one main steam control valve, one reheat stop valve and one reheat intercept valve will be dismantled and visual and surface examinations will be conducted of valve seats, disks and stems. If unacceptable flaws or excessive corrosion are found in a valve, all other valves of that type will be dismantled and inspected. Valve bushings will be inspected and cleaned and bare diameters will be checked for proper clearance.

f. Disassembly and complete inspection of normally inaccessible parts of the turbine at approximately

10-year intervals during plant shutdown coinciding with inservice inspection as required by ASME B&PV Code, Section XI.

g. An in-place visual examination of the turbine assembly at accessible locations is conducted during refueling shutdowns at intervals not exceeding three years. 10

h. For further recommendations, see the applicable turbine vendor engineering reports.

10.2.4 Evaluation

The turbine-generator and its related steam-handling system are designed in accordance with the latest codes and standards, and erected in a manner to eliminate leakage at all joints.

The possibility exists that activity in the secondary side of the steam generator can occur. This activity would be a function of the tube leakage from the primary side of the steam generator.

The reactor coolant circulates from the reactor core, where it removes heat from the fuel elements, to the steam generators, and back to the core. In the steam generators, heat from the pressurized reactor coolant is transferred across metal tube walls to the secondary coolant to generate steam. The steam passes through the turbine, is condensed, and returns to the steam generators.

A small percentage of the fuel elements may exhibit small pinholes or cracks over the lifetime of the station allowing the diffusion of radioactive fission products from the fuel into the reactor coolant. This is discussed in the NSSS SSAR Section 11.1. The reactor coolant is continuously purified in a side stream which passes through filters and demineralizers in the CVCS. The filters and demineralizers remove a large portion of the iodine, other fission products, and radioactive corrosion products.

1

A steam generator tube leak is the only condition that could result in fission products entering the secondary coolant system. If a leak develops, some radioactive reactor coolant is transferred to the secondary system. In addition to the steam generator leak rate, the secondary coolant system activity is affected by moisture carryover, blowdown rates, and partition factors in the steam generator and condenser.

The activity in the reactor coolant is a function of several factors, such as, fuel defect level, system volumes, purification flow rates, and CVCS removal factors.

Once a determination of these variables is made, the secondary side activity is calculable as a function of this leak rate. The steam generator blowdown processing system (described in subsection 10.4.8) and condensate cleanup system (described in subsection 10.4.6) both limit the activity of the steam generator secondary side water. Table 11.1-5 lists the expected secondary coolant (steam generator) equilibrium fission and corrosion product activities.

The activity concentrations in the area of the turbine generator are determined to be low enough to classify the area as Zone I, as defined in section 12.3. No shielding or controlled access are required.

Further discussion of releases to the Turbine Building and to the environment is given in Sections 11.2 and 11.3.

10.3.3.4 Main Steam Stop Valve Bypass Valves 10

The main steam stop valves are provided with 4-inch bypass valves, which are normally closed and are designed to fail closed. Open bypass valves would tend to negate the protection provided by the main steam isolation valves. Therefore, the valves close within 10 seconds of receipt of a closure signal using the same closing logic that exists for the main steam isolation valves.

10.3.3.5 Flow Restrictors

A flow restrictor is installed in each steam generator, primarily to limit the steam flow in the event of a main steamline break. It also provides a portion of the pressure differential used for flow measurement.

10.3.3.6 Auxiliary Feedwater Pump Steam Supply

Lines are provided upstream of the isolation valve (see Figure 10.3-1) in the steam outlet lines from the steam generators 3 and 4 to supply steam to the turbine-driven auxiliary feedwater pump. These lines assure an adequate source of steam to the turbine-driven auxiliary feedwater pump when steam generators are isolated and are producing steam from reactor decay heat.

10

Each line is provided with an automatically operated isolation valve of Safety Class 2 design at its junction with the main steam line. The remainder of the line is constructed to Safety Class 3 requirements. The isolation valves are automatically closed on a loss of pressure signal caused by steam blowdown through a postulated line break.

10.3.4 Inspection and Testing Requirements

Before placing the system into service, all foreign material and oxides are removed from the piping. During cleaning, entry of any fluid into the steam generators is prevented. The main steam lines are hydrostatically tested to confirm leaktightness. The testing of Safety Class 2 components conforms to the requirements of the ASME Code, Section III, Arcticle NC-6000. 10

10.4.1.5 Instrumentation Application

a. Hotwell

Each condenser shell is provided with local and remote hotwell level and pressure indication. The remote indication is by means of indicators and alarms in the control room. The condensate level in the condenser hotwell is maintained within proper limits by automatic controls which provide for transfer of condensate to and from the condensate storage tank as needed to satisfy the requirements of the steam system. Condensate temperature is measured in the suction lines of the condensate pumps.

Analytical monitoring equipment is provided to detect leakage of
circulating water into the condenser. The condenser hot well is
also monitored continuously and automatically for cation
conductivity, High conductivity is alarmed in the control room.
The condensate cleanup system maintains feedwater within
chemistry specifications during normal operation. See 10
section 10.4.6. The maximum allowable leak rate is a function of
the site specific circulating water chemistry and resin selection
of the condensate cleanup system. Alarm set points for
conductivity monitoring will be determined by site specific
circulating water chemistry.

b. Exhaust Hood

An exhaust hood spray system with water supplied by the condensate system is provided. Excessive temperature in the turbine exhaust hood causes a thermostatically controlled spray valve to open, thereby preventing further increases in temperature. The valve closes again after all criteria for shutting off the spray have been met. A high condenser backpressure alarm set at 7 in Hg. abs. is provided. The high backpressure turbine trip setting is approximately 14 in. Hg abs.

c. Water Box

Water box pressure and temperature measurements are provided.

d. Radioactivity

Radiation monitoring equipment on the condenser vacuum pump discharge lines detects the presence of noncondensable radioactive gases in the system and initiates an alarm. Radiation monitoring equipment on the steam generator blowdown sampling lines (subsection 9.3.2) serves as a backup for the condenser off-gas detectors and provides the means for determining the steam generator in which leakage is occurring.

10.4.2 Main Condenser Evacuation System

10.4.2.1 Design Bases

The condenser evacuation system is designed to remove all non-condensibles and associated water vapor from the condenser. The system will establish and maintain required system vacuum and will provide for deaeration of condensate.

The system is designed for a venting capacity in accordance with the recommendations of the Heat Exchange Institute, (HEI) Standards for Steam Surface Condensers. 6

10.4.2.2 System Description

The condenser evacuation system consists of three 50-percent-capacity motor-driven mechanical vacuum pumps as shown in Figure 10.4-5.

During startup, all three pumps can be operated to reduce the startup time. During power operation, one or two pumps are 4
required, depending on the amount of condenser leakage.

The exhaust from the vacuum pumps are discharged to the controlled access area ventilation filtering units except during 6
the hogging period.

10.4.2.3 Safety Evaluation

The safety evaluation of this system is given in subsection 10.4.1.3, in conjunction with the evaluation of the condensers.

The condenser off-gas normally is discharged to the controlled access area ventilation filtering units. The radiation level in the gas is continuously monitored by the condenser vacuum pumps monitor, and indication is given in the control room. 4
Radioactive elements present in the secondary system, which can ultimately reach the condenser off-gas, can also be detected by the steam generator liquid sample monitor (section 11.5).

The presence of radiation above the set point is annunciated by a single window category alarm on the main control board, and

10.4.4.4 Tests and Inspections

The steam dump system meets the requirements of ANSI B16.10, face-to-face and end-to-end dimensions of ferrous valves, 1973 edition. During unit operation each dump valve is periodically tested. The isolation valve are closed, and the dump valves are checked for performance and timing with remote operation. Similarly each isolation valve is tested with local operation. The dump valves are also operated during initial startup and during shutdown.

The steam dump lines are hydrostatically tested to confirm leaktightness. Visual inspection of pipe weld joints confirms the exterior condition of the weld.

10.4.4.5 Instrumentation Applications

Indicating lights are provided in the control room for each dump valve to indicate when the valve is fully closed and fully open.

The low-low average temperature interlock for steam dump block isthe only safety-related instrumentation in this system, and it is in accordance with IEEE 279-1971.

Detailed descriptions of the steam dump instrumentation and controls are provided in the NSSS SSAR, section 7.7.

10.4.5 Circulating Water System

10.4.5.1 Design Bases

The circulating water system provides cooling water for the main condenser. It is designed to remove approximately 9 x 10^9 Btu/hr of cycle heat.

This system is not safety-related and is classified nonnuclear safety.

The source of the cooling water is given in the Utility-Applicants SAR.

10.4.5.2 System Description

The Circulating Water system description is given in the Utility-Applicants SAR.

10.4.5.3 Safety Evaluation

The safety evaluation of the circulating water system is given in the Utility-Applicants SAR.

Failure in the expansion joint at the main condenser interface (full CWS flow) does not cause failure of safety-related equipment due to flooding, as no such equipment is installed in the turbine building, and there is no direct access to the auxiliary building from the turbine building. In leakage from 10 the common wall crack is considered negligible because of the thickness of the wall and the short duration of flood (the spillage will flow outside through doors and opening in the turbine building).

10.4.5.4 Tests and Inspection

The tests and inspection requirements are given in the Utility-Applicants SAR.

10.4.5.5 Instrumentation Application

The description of the instrumentation and controls is given in the Utility-Applicants SAR.

10.4.6 Condensate Cleanup System

The condensate cleanup system is designed to treat 100 percent of the normal full load condensate flow. The condensate cleanup system utilizes a filter-demineralizer type design with vessels fabricated in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII. The filter-demineralizer vessels employ vertical filter elements on which nonregenerated powdered ion exchange resin is coated which simultaneously filters and demineralizes the condensate to secondary side water chemistry requirements. Six filter-demineralizer units are provided. Five vessels are on-line; the sixth, freshly precoated, will remain in 6 the standby condition until such time that one of the five on-line vessels goes offstream. The condensate cleanup system accomplishes two main functions by filtration and demineralization of condensate:

a. Reduce feedwater crud (iron, copper and other insoluable metallic oxides) picked up from the condenser, feedwater heaters 6 and steam generators.

low-pressure feedwater heaters between the discharge of the condensate booster pumps and the suction of the feed pumps. This bypass is sized to reduce the frictional resistance of the condensate system to allow the condensate pumps and booster pumps to run out on their characteristic curves while maintaining a satisfactory net positive suction head at the feed pumps.

b. Steam Supply System

Steam to drive the feedwater pump turbines is supplied from the main steam header at low loads. Reheated crossover steam taken between the high-pressure and low-pressure turbines drives these turbines during normal operation.

c. Feedwater Heaters

Feedwater heaters heated by the extraction steam from the turbine are used for regenerative feedwater heating in connection with a 1379-MW maximum-guaranteed turbine generator unit which operates at 1015 psia, 0.47-percent moisture inlet to 3 inches Hg absolute exhaust.

The feedwater heaters are arranged as shown in figures 10.4-1 and 10.3-2.

Bypass piping and block valves are provided around feedwater heaters to take them out of service for maintenance.

d. Feedwater Control Valves 10

Feedwater flow is controlled automatically above 15-percent load by a three-element controller using steam generator water level, steam flow, and feedwater flow to control the main feedwater control valve to each steam generator. This valve also acts as a 10
back-up for the feedwater stop valve in the event of a containment isolation or feedwater line break. This valve is a nuclear safety class 3 valve and is designed to fail closed.

The feedwater control valve and the feedwater bypass control valve will have a stroke time of 20 seconds opening or closing 10
over the range of 0-1900 psig under normal feedwater control. 6
These valves will close in five seconds for 10
emergency conditions excluding the signal generation and 6
transmission time. As discussed in RESAR-414, Section 7.3.1.1.6 and RESAR-414, Figures 7.2-1 and 7.3-2, the feedwater control 10

valves and bypass control valves will receive signals to close from the feedwater isolation signal. 10

e. Chemical Additives

Hydrazine and an amine are used for oxygen scavenging and pH control, respectively. The chemicals are metered into the condensate downstream of the condensate polishing system and into the feedwater downstream of the auxiliary feedwater connection into each steam generator's feedwater line.

6

The two motor driven and one turbine driven pump are arranged as shown on Figure 10.4-3. Runout protection in the event of a drop 1
in the steam generator pressure is provided by flow orifices located in the discharge lines of the motor-driven pumps and the turbine-driven pump. The individual auxiliary feed lines to each steam generator are provided with a normally open, pneumatically operated feed regulator valve, designed to fail open, with a nonreturn valve downstream, and locally operated manual isolation valve upstream and downstream. Remote manual control of the feed regulator is provided from the control room, with provision for local manual operation. Air accumulators are provided for the pneumatically operated valves. They have sufficient capacity to permit remote valve closure for isolation of a secondary system break where local valve operation cannot be accomplished within the required time period following the incident. The valves are located near the auxiliary feed pumps to allow local manual operation in the event of a control room evacuation. The nonreturn valve prevents backflow in the event of a pipe break on the pump side of the valve.

The flow orifices installed in the discharge lines of the auxiliary feedwater pumps provide a means of limiting the quantity of water spilled in the event of a feedwater line break. They also limit the auxiliary feedwater flow delivered to a faulted steam generator following a main steam line break inside containment prior to manual isolation of the break by the operator. The maximum permissible flow to a single steam generator is based on the containment pressure limits established by the containment pressure analysis for a main steam line break inside containment.

The two auxiliary feed lines to each steam generator (one from a motor-driven pump and one from the turbine-driven pump) join to form one line. A flow meter is located in this line as close to the auxiliary feed check valves as possible to minimize the length of piping between the flow meter and the check valve where a break would result in no flow indication. Remote indication of the flow measurement is provided in the control room and at the hot-shutdown panel.

To avoid the possibility of a single failure stopping all auxiliary feedwater flow to a steam generator, no valves are located in this common line. The single auxiliary feedline joins the safety class section of the main feedwater line downstream of

the last main feedwater valve. Because the auxiliary feedwater system is required to operate following an accident, all valves and instrumentation are located outside the containment building. The turbine steam inlet valve is a fail open air-operated type with a dc pilot solenoid. The solenoid is supplied from a station 125-Vdc bus. The turbine speed control governor is nonelectric except for the remote speed-setting signal. The loss of the remote speed-setting signal results in the turbine running 6
at the high setting of the speed-setting range. The power supply for turbine speed-setting and for flow-control manual stations is from the station inverters, which are supplied from the safety-related 125-Vdc batteries. An elecrical failure mode analysis is shown in Table 10.4-2 and Figure 10.4-4.

b. Pumps

The two electric-motor-driven, horizontal, centrifugal pumps are of identical design. Each pump is capable of delivering the 1
minimum required flow into two steam generators against a backpressure equivalent to the accumulation pressure of the 10
lowest set safety valve plus system frictional losses and static head.

A turbine-driven, horizontal, centrifugal pump is also provided with a rated capacity of approximately twice that of each motor 1
driven pump. The time within which the pump delivers its rated flow and the backpressure against which this rated flow must be discharged are as described previously for the motor-driven pumps. The system requirements of the auxiliary Feedwater system 1
are given in Table 10.4-3.

10.4.9.3 Safety Evaluation

The auxiliary feedwater system is designed to Safety Class 2 and 3 requirements. In the event of a loss of offsite power, the motor-driven and turbine-driven auxiliary feedwater pumps start. The operator can then manually stop the motor-driven pumps and keep the turbine-driven pump operating; this reduces the diesel 6
generator load. The turbine driven pump does not have any auxiliaries requiring electrical power. For redundancy, steam for the driver is supplied from two steam generators; supply from one line meets the turbine driver requirements. The loss of steam supply to the turbine coincident with a single active failure of either motor driven pump will not prevent the system 10
from delivering the minimum required flow into two steam generators.

Steam blowdown caused by a postulated break in a steam supply
line to the turbine driven auxiliary feedwater pump will be
stopped by automatic fast closure of the steam supply isolation 10
valves on a loss of pressure signal.

In the event of a feedwater line break inside the containment, the larger-than-normal flow is detected by the flow-measuring

device in the common auxiliary feedwater line to the faulted 10
loop. Either the capacity of the turbine-driven pump or the
capacity of the unaffected motor-driven pump is sufficient to
deliver the minimum flow to two effective steam generators during 10
this event (where all the flow of one motor-driven pump and part
of the flow from the turbine-driven pump are lost until the break
can be isolated). Flow limiting orifices are used to limit the 10
flow spilled from the break.

Sufficient redundancy is provided throughout the auxiliary
feedwater system and supporting systems to ensure safe plant
shutdown. This system supplies the required flow to a minimum of
two steam generators, while subjected to a single active failure
in the short term, (less than 24 hours) or a single active or
passive failure in the long term during periods when the main
feed system is out of operation due to loss of electric power
(NSSS SSAR Section 3.1). This flow is sufficient to enable the 6
plant to be taken to and maintained in a safe condition under any
accident situation. One motor-driven pump is capable of
providing the required flow.

The auxiliary feedwater system is capable of withstanding adverse environmental conditions. It is designed to seismic Category I requirements. The system is located within tornado-resisting structures, and is protected from tornado-generated missiles. The auxiliary feedwater storage tank is located within the auxiliary building, and is designed to withstand tornado and missile penetration. Adequate protection against corrosion is ensured by fabricating the tank from a corrosion-resistant material, such as coated carbon steel. The auxiliary feedwater pumps are located in an enclosed bay of the auxiliary building at
a floor elevation of 94 feet, 6 inches. It is not anticipated 1
that any radioactive material is present in the system. All redundant components, including pumps, are physically separated from each other by a proper arrangement of concrete barriers. These barriers are designed to preclude coincident damage to redundant equipment in the event of a postulated pipe rupture, equipment failure, or missile generation. Redundant motor-driven pumps are supplied from the physically and electrically independent safety-related buses, which can be supplied by the diesel generators.

Power and control cables for redundant pumps are separated in accordance with the criteria described in Section 8.3. Each pump is situated in a separate compartment and is protected from other component failures by walls constructed to seismic Category I requirements.

Flooding may occur from a pipe break in the auxiliary feedwater pump discharge; therefore, separate compartment design and drainage is provided to prevent flooding of adjacent equipment.

TABLE 10.4-2

FAILURE MODE ANALYSIS (ELECTRICAL)-AUXILIARY FEEDWATER SYSTEM

BREAK IN FEEDWATER PIPE TO STEAM GENERATOR NO.4* INSIDE CONTAINMENT

AND SINGLE ELECTRICAL FAILURE

(Sheet 1 of 3) 1

Failure	Description	Function	Failure Mode	Effect of Failure	Analysis	
1	Diesel gen. A (active failure)	Provides stand-by Power to AFW pump motor (1)	Diesel gen. A fails to start	a. AFW pump (1) inoperative b. Steam gen 1 and 4 will not be supplied by pump (1)	Meets single failure criteria a. Steam gen 1 and 2 supplied from (3) b. Steam gen. 2 and 3 supplied from (2) and (3) c. Valves (6), (7) close from control room	10 1 10 1
2	Diesel gen B (active failure)	Provides stand-by Power to AFW pump motor (2)	Diesel gen. B fails to start	a. AFW pump (2) inoperative b. Steam gen 2 and 3 will not be supplied by pump (2)	Meets single failure criteria a. Steam gen 1 supplied from (1) and (3) b. Steam gen. 2 and 3 supplied from (3) c. Valves (6) and (7) close from control room	10 1 10 1 10 1

TABLE 10.4-2
FAILURE MODE ANALYSIS (ELECTRICAL)-AUXILIARY FEEDWATER SYSTEM
BREAK IN FEEDWATER PIPE TO STEAM GENERATOR NO.4* INSIDE CONTAINMENT
AND SINGLE ELECTRICAL FAILURE
(Sheet 2 of 3)

Failure	Description	Function	Failure Mode	Effect of Failure	Analysis
3	Battery A System (passive failure)	a. Provides control power to pump (1) motor b. Provides control power to valves (6),(7),(8),(9)	Battery A System lost	a. AFW Pump (1) inoperative b. Steam gen 1 and 4 will not be supplied by pump (1) c. Valves (6),(7),(8),(9), fail open	Meets single failure criteria a. Steam gen. 1 supplied from (3) b. Steam gen. 2 and 3 supplied from (2) and (3) c. Valves (6) and (7) will require manual action locally for closing d. Throttling control on valves (8), and (9), will not be available in control room; will required manual action locally
4	Battery B System (passive failure)	a. Provides control power to pump (2) motor b. Provides control power to valves (10),(11),(12),(13) c. Provides control power to inlet valve (4), speed setter (5)	Battery B System lost	a. AFW Pump (2) inoperative b. Steam gen 2 and 3 will not be supplied by pump (2) c. Valves (10),(11),(12),(13) fail open	Meets single failure criteria a. Steam gen. 1 supplied from (1) and (3) b. Steam gen. 2 and 3 supplied from (3)

TABLE 10.4-2
FAILURE MODE ANALYSIS (ELECTRICAL)-AUXILIARY FEEDWATER SYSTEM
BREAK IN FEEDWATER PIPE TO STEAM GENERATOR NO.4* INSIDE CONTAINMENT
AND SINGLE ELECTRICAL FAILURE
(Sheet 3 of 3) 1

Failure	Description	Function	Failure Mode	Effect of Failure	Analysis	
4 (con't)				d. Valve (4) fails e. Signal from speed setter (5) lost	c. Valves (6), and (7) closed from control room d. Throttling control on valves (10),(11),(12) and (13) will not be available in control room; will require manual action locally e. Pump (3) will run at highest speed of speed setter range.	10 1 10
5	Train A cable System (passive failure)	See failures 1 and 3	See failures 1 and 3	See failure 3	Meets single failure criteria See failure 3	
6	Train B cable System	See failures 2 and 4	See failures 2 and 4	See failure 4	Meets single failure criteria See failure 4	

* Analysis and results for breaks on lines to generator 1, 2 or 3 will be identical 1

TABLE 10.4-3

AUXILIARY FEEDWATER SYSTEM REQUIREMENTS

	W	C-E	B&W
Motor Driven Auxiliary Feedwater Pumps Number	2	later	later
Required Flow; gpm	550	later	later
Turbine Driven Auxiliary Feedwater Pump Number	1	later	later
Required Flow; gpm	1100	later	later
Auxiliary Feedwater Storage Tank Capacity; gallons	290,000	later	later
Time allowed to deliver required flow following the initiation signal; sec.	60	later	later

1

LIQUID WASTE PROCESSING SYSTEM DESIGN EFFLUENT RELEASE CONCENTRATIONS (uCi/gm) (Westinghouse-414)

2

Isotope	Low Activity Waste Sample Tank Effluent		Laundry & Hot Shower Waste Holdup & Monitor Tank Effluent			
	Normal Capacity	Peak Capacity	Normal Capacity	Peak Capacity	Peak Capacity (R.O. unit nonoperational)	
Br-83	Neg	Neg	Neg	Neg	Neg	
Br-84	Neg	Neg	Neg	Neg	Neg	
Br-85	Neg	Neg	Neg	Neg	Neg	
I-129	Neg	Neg	Neg	Neg	Neg	
I-130	Neg	Neg	Neg	Neg	Neg	
I-131	6.0(-6)	1.2(-5)	1.1(-7)	5.4(-7)	1.6(-5)	
I-132	Neg	Neg	Neg	Neg	Neg	
I-133	3.2(-8)	1.7(-6)	Neg	2.5(-8)	7.2(-7)	
I-134	Neg	Neg	Neg	Neg	Neg	
I-135	Neg	6.1(-9)	Neg	Neg	Neg	
Rb-86	1.5(-8)	1.8(-8)	1.1(-9)	2.3(-9)	6.6(-8)	
Rb-88	Neg	Neg	Neg	Neg	Neg	
Rb-89	Neg	Neg	Neg	Neg	Neg	
Cs-134	6.0(-6)	6.0(-6)	8.3(-7)	8.3(-7)	2.4(-5)	
Cs-136	5.2(-6)	1.0(-5)	3.1(-7)	8.5(-7)	2.5(-5)	
Cs-137	3.3(-6)	3.3(-6)	4.5(-7)	4.5(-7)	1.3(-5)	10
Cs-138	Neg	Neg	Neg	Neg	Neg	
H-3	1.8(-1)	1.8(-1)	3.5(-5)	3.5(-5)	3.5(-5)	
Cr-51	1.5(-9)	1.7(-9)	6.6(-9)	1.1(-8)	3.2(-8)	
Mn-54	Neg	Neg	Neg	Neg	2.8(-8)	
Mn-56	Neg	Neg	Neg	Neg	Neg	
Fe-55	N.A.	N.A.	N.A.	N.A.	N.A.	
Fe-59	Neg	Neg	Neg	Neg	1.0(-8)	
Co-58	1.1(-9)	1.2(-9)	Neg	Neg	2.3(-8)	
Co-60	Neg	Neg	Neg	Neg	1.0(-8)	
Sr-89	1.7(-9)	1.8(-9)	Neg	1.2(-9)	3.4(-8)	
Sr-90	Neg	Neg	Neg	Neg	1.1(-9)	
Sr-91	Neg	Neg	Neg	Neg	Neg	
Sr-92	Neg	Neg	Neg	Neg	Neg	
Y-90	Neg	Neg	Neg	Neg	Neg	
Y-91m	Neg	Neg	Neg	Neg	Neg	
Y-91	Neg	Neg	Neg	Neg	4.6(-9)	
Y-92	Neg	Neg	Neg	Neg	Neg	

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TABLE 11.2-2
(SHEET 2 of 4)

LIQUID WASTE PROCESSING SYSTEM DESIGN
EFFLUENT RELEASE CONCENTRATIONS (uCi/gm)
(Westinghouse-414)

Isotope	Low Activity Waste Sample Tank Effluent		Laundry & Hot Shower Waste Holdup & Monitor Tank Effluent			
	Normal Capacity	Peak Capacity	Normal Capacity	Peak Capacity	Peak Capacity (R.O. unit nonoperational)	
Y-93	Neg	Neg	Neg	Neg	Neg	
Zr-95	Neg	Neg	Neg	Neg	5.3(-9)	
Nb-95	Neg	Neg	Neg	Neg	5.0(-9)	10
Mo-99	4.6(-8)	1.6(-7)	Neg	6.7(-8)	1.9(-6)	
Tc-99m	Neg	Neg	Neg	Neg	Neg	
Ru-103	Neg	Neg	Neg	Neg	4.6(-9)	
Ru-106	Neg	Neg	Neg	Neg	1.3(-9)	
Rh-103m	Neg	Neg	Neg	Neg	Neg	
Rh-106	Neg	Neg	Neg	Neg	Neg	
Ag-110m	Neg	Neg	Neg	Neg	9.3(-9)	
Te-125m	Neg	Neg	Neg	Neg	2.4(-9)	
Te-127m	1.2(-9)	1.3(-9)	Neg	Neg	2.5(-8)	
Te-127	Neg	Neg	Neg	Neg	Neg	
Te-129m	6.8(-9)	7.5(-9)	3.4(-9)	5.0(-9)	1.4(-7)	
Te-129	Neg	Neg	Neg	Neg	Neg	
Te-131m	Neg	2.3(-9)	Neg	Neg	1.5(-8)	
Te-131	Neg	Neg	Neg	Neg	Neg	
Te-132	2.6(-8)	7.2(-8)	Neg	3.2(-8)	9.1(-7)	
Te-134	Neg	Neg	Neg	Neg	Neg	
Ba-137m	Neg	Neg	Neg	Neg	Neg	
Ba-140	1.2(-9)	1.5(-9)	Neg	Neg	2.7(-8)	
La-140	Neg	Neg	Neg	Neg	1.4(-9)	
Ce-141	Neg	Neg	Neg	Neg	5.0(-9)	
Ce-143	Neg	Neg	Neg	Neg	Neg	
Ce-144	Neg	Neg	Neg	Neg	3.4(-9)	
Pr-143	Neg	Neg	Neg	Neg	4.2(-9)	
Pr-144	Neg	Neg	Neg	Neg	3.4(-9)	

NEG $\leq 10^{-10}$ uCi/gm

GIBBSSAR
TABLE 11.2-2
(SHEET 3 of 4)

LIQUID WASTE PROCESSING SYSTEM DESIGN
EFFLUENT RELEASE CONCENTRATIONS (uCi/gm)
(Westinghouse-414)

Isotope	High Activity Waste Recycle Tank Effluent (no decay)
Br-83	9.3(-7)
Br-84	4.7(-7)
Br-85	6.0(-8)
I-129	3.9(-12)
I-130	1.4(-7)
I-131	2.4(-4)
I-132	2.8(-4)
I-133	3.8(-4)
I-134	5.7(-5)
I-135	2.1(-4)
Rb-86	4.0(-7)
Rb-88	2.4(-4)
Rb-89	1.1(-5)
Cs-134	1.2(-4)
Cs-136	1.6(-4)
Cs-137	6.5(-5)
Cs-138	4.9(-5)
H-3	3.5(0)
Cr-51	3.6(-8)
Mn-54	2.8(-9)
Mn-56	9.8(-8)
Fe-55	N.A.
Fe-59	1.1(-8)
Co-58	2.4(-8)
Co-60	1.0(-8)
Sr-89	3.7(-8)
Sr-90	1.1(-9)
Sr-91	5.8(-8)
Sr-92	1.2(-8)
Y-90	2.9(-10)
Y-91m	3.6(-8)
Y-91	4.9(-9)
Y-92	1.1(-8)
Y-93	3.5(-9)
Zr-95	5.6(-9)

10

TABLE 11.2-2
(SHEET 4 of 4)

LIQUID WASTE PROCESSING SYSTEM DESIGN
EFFLUENT RELEASE CONCENTRATIONS (uCi/gm)
(Westinghouse-414)

Isotope	High Activity Waste Recycle Tank Effluent (no decay)
Nb-95	5.6(-9)
Mo-99	6.6(-6)
Tc-99m	6.0(-6)
Ru-103	5.0(-9)
Ru-106	1.3(-9)
Rh-103m	5.0(-9)
Rh-106	1.3(-9)
Ag-110m	9.4(-9)
Te-125m	2.5(-9)
Te-127m	2.6(-8)
Te-127	1.1(-7)
Te-129m	1.6(-7)
Te-129	1.6(-7)
Te-131m	2.3(-7)
Te-131	1.2(-7)
Te-132	2.6(-6)
Te-134	3.0(-7)
Ba-137m	1.2(-5)
Ba-140	3.6(-8)
La-140	1.2(-8)
Ce-141	5.5(-9)
Ce-143	4.5(-9)
Ce-144	3.4(-9)
Pr-143	5.5(-9)
Pr-144	3.4(-9)

10

NEG ≤, 10^{-10} uCi/gm

2

GIBBSSAR
TABLE 11.2-3
(SHEET 1 of 4) 10

LIQUID WASTE PROCESSING COMPONENT ISOTOPIC INVENTORIES (Ci) (1)
(Westinghouse-414)

Isotope	High Activity Waste Collection Tank	High Activity Waste Recycle Tank	Low Activity Waste Collection Tank
Br-83	1.8(0)	1.8(-5)	1.8(-1)
Br-84	8.9(-1)	8.9(-6)	9.1(-2)
Br-85	1.1(-1)	1.1(-6)	1.1(-2)
I-129	7.4(-7)	1.4(-11)	7.6(-8)
I-130	2.6(-2)	2.6(-6)	2.7(-3)
I-131	4.5(1)	4.5(-3)	4.5(0)
I-132	5.3(1)	5.3(-3)	5.3(0)
I-133	7.2(1)	7.2(-3)	6.8(0)
I-134	1.1(1)	1.1(-3)	1.1(0)
I-135	4.0(1)	4.0(-3)	4.2(0)
Rb-86	1.5(-1)	7.5(-6)	1.5(-2)
Rb-88	9.1(1)	4.5(-3)	9.1(0)
Rb-89	4.2(0)	2.1(-4)	4.2(-1)
Cs-134	4.5(1)	2.3(-3)	4.5(0)
Cs-136	6.1(1)	3.0(-3)	1.1(1)
Cs-137	2.5(1)	1.2(-3)	2.5(0)
Cs-138	1.8(1)	9.3(-4)	1.9(0)
H-3	6.6(1)	6.6(1)	6.8(0)
Cr-51	6.8(-2)	6.8(-7)	6.8(-3)
Mn-54	5.3(-3)	5.3(-8)	5.3(-4)
Mn-56	1.9(-1)	1.9(-6)	1.9(-2)
Fe-55	N.A.	N.A.	N.A.
Fe-59	2.1(-2)	2.1(-7)	2.1(-3)
Co-58	4.5(-2)	4.5(-7)	4.5(-3)
Co-60	1.9(-2)	1.9(-7)	1.9(-3)
Sr-89	7.0(-2)	7.0(-7)	7.2(-3)
Sr-90	2.1(-3)	2.1(-8)	2.1(-4)
Sr-91	1.1(-1)	1.1(-6)	1.1(-2)
Sr-92	2.3(-2)	2.3(-7)	2.3(-3)
Y-90	5.5(-4)	5.5(-9)	5.7(-5)
Y-91m	6.8(-2)	6.8(-7)	6.8(-3)
Y-91	9.3(-3)	9.3(-8)	9.5(-4)
Y-92	2.1(-2)	2.1(-7)	2.1(-3)
Y-93	6.6(-3)	6.6(-8)	6.8(-4)
Zr-95	1.1(-2)	1.1(-7)	1.1(-3)
Nb-95	1.1(-2)	1.1(-7)	1.1(-3)
Mo-99	1.2(1)	1.2(-4)	1.2(0)
Tc-99m	1.1(1)	1.1(-4)	1.1(0)
Ru-103	9.5(-3)	9.5(-8)	9.5(-4)

10

TABLE 11.2-3
(SHEET 2 of 4) 10

LIQUID WASTE PROCESSING COMPONENT ISOTOPIC INVENTORIES (Ci) (1)
(Westinghouse-414)

Isotope	High Activity Waste Collection Tank	High Activity Waste Recycle Tank	Low Activity Waste Collection Tank	
				2
Ru-106	2.5(-3)	2.5(-8)	2.5(-4)	
Rh-103m	9.5(-3)	9.5(-8)	9.5(-4)	
Rh-106	2.5(-3)	2.5(-8)	2.5(-4)	
Ag-110m	1.8(-2)	1.8(-7)	1.8(-3)	
Te-125m	4.7(-3)	4.7(-8)	4.9(-4)	
Te-127m	4.9(-2)	4.9(-7)	4.9(-5)	
Te-127	2.1(-1)	2.1(-6)	2.1(-2)	
Te-129m	3.0(-1)	3.0(-6)	3.0(-2)	
Te-129	3.0(-1)	3.0(-6)	3.0(-2)	
Te-131m	4.4(-1)	4.4(-6)	4.5(-2)	
Te-131	2.3(-1)	2.3(-6)	2.3(-2)	
Te-132	4.9(0)	4.9(-5)	4.9(-1)	10
Te-134	5.7(-1)	5.7(-6)	5.7(-2)	
Ba-137m	2.3(1)	2.3(-4)	2.3(0)	
Ba-140	6.8(-2)	6.8(-7)	6.8(-3)	
La-140	2.3(-2)	2.3(-7)	2.3(-3)	
Ce-141	1.0(-2)	1.0(-7)	1.1(-3)	
Ce-143	8.5(-3)	8.5(-8)	8.7(-4)	
Ce-144	6.4(-3)	6.4(-8)	6.4(-4)	
Pr-143	1.0(-2)	1.0(-7)	1.1(-3)	
Pr-144	6.4(-3)	6.4(-8)	6.4(-4)	

TABLE 11.2-3
(Sheet 3 of 4)

LIQUID WASTE PROCESSING COMPONENT ISOTOPIC INVENTORIES (Ci)
(Westinghouse-414)

Isotope	Low Activity Waste Sample Tank	Laundry & Hot Shower Waste Collection Tank	Laundry & Hot[2] Shower Holdup and Monitor Tank
Br-83	8.9(-7)	3.5(-5)	3.5(-5)
Br-84	4.5(-7)	1.8(-5)	1.8(-5)
Br-85	5.7(-10)	2.3(-6)	2.3(-6)
I-129	Neg	Neg	Neg
I-130	1.3(-7)	5.3(-7)	5.3(-7)
I-131	2.3(-4)	9.1(-4)	9.1(-4)
I-132	2.6(-4)	1.1(-3)	1.1(-3)
I-133	3.4(-4)	1.4(-3)	1.4(-3)
I-134	5.5(-5)	2.2(-4)	2.2(-4)
I-135	2.1(-4)	7.9(-4)	7.9(-4)
Rb-86	3.8(-7)	3.0(-6)	3.0(-6)
Rb-88	2.3(-4)	1.8(-3)	1.8(-3)
Rb-89	1.0(-5)	8.3(-5)	8.3(-5)
Cs-134	1.1(-4)	9.1(-4)	9.1(-4)
Cs-136	1.5(-4)	1.2(-3)	1.2(-3)
Cs-137	6.2(-5)	4.9(-4)	4.9(-4)
Cs-138	4.7(-5)	3.7(-4)	3.7(-4)
H-3	3.4(0)	1.3(-3)	1.3(-3)
Cr-51	3.4(-8)	1.4(-6)	1.4(-6)
Mn-54	2.6(-9)	1.1(-7)	1.1(-7)
Mn-56	2.6(-9)	3.7(-6)	3.7(-6)
Fe-55	N.A.	N.A.	N.A.
Fe-59	9.5(-8)	4.2(-7)	4.2(-7)
Co-58	2.3(-8)	9.1(-7)	9.1(-7)
Co-60	9.5(-9)	3.8(-7)	3.8(-7)
Sr-89	3.6(-8)	1.4(-6)	1.4(-6)
Sr-90	1.1(-9)	4.2(-8)	4.2(-8)
Sr-91	5.5(-8)	2.2(-6)	2.2(-6)
Sr-92	1.1(-8)	4.5(-7)	4.5(-7)
Y-90	2.8(-10)	1.1(-8)	1.1(-8)
Y-91m	3.4(-8)	1.4(-6)	1.4(-6)
Y-91	4.7(-9)	1.9(-7)	1.9(-7)
Y-92	1.1(-8)	4.2(-7)	4.2(-7)
Y-93	3.4(-9)	1.3(-7)	1.3(-7)
Zr-95	5.3(-9)	2.1(-7)	2.1(-7)
Nb-95	5.3(-9)	2.1(-7)	2.1(-7)
Mo-99	6.2(-6)	2.5(-4)	2.5(-4)
Tc-99m	5.7(-6)	2.3(-4)	2.3(-4)

TABLE 11.2-3
(Sheet 4 of 4)

LIQUID WASTE PROCESSING COMPONENT ISOTOPIC INVENTORIES (Ci)
(Westinghouse-414)

Isotope	Low Activity Waste Sample Tank	Laundry & Hot Shower Waste Collection Tank	Laundry & Hot[2] Shower Holdup and Monitor Tank	
Ru-103	4.7(-9)	1.9(-7)	1.9(-7)	
Ru-106	1.2(-9)	4.9(-8)	4.9(-8)	
Rh-103m	4.7(-9)	1.9(-7)	1.9(-7)	
Rh-106	1.2(-9)	4.9(-8)	4.9(-8)	
Ag-110m	8.9(-9)	3.6(-7)	3.6(-7)	
Te-125m	2.5(-9)	9.5(-8)	9.5(-8)	
Te-127m	2.5(-8)	9.8(-7)	9.8(-7)	10
Te-127	1.1(-7)	4.2(-6)	4.2(-6)	
Te-129m	1.1(-8)	6.1(-6)	6.1(-6)	
Te-129	.5(-7)	6.1(-6)	6.1(-6)	
Te-131m	1.5(-7)	8.7(-6)	8.7(-6)	
Te-131	1.1(-7)	4.5(-6)	4.5(-6)	
Te-132	2.5(-6)	9.8(-5)	9.8(-5)	
Te-134	2.5(-7)	1.1(-5)	1.1(-5)	
Ba-137m	1.1(-5)	4.5(-4)	4.5(-4)	
Ba-140	3.4(-8)	1.4(-6)	1.4(-6)	
La-140	1.1(-8)	4.5(-7)	4.5(-7)	
Ce-141	5.3(-9)	2.1(-7)	2.1(-7)	
Ce-143	4.3(-9)	1.7(-7)	1.7(-7)	
Ce-144	3.2(-9)	1.3(-7)	1.3(-7)	
Pr-143	5.3(-9)	2.1(-7)	2.1(-7)	
Pr-144	3.2(-9)	1.3(-7)	1.3(-7)	

(1) Zero decay credit 2

(2) No credit for R.O. processing

10

2

TABLE 11.2-5
(Sheet 1 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameter	
Pumps				
1. Reactor coolant drain collection tank pumps	mfgs. std.	NNS		6
Number			1	
Type			Canned	
Design pressure, psig			150	
Design temperature, F			200	
Design flow, gpm				
Recirculation Mode			100	10
Process Mode			35	
Design head, ft				
Recirculation Mode			200	10
Process Mode			250	
Material			SS	

TABLE 11.2-5
(Sheet 2 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameter
2. High activity waste collection pumps	mfgs. std.	NSS	10
Number			1
Type			Canned
Design pressure, psig			150
Design temperature, F			200
Design flow, gpm			
Recirculation Mode			100 10
Process Mode			35
Design head, ft			
Recirculation Mode			200 10
Process Mode			250
Material			SS

TABLE 11.2-5
(Sheet 3 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameter	
3. High activity waste recycle tank pump	mfgs. std.	NNS		6
Number			1	
Type			Canned	
Design pressure, psig			150	
Design temperature, F			200	
Design flow, gpm				
Recirculation Mode			100	10
Process Mode			35	
Design head, ft				
Recirculation Mode			200	10
Process Mode			250	
Material			SS	

 2

TABLE 11.2-5
(Sheet 4 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

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2

 2

TABLE 11.2-5
(Sheet 5 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

(Deleted) 2

TABLE 11.2-5
(Sheet 6 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameters	
4. Laundry and hot shower waste collection tank pumps	mfgs. std.	NNS		10
Number			2	
Type			Centrifugal	2
Design pressure, psig			150	
Design temperature, F			200	
Design flow, gpm				
Recirculation Mode			100	10
Process Mode			35	
Design head, ft				
Recirculation Mode			200	10
Process Mode			250	
Material			SS	

TABLE 11.2-5
(Sheet 7 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameters	
5. Low activity waste collection tank pumps	mfgs. std.	NNS		6
Number			2	
Type			Centrifugal	2
Design pressure, psig			150	
Design temperature, F			200	
Design flow, gpm				
Recirculation Mode			200	10
Process Mode			35	
Design head, ft				
Recirculation Mode			200	10
Process Mode			250	
Material			SS	

 2

TABLE 11.2-5
(Sheet 8 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameters	
6. Low activity waste sample tank pumps	mfg. std.	NNS		10
Number			2	
Type			Canned	
Design pressure, psig			150	
Design temperature, F			200	
Design flow, gpm				
Recirculation Mode			100	10
Process Mode			35	
Design head, ft				
Recirculation Mode			200	10
Process Mode			250	
Material			SS	

TABLE 11.2-5
(Sheet 9 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameters	
7. Laundry and hot shower holdup and monitor tank pump	mfgs. std.	NNS		6
Number			1	
Type			Canned	
Design pressure, psig			150	
Design temperature, F			200	
Design flow, gpm				
Recirculation Mode			100	10
Process Mode			35	
Design head, ft				
Recirculation Mode			200	10
Process Mode			250	
Material			SS	

 2

TABLE 11.2-5
(Sheet 10 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameters
Heat Exchangers			
Reactor coolant drain collection tank heat exchanger	Tube side ASME VIII	NNS	
	Shell side ASME III Code Class 2	2	
Number			1
Type			U-tube
Est. UA, Btu/hr -F			70,000
Design pressure,(1) psig			
shell			150
tube			250

2

2

TABLE 11.2-5
(Sheet 11 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component		Code Design	Safety Class	Parameters
Design temperature, F				
	shell			250
	tube			250
Design flow, lb/hr	shell			112,000
	tube			44,600
Temperature in, F	shell			105
	tube			180
Temperature out, F	shell			125
	tube			130
Material	shell			CS
	tube			SS

(1) External design pressure - 60 psig

 2

TABLE 11.2-5
(Sheet 12 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameters
Tanks			
1. Reactor coolant drain collection tank	ASME VIII	NNS	
Number			1
Usable volume, gal			350
Type			Horiz.
Design pressure, psig (1)			100
Design temperature, F			250
Material			SS
Diaphragm			No

2

TABLE 11.2-5
(Sheet 12a of 29) 2

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameter
2. High activity waste collecton tanks	API 620	NNS	
Number			2
Usable volume, gal			5,000 (each)
Type			Vert.
Design pressure			Atmos.
Design temperature, F			200
Material			SS
Diaphragm			No

6

---

(1) External design pressure - 60 psig

 2

TABLE 11.2-5
(Sheet 13 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameter
3. High activity waste recycle tank	ASME VIII	NNS	
Number			1
Usable volume, gal			5000
Type			Vert.
Design pressure			Atmos.
Design temperature, F			200
Material			SS
Diaphragm			Yes

2

 |2

TABLE 11.2-5
(Sheet 14 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameter	
4. Laundry and hot shower tanks	API 620	NNS		2 6
Number			2	
Usable volume, gal			10,000(each)	
Type			Vert.	
Design pressure			Atmos.	
Design temperature, F			200	
Material			SS	
Diaphragm			No	

 |2

TABLE 11.2-5
(Sheet 15 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameter
5. Low activity waste collection tanks	API 620	NNS	
Number			10
Usable volume, gal			10,000 (each)
Type			Vert.
Design pressure			Atmos.
Design temperature, F			200
Material			SS
Diaphragm			No
6. Low activity waste sample tanks	API 620	NSS	
Number			2
Usable volume, gal			5000 (each)
Type			Vert.
Design pressure			Atmos.
Design temperature, F			200
Material			SS
Diaphragm			No

|2 |10 |2 |10

TABLE 11.2-5
(Sheet 16 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameter	
7. Reverse osmosis concentrates tank	API 620	NNS		6
Number			1	
Usable volume, gal			1000	
Type			Vert.	
Design pressure			Atmos.	
Design temperature, F			200	
Material			SS	
Diaphragm			No	
8. Evaporator reagent tanks	ASME VIII	NNS		6
Number			2	
Usable volume, gal			5 (each)	
Type			Vert.	
Design pressure, psig			150	
Design temperature, F			200	
Material			SS	
Diaphragm			No	

TABLE 11.2-5
(Sheet 17 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameter
9. Laundry and hot shower holdup and monitor tanks	API 620	NNS	|2 |10
Number			2
Usable volume, gal			5000 (each)
Type			Vert.
Design Pressure, psig			Atmos.
Design Temperature, F			200
Material			SS
Diaphragm			No

 2

TABLE 11.2-5
(Sheet 18 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

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TABLE 11. 2-5
(Sheet 19 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameter	
Demineralizers				
1. High activity waste recycle demineralizer	ASME VIII	NNS		2 10
Number			1	
Type			Flushable	
Design pressure, psig			150	
Design temperature, F			200	
Design flow, gpm			35	
Resin volume, ft^3			30	
Material			SS	
Resin type			IRN-150(1)	
Design process decontamination factor			10	
2. Low activity waste sample demineralizer	ASME VIII	NNS		2
Number			1	
Type			Flushable	
Design pressure, psig			150	
Design temperature, F			200	
Design flow, gpm			35	

|2

TABLE 11. 2-5
(Sheet 20 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameter	
Resin volume, ft^3			30	2
Material			SS	
Resin type			IRN-150[1]	
Design process decontamination factor			10	

[1] Rohm and Haas Amberlite or equivalent

Filters

Component	Code Design	Safety Class	Parameter	
1. High activity waste filter	ASME VIII	NNS		6
Number			1	
Design pressure, psig			150	
Design temperature, F			200	
Design flow, gpm			35	
P at design flow, psi			5	
Size of particles, 98 percent ret., microns (nominal)			25	
Surface radiation level, R/hr			100	
Materials				
Housing			SS	
Filter Element			EICF*	

 2

TABLE 11.2-5
(Sheet 21 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

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2

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TABLE 11.2-5
(Sheet 22 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

(Deleted)

2

TABLE 11.2-5
(Sheet 23 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameter	
2. Laundry and hot shower waste filter	ASME VIII	NNS		10
Number			1	
Design pressure, psig			150	
Design temperature, F			200	
Design flow, gpm			35	
P at design flow, psi			5	
Size of particles, 98 percent ret., microns (nominal)			25	
Surface radiation level, mR/hr			<100	
Materials				
Housing			SS	
Filter Element			EICF*	

TABLE 11.2-5
(Sheet 24 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameter	
3. Low activity waste filter	ASME VIII	NNS		
Number			1	6 2
Design pressure, psig			150	
Design temperature, F			200	
Design flow, gpm			35	
P at design flow, psi			0.5	
Size of particles, 98 percent ret., microns (nominal)			25	
Materials				
Housing			SS	
Filter Element			EICF*	

* EICF = Epoxy Impregnate Celluose Fiber 10

 2

TABLE 11.2-5
(Sheet 25 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

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2

TABLE 11.2-5
(Sheet 26 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameters	
Strainers				
1. Laundry and hot shower waste collection tank strainer	ASME VIII	NNS		6 2
Number			1	
Type			Basket	
Design pressure, psig			150	
Design temperature, F			200	
Design flow, gpm			35	
P at design flow, psi			0.5	
Nominal rating, inch			0.0625	
Surface radiation level			Neg.	
Materials			SS	

|2

TABLE 11.2-5
(Sheet 27 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameters	
2. Low activity waste collection tank strainers	ASME VIII	NNS		|10 |2
Number			2	
Type			Basket	
Design pressure, psig			150	
Design temperature, F			200	
Design flow, gpm			35	
P at design flow, psi			Neg.	
Nominal rating, in			1/16	
Surface radiation level			Neg.	
Materials			SS	

TABLE 11.2-5
(Sheet 28 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameters	
Evaporators				
High activity waste evaporator				2
Process side	ASME VIII	NNS		10
Steam side	ASME VIII	NNS		6
Number			1	
Steam design pressure, psig			50	
Design flow, gpm			15	
Feed conc., ppm boron			10 - 2500	
Bottoms conc., ppm boron			7000 - 21,000	
Shell material			Inconel 625	10
Tube material			Titanium	
Low activity waste evaporator				2
Process side	ASME VII	NNS		6
Steam side	ASME VIII	NNS		

 2

TABLE 11.2-5
(Sheet 29 of 29)

EQUIPMENT PRINCIPAL DESIGN PARAMETERS

Component	Code Design	Safety Class	Parameters	
Number			1	
Steam design pressure, psig			50	
Design flow, gpm			15	
Shell material			Inconel 625	10
Tube material			Titanium	2
Laundry reverse osmosis system	ASME VIII	NNS		10
Number			1	
Design flow, gal/day			15,000	
Percent rejection (solids), minimum			90	
Percent recovery, minimum			97	
				2

TABLE 11.2-6
(Sheet 1 of 2)

DESIGN LIQUID EFFLUENT RELEASES (Ci/yr)
(WESTINGHOUSE-414)

Isotope	LWPS[1]	Turbine Building Drains[2]	SGBPS Controlled Release[3]	Primary System[4][5] Water Balance	Total	
Br-83	neg	6.6(-6)	6.6(-6)	1.6(-4)	1.7(-4)	
Br-84	neg	1.8(-6)	1.8(-6)	8.0(-5)	8.4(-5)	
Br-85	neg	3.3(-8)	3.3(-8)	1.0(-5)	1.0(-5)	
I-129	3.1(-10)	3.4(-11)	3.4(-11)	6.6(-10)	1.0(-9)	
I-130	1.2(-8)	1.2(-6)	1.2(-6)	2.4(-5)	2.6(-5)	
I-131	1.3(-2)	2.1(-3)	2.1(-3)	4.1(-2)	5.8(-2)	10
I-132	neg	1.8(-3)	1.8(-3)	4.8(-2)	5.2(-2)	
I-133	3.5(-4)	3.2(-3)	3.2(-3)	6.5(-2)	7.2(-2)	
I-134	neg	2.6(-4)	2.6(-4)	9.7(-3)	1.0(-2)	
I-135	5.6(-7)	1.7(-3)	1.7(-3)	3.6(-2)	3.9(-2)	
Rb-86	3.7(-5)	7.7(-6)	7.7(-6)	6.8(-5)	1.2(-4)	
Rb-88	neg	1.2(-3)	1.2(-3)	4.1(-2)	4.3(-2)	
Rb-89	neg	4.9(-5)	4.9(-5)	1.9(-3)	2.0(-3)	
Cs-134	1.4(-2)	2.3(-3)	2.3(-3)	2.0(-2)	3.9(-2)	
Cs-136	1.3(-2)	3.1(-3)	3.1(-3)	2.7(-2)	4.6(-2)	
Cs-137	1.0(-2)	1.2(-3)	1.2(-3)	1.1(-2)	2.3(-2)	
Cs-138	neg	3.7(-4)	3.7(-4)	8.3(-3)	9.0(-3)	
H-3	2.7(2)	6.1(1)	6.1(1)	6.0(2)	9.9(2)	
Cr-51	1.3(-5)	3.4(-7)	3.4(-7)	6.1(-6)	2.0(-5)	
Mn-54	5.5(-6)	2.7(-8)	2.7(-8)	4.8(-7)	6.0(-6)	
Mn-56	neg	7.2(-7)	7.2(-7)	1.7(-5)	1.8(-5)	
Fe-55	NA	NA	NA	NA	NA	
Fe-59	2.7(-6)	1.1(-7)	1.1(-7)	1.9(-6)	4.8(-6)	
Co-58	6.1(-6)	2.3(-7)	2.3(-7)	4.1(-6)	1.1(-5)	
Co-60	3.1(-6)	9.6(-8)	9.6(-8)	1.7(-6)	5.0(-6)	
Sr-89	1.0(-5)	3.5(-7)	3.5(-7)	6.3(-6)	1.7(-5)	
Sr-90	2.1(-6)	1.1(-8)	1.1(-8)	1.9(-7)	2.3(-6)	
Sr-91	1.6(-9)	5.1(-7)	5.1(-7)	9.9(-6)	1.1(-5)	
Sr-92	neg	9.0(-8)	9.0(-8)	2.0(-6)	2.2(-6)	
Y-90	3.2(-9)	2.8(-9)	2.8(-9)	4.9(-8)	5.8(-8)	
Y-91m	neg	1.7(-7)	1.7(-7)	6.1(-6)	6.4(-6)	
Y-91	1.2(-6)	4.7(-8)	4.7(-8)	8.3(-7)	2.1(-6)	
Y-92	neg	8.4(-8)	8.4(-8)	1.9(-6)	2.1(-6)	
Y-93	1.0(-10)	3.1(-8)	3.1(-8)	6.0(-7)	6.6(-7)	
Zr-95	1.4(-6)	5.4(-8)	5.4(-8)	9.5(-7)	2.6(-6)	
Nb-95	1.3(-6)	5.4(-8)	5.4(-8)	9.5(-7)	2.4(-6)	

TABLE 11.2-6
(Sheet 2 of 2)

DESIGN LIQUID EFFLUENT RELEASES (Ci/yr)
(WESTINGHOUSE-414)

Isotope	LWPS(1)	Turbine Building Drains(2)	SGBPS Controlled Release(3)	Primary System(4)(5) Water Balance	Total
Mo-99	4.5(-4)	6.0(-5)	6.0(-5)	1.1(-3)	1.7(-3)
Tc-99m	6.0(-9)	5.1(-5)	5.1(-5)	1.0(-3)	1.1(-3)
Ru-103	1.2(-6)	4.8(-8)	4.8(-8)	8.5(-7)	2.1(-6)
Ru-106	5.9(-7)	1.2(-8)	1.2(-8)	2.2(-7)	8.3(-7)
Rh-103m	neg	2.6(-8)	2.6(-8)	8.5(-7)	9.1(-7)
Rh-106	neg	1.2(-10)	1.2(-10)	2.2(-7)	2.2(-7)
Ag-110m	2.5(-6)	9.0(-8)	9.0(-8)	1.6(-6)	4.3(-6)
Te-125m	6.3(-7)	2.4(-8)	2.4(-8)	4.3(-7)	1.1(-6)
Te-127m	5.0(-6)	2.5(-7)	2.5(-7)	4.4(-6)	9.9(-6)
Te-127	2.3(-9)	9.6(-7)	9.6(-7)	1.9(-5)	2.1(-5)
Te-129m	4.0(-5)	1.6(-6)	1.6(-6)	2.7(-5)	7.0(-5)
Te-129	neg	9.0(-7)	9.0(-7)	2.7(-5)	2.9(-5)
Te-131m	3.2(-5)	2.2(-6)	2.2(-6)	3.9(-5)	7.5(-5)
Te-131	neg	3.9(-7)	3.9(-7)	2.0(-5)	2.1(-5)
Te-132	2.3(-4)	2.5(-5)	2.5(-5)	4.4(-5)	7.2(-4)
Te-134	neg	1.3(-6)	1.3(-6)	5.1(-5)	5.4(-5)
Ba-137m	neg	5.9(-6)	5.9(-6)	2.0(-3)	2.0(-3)
Ba-140	6.9(-6)	3.5(-7)	3.5(-7)	6.1(-6)	1.4(-5)
La-140	3.1(-7)	1.1(-7)	1.1(-7)	2.0(-6)	2.5(-6)
Ce-141	1.3(-6)	5.3(-8)	5.3(-8)	4.4(-7)	2.3(-6)
Ce-143	1.1(-8)	4.2(-8)	4.2(-8)	7.7(-7)	8.7(-7)
Ce-144	9.1(-7)	3.2(-8)	3.2(-8)	5.8(-7)	1.6(-6)
Pr-143	1.1(-6)	5.3(-8)	5.3(-8)	9.4(-7)	2.1(-6)
Pr-144	9.1(-7)	3.2(-8)	3.2(-8)	5.8(-7)	1.6(-6)
Total Excluding H-3					4.0(-1)

10

(1) 2.3(9) cc/yr (Drain Channel B)
(2) 5.5(9) cc/yr
(3) 5.5(9) cc/yr controlled release allowance for operational flexibility
(4) 1.7(8) cc/yr (Drain Channel A)
(5) Zero holdup time assumed
(6) Neg $<10^{-10}$

TABLE 11.3-3
(Sheet 1 of 3) 2

GASEOUS WASTE PROCESSING SYSTEM - PROCESS PARAMETERS

(Westinghouse-414)

Item		Temperature (F)	Pressure (psig)	Flow (scfm)	N2 Percent	H2 Percent
Gas Stream Descriptions						
1	Volume control tank purge	130	15	0.7	0	100
2	Gas decay tank discharge to compressor	AMB*	1.0	40	99.9	0.1
3	Compressor suction	AMB	0.5	40.7	98.3	1.7
4	Compressor discharge to recombiner	140	<130	40.7	98.3	1.7
5	Recombiner discharge to gas decay tanks	140	<120	40	99.9	0.1
6	Miscellaneous vents (evaporators, reactor coolant drain tanks, recycle holdup tank vent eductor)	VAR**	0.5	neg.	0	100
7	Recombiner oxygen supply	AMB	50	0.35	0	0
8	Recombiner calibrating gas	AMB	15	0.004	94	6
9	Recombiner calibrating gas	AMB	ATM***	0.004	94	6
10	Recombiner nitrogen supply	AMB	100	0	100	0
11	NSSS nitrogen supply	AMB	100	0	100	0
12	Nitrogen relief to plant vent	AMB	100	0	100	0
13	NSSS hydrogen supply	AMB	100	0.7	0	100

TABLE 11.3-2

DESIGN ANNUAL RELEASE IN CURIES OF RADIOACTIVE GASEOUS EFFLUENTS (Ci/yr) 2

(Westinghouse-414)

		Building Ventilation			Condenser		4
Isotope	GWPC[1]	Reactor	Auxiliary	Turbine	Air Ejector	Total	2
Ar-41	0.0	2.5E01	0.0	0.0	0.0	2.5E 01	
Kr-85m	7.8E-02	---				7.8E-02	
Kr-85m	6.7E-01	7.5E01	1.7E01	0.0	0.0	9.2E01	
Kr-85	2.8E04	5.0E01	0.0	0.0	0.00	2.8E04	
Kr-87	1.5E-01	1.7E01	8.3E00	0.0	0.0	2.5E01	
Kr-88	8.4E-01	9.2E01	4.2E01	0.0	2.5E01	1.6E02	
Kr-89	6.7E-04	---	---	---	---	6.7E-04	
Xe-131m	2.0E01	1.0E02	0.0	0.0	0.0	1.2E02	10
Xe-133m	3.3E01	3.6E02	1.7E01	0.0	8.3E00	4.4E02	
Xe-133	1.1E03	2.4E04	8.3E02	0.0	5.3E02	2.6E04	
Xe-135m	1.3E-02	0.0	0.0	0.0	0.0	1.3E-02	
Xe-135	3.2E00	4.0E02	5.8E01	0.0	3.3E01	4.9E02	
Xe-137	1.3E-03	---	---	---	---	1.3E-03	
Xe-138	1.7E-02	0.0	8.3E00	0.0	0.0	8.3E00	
I-129	1.3E-05	---	---	---	---	1.3E-05	
I-130	2.4E-05	---	---	---	---	2.4E-05	
I-131	6.5E-01	1.3E-01	3.3E-02	9.2E-04	1.9E-02	8.3E-01	
I-132	8.9E-03	---	---	---	---	8.9E-03	
I-133	1.1E-01	8.2E-02	4.9E-02	1.4E-03	3.1E-02	2.7E-01	
I-134	7.0E-04	---	---	---	---	7.0E-04	
I-135	1.7E-02	---	---	---	---	1.7E-02	

(1) 100 scfy leakage at 40 yr holdup 2

TABLE 11.4-1

ANTICIPATED TOTAL SOLID WASTE GENERATED PER YEAR
(Westinghouse-414)

2

Item	Quantity
Spent resins	280 ft^3
Evaporator bottoms	2835 ft^3
Chemical drain tank effluents	390 ft^3
Condensate demineralizer resin	802 ft^3*
Spent filter cartridge assemblies	21
Steam generator blowdown resins	600ft^3**
RO system concentrates	1000 ft^3
Dry compacted waste	2500 ft^3***

2

* No condenser leakage

** 110 lb/day primary to secondary leak

*** Based on USNRC WASH 1258

The yearly estimated total number of 50-ft^3 solid-waste containers is 100, and the number of 55-gallon solid-waste drums is 400.

TABLE 11.4-2
(Sheet 1 of 15)

SOLID WASTE MANAGEMENT SYSTEM EXPECTED ACTIVITIES
(Westinghouse-414)

1. Chemical Waste 2

Isotope	µCi/gm	Ci/yr	Chemical Drain Ci-Tank Inventory	
Br-83	9.3(-2)	1.0(0)	2.1(-1)	
Br-84	4.7(-2)	5.2(-1)	1.1(-1)	
Br-85	6.0(-3)	6.6(-2)	1.4(-2)	
I-129	3.9(-8)	4.3(-7)	8.9(-8)	
I-130	1.4(-3)	1.5(-2)	3.2(-3)	
I-131	2.4(0)	2.7(1)	5.5(0)	
I-132	2.8(0)	3.1(1)	6.4(0)	
I-133	3.8(0)	4.2(1)	8.6(0)	
I-134	5.7(-1)	6.3(0)	1.3(0)	
I-135	2.1(0)	2.3(1)	4.8(0)	
Rb-86	8.0(-3)	8.8(-2)	1.8(-2)	
Rb-88	4.8(0)	5.3(1)	1.1(1)	
Rb-89	2.2(-1)	2.4(0)	5.0(-1)	
Cs-134	2.4(0)	2.7(1)	5.5(0)	
Cs-136	3.2(0)	3.5(1)	7.3(0)	
Cs-137	1.3(0)	1.4(1)	3.0(0)	
Cs-138	9.7(-1)	1.1(1)	2.2(0)	
H-3	3.5(0)	3.9(1)	7.9(0)	10
Cr-51	3.6(-3)	4.0(-2)	8.2(-3)	
Mn-54	2.8(-4)	3.1(-3)	6.4(-4)	
Mn-56	9.8(-3)	1.1(-1)	2.2(-2)	
Fe-55	N.A.	N.A.	N.A.	
Fe-59	1.1(-3)	1.2(-2)	2.5(-3)	
Co-58	2.4(-3)	2.7(-2)	5.5(-3)	
Co-60	1.0(-3)	1.1(-2)	2.3(-3)	
Sr-89	3.7(-3)	4.1(-2)	8.4(-3)	
Sr-90	1.1(-4)	1.2(-3)	2.5(-4)	
Sr-91	5.8(-3)	6.4(-2)	1.3(-2)	
Sr-92	1.2(-3)	1.3(-2)	2.7(-3)	
Y-90	2.9(-5)	3.2(-4)	6.6(-5)	
Y-91m	3.6(-3)	4.0(-2)	8.2(-3)	
Y-91	4.9(-4)	5.4(-3)	1.1(-3)	
Y-92	1.1(-3)	1.2(-2)	2.5(-3)	
Y-93	3.5(-4)	3.9(-3)	7.9(-4)	
Zr-95	5.6(-4)	6.2(-3)	1.3(-3)	
Nb-95	5.6(-4)	6.2(-3)	1.3(-3)	

2

TABLE 11.4-2
(Sheet 4 of 15)

SOLID WASTE MANAGEMENT SYSTEM EXPECTED ACTIVITIES
(Westinghouse-414)

Isotope	uCi/gm	Ci/Yr	Ci-Ro Conc Tk	
Tc-99m	1.5(-4)	3.3(-3)	5.5(-4)	
Ru-103	1.2(-7)	2.8(-6)	4.6(-7)	
Ru-106	3.1(-8)	7.1(-7)	1.2(-7)	
Rh-103m	1.2(-7)	2.8(-6)	4.6(-7)	
Rh-106	3.1(-8)	7.1(-7)	1.2(-7)	
Ag-110m	2.3(-7)	5.2(-6)	8.6(-7)	
Te-125m	6.1(-8)	1.4(-6)	2.3(-7)	
Te-127m	6.3(-7)	1.4(-5)	2.4(-6)	
Te-127	2.7(-6)	6.0(-5)	1.0(-5)	
Te-129m	3.9(-6)	8.8(-5)	1.5(-5)	
Te-129	3.9(-6)	8.8(-5)	1.5(-5)	
Te-131m	5.6(-6)	1.3(-4)	2.1(-5)	10
Te-131	2.9(-6)	6.6(-5)	1.1(-5)	
Te-132	6.3(-5)	1.4(-3)	2.4(-4)	
Te-134	1.9(-5)	4.4(-4)	7.3(-5)	
Ba-137m	2.9(-4)	6.6(-3)	1.1(-3)	
Ba-140	8.7(-7)	2.0(-5)	3.3(-6)	
La-140	2.7(-6)	6.2(-5)	1.0(-5)	
Ce-141	1.3(-7)	3.0(-6)	5.0(-7)	
Ce-143	1.1(-7)	2.5(-6)	4.1(-7)	
Ce-144	8.2(-8)	1.9(-6)	3.1(-7)	
Pr-143	1.3(-7)	3.0(-6)	5.0(-7)	
Pr-144	8.2(-8)	1.9(-6)	3.1(-7)	

Basis:
1. No decay credit
2. R.O. Conc Tank Usable Vol, Gal = 1000
3. 1% Failed Fuel 2
4. DF = 30
5. 150,000 gallons/Yr processed at 0.96 recovery

TABLE 11.4-2
(Sheet 5 of 15)

SOLID WASTE MANAGEMENT SYSTEM EXPECTED ACTIVITIES 2
(Westinghouse-414)

3. Liquid Waste Processing System Evaporator Concentrates

Isotope	High Act. Waste Concs uCi/gm	L.A.W. Concs uCi/gm	Conc. Waste Tank 2,000 gal Ci	Concentrate Ci/Yr	
Br-83	9.3(-1)	9.3(-2)	7.1(0)	2.8(1)	
Br-84	4.7(-1)	4.7(-2)	3.6(0)	1.4(1)	
Br-85	6.0(-2)	6.0(-3)	4.6(-1)	1.8(0)	
I-129	3.9(-7)	3.9(-8)	3.0(-6)	1.2(-5)	
I-130	1.4(-2)	1.4(-3)	1.1(-1)	4.2(-1)	
I-131	2.4(1)	2.4(0)	1.8(2)	7.2(2)	
I-132	2.8(1)	2.8(0)	2.1(2)	8.4(2)	
I-133	3.8(1)	3.8(0)	2.9(2)	1.1(3)	
I-134	5.7(0)	5.7(-1)	4.3(1)	1.7(2)	
I-135	2.1(1)	2.1(0)	1.6(2)	6.3(2)	
Rb-86	8.0(-2)	8.0(-3)	6.1(-1)	2.4(0)	
Rb-88	4.8(1)	4.8(0)	3.6(2)	1.4(3)	
Rb-89	2.2(0)	2.2(-1)	1.7(1)	6.6(1)	
Cs-134	2.4(1)	2.4(0)	1.8(2)	7.2(2)	
Cs-136	3.2(1)	3.2(0)	2.4(2)	9.6(2)	
Cs-137	1.3(1)	1.3(0)	9.9(1)	3.9(2)	
Cs-138	9.7(0)	9.7(-1)	7.4(1)	2.9(2)	10
H-3	3.5(0)	3.5(0)	2.7(1)	1.1(3)	
Cr-51	3.6(-2)	3.6(-3)	2.7(-1)	1.1(0)	
Mn-54	2.8(-3)	2.8(-4)	2.1(-2)	8.4(-2)	
Mn-56	9.8(-2)	9.8(-3)	7.4(-1)	2.9(0)	
Fe-55	N.A.	N.A.	N.A.	N.A.	
Fe-59	1.1(-2)	1.1(-3)	8.4(-2)	3.3(-1)	
Co-58	2.4(-2)	2.4(-3)	1.8(-1)	7.2(-1)	
Co-60	1.0(-2)	1.0(-3)	7.6(-2)	3.0(-1)	
Sr-89	3.7(-2)	3.7(-3)	2.8(-1)	1.1(0)	
Sr-90	1.1(-3)	1.1(-4)	8.4(-3)	3.3(-2)	
Sr-91	5.8(-2)	5.8(-3)	4.4(-1)	1.7(0)	
Sr-92	1.2(-2)	1.2(-3)	9.1(-2)	3.6(-1)	
Y-90	2.9(-4)	2.9(-5)	2.2(-3)	8.7(-3)	
Y-91m	3.6(-2)	3.6(-3)	2.7(-1)	1.1(0)	
Y-91	4.9(-3)	4.9(-4)	3.7(-2)	1.5(-1)	
Y-92	1.1(-2)	1.1(-3)	8.4(-2)	3.3(-1)	
Y-93	3.5(-3)	3.5(-4)	2.7(-2)	1.1(-1)	
Zr-95	5.6(-3)	5.6(-4)	4.3(-2)	1.7(-1)	

TABLE 11.4-2
(Sheet 6 of 15)

SOLID WASTE MANAGEMENT SYSTEM EXPECTED ACTIVITIES (Westinghouse-414) 2

Isotope	High Act. Waste Concs uCi/gm	L.A.W. Concs uCi/gm	Conc. Waste Tank 2,000 gal Ci	Concentrate Ci/Yr	
Nb-95	5.6(-3)	5.6(-4)	4.3(-2)	1.7(-1)	
Mo-99	6.6(0)	6.6(-1)	5.0(1)	2.0(2)	
Tc-99m	6.0(0)	6.0(-1)	4.6(1)	1.8(2)	
Ru-103	5.0(-3)	5.0(-4)	3.8(-2)	1.5(-1)	
Ru-106	1.3(-3)	1.3(-4)	9.9(-3)	3.9(-2)	
Rh-103m	5.0(-3)	5.0(-4)	3.8(-2)	1.5(-1)	
Rh-106	1.3(-3)	1.3(-4)	9.9(-3)	3.9(-2)	
Ag-110m	9.4(-3)	9.4(-4)	7.1(-2)	2.8(-1)	
Te-125m	2.5(-3)	2.5(-4)	1.9(-2)	7.5(-2)	
Te-127m	2.6(-2)	2.6(-3)	2.0(-1)	7.8(-1)	
Te-127	1.1(-1)	1.1(-2)	8.4(-1)	3.3(0)	
Te-129m	1.6(-1)	1.6(-2)	1.2(0)	4.8(0)	
Te-129	1.6(-1)	1.6(-2)	1.2(0)	4.8(0)	10
Te-131m	2.3(-1)	2.3(-2)	1.7(0)	6.9(0)	
Te-131	1.2(-1)	1.2(-2)	9.1(-1)	3.6(0)	
Te-132	2.6(0)	2.6(-1)	2.0(1)	7.8(1)	
Te-134	3.0(-1)	3.0(-2)	2.3(0)	9.0(0)	
Ba-137m	1.2(1)	1.2(0)	9.1(1)	3.6(2)	
Ba-140	3.6(-2)	3.6(-3)	2.7(-1)	1.1(0)	
La-140	1.2(-2)	1.2(-3)	9.1(-2)	3.6(-1)	
Ce-141	5.5(-3)	5.5(-4)	4.2(-2)	1.7(-1)	
Ce-143	4.5(-3)	4.5(-4)	3.4(-2)	1.4(-1)	
Ce-144	3.4(-3)	3.4(-4)	2.6(-2)	1.0(-1)	
Pr-143	5.5(-3)	5.5(-4)	4.2(-2)	1.7(-1)	
Pr-144	3.4(-3)	3.4(-4)	2.6(-2)	1.0(-1)	

Basis:
1. No decay credit
2. H.A.W. concentrated to 12% boric acid 2
3. Conc. Wst tank inventory at 100% H.A.W. concentrates
4. H.A.W., gal/Yr = 6,000 10
5. L.A.W., gal/Yr - 20,368
6. 1% Failed Fuel

2

TABLE 11.4-2
(Sheet 7 of 15) 2

SOLID WASTE MANAGEMENT SYSTEM EXPECTED ACTIVITIES
(Westinghouse-414)

4. IWMS High Activity Waste Resin

Isotope	Ci/Yr	uCi/gm (Resin)	
Br-83	1.9(-3)	2.2(-3)	
Br-84	9.4(-4)	1.2(-3)	
Br-85	1.2(-4)	1.5(-4)	
I-129	7.8(-9)	9.4(-9)	
I-130	2.8(-4)	3.4(-4)	
I-131	4.8(-1)	5.8(-1)	
I-132	5.6(-1)	6.7(-1)	
I-133	7.6(-1)	9.1(-1)	
I-134	1.1(-1)	1.4(-1)	
I-135	4.2(-1)	5.0(-1)	
Rb-86	8.9(-5)	1.1(-4)	
Rb-88	5.3(-2)	6.4(-2)	
Rb-89	2.4(-3)	2.9(-3)	
Cs-134	2.7(-2)	3.2(-2)	
Cs-136	3.6(-2)	4.3(-2)	
Cs-137	1.4(-2)	1.7(-2)	
Cs-138	1.1(-2)	1.3(-2)	
Cr-51	7.2(-4)	8.6(-4)	
Mn-54	5.6(-6)	6.7(-6)	
Mn-56	2.0(-4)	2.4(-4)	10
Fe-55	N.A.	N.A.	
Fe-59	2.2(-5)	2.6(-5)	
Co-58	4.8(-5)	5.8(-5)	
Co-60	2.0(-5)	2.4(-5)	
Sr-89	7.4(-5)	8.9(-5)	
Sr-90	2.2(-6)	2.6(-6)	
Sr-91	1.2(-4)	1.4(-4)	
Sr-92	2.4(-5)	2.9(-5)	
Y-90	5.8(-7)	7.0(-7)	
Y-91m	7.2(-5)	8.6(-5)	
Y-91	9.8(-6)	1.2(-5)	
Y-92	2.2(-5)	2.6(-5)	
Y-93	7.0(-6)	8.4(-6)	
Zr-95	1.1(-5)	1.3(-5)	
Nb-95	1.1(-5)	1.3(-5)	
Mo-99	1.3(-2)	1.6(-2)	
Tc-99m	1.2(-2)	1.4(-2)	

2

TABLE 11.4-2
(Sheet 8 of 15)

SOLID WASTE MANAGEMENT SYSTEM EXPECTED ACTIVITIES
(Westinghouse-414)

Isotope	Ci/Yr	uCi/gm (Resin)	
Ru-103	1.0(-5)	1.2(-5)	
Ru-106	2.6(-6)	3.1(-6)	
Rh-103m	1.0(-5)	1.2(-5)	
Rh-106	2.6(-6)	3.1(-6)	
Ag-110m	1.9(-5)	2.3(-5)	
Te-125m	5.0(-6)	6.0(-6)	
Te-127m	5.2(-5)	6.2(-5)	
Te-127	2.2(-4)	2.6(-4)	
Te-129m	3.2(-4)	3.8(-4)	
Te-129	3.2(-4)	3.8(-4)	
Te-131m	4.6(-4)	5.5(-4)	10
Te-131	2.4(-4)	2.9(-4)	
Te-132	5.2(-3)	6.2(-3)	
Te-134	6.0(-4)	7.2(-4)	
Ba-137m	2.4(-2)	2.9(-2)	
Ba-140	7.2(-5)	8.6(-5)	
La-140	2.4(-5)	2.9(-5)	
Ce-141	1.1(-5)	1.3(-5)	
Ce-143	9.0(-6)	1.1(-5)	
Ce-144	6.8(-6)	8.2(-6)	
Pr-143	1.1(-5)	1.3(-5)	
Pr-144	6.8(-6)	8.2(-6)	

Basis:
1. No. decay credit 2
2. DF = 10 for all isotope except Cs, Rb = 2 10
3. 1% Failed Fuel
4. 30 ft^3 resin charge 2

TABLE 11.4-2
(Sheet 9 of 15)

SOLID WASTE MANAGEMENT SYSTEM EXPECTED ACTIVITIES
(Westinghouse-414) 2

5. LWMS Low Activity Waste Resin

Isotope	Ci/Yr	uCi/gm (Resin)
Br-83	5.5(-3)	6.6(-3)
Br-84	3.2(-4)	3.8(-4)
Br-85	4.1(-5)	4.9(-5)
I-129	2.6(-9)	3.2(-9)
I-130	9.6(-5)	1.2(-4)
I-131	1.6(-1)	2.0(-1)
I-132	1.9(-1)	2.3(-1)
I-133	2.6(-1)	3.1(-1)
I-134	3.8(-2)	4.5(-2)
I-135	1.4(-1)	1.7(-1)
Rb-86	3.1(-5)	3.7(-5)
Rb-88	1.8(-2)	2.2(-2)
Rb-89	8.2(-4)	9.9(-4)
Cs-134	7.3(-2)	8.7(-2)
Cs-136	1.2(-2)	1.4(-2)
Cs-137	4.8(-3)	5.8(-3)
Cs-138	3.8(-3)	4.5(-3)
Cr-51	2.5(-4)	3.0(-4)
Mn-54	1.9(-6)	1.9(-6)
Mn-56	6.9(-5)	8.2(-5)
Fe-55	N.A.	N.A.
Fe-59	7.5(-6)	9.0(-6)
Co-58	1.6(-5)	2.0(-5)
Co-60	6.9(-6)	8.2(-6)
Sr-89	2.5(-5)	3.0(-5)
Sr-90	7.5(-7)	9.1(-7)
Sr-91	4.1(-5)	4.9(-5)
Sr-92	8.2(-6)	9.9(-6)
Y-90	2.0(-7)	2.4(-7)
Y-91m	2.5(-5)	3.0(-5)
Y-91	3.4(-6)	4.0(-6)
Y-92	7.5(-6)	9.1(-6)
Y-93	2.4(-6)	2.9(-6)
Zr-95	3.8(-6)	4.5(-6)
Nb-95	3.8(-6)	4.5(-6)
Mo-99	4.5(-3)	5.3(-3)
Tc-99m	4.1(-3)	4.9(-3)

10

TABLE 11.4-2 2
(Sheet 10 of 15)

SOLID WASTE MANAGEMENT SYSTEM EXPECTED ACTIVITIES
(Westinghouse-414)

Isotope	Ci/Yr	uCi/gm (Resin)	
Ru-103	3.4(-6)	4.1(-6)	
Ru-106	8.9(-7)	1.1(-6)	
Rh-103m	3.4(-6)	4.1(-6)	
Rh-106	8.9(-7)	1.1(-6)	
Ag-110m	6.5(-6)	7.8(-6)	
Te-125m	1.7(-6)	2.1(-6)	
Te-127m	1.8(-5)	2.1(-5)	
Te-127	7.5(-5)	9.1(-5)	
Te-129m	1.1(-4)	1.3(-4)	
Te-129	1.1(-4)	1.3(-4)	10
Te-131m	1.6(-4)	1.9(-4)	
Te-131	8.2(-5)	9.9(-5)	
Te-132	1.8(-3)	2.1(-3)	
Te-134	2.1(-4)	2.5(-4)	
Ba-137m	8.2(-3)	9.9(-3)	
Ba-140	2.5(-5)	3.0(-5)	
La-140	8.2(-6)	9.9(-6)	
Ce-141	3.8(-6)	4.5(-6)	
Ce-143	3.1(-6)	3.7(-6)	
Ce-144	2.3(-6)	2.8(-6)	
Pr-143	3.8(-6)	4.5(-6)	
Pr-144	2.3(-6)	2.8(-6)	

Basis:
1. No decay credit
2. DF = 10 for all nuclides except Cs, Rb = 1
3. 1% Failed Fuel 2
4. 30 ft^3 resin charge

TABLE 11.4-2
(Sheet 11 of 15)

SOLID WASTE PROCESSING SYSTEM EXPECTED ACTIVITIES 2
(Westinghouse-414)

6. Steam Generator Blowdown Resin

(a) Mixed bed demineralizer

Isotope	Ci/Yr	uCi/gm	
Br-83	3.3(0)	1.7(0)	
Br-84	9.0(-1)	4.5(-1)	
Br-85	1.7(-2)	8.4(-3)	
I-129	1.9(-6)	9.3(-7)	
I-130	6.3(-2)	3.2(-2)	
I-131	1.1(2)	5.7(1)	
I-132	9.9(1)	5.0(1)	
I-133	1.8(2)	8.9(1)	
I-134	1.4(1)	7.2(0)	
I-135	9.0(1)	4.5(1)	
Rb-86	2.0(-1)	1.0(-1)	
Rb-88	3.2(1)	1.6(1)	
Rb-89	1.2(0)	6.0(-1)	
Cs-134	5.9(0)	2.9(0)	
Cs-136	7.7(1)	3.8(1)	
Cs-137	3.2(1)	1.6(1)	10
Cs-138	9.3(0)	4.7(0)	
Cr-51	1.7(-1)	8.7(-2)	
Mn-54	1.4(-2)	7.0(-3)	
Mn-56	3.6(-1)	1.8(-1)	
Fe-55	N.A.	N.A.	
Fe-59	5.4(-2)	2.7(-2)	
Co-58	1.1(-1)	5.7(-2)	
Co-60	4.8(-2)	2.4(-2)	
Sr-89	1.8(-1)	8.9(-2)	
Sr-90	5.4(-3)	2.7(-3)	
Sr-91	2.6(-1)	1.8(-1)	
Sr-92	4.5(-2)	2.3(-2)	
Y-90	1.4(-3)	7.0(-4)	
Y-91m	8.7(-2)	4.4(-2)	
Y-91	2.3(-2)	1.2(-2)	
Y-92	4.2(-2)	2.1(-2)	
Y-93	1.6(-2)	8.0(-3)	
Zr-95	2.7(-2)	1.4(-2)	
Nb-95	2.7(-2)	1.4(-2)	

TABLE 11.4-2 2
(Sheet 12 of 15)

SOLID WASTE PROCESSING SYSTEM EXPECTED ACTIVITIES
(Westinghouse-414)

Isotope	Ci/Yr	uCi/gm	
Mo-99	3.0(1)	1.5(1)	
Tc-99m	2.6(1)	1.3(1)	
Ru-103	2.4(-2)	1.2(-2)	
Ru-106	6.3(-3)	2.7(-3)	
Rh-103m	1.3(-2)	6.0(-3)	
Rh-106	6.3(-5)	3.2(-5)	
Ag-110m	4.5(-2)	2.3(-2)	
Te-125m	1.2(-2)	6.0(-3)	
Te-127m	1.3(-1)	6.3(-2)	
Te-127	4.8(-1)	2.4(-1)	
Te-129m	7.8(-1)	3.9(-1)	
Te-129	4.5(-1)	2.3(-1)	10
Te-131m	1.1(-2)	5.4(-3)	
Te-131	2.0(-1)	1.0(-1)	
Te-132	1.2(1)	6.2(0)	
Te-134	6.6(-1)	3.3(-1)	
Ba-137m	2.9(0)	1.7(-1)	
Ba-140	1.7(-1)	8.7(-2)	
La-140	5.7(-2)	2.9(-2)	
Ce-141	2.6(-2)	1.3(-2)	
Ce-143	2.1(-2)	1.1(-2)	
Ce-144	1.6(-2)	8.0(-3)	
Pr-143	2.6(-2)	1.3(-2)	
Pr-144	1.6(-2)	8.0(-3)	

Basis:
1. 750 gpm blowdown rate 2
2. 1% Failed Fuel 10
3. 1.440 lb/day primary leakage
4. DF = 10^2 for all isotopes except Cs, Rb = 2
5. No decay credit 2
6. 1st series mixed bed - only
7. 75 ft^3 resin charge 10

TABLE 11.4-2
(Sheet 13 of 15) 2

SOLID WASTE PROCESSING SYSTEM EXPECTED ACTIVITIES
(Westinghouse-414)

(b) Cation Demineralizer

Isotope	Ci/Yr	uCi/gm	
Rb-86	1.8(-2)	8.8(-3)	
Rb-88	2.8(0)	1.4(0)	
Rb-89	1.1(-1)	5.6(-2)	
Cs-134	5.3(0)	2.6(0)	10
Cs-136	6.9(0)	3.5(0)	
Cs-137	2.8(0)	1.4(0)	
Cs-138	8.4(-1)	4.2(-1)	
Total	2.66(-1)		2

Basis:
1. 1% Failed Fuel 10
2. 1440 lbs/day primary leakage
3. No decay credit 2
4. 75 gpm flow rate
5. 75 ft³ resin charge 10
6. DF = 10 2

TABLE 11.4-2
(Sheet 14 of 15)

SOLID WASTE PROCESSING SYSTEM EXPECTED ACTIVITIES 2
(Westinghouse-414)

7. Condensate Cleanup System Resin

Isotope	Ci/Yr	uCi/gm	
Br-83	3.7(-4)	1.7(-5)	
Br-84	2.3(-5)	1.0(-6)	
Br-85	4.0(-8)	1.8(-9)	
I-129	NEG	NEG	
I-130	1.0(-7)	4.5(-9)	
I-131	2.1(-3)	9.5(-5)	
I-132	2.8(-5)	1.3(-6)	
I-133	4.6(-4)	2.1(-5)	
I-134	1.6(-6)	7.3(-8)	
I-135	7.4(-5)	3.4(-6)	
Cr-51	5.6(-3)	2.5(-4)	
Mn-54	4.5(-3)	2.0(-4)	
Mn-56	4.5(-5)	2.0(-6)	
Fe-55	N.A.	N.A.	
Fe-59	2.9(-3)	1.3(-4)	
Co-58	8.8(-3)	4.0(-4)	
Co-60	1.1(-7)	5.0(-9)	10
Sr-89	1.0(-2)	4.5(-4)	
Sr-90	1.2(-8)	5.5(-10)	
Sr-91	1.2(-4)	5.5(-6)	
Sr-92	5.8(-6)	2.6(-7)	
Y-90	4.2(-6)	1.9(-7)	
Y-91m	3.5(-6)	1.6(-7)	
Y-91	1.6(-3)	7.3(-5)	
Y-92	7.3(-6)	3.3(-7)	
Y-93	7.8(-6)	3.5(-7)	
Zr-95	2.0(-3)	9.1(-5)	
Nb-95	1.1(-3)	5.0(-5)	
Mo-99	9.6(-2)	4.4(-3)	
Tc-99m	7.3(-3)	3.3(-4)	
Ru-103	1.1(-3)	5.0(-5)	
Ru-106	1.4(-8)	5.0(-5)	
Rh-103m	5.9(-7)	2.7(-8)	
Rh-106	2.4(-11)	1.1(-12)	
Ag-110m	3.8(-9)	1.7(-10)	
Te-125m	3.4(-4)	1.5(-5)	
Te-127m	7.2(-3)	3.3(-4)	

TABLE 11.4-2
(Sheet 15 of 15) 2

SOLID WASTE PROCESSING SYSTEM EXPECTED ACTIVITIES
(Westinghouse-414)

Isotope	Ci/Yr	uCi/gm	
Te-127	3.7(-4)	1.7(-5)	
Te-129m	5.2(-2)	2.4(-3)	
Te-129	4.7(-9)	2.1(-10)	
Te-131m	2.7(-7)	1.2(-8)	
Te-131	6.8(-6)	3.1(-7)	
Te-132	8.2(-2)	3.7(-3)	
Te-134	3.9(-5)	1.8(-6)	10
Ba-137m	1.1(-5)	5.0(-7)	
Ba-140	5.8(-4)	2.6(-5)	
La-140	1.9(-4)	8.6(-6)	
Ce-141	1.8(-3)	8.2(-5)	
Ce-143	5.9(-5)	2.7(-6)	
Ce-144	4.8(-3)	2.2(-4)	
Pr-143	7.1(-4)	3.2(-5)	
Pr-144	3.3(-3)	1.5(-4)	

Basis:
1. 1% Failed Fuel 10
2. 1440 lb/day primary leakage
3. No decay credit 2
4. DF = 10 all isotopes except Cs, Rb = 1
5. 800 ft^3 powdered resin 10

TABLE 11.4-3

EXPECTED ACTIVITIES OF EXPENDED FILTER CARTRIDGE ASSEMBLIES (1) (2)

(Westinghouse-414) 2

Isotope	Activity per Cartridge (Ci/yr)		
	HAW Filter	L&HS Filter	
Mo-99	1.3 (2)	4.5 (-3)	
Mn-54	5.7 (-2)	1.9 (-6)	
Mn-56	2.0 (0)	6.7 (-5)	
Co-58	4.9 (-1)	1.6 (-5)	10
Co-60	2.0 (-1)	6.8 (-6)	
Fe-59	2.2 (-1)	7.5 (-6)	
Cr-51	7.4 (-1)	2.5 (-5)	

Basis:
1. HAW filter processing 60,000 gal/yr at 1.0 reactor coolant fraction
2. L&HS filter processing 200,000 gal/yr
3. DF=10, NO DECAY
4. 1% failed fuel

Notes: 2
(1) For NSSS supply filters see NSSS SAR.
(2) Balance of plant filter cartridge assemblies are expected to vary between the activities of HAW and L&MS filters.

TABLE 11.4-4

SPENT RESIN VOLUME

Item	Number	Resin Volume Each, Ft³	Replacement Frequency/Yr	
CVCS mixed bed demineralizer	2	75	.5	
CVCS Cation bed demineralizer	2	75	.5	
Recycle evaporator feed demineralizer	2	75	*	
Recycle evaporator condensate demineralizer	1	30	*	
Thermal regeneration demineralizer	5	74.3	1	
High activity waste recycle demineralizer	1	30	*	2
Low activity waste sample condensate demineralizer	1	30	*	
Spent fuel pit demineralizer	2	75	*	
			280 ft³	

* Estimated replacement depends largely on plant operation

4. The battery charger will supply at least (U/A FSAR) amperes at (U/A FSAR) volts for at least 10
(U/A FSAR) hours.

d. At least once per 18 months, during shutdown, by verifying that the battery capacity is adequate to supply and maintain in OPERABLE status all of the actual emergency loads for 4 hours when the battery is subjected to a battery service test. 10

e. At least once per 60 months, during shutdown, by verifying that the battery capacity is at least 80% of the manufacturer's rating when subjected to a performance discharge test. This performance discharge test shall be performed subsequent to the satisfactory completion of the required battery service test.

SURVEILLANCE REQUIREMENTS

4.8.2.3.1 Each D. C. bus train shall be determined OPERABLE at least and energized at least once per 7 days by verifying correct circuit breaker alignment and 10
indicated power availability.

4.8.2.3.2 Each 125-volt battery bank and charger shall be demonstrated OPERABLE:

a. At least once per 7 days by verifying that:

1. The electorlyte level of each pilot cell is between the minimum and maximum level indication marks,

2. The pilot cell specific gravity, corrected to 77°F, and full electrolyte level is ≥ (U/A FSAR) 10

3. The pilot cell voltage is ≥ (U/A FSAR) volts, and

4. The overall battery voltage is ≥ 125 volts.

b. At least once per 92 days by verifying that:

1. The voltage of each connected cell is ≥ (U/A FSAR) volts under float charge and has not decreased more than (U/A FSAR) volts from the value observed during the original acceptance test, 10

2. The specific gravity, corrected to 77°F, and full electrolyte level, of each connected cell is ≥ (U/A FSAR) and has not decreased more than (U/A FSAR) from the value observed during the previous test, and

3. The electrolyte level of each connected cell is between the minimum and maximum level indication marks.

c. At least once per 18 months by verifying that:

1. The cells, cell plates and battery racks show no visual indication of physical damage or abnormal deterioration.

2. The cell-to-cell and terminal connections are clean, tight, and coated with anti-corrosion material,

3. The resistance of each cell-to-cell and terminal connection is ≤ 0.01 ohms. 10

ELECTRICAL POWER SYSTEMS

A.C. DISTRIBUTION - SHUTDOWN

LIMITING CONDITION FOR OPERATION

3.8.2.2 As a minimum, the following A. C. electrical busses shall be OPERABLE and energized from sources of power other than a diesel generator but aligned to an OPERABLE diesel generator.

1 - (6900) volt Emergency Bus

1 - (480) volt Emergency Bus

2 - (118) volt A. C. Vital Busses

APPLICABILITY: MODES 5 and 6.

ACTION:

With less than the above complement of A. C. busses OPERABLE and energized, establish CONTAINMENT INTEGRITY within 8 hours.

SURVEILLANCE REQUIREMENTS

4.8.2.2 The specified A. C. busses shall be determined OPERABLE and energized from A. C. sources other than the diesel generators at least once per 7 days by verifying correct breaker alignment and indicated power availability.

ELECTRICAL POWER SYSTEMS

D.C. DISTRIBTUION - OPERATING

LIMITING CONDITION FOR OPERATION

3.8.2.3 The following D. C. busses shall be energized and OPERABLE:

TRAIN "A" (Channel I) consisting of 125-volt D.C. bus No. 1ED1, 125-volt D.C. battery bank No. BTIED1 and a full capacity charger either BC1ED1-1 or BC1ED1-2

TRAIN "B" (Channel II) consisting of 125-volt D.C. bus No. 1ED2, 125-volt D.C. battery bank No. BT1ED2 and a full capacity charger either BC1ED2-1 or BC1ED2-2 10

Channel III consisting of 125-volt D.C. bus No. 1ED3, 125-volt D.C. battery bank BT1ED3 and a full capacity charger either BC1ED3-1 or BC1ED3-2

Channel IV consisting of 125-volt D.C. bus No. 1ED4, 125-volt D.C. battery bank BT1ED4 and a full capacity charger either BC1ED4-1 or BC1ED4-2

APPLICABILITY MODES 1, 2, 3 and 4.

ACTION:

a. With one 125-volt D.C. bus inoperable, restore the inoperable bus to OPERABLE status within 2 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours. 10

b. With one 125-volt D.C. battery and/or both of its chargers inoperable, restore the inoperable battery and/or one charger to OPERABLE status within 2 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

10. Verifying the diesel generator's capability to:

    a) Synchronize with the offsite power source while the generator is loaded with its emergency loads upon a simulated restoration of offsite power,

    b) Transfer its loads to the offsite power source, and

    c) Proceed through its shutdown sequence.

11. Verifying that with the diesel generator operating in a test mode (connected to its bus), simulated safety injection signal overrides the test mode by (1) returning the diesel generator to standby operation and (2) automatically energizes the emergency loads with offsite power.

12. Verifying that the fuel transfer pump transfers fuel from each fuel storage tank to the day and engine-mounted tank of each diesel via the installed cross connection lines. 10

d. At least once per 10 years or after any modifications which could affect diesel generator interdependence by starting both diesel generators simultaneously, during shutdown, and verifying that both diesel generators accelerate to at least (Utility Applicant's FSAR) rpm in ≤ 10 seconds.

4.8.1.1.3 Reports - All diesel generator failures, valid or non-valid, shall be reported to the Commission pursuant to Specification 6.9.1. If the number of failures in the last 100 valid tests (on a per nuclear unit basis) is ≥ 7, the report shall be supplemented to include the additional information recommended in Regulatory Position C.3.b of Regulatory Guide 1.108, Revision 1, August 1977.

TABLE 4.8-1

DIESEL GENERATOR TEST SCHEDULE

Number of Failures In Last 100 Valid Tests*	Test Frequency
≤ 1	At least once per 31 days
2	At least once per 14 days
3	At least once per 7 days
≥ 4	At least once per 3 days

10

*Criteria for determining number of failures and number of valid tests shall be in accordance with Regulatory Position C.2.e of Regulatory Guide 1.108, Revision 1, August 1977, where the last 100 tests are determined on a per nuclear unit basis. For the purposes of this test schedule, only valid tests conducted after the OL issuance date shall be included in the computation of the "last 100 valid tests." Entry into this test schedule shall be made at the 31 day test frequency.

c. At least once per 18 months during shutdown by:

1. Subjecting the diesel to an inspection in accordance with procedures prepared in conjunction with its manufacturer's recommendations for this class of standby service,

2. Verifying the generator capability to reject a load of ≥ (largest single emergency load) kW while maintaining voltage at ___±___ volts (Utility Applicant's FSAR) and frequency at ___±___ Hz (Utility Applicant's FSAR)

3. Verifying the generator capability to reject a load (continuous rating) (U/A FSAR) kW without exceeding 75 percent of the difference between nominal speed and the overspeed trip setpoint, or 15 percent above nominal, whichever is lower.

4. Simulating a loss of offsite power by itself, and:

   a) Verifying de-energization of the emergency busses and load shedding from the emergency busses.

   b) Verying the diesel starts from ambient condition on the auto-start signal, energizes the emergency busses with permanently 10
   connected loads, that the load shedding is automatically blocked during the sequencing cycle and is automatically reinstated at the completion of the sequencing cycle, energizes the auto-connected shutdown loads through the load sequencer and operates for ≥ 5 minutes while its generator is loaded with the shutdown loads.

5. Verifying that on an ESF actuation test signal (without loss of offsite power) the diesel generator starts on the auto-start signal and operates on standby for ≥ 5 minutes.

6. Verifying that on a simulated loss of the diesel generator (with offsite power not available), the loads are shed from the emergency busses and that subsequent loading of the diesel generator is in accordance with design requirements.

7. Simulating a loss of offsite power in conjunction
with an ESF actuation test signal, and: 10

    a) Verifying de-energization of the emergency busses and load shedding from the emergency busses.

    b) Verifying the diesel starts from ambient condition on the auto-start signal, energizes the emergency busses with permanently connected (accident) loads through the load sequencer, that the load shedding is automatically blocked during the sequencing
    cycle and is automatically reinstated at the 10
    completion of the sequencing cycle and operates for ≥ 5 minutes while its generator is loaded with the emergency loads.

    c) Verifying that all diesel generator trips, except engine overspeed and generator differential, are automatically bypassed upon loss of voltage on the emergency bus concurrent with safety injection actuation signal.

8. Verifying the diesel generator operates for at least 24 hours. During the first 2 hours of this test, the diesel generator shall be loaded to ≥ (2-hour rating) (Utility Applicant's FSAR) kW and during the remaining 22 hours of this test, the
diesel generator shall be loaded to ≥ (continuous 10
rating) (Utility Applicant's FSAR) kW. Within 5 minutes after completing this 24 hour test, repeat Specifiation 4.8.1.1.2.c.4.

9. Verifying that the auto-connected loads to each diesel generator do not exceed the 2000 hour rating of (Utility Applicant's FSAR) kW.

4.8.1.1.1 Each of the above require independent circuits between the offsite transmission network and the onsite Class 1E 10 distribution system shall be:

a. Determined OPERABLE at least once per 7 days by verifying correct breaker alignments, indicated power availability, and

b. Demonstrated OPERABLE at least once per 18 months during shutdown by transferring (manually and automatically) unit power supply from the normal circuit to the alternate circuit.

4.8.1.1.2 Each diesel generator shall be demonstrated OPERABLE:

a. In accordance with the frequency specified in table 4.8-1 on a STAGGERED TEST BASIS by: 10

1. Verifying the fuel level in the day and engine-mounted fuel tank,

2. Verifying the fuel level in the fuel storage tank,

3. Verifying the fuel transfer pump can be started and transfers fuel from the storage system to the day and engine-mounted tank. 10

4. Verifying the diesel starts from ambient condition, and accelerates to at least (Utility Applicant's FSAR) rpm in ≤10 seconds,

5. Verifying the generator is synchronized, loaded to (continuous rating) in ≤60 seconds, and operates for ≥60 minutes, 10

6. Verifying the diesel generator is aligned to provide standby power to the associated emergency busses, and

7. Verifying that the automatic load sequence timer is OPERABLE with the interval between each load block within ±10 percent of its design interval. 10

b. Fuel oil samples from supply tank shall be periodically analyzed (at least once every 3 months) to verify that the fuel oil meet specified quality limits. The fuel oil analysis shall be conducted in accordance with ASTM-D2274-70. The fuel oil impurity level shall be maintained below 2 mg of insolubles per 100 ml or the limit specified by the diesel-generator manaufacturers if more restrictive. 10

These requirements shall be supplemented by the requirements of ASTM-D270-65 (1975) "Standard Method of Sampling Petroleum and Petroleum Products", ASTM-D975-74 "Standard Specification for Diesel Fuel Oils" and the "Cloud Point" requirements of NRC Regulatory Guide 1.137 Position C.2.b.

3/4.8 ELECTRICAL POWER SYSTEMS

3/4.8.1 A.C. SOURCES

OPERATING

LIMITING CONDITION FOR OPERATION

3.8.1.1 As a minimum, the following A. C. electrical power sources shall be OPERABLE:

a. Two physically independent circuits between the offsite transmission network and the onsite Class 1E distribution system, and

b. Two separate and independent diesel generators each with:

   1. Separate day and engine-mounted fuel tanks containing a minimum of 1600 gallons of fuel, 10

   2. A separate fuel storage system containing a minimum of 90,000 gallons of fuel, and 10

   3. A separate fuel transfer pump.

APPLICABILITY MODES 1, 2, 3 and 4.

ACTION:

a. With either an offsite circuit or diesel generator of the above required A. C. electrical power sources inoperable, demonstrate the OPERABILITY of the remaining A. C. sources by performing Surveillance Requirements 4.8.1.1.1.a and 4.8.1.1.2.a.4 within one hour and at least once per 8 hours thereafter; restore at least two offsite circuit and two diesel generators to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours. 10

b. With one offsite circuit and one diesel generator of the above required A. C. electrical power sources inoperable, demonstrate the OPERABILITY of the remaining A. C. sources by performing Surveillance Requirements 4.8.1.1.1.a and 4.8.1.1.2.a.4 within one 10
hour and at least once per 8 hours thereafter; restore

at least one of the inoperable sources to OPERABLE
status within 12 hours or be in at least HOT STANDBY
within the next 6 hours and in COLD SHUTDOWN within the
following 30 hours. Restore at least two offsite
circuits and two diesel generators to OPERABLE status
within 72 hours from the time of initial loss or be in 10
at least HOT STANDBY within the next 6 hours and in COLD
SHUTDOWN within the following 30 hours.

c. With two of the above required offsite A. C. circuits
inoperable, demonstrate the OPERABILITY of two diesel
generators by performing Surveillance
Requirement 4.8.1.1.2.a.4 within one hour and at least 10
once per 8 hours thereafter, unless the diesel
generators are already operating; restore at least one
of the inoperable offsite sources to OPERABLE status
within 24 hours or be in at least HOT STANDBY within the
next 6 hours. With only one offsite source restored,
restore at least two offsite circuits to OPERABLE status 10
within 72 hours from time of initial loss or be in at
least HOT STANDBY within the next 6 hours and in COLD
SHUTDOWN within the following 30 hours.

d. With two of the above required diesel generators
inoperable, demonstrate the OPERABILITY of two offsite
A. C. circuits by performing Surveillance
Requirement 4.8.1.1.1.a within one hour and at least
once per 8 hours thereafter; restore at least one of the
inoperable diesel generators to OPERABLE status within
2 hours or be in at least HOT STANDBY within the next
6 hours and in COLD SHUTDOWN within the following
30 hours. Restore the two diesel generators to OPERABLE
status within 72 hours from time of initial loss or be
in at least HOT STANDBY within the next 6 hours and in
COLD SHUTDOWN within the following 30 hours.

Question 010.19 (3.6) (RSP)

The design of your main steam and feedwater systems includes an 80 ft break exclusion area in the tunnel between containment and the turbine building. The surrounding areas (adjacent and below) contain safety related equipment of systems such as auxiliary feedwater, component cooling water, residual heat removal, and safety injection. Separation should be the primary means of protecting safety related equipment from the effects of pipe breaks. It is our position that in your present design, adequate separation between your main steam and feedwater lines and equipment necessary to bring the plant to a safe cold shutdown does not exist.

Revise the SAR to show the new plant layout and arrangement resulting from our meeting in October, 1977, and subsequent telephone conversations with regards to protection of safety related equipment in the auxiliary building from the effects of a main steam or feedwater line break outside containment. Include a discussion of the protection provided, in addition to the new plant layout and arrangement drawings. 6

Response 010.19

Revised general arrangements to provide greater separation between high energy lines and safety related equipment are shown in amended Figures 1.2-3 through 1.2-10. In summary the following changes were made to meet this objective.

1. The motor driven auxiliary feedwater pumps were relocated from the floor below the feedwater piping tunnel to below grade Elevation 72'6".

2. Both safety related cableways had been located at the same elevation on the floor below the feedwater tunel. These cableways have been rearranged so that one cableway is below the other. In addition, separation between safety related cableways and the high energy piping in the turbine building has been provided.

3. An additional barrier at floor Elevation 140'6", has been provided between the mainsteam and feedwater tunnels and the RHR heat exchangers.

   The environment effects of cracks between the containment and the moment restrains outboard of the isolation valves in the main steam and feedwater tunnels

are in accordance with the requirements of NRC BTP 10
APCSB 3-1 as stated in Section 3.6. Provisions for
venting the main steam and feedwater tunnels are shown 6
on the general arrangement drawings.

Design provisions will be made to protect both the upper
and lower safety cableway from the dynamic effects of a 10
break in the feedwater piping. 6

Question 010.30 (9.1.4)

Section 9.1.4 of your PSAR includes a description of the fuel cask handling crane. Provide a description and evaluation of other fuel handling equipment and facilities that are outside the scope of RESAR-414, and within the scope of GIBBSSAR. 6

Response 010.30

Description of the Containment polar crane and decontamination equipment is included in GIBBSSAR Section 9.1.4.2. For design data of fuel handling equipment in G&H scope see Table 9.1-6.

Question 010.31 (9.1.4) (RSP)

The evaluation of the RESAR-414 reactor vessel head drop analysis topical report has not been approved for reference by utilities referencing the RESAR-414 docket. It is our position that you commit to a single failure proof containment overhead crane for
handling the RESAR-414 vessel head pending acceptance of the 6
topical report. This crane should be designed, tested, and inspected in accordance with Regulatory Guide 1.104. Indicate your intent to comply with this position.

Response 010.31

Compliance with Regulatory Guide 1.104 for the design, testing and inspection of the containment polar crane is discussed in
revised GIBBSSAR Sections 9.1.4 and 9.1.5. 10

Design data for the crane are in new Table 9.1-6.

6

Question 010.78

(a) Correct the following discrepancies in Table 1.8-1: Table 1.8-1 lists the emergency boration system to be within the design scope of RESAR-414. This system has been deleted from the RESAR-414 scope of design. Revise Table 1.8-1 and your PSAR as necessary.

(b) Revise Table 1.8-1 to include the design responsibility of the containment overhead handling crane in the GIBBSSAR scope. 10

(c) Revise Table 1.8-1 to identify that the Utility-Applicant will be responsible for the design of the new fuel storage racks as you have specified in Section 9.1.1 and in response to our request 010.27.

Response 010.78

See Revised Table 1.8-1, Sheets 4, 9, and 11.

Question 010.79

Table 3.2-1 does not include the classification of the spent fuel pool and fuel pool liners. It is our position that the fuel pool and its liner plate be designed to seismic Category I requirements, or that you demonstrate that a failure of the linear as a result of an SSE will not cause any of the following:

(1) Significant releases of radioactivity due to mechanical damage to the fuel;

(2) Significant loss of water from the pool which could uncover the fuel and lead to release of radioactivity due to heat-up; 10

(3) Loss of ability to cool the fuel due to flow blockage caused by a portion, or one complete section of the linear plate falling on top of the fuel racks;

(4) Damage to safety related equipment as a result of pool leakage; and

(5) Uncontrolled release of significant quantities of radioactive fluids to the environs.

Response 010.79

Table 3.2-1 provides the classification of components and systems, but does not include structures. Section 3.2.1.1 has been revised to include the spent fuel pool and fuel pool liners.

Question 010.80

Your response to our request 010.17 is not complete. In addition to the tornado missile protection of the diesel generator ventilation openings, describe the tornado missile protection provided for all other safety related ventilation openings.

Response 010.80 10

The tornado missile protection of the ventilation openings for the control room and the uncontrolled access area will be shown on Figures 1.2-4 and 1.2-7, issued for Amendment 4. There are two seperate air intakes, each providing sufficient makeup air for one control room unit and one uncontrolled access area unit of the same electrical Class 1E Bus. One of these openings is located in a penthouse on the roof of the auxiliary building. It consists of a vertical opening with bird screen and rain protection and a tornado-missile-proof concrete labyrinth which will prevent a tornado generated missile from entering the ventilation duct. The other opening is in the wall of the auxiliary building and the same type of protection is provided. A tornado generated missile will be stopped by a wall, floor or ceiling slab of a concrete plenum chamber internal to the opening. Diesel generator ventilation openings are shown in Figure 9.4-19. The other ventilation equipment requiring ventilation openings in the auxiliary building exterior is non-nuclear safety related and does not neea tornado protection. However, these openings will be constructed in the same manner as discussed above to prevent a tornado generated missile from entering the building, and will be shown on Figure 1.2-6 issued for Amendment 4.

Question 010.81

In your response to our request 010.19 you state that the two safety related cable chases below the feewater tunnel have been rearranged so that one safety related chase is below the other. You also state that provisions will be made to protect the lower cable chase from the dynamic effects of a break in the feedwater piping. It is our position that if the main feedwater piping in the area above the cable chases does not meet the "superpipe" criteria, then both safety related cable chases must be protected from the dynamic effects of a feedwater pipe break since a single active failure in equipment served by the remaining cable chase would prevent safe cold shutdown. Verify that your design meets our position and clarify exactly where in the main feedwater system the "superpipe" ends. Also revise the figures in Section 10
3.6 to make them consistent with the new arrangements identified in Section 1.2, Amendment 6, and identify postulated break locations in the main feedwater system.

Response 010.81

Both safety related cableways will be protected from the dynamic effects of a feedwater pipe break. See the revised response to Question 010.19. The "superpipe" portion of the feedwater system ends at the upstream side of the bending and torsion limiting (moment) restraints. Figures 3.6-1A and 3.6-1B have been revised to make them consistent with the general arrangement drawings. Postulated break locations are shown on Figures 3.6-1A and 3.6-1B.

Question 010.82

Figures 3.6-10 and 11, Amendment 6, show AFW discharge piping runs in the area of the component cooling water system piping and the RHR system piping. It is our position that a pipe break in the auxiliary feedwater system piping should not damage either train of the CCW or RHR system, since a single active failure in the remaining CCW or RHR train would prevent safe cold shutdown. Show how your design will meet this position or revise your 10
design as necessary.

Response 010.82

A pipe break in the auxiliary feedwater system piping will not damage either train of the CCW or RHR system. See revised Section 3.6.1.1.

Question 010.83

Figure 9.1-3, Amendment 6, shows the seismic I refueling water
storage tank connected to the nonseismic refueling water
purification pump. It is our position that two seismic
Category I, Quality Group B, normally closed valves in series be
used to isolate the refueling water storage tank from the
refueling water purification pump. These valves should also
receive an automatic closure signal in the event of a LOCA in 10
order to meet the single active failure criteria. Revise your
design as necessary to meet this position. Figure 9.1-3 also
shows isolation valve RV-SF-002 to fail in the open position.
Since this valve separates a safety from non-safety system, it
should fail in the closed position.

Response 010.83

See revised Figure 9.1-3.

Question 010.84

Section 9.1.3.1, item f, lists the Regulatory Gudes and General Design Criteria to which your spent fuel pool cooling system will be designed. General Design Criterion 44, "Cooling Water," also applies in part to the spent fuel pool cooling system. Verfiy that your system will meet the applicable requirement of General Design Criterion 44. 10

Response 010.84

See revised Section 9.1.3.1.

Question 010.85

Your responses to our requests 010.29 and 010.31 indicate that you may misunderstand the intent of proposed Regulatory Guide 1.104. Your fuel building overhead crane does not have to comply with the positions of proposed Regulatory Guides 1.104 since your analysis shows that a cask drop will not result in damage to the fuel pool or its contents and will not prevent safe plant shutdown. However, since we have not completed our review of the Westinghouse Topical Report analyzing the consequences of a reactor vessel head drop, it is our position that the containment polar crane be single failure proof and meet the guidelines of our Branch Technical Position 9-1 or proposed Regulatory Guide 1.104. If the topical report is found acceptable, then the polar crane inside containment will no longer need to be designed in accordance with our BTP 9-1 or proposed Regulatory Guide 1.104. 10

Provide a commitment that the containment polar crane will meet the guidelines of our BTP 9-1 or proposed Regulatory Guide 1.104 if the Westinghouse topical report regarding a vessel head drop is found acceptable.

Response 010.85

The single failure-proof concept is followed for the fuel building overhead crane to prevent damage to the building and slabs, as discussed in Section 9.1.2.3f.

See the revised response to Question 010.31 and revised Sections 9.1.4.1 and 9.1.4.4 for a discussion of the containment polar crane design.

Question 010.86

In Section 9.1.5 of your SAR, you state that the detailed specifications of cranes and vendors compliance with Regulatory Guide 1.104 will be provided at the time of the Utility-Applicant's SAR. It is our position that you provide for GIBBSSAR PDA the design codes and standards that will be used in the design of these cranes. It is out position that the detailed specification and vendors compliance with BTP 9-1 or Regulatory Guide 1.104 be addressed in your Final Design Report and not in 10
the Utility-Applicant's SAR. Revise your SAR to include the necessary information.

Response 010.86

The design codes and standards that will be used in the design of these cranes are listed in revised Section 9.1.5. The detailed specifications and vendor's compliance with the intent of Regulatory Guide 1.104 will be addressed in the Utility Applicants Final Safety Analysis Report as stated in Section 9.1.5.

Question 010.87

In your response to our request 010.32 you state that the details of certain areas of the GIBBSSAR fuel handling layout are contingent upon the Utility-Applicant's FSAR. Specify which areas you refer to and verify that the location of safety-related equipment below the cask handling or containment polar cranes will not be involved. Also identify any interface requirements imposed upon the Utility-Applicant for these areas.

Response 010.87

10

The areas in the fuel handling layout contingent upon the Utility Applicants FSAR are:

a) Decontamination Equipment Area - See Section 9.1.4.2.c

b) New Fuel Storage Racks - See Table 9.1-1, for interface requirements.

c) Manipulator Crane Layout - See Table 9.1-5 and RESAR 414 Appendix 9A-7 for interface requirements. The location of Safety-Related equipment below the cask landing or containment polar cranes will not be involved.

Question 010.88

Your response to our position 010.38 is unacceptable. You state
that the reactor coolant pumps are within Westinghouse scope and
GIBBSSAR CCW will follow interface criteria imposed by RESAR-414.
The RESAR-414 Safety Evaluation Report imposes further
requirements on the balance-of-plant designer of the component 10
cooling water system to the RCP's. It is our position that your
design meet these requirements as set forth in the RESAR-414 SER
and our position 010.38. Revise your design as necessary to meet
this position.

Response 010.88

A response will be provided later.

Question 010.89

In Section 9.2 you indicate that alternate designs of the service
water system cooling water system and chilled water system may be
used at sites where the quality and temperature of the service
water system allow. It is our position that you provide P&ID's
of your alternate SWS design for sites where the chilled water
systems are to be cooled by service water rather than the
component cooling water system, and that you provide the P&ID's
of your alternate CCW design for sites where the component 10
cooling water system will be used to cool the diesel generators
and the CVCS chiller. These drawings should be clearly
identified as to which site envelopes they apply. Also, provide
the design parameters of the heat exchangers for the engineered
safety features chilled water system that will be used in place
of the chiller units at sites where SWS or CCW system temperature
is below 90 F.

The description and P&ID's of each alternate system design along with their respective interface requirements should be clearly identified. Utility applicants referencing GIBBSSAR will be required to identify which system designs they intend to use for their application and will be reviewed its applicability on a case-by-case basis.

Response 010.89

A response will be provided later.

Question 010.90

Table 9.2-10 of your PSAR regarding component cooling water
interfaces is not complete. RESAR-414 also has interface
requirements for the CCW to the RCP's identified in Section 5A of
RESAR-414. Verify that your CCW design meets these requirements. 10
Also discuss how your design meets the safety related interface
requirements in RESAR-414, Section 5A, regarding protection
against a pressurizer relief tank rupture disc missile.

Response 010.90

A response will be provided later.

Question 010.91

In your response to our request 010.43 you state that the reactor makeup water storage tank and associated safety related piping and pumps will be designed to seismic Category I requirement, but will be non-nuclear safety class. It is our position that those portions of the reactor water makeup system that are used as a seismic Category I makeup source be designed to Quality Group C requirements as shown on Figures 9.2-5 and 9.2-6. Revise your design Section 9.2.3 and Figure 9.1-3 as necessary. Also revise Table 3.2-1 to include the piping and valves of the reactor makeup water system that provide makeup to the spent fuel pool. 10

Response 010.91

The seismic Category I makeup source has been changed from the Reactor Makeup Water System to the Fire Protection System. Consequently, the Reactor Makeup Water System has been classified as non-nuclear safety related. The fire protection booster pumps and the system piping and valves used as the seismic Category I makeup source will be designed to Safety Class 3 and seismic Category I requirements. See Section 9.2.3.2, revised Sections 9.1.2.2, 9.5.1.1, 9.5.1.2, and 9.5.1.6.5, revised Table 3.2-1, and revised Figures 9.1-3, 9.2-1, 9.2-2, 9.2-6, 9.4-5, and 9.5-1B.

Question 010.92

Figure 9.2.6, Amendment 2 has the following discrepancies:

(a) Make-up connection to the emergency boration surge tank. This system has been deleted from the RESAR-414 scope.

(b) Non-nuclear safety class identification on the makeup lines 10
to the chilled water expansions tank and the WPS low activity waste evaporator package is directly connected to a safety class 3 line without acceptable isolation.

Revise Figure 9.2-6 as necessary.

Response 010.92

The makeup connection to the emergency boration surge tank was deleted in Amendment 9. See revised Figures 9.2-6 and 9.4-5.

Question 010.93

In Section 9.3.3 you state that if ruptures of tanks or cracks in large piping occur, total flooding of the auxiliary building is prevented by operator action and your arrangement of floor drains. It is our position that no credit for operator action be taken for at least 30 minutes following an alarm which notifies the operator in the control room that operator action is 10
required. Verify that in the event of a tank rupture or pipe crack (break in non-seismic lines), safety related equipment will not be affected for at least 30 minutes following an alarm which notifies the operator of a potential flooding in the auxiliary building.

Response 010.93

See revised Sections 9.3.3.2 and 9.3.3.3.

Question 010.94

Your response to our request 010.50 regarding the RESAR-414 CVCS interface requirements in Section 9A is not complete. Section 9A of RESAR-414 also requires that CVCS valves 110B.111B, 8339,
8355, and 8361 to be locked shut during refueling operations. 10
Verify that you will comply with this interface.

Response 010.94

GIBBSSAR will comply with this interface. See revised Tables 9.3-6 and 9.1-5.

Question 010.95

Your response to our request 010.55 states that the Figure 9.4-4 "Main Steam and Feedwater Area Ventilation Flow Diagram," will be provided later. Verify that none of the equipment located in this area is necessary to bring the plant to a safe cold shutdown and that the ventilation system is not required to be safety grade.

Response 010.95

Figure 9.4-4 has been deleted. The main steam and feedwater area ventilation is shown on revised Figure 9.4-7. The main steam and feedwater area ventilation system is not required to be safety grade. The equipment located in this area is not required to bring the plant to a cold shutdown if offsite power is available and the condenser is available. If offsite power is not available or the condenser is not available, then the power operated relief valves, which are located in this area, would be used. They would operate in conjunction with Auxiliary Feedwater System to remove residual heat during the first stage of the cooldown. The power operated relief valves are equipped with handwheels so that they can be operated locally. See the response to Question 010.66. 10

Question 010.96

Your response to our request 010.58 regarding the automatic start of safety related auxiliary air cooling units refers to Section 9.4.5.1 where you state that the auxiliary cooling units will start simultaneously with the equipment they serve. Section 9.2.9.3 states that during an emergency mode, both the containment spray pump room coils and safety injection pump room coils automatically receive chilled water through the opening of the ESF chilled water valves that control flow to these coils. 10
It is our position that all the other safety related cooling units also automatically receive chilled water to their coils. Verify that the other safety related pump room auxiliary cooling units will automatically receive chilled water to their coils when the equipment in the rooms that they serve are automatically started.

Response 010.96

All the safety related pump rooms will automatically receive chilled water to the coils whenever the equipment is started or upon receipt of an "S" singal. See Sections 9.2.9.3 and 9.4.5.1 and Figure 9.4-5.

Question 010.97

Your response to our request 010.66 regarding the safety related main steam power operated relief valves states that a response will be provided later. It is our position that the power operated relief valves, valve actuators, power supplies, instrumentation and controls all be designed to seismic Category I requirements and be operable from the control room. 10
Revise your design to meet this position and show that safe cold shutdown can be accomplished from the control room using only safety grade equipment, with or without offsite power. (See Reactor Systems Branch request 212.35 regarding cold shutdown using only safety grade equipment.)

Response 010.97

The response to NRC Question 010.66 was provided in Amendment 7. Section 10.3.3.2 describes the methods of valve actuation.

Question 010.98

Your response to our request 010.6B states that flooding of safety related equipment in the auxiliary building cannot occur from a failure in the circulating water system since access to the auxiliary building from the turbine building is through watertight doors. It is our position that these watertight doors be alarmed and indicated in the control room. Also provide the following information regarding the watertight doors and flooding in the turbine building.

a) Discuss the qualifications of the watertight doors and their testing and inspection requirements.

b) Identify the number of watertight doors between the turbine and auxiliary buildings and their elevations. 10

c) Describe how other penetrations between the two buildings will be qualified to maintain their integrity during flooding in the turbine building, and

d) Describe the indications that will be provided in the control room to notify the operator of flooding in the turbine building.

Response 010.98

As stated in revised Section 10.4.5.3, there is no direct access to the auxiliary building from the turbine building. Access to the auxiliary building is from the electrical building through an enclosed corridor as shown in Figure 1.2-4. There are no piping or electrical penetrations between the auxiliary building and the turbine building below the water level that would result from a failure in the circulalting water system. This level is dependent on the circulating water system flow rate, and will be presented in the Utility Applicants SAR. Flooding in the turbine building is alarm in the control room by level switches in the turbine building sumps.

Question 010.99

Your response to our request 010.69 states that the feedwater isolation signal is utilized to automatically close all the feedwater isolation valves. It is our position that your feedwater regulating valves and bypass valves also receive 10 signals to close from the feedwater isolation signal. Verify that your design meets this position.

Response 010.99

As shown in RESAR 414, Figures 7.3-2 and 7.2-1, the feedwater control valves and bypass control valves close on receipt of a feedwater isolation signal. Also see revised section 10.4.7.2.

Question 010.100

Your response to our request 010.71 regarding a main steam line break in the common line to the turbine driven pump did not consider a single active failure. If one of the motor driven pumps fails to start the remaining motor driven pump will be feeding only one intact steam generator and one of the generators that is blowing down via the broken steam line to the turbine driven pump. It is our position that as a result of any single active failure considered that your design must meet the minimum 10
RESAR-414 requirements which include minimum auxiliary feedwater flow to two effective steam generators. Revise your design as necessary to meet this position. An acceptable method of meeting this position would include normally closed steam isolation valves to the turbine driven pump, rather than normally open.

Response 010.100

The steam supply to the turbine driven auxiliary feedwater pump has been vented. The supply isolation valves will be automatically dosed on a loss of pressure signal caused by steam blowdown through a postulated line break.

The isolation valves are normally open to keep the steam supply headers under pressure to minimize the occurrence of a steam hammer in the lines. See revised Sections 10.3.3.6 and 10.4.9.3 and revised Figure 10.3-1.

Question 010.101

In Section 10.4.9.3 you state that in the event of a feedwater
line break inside containment, either the capacity of the turbine
driven pump or the unaffected motor-driven pump is sufficient to
deliver the minimum flow to the operable steam generators during
the event where all of the flow from one motor driven pump and
part of the flow from the turbine driven pump are lost until the 10
break can be isolated. You have not considered a single active
failure in this analysis and, therefore, the design does not meet
our pipe break concurrent with a single active failure criteria.
It is our position that the minimum flow to the two steam
generators (as required in RESAR-414) be automatically delivered
following a feedwater line break inside containment and a single
active failure of any AFW pump. Revise your design as necessary
to meet this position.

Response 010.101

As stated in Section 10.4.9.3, either the capacity of the turbine driven pump or the unaffected motor driven pump is sufficient to deliver the minimum flow to two effective steam generators. If the unaffected motor driven pump is assumed to be inoperable because of a single active failure, then the capacity of turbine driven pump alone (where part of the flow from this pump is lost to the break) is sufficient to fulfill the minimum safety requirements of the system. See revised Sections 10.4.9.2 and 10.4.9.3.

Question 010.102

Your response to our request 010.12 regarding feedwater hammer is
not complete. It is our position that you commit to meet the
RESAR-414 interface requirement in Section 10.2 of NUREG 0491
dated November 1978 which will require tests at nuclear power 10
plants to verify that damaging water hammer will not occur in the
model H steam generator.

Response 010.102

A response will be provided later.

Question 010.103

In response to our request 010.59 regarding the turbine driven
auxiliary feedwater pump room ventilation system, you state that
auxiliary cooling units are unnecessary since the turbine
exterior logging temperature will reach 165 F and the room
equilibrium temperature will be 114 F. Verify that all safety
related equipment such as valves, controls and instruments will
be environmentally qualified for continuous operation at the 10
worst expected temperature and humidity.

Response 010.103

The safety related equipment associated with the turbine driven auxiliary feedwater pump will be environmentally qualified for continuous operation at the worst expected temperature and humidity. See revised Table 3.11-4.

POWER SYSTEMS BRANCH

Question 040.01

General Comments

Gibbs & Hill, Inc., should provide in this balance of plant SAR:

a. As complete a description as possible for each system at this stage of design to address concerns in the corresponding Standard Review Plans.

b. A tabulation of interface requirements for each system designed by G&H which interface with other systems (or components) provided by the utility applicant, and

c. A tabulation of systems and major components provided by the utility applicant. In each of these areas G&H should provide in this SAR as much typical description as possible (including drawings) for each system or component at this stage of design to address as many concerns as possible contained in the corresponding Standard Review Plans and in each case conclude your description with a statement to the affect "a complete of this system (or component) will be provided in the utility applicant's SAR."

Some examples:

1. The diesel generator unit and auxiliary systems, i.e., 10
diesel generator, diesel generator fuel oil system, cooling system, lubrication system, starting air system and air intake and exhaust system.

2. Turbine generator

3. Main Condenser

4. Turbine Bypass system

5. Others

Response 040.01

GIBBSSAR provides as complete a description as possible for each system at this stage of design. The concerns in the corresponding Standard Review plans have been considered during the course of preparation of these descriptions.

Section 1.8 discusses the interface criteria. Table 1.8-1 defines the design responsibility interfaces; Table 1.8-2 presents fluid system interfaces; Table 1.8-3 presents the interfaces for the Utility-Applicant for SAR inputs.

For those systems and major components that will be provided by
the Utility-Applicant, GIBBSSAR provides as much typical
description as possible (including drawings) for each system or 10
component at this stage of design, addressing as many concerns as
possible contained in the corresponding Standard Review Plans.

Question 040.2 (Table 1.1-1)

Exceptions taken to RESAR-414.

This table states that the motors listed in RESAR-414 rated for
4000V are furnished rated for 6600V in accordance with the
GIBBSSAR designed AC distribution system. It is noted that the
motors involved are furnished by RESAR-414. (Tables 1.7-1 and
8.3-2 of RESAR 414). Concurrence from RESAR-414 should be 10
obtained and Table 1.8. GIBBSSAR revised to reflect the
procurement responsibility of all major components including the
motors addressed in the Table 1.1-1 exception.

Response 040.2

A response will be provided later.

Question 040.3 (3.1.13)

General Design Criterion (GDC) 13, Instrumentation and Control.
The discussion pertaining to GDC 13 should reference Chapter 8 10
equipment as well as Chapter 7 in order to indicate the degree of
compliance for all equipment involved with engineering safeguards
systems to GDC 13.

Response 040.3

See revised Section 3.1.1.

Question 040.4 (3.1.17)

General Design Criterion 17. Electric Power Systems.

Paragraph four (4) of the "Discussion" pertaining to GDC 17 states, in part, "During a postulated LOCA, both diesel generators start automatically and connect to their respective buses. Safety-related loads are sequentially loaded onto the ESF buses if there is a loss of offsite power."

Regarding the first sentence quoted above concerning connecting the diesel generators to the ESF buses, the SAR should be clarified to indicate that off-site power must be unavailable before connecting the diesel generators to their respective buses (see section 8.3-2 of RESAR-414). Regarding the second sentence quoted above concerning load sequencing, it is inferred that the loads are not sequenced if off-site power is available. Section 8.1.17 should be revised to clarify the above items. 10

Response 040.4

See revised Section 3.1.17

Question 040.5 (8.1.4)

Regulatory Guide 1.62 should be included in the documents listed in the design criteria. 10

Response 040.5

See revised Section 8.1.4.

Question 040.6 (8.1.5)

Address Regulatory Guides 1.40, 1.47, 1.53, 1.62 and 1.73 and the compliance thereto. 10

Response 040.6

See revised Section 8.1.5.

Question 040.7 (8.1.2, 8.3.1.1)

Load Break Switch.

Provide the logic for operation of the load-break switch in the areas of closing, tripping during startup, normal operation, shutdown, loss of preferred power and turbine trip, including interlocks with other bus supply breakers. Address the level of design qualification and reliability. 10

Response 040.7

See revised Section 8.3.1.1.a.

Question 040.8 (8.2.1)

Include the power requirements (KVA ratings) for station service, unit auxiliary and main transformers and the corresponding input voltage requirements as interface requirements for the utility 10 applicant.

Response 040.8

Input voltage requirements as interface requirements for the utility applicant are described in revised Section 8.2.1. Transformer ratings will be provided later.

Question 040.9 (8.3.1.1.a)

Section 8.3.1.1.a discusses tripping the reactor coolant pump
breakers in the event of a decrease-frequency condition.
RESAR-414 interface requirements of Section 7A indicates that
reactor coolant pump speed sensors provide a reactor trip on pump
underspeed but does not trip the RCP breakers on power frequency 10
decay rates of 5 Hz/second. Since Section 8.2.1 of GIBBSSAR
specifies a frequency decay rate of 5 Hz/sec or less, it appears
from the discussion in section 8.3.1.1.a that an inconsistency
exists between the information presented in Section 8.3.1.1.a and
that contained in Section 7A of RESAR-414.

Response 040.9

See revised Sections 8.2.1 and 8.3.1.1.a

Question 040.10 (8.3.1.1.a)

Provide a listing of all switchgear (by bus nomenclature) within the design and specifically address the source or control power to each. This is needed to facilitate an independent review of 10 how your emergency power system design meets the single failure criterion and to determine the extent of loss due to postulated failures.

Response 040.10

See revised Section 8.3.2.1 and Table 8.3-8.

Question 040.11 (8.3.1.1.b(8))

The discussion pertaining to automatic loading and stripping of buses should be expanded to provide more detail in the areas of load shedding and sequential loading of the diesel generator buses. Any residual loads on the emergency buses should be addressed. Figure 8.3-2 should be revised to depict both modes of sequencing (1- loss of preferred power and 2- a safety injection actuation signal). Figure 8.3-2 should show the load 10
blocks in accordance with the appropriate tables (8.3-1, 8.3-2). Refer to 040.22 on staff position regarding diesel generator bus shedding.

Response 040.11

See revised Section 8.3.1.1,b(8) and Figure 8.3-2. Figure 8.3-2 currently shows both modes of sequencing. The intent of this diagram is to show the major 6.9 kV loads and the logic of the sequencing system. A complete detailed description of the various load blocks is contained in Tables 8.3-1 and 8.3-2, which are referenced in Figure 8.3-2. The figure is modified to include the load shedding interlock during sequencing and the additional Bus 1EA1 voltage system.

Question 040.12 (8.3.1.1.b.11)

The discussion on relay protection should be expanded to specify the location of the alarm and indication monitors.

Recent experience with Nuclear Power Plant Class IE electrical system equipment protective relay applications has established 10 that relay trip setpoint drifts with conventional type relays have resulted in premature trips of redundant safety related system pump motors when the safety system was required to be operative. While the basic need for proper protection for feeders/equipment against permanent faults is recognized, it is the staff's position that total non-availability of redundant safety systems due to spurious trips in protective relays is not acceptable.

Provide a description of your circuit protection criteria for safety systems/equipment to avoid the above referred protective relay trip set point drift problems.

Response 040.12

Response to this question is provided in revised Section 8.3.1.1.b.11.

Question 040.13 (8.3.1.1.b.12)

Diesel generator testing, paragraph 16.3/4.8.1.1.2 should be expanded to consider RG 1.108 and the following:

a) Verifying that on loss of offsite power the diesel generators start on the autostart signal, the emergency buses are energized with permanently connected loads, the 10
auto-connected shutdown loads are energized through the load sequencer, and the system operates for five minutes while the generators are loaded with the shutdown loads.

b) Verifying that on a safety features actuation signal (without loss of offsite power) the diesel generators start on the autostart signal and operate on standby for five minutes.

The above tests should be performed at least once per 18 months.

Response 040.13

See revised Section 16.3/4.8.1.

Question 040.14 (8.3.1.2.6)

Provide a listing of the following for the containment electrical penetrations by voltage Class: I^2t ratings, maximum predicted fault currents, identification of maximizing faults, protective equipment setpoints, and expected clearing times.

Response 040.14

The selection of electrical penetrations is described in Section 8.3.1.2.6, "Compliance with Regulatory Guide 1.63". Detail information concerning the design of the electrical penetration assembly will be provided in the Utility Applicant's 10
FSAR when the detailed design data become available.

Question 040.15 (8.3.1.4.2.5)

The type of barrier employed on the crossover trays should be specified.

Response 040.15

Discussion of barrier has been deleted from Section 8.3.1.4.2.5. See revised Section 9.5.1.6.4, General Plant Guidlines for design criteria. The design of the type of barrier used will be 10
included in the Utility Applicant's FSAR.

Question 040.16 (8.3.1.4.3)

The seismic category of the trays and supports carrying non-Class IE circuits, that could jeopardize the integrity of 10
Class IE circuits, should be specified.

Response 040.16

See revised Section 3.10.1

Question 040.17 (8.3.1.1.c(3)) (8.3.1.1.e(10))

Specify the "other manual control alarms" associated with inhibiting automatic operation discussed in 8.3.1.1.e(10). Specify the location of all alarms. Provide additional information on the diesel generator trouble alarm discussed in this paragraph. The alarms should be in accordance with the following:

Diesel generator alarms in the control room: A review of malfunction reports of diesel generators at operating nuclear plants has uncovered that in some cases the information available to the control room operator to indicate the operational status 10
of the diesel generator may be imprecise and could lead to misinterpretation. This can be caused by the sharing of a single annunciator station to alarm conditions that render a diesel generator unable to respond to an automatic emergency start signal and to also alarm abnormal, but not disabling, conditions. Another cause can be the use of wording of an annunciator window that does not specifically say that a diesel generator is inoperable (i.e., unable at the time to respond to an automatic emergency start signal) when in fact it is inoperable for the purpose.

Review and evaluate the alarm and control circuitry for the diesel generators at your facility to determine how each condition that renders a diesel generator unable to respond to an automatic emergency start signal is alarmed in the control room. These conditions include not only the trips that lock out the diesel generator start and require manual reset, but also control switch or mode switch positions that block automatic start, loss of control voltage, insufficient starting air pressure or battery voltage, etc. This review should consider all aspects of possible diesel generator operational conditions, for example test conditions and operation from local control stations. One area of particular concern is the unreset condition following a manual stop at the local station which terminates a diesel generator test and prior to reseting the diesel generator controls for enabling subsequent automatic operation.

Provide the details of your evaluation, the results and conclusions, and a tabulation of the following information:

(a) all conditions that render the diesel generator incapable of responding to an automatic emergency start signal for each operating mode as discussed above;

(b) the wording on the annunciator window in the control room that is alarmed for each of the conditions identified in (a);

(c) any other alarm signals not included in (a) above that also cause the same annunciator to alarm; 10

(d) any condition that renders the diesel generator incapable of responding to an automatic emergency start signal which is not alarmed in the control room; and

(e) any proposed modifications resulting from this evaluation.

Response 040.17

See revised section 8.3.1.1.c.

Question 040.18 (8.3.2.1.b)

Provide the basis for establishing 24 hours as the time required to restore the battery from minimum charge to fully charged state, while supplying its normal steady state loads.

Response 040.18

Section 8.3.2.1.b has been revised to reflect the change of charging period from 24 to 12 hours.

12 hours has been established as the time required to restore the battery from designed minimum charge to fully charged state. The 12-hour period has been selected to reflect manufacturer's 10
recommended optimal charging period for the battery.

Each Class 1E 125-V battery system is serviced by two redundant battery chargers to permit charger maintenance without degrading system integrity. Each charger may be supplied from either one of two Class 1E 480V MCC's. With this flexibility of design it is extremely unlikely that the Class 1E, 125-V battery will be discharged to its designed minimum charge state during any normal or emergency mode of operation. Consequently, the 12-hour charging period is unlikely to be fully utilized.

Question 040.19 (8.3.2.1.c)

DC System testing.

The DC testing delineated in 16.3/4.8.2.32 should include a resistance measurement cell-to-cell and terminal connections at 10
least once each 18 months.

Response 040.19

See revised Section 16.3/4.8.2.3.2.

Question 040.20 (8.3.2.3)

Regulatory Guide 1.40, 1.62 and 1.108 should be added to the list of references (per 040.6, 040,13).

Response 040.20

See revised Section 8.1.4. It is assumed that the Question number identified in the Question should be 040.5 and 040.12. 10

Question 040.21 (8.3.1.1.b.8) Fig. 8.3-2

Paragraph 8.3.1.1.b.8 and Figure 8.3-2 indicate that a second level of voltage protection is provided with a time delay in order to protect the onsite power system from any adverse effects that could result from a substained degraded voltage condition on the offsite power system. Provide the design details of both protection systems. The design shall satisfy the following criteria:

a) The selection of voltage and time set points shall be determined from an analysis of the voltage requirements of the safety-related loads at all onsite system distribution levels;

b) The voltage protection shall include coincidence logic to preclude spurious trips of the offsite power source;

c) The time delay selected shall be based on the following conditions:

   (1) The allowable time delay, including margin, shall not exceed the maximum time delay that is assumed in the FSAR accident analyses; 10

   (2) The time delay shall minimize the effect of short duration disturbances from reducing the availability of the offsite power source(s); and

   (3) The allowable time duration of a degraded voltage condition at all distribution system levels shall not result in failure of safety systems or components;

d) The voltage sensors shall automatically initiate the disconnection of offsite power sources whenever the voltage set point and time delay limits have been exceeded;

e) The voltage sensors shall be designed to satisfy the following requirements:

   1) Class 1E equipment shall be utilized and shall be physically located at and electrically connected to the emergency switchgear.

   2) An independent scheme shall be provided for each division of emergency power.

3) Capability for test and calibration during power operation shall be provided.

4) Annunciation must be provided in the control room for any bypasses incorporated into the design; and

f) The Technical Specifications shall include limiting condition for operation, surveillance requirements, trip set points with minimum and maximum limits, and allowable values for the second level voltage protection sensors and associated time delay devices.

Response 040.21

See revised Sections 8.3.1.1.b(8), 8.3.1.1.b(12) and 16.3/4.8.1. 10

The limiting conditions of operation and surveillance requirements of the 6.9 kV Class 1E bus under-voltage and degraded voltage protection systems are part of the load shedding requirements described in Section 16.3/4.8.1.

The trip set points and tolerances for these systems will be provided in the Utility Applicant's FSAR.

Question 040.22

We require that when the diesel generator is supplying power to the emergency bus, the design shall automatically prevent load shedding of the emergency bus during the sequencing cycle. The design shall also include the capability of the load shedding feature to be automatically reinstated at the completion of the sequencing cycle.

Provide the details of your design and state your intent to comply with this position or provide justification for any exceptions taken.

We further require that the Technical Specifications include a test requirement to demonstrate the full functional operability of the bypass and reinstatement feature at least once per 10
18 months during shutdown. Proper operation shall be determined by:

> Verifying that on interruption of the onsite sources the loads are shed from the emergency buses in accordance with design requirements and that subsequent loading of the onsite sources is through the load sequencer.

Response 040.22

See revision of Sections 8.3.1.1,b(8), 8.3.1.1,b(12) and 16.3/4.8.1

Question 040.23

The voltage levels at the safety-related buses should be
optimized for the full load and minimum load conditions that are
expected throughout the anticipated range of voltage variations 10
of the offsite power source by appropriate adjustment of the
voltage tap settings of the intervening transformers. We require
that the adequacy of the design in this regard be verified by
actual measurement.

Provide a description of the method for making this verification. Provide the documentation required to establish that this verification will be accomplished.

Response 040.23

See revised Section 8.3.1.1.b.

Question 040.24

Provide a description of the physical arrangement utilized in your design to connect the field cables inside containment to the containment penetrations, e.g. connectors, splices, or terminal blocks. Provide supportive documentation that these physical interfaces are qualified to withstand a LOCA or steam line break environment.

Response 040.24

Connectors, termination lugs, and terminal blocks will all be utilized in connecting the field cables inside the containment to the electrical penetrations. Connectors will be used on coax and triax cables, termination lugs be used on large power cables, and terminal blocks located in terminal boxes will be utilized by all other cables. 10

All Class 1E connections between field cable and electrical penetrations inside the containment will be qualified to withstand the environmental conditions resulting from a LOCA or steam line break. After the penetration vendor has been selected, and the detailed design finalized, the supportive documentation will be provided in the Utility Applicant's FSAR.

Question 040.25

Provide a listing of all motor operated valves within your design that require power lock out in order to meet the single failure criterion and provide the details of your design that accomplish this requirement.

Response 040.25

Motor operated valves which are required to have a power lockout feature are listed below. These valves are not required to open or close in various safety system operational sequences, but are manually controlled and are operable from the control room. 10

Valve No.	Valve Functions	Valve Position
9011 A/B	normal cooldown	closed
9013 A/B	normal cooldown	closed
9016 A/B	RHR/HL Recirc	closed
8807	HHSI/HL Recirc	closed

To accomplish the power lockout design, a disconnecting device will be added in the power circuit of each valve after the thermal overload elements. This disconnecting device will be located in the motor control center. Control room indications of the positions of each motor operated valve and the positions of the disconnect device will be provided.

An administrative operating procedure will be followed to manually open the above mentioned disconnecting device in the corresponding motor control center, after the valve operation is completed. The position indications of the valve in the control room is still operational since the starter control transformer remains energized.

The re-energizing of the valve motor can only be accomplished by manually closing the disconnect device and operating the control switch located in the control room.

Question 040.26

Provide a description of the capability of the emergency power system battery chargers to properly function and remain stable upon the disconnection of the battery. Include in the 10 description any foreseen modes of operation that would require battery disconnection such as when applying an equalizing charge.

Response 040.26

See revised Section 8.3.2.1.a

Question 040.27

Provide the details of your design of the DC power system that
assures equipment will be protected from damaging overvoltages 10
from the battery chargers that may occur due to faulty regulation
or operator error.

Response 040.27

See revised Section 8.3.2.1.b.

Question 040.28

Provide the results of a review of your operating, maintenance, and testing procedures to determine the extent of usage of jumpers or other temporary forms of bypassing functions for operating, testing, or maintaining of safety related systems. Identify and justify any cases where the use of the above methods cannot be avoided. Provide the criteria for any use of jumpers for testing.

Response 040.28

At the operating license review stage, a review of operating,
maintenance, and testing procedures will be made to determine the
extent of usage of jumpers or other temporary forms of bypassing 10
functions for operating, testing, or maintaining of safety
related systems results of this review will be provided in the
Utility Applicant's FSAR.

The criteria for the use of jumpers in testing is in comformance with Regulatory Guide 1.118.

Question 040.29

We request that you perform a review of the electrical control circuits for all safety related equipment, so as to assure that disabling of one component does not, through incorporation in other interlocking or sequencing controls, render other components inoperable. All modes of test, operation, and failure should be considered. Describe and state the results of your review.

Response 040.29

The electrical control circuits for all BOP safety related
equipment are designed to assure that the disabling of one 10
component does not, through incorporation of interlocking or
sequencing controls, render other components inoperable. In the
cases where this condition can not be avoided, administrative
procedure will be provided to assure the operating personnel's
awareness of the system constraint during all modes of operation.
These control circuits will be reviewed and the results discussed
in the Utility Applicant's FSAR.

Question 040.30

The information regarding the onsite communications system (Section 9.5.2) does not adequately cover the system capabilities during transients and accidents. Provide the following information:

a) Identify all working stations on the plant site where it may be necessary for plant personnel to communicate with the control room or the emergency shutdown panel during and/or following transients and/or accidents (including fires) in order to mitigate the consequences of the event and to attain a safe cold plant shutdown.

b) Indicate the maximum sound levels that could exist at each of the above identified working stations for all transients and accident conditions.

c) Indicate the types of communication systems available at each of the above identified working stations.

d) Indicate the maximum background noise level that could exist at each working station and yet reliably expect effective communication with the control room using: 10

1. the page party communications system, and

2. any other additional communication system provided that working station.

e) Describe the performance requirements and tests that the above onsite working stations communication systems will be required to pass in order to be assured that effective communication with the control room or emergency shutdown panel is possible under all conditions.

f) Identify and describe the power source(s) provided for each of the communications systems.

g) Discuss the protective measures taken to assure a functionally operable onsite communication system. The discussion should include the considerations given to component failures, loss of power, and the severing of a communication line or trunk as a result of an accident or fire.

Response 040.30 10

A response will be provided later.

Question 040.31 (Fig. 8.3-1)

This figure should be revised to indicate input transformer ratings and major bus voltages (see 040.7).

Response 040.31 10

Major bus voltages are shown in Figure 8.3-1. Transformer ratings will be provided later.

Question 040.32 (Tables 8.3-1, 8.3-2)

Some of the component nomenclature and ratings of tables 8.3-1
and 8.3-2 do not correspond with those listed in RESAR 414,
tables 8.3-1, 8.3-2. (Examples: Station Service Water Pumps vs. 10
Essential Service Water Pumps, 450 HP rating for RHR Pumps vs.
500 HP.)

Review the RESAR-414/GIBBSSAR Tables 8.3-1, 8.3-2 and revise the listing as necessary to resolve the differences.

Response 040.32

A response will be provided later.

Question 040.33

Address the degree of compliance with Branch Technical Position ASB 9.5-1 regarding the capacity of the battery operated lighting units in the essential lighting system. Additionally clarify the 10
description regarding fixed self-contained lighting and portable hand lighting in view of the ASB 9.5-1 requirements.

Response 040.33

For a discussion of the capacity of the battery operated lighting units in the essential lighting system, and the discriptions of the fixed self-contained and portable hand held lighting units, see subsection 9.5.1.6.4.e and Section 9.5.3.

Question 040.34 (3.2) (3.6)

In tables 3.2-1 sheet 7, and 3.6-1, sheet 1, the Main Steam System is listed for classification. The description states:

"Piping and valves (within the containment, from the steam generator nozzle up to an including the main steam stop valves)."

a. Clarify the above and explicitly describe the "main steam stop valves".

b. Are the main steam stop valves what are normally called the main steam isolation valves and are they located inside the containment as stated? 10

Response 040.34

The main steam stop valves are the main steam isolation valves which are explicity described in Section 10.3.3.3.

These valves are located outside the containment as shown on Figure 10.3-1. Table 3.2-1 sheet 7 has been revised to clarify the classification.

Question 040.35

Discuss your conformance to R.G. 1.137 and ANSI N135 relative to the Emergency Diesel Generator Fuel OIl Storage and Transfer System (EDGFOSTS). 10

Reponse 040.35

A response will be provided later.

Question 040.36

Section 9.5.4.1 indicates that the diesel separator day tanks
are sized for 4 hours of operation whereas Table 9.5-2 indicates 10
that the capacity of the tanks is sufficient for 3 hours of
operation. Correct this discrepancy.

Response 040.36

A response will be provided later.

Question 040.37

Table 9.5-1, sheet 1, indicates that the fuel oil day tank for
each diesel generator has a capacity of 1790 gallons. Branch 10
technical position ASB 9.5-1 and Regulatory Guide 1.120 limits
the total capacity of day tanks in the diesel generator area to
not more than 1100 gallons. Revise your PSAR to conform to the
above requirements.

Response 040.37

A response will be provided later.

Question 040.38

Discuss your conformance to regulatory guides 1.36, 1.39, 1.68, 1.102, and 1.117, relative to the diesel generator auxiliary systems.

Response 040.38

Conformance to Regulatory Guides 1.26 and 1.29, related to quality group classification and seismic design classification, respectively, is discussed in revised Sections 9.5.4 through 9.5.8.

Conformance to Regulatory Guide 1.68, related to preoperational and initial startup test programs is discussed in revised Sections 9.5.4 through 9.5.8 and Chapter 16. 10

Conformance to Regulatory Guides 1.102 and 1.117, related to flood protection and tornado design classification, respectively, is achieved by locating the diesel generator auxiliary systems in the seismic Category I Auxiliary Building, with the exception of the fuel oil storage tanks, which are located underground, as discussed in revised Sections 9.5.4 through 9.5.8.

Question 040.39 (9.5.4)

Provide a table with a listing of information that all the provided later by the utility applicant (U-A) to satisfy and complete the requirements stated in Standard Review Plan 8.5.4 "Emergency Diesel Fuel Oil Storage and Transfer System". For example:

> Table 9.5-1, sheet 2, has notes #1 and #3 and which state that the information is dependent on the selections of the diesel-generator manufacturer. Therefore the requested listing should show that the required information will be included in the Applicant's SAR when the diesel generator is selected. (See General notes.) 10

Response 040.39

See Table 9.5.-12.

Question 040.40

In reference to Fig. 9.5-2, Diesel Fuel Oil System

1. There is a note on the fuel oil storage tank that the 4" vents have a flame arrestor. Provide a similar note for the vents on the day tanks. 10

2. There is an indication that the storage tanks are Seismic Cat. I, Class 3. Provide the classification of the day tanks.

Response 040.40

A response will be provided later.

Question 040.41

The day tank associated with each diesel generator set should be provided with an overflow line to return excess fuel oil 10
delivered by the transfer pump back to the fuel oil storage tanks. Show this on Fig. 9.5-2 (SRP 9.5.4, Part III, Item 5d).

Response 040.41

A response will be provided later.

Question 040.42

Identify any high energy piping system(s) in the diesel engine room areas and indicate what means are provided to protect the following diesel engine systems from the effects of a failure of high energy piping:

a. fuel oil systems

b. cooling water system

c. air starting system 10

d. lubrication system

e. combustion air intake and exhaust system

(ERP 9.5.4 Part III, Item 8; SRP 9.5.5, Part III, Item 4; SRP 9.5.6, Part III, Item 5; SRP 9.5.7, Part III, Item 3; SRP 9.5.8, Part III, Item 6c).

Response 040.42

A response will be provided later.

Question 040.43

Figure 9.5-2, Flow Diagram Diesel Fuel Oil System, shows a filter in one line from the fuel oil storage tank but does not show a differential pressure switch for monitoring for cleanliness. 10
Indicate the means for monitoring the filter for cleanliness and also if there will be alarms locally and in the control room (SRP 9.5.4, Part III, Item 1).

Response 040.43

A response will be provided later.

Question 040.44

Figure 9.5-2 does not show and section 9.5.4 does not discuss any instrumentation for measuring flow rate for the emergency diesel generator fuel oil system. Provide information showing the means for monitoring flow rate and any alarms provided (SRP 9.5.4, Part III, Item 1). 10

Response 040.44

A response will be provided later.

Question 040.45

Figures 9.5-2 and 9.5-3 show a fill connection and vent in the underground fuel oil storage tank. Indicate the height of the vent and fill connection relative to the FNF flood level (SRP 10 9.5.4, Part III, Item 5a).

Response 040.45

A response will be provided later.

Question 040.44

Figure 9.5-2 does not show and section 9.5.4 does not discuss any
instrumentation for measuring flow rate for the emergency diesel 10
generator fuel oil system. Provide information showing the means
for monitoring flow rate and any alarms provided (SRP 9.5.4, Part
III, Item 1).

Response 040.44

A response will be provided later.

Question 040.47

In section 9.5.5 discuss the external source of water supply for cooling the diesel generator cooling system. Include in the SAR; 1) the G&H interface requirements and 2) a statement that the cooling water system description will be in the U-A SAR if this is the case.

Response 040.47 10

As shown in Figure 9.5-4, the external source of water supply for cooling the diesel generator cooling system is the service water system, which is described in Section 9.2.1.

The design responsibility is indicated in Table 1.8-1.

The cooling water system description is included in GIBBSSAR. See revised Section 9.5.5.2.

Question 040.48

Figure 9.5-4, Emergency Diesel Generator Cooling Water System, shows triangles with a numerical value of 6. Indicate the significance of these symbols. 10

Response 040.48

The symbol denotes changes made to the Figure for Amendment 6. See revised Figure 9.5-4.

Question 040.49

Figure 9.5-4 shows a surge tank (standpipe in the diesel) generator cooling water system. The surge tank will provide a reserve to compensate for system changes in volume and any minor leaks during operation. The surge tank will also maintain the required NPSH on the system circulating pump. Demonstrate that the surge tank size will be adequate to maintain the required NPSH and makeup water for seven days continuous operation of the diesel generator at maximum rated load, or provide a seismic Category 1, quality group makeup water supply to the surge tank.

Response 040.49 10

The surge tank will contain a sufficent volume of water and will be located to maintain the NPSH required by the pump for seven days of coninuous operation of the diesel generator at maximum rated load. The evaporation of water from the surge tank will be minimal, and loss of function of the jacket cooling water loop because of evaporation is not considered likely. See revised section 9.5.5.2.

Question 040.50

In sections 9.5.5, 9.5.6, 9.5.7 and 9.5.8 you state that "when a component is commercially unavailable as ACME Class 3 design, the component will be of the highest commercial quality available from the chosen manufacturer." Indicate what particular components these statements refer to describe what is your 10
interpretation of "the highest commercial quality available", and will these particular components be seismically qualified either by analysis or test to assure availability of the diesel generators under all normal and accident conditions.

Response 040.50

See Table 9.5-10.

Question 040.51

Section 9.5.5 states that instrumentation and controls for the diesel generator cooling water system are outlined in subsection 8.3.1.1.c. However, this subsection does not include the desired 10
information, it indicates that instrumentation and alarms for the diesel generator cooling system are discussed in Section 9.5. Provide this information. (See general comments.)

Response 040.51

A response will be provided later.

Question 040.52

Figure 9.5-4 shows temperature and pressure instrumentation in one diesel generator cooling system. Provide information in Section 9.5.5 to indicate if there will be alarms locally and in 10
the control room if the cooling water temperature or pressure are above or below the recommended limits.

Response 040.52

See revised Sections 9.5.5.2 and 9.5.5.3.

Question 040.53

Provide a discussion of the measures that will be taken in the design of the standby diesel generator air starting system to preclude the fouling of the starting air valve or filter with contaminants such as water, oil carryover and rust (SRP 9.5.6, Part III, Item 1).

Response 040.53

Strainers have been provided between the air receiver outlet and the solenoid valve to preclude fouling of the valve. See revised Section 9.5.6.2 and Figure 9.5-5. 10

In addition, each air receiver is equipped with a drain which can be opened periodically to remove accumulated moisture.

Question 040.54

In reference to Figure 9.5-5, Emergency Diesel Generator Starting Air System:

1. Indicate if the filters shown will have means for monitoring for cleanliness and also have alarms for alerting operators. 10

2. Indicate if the air receivers will have alarms to alert operators if the pressure falls below the minimum allowable value.

Response 040.54

See revised Section 9.5.6.2 and revised Figure 9.5-5.

Question 040.55

Section 9.5.6 indicates that information on instrumentation and monitoring of the diesel generator air starting system is provided in subsection 7.3.1.1.g. However, the subsection is entitled "Control Room Air-Conditioning System". Provide the 10
information and the proper reference. (See general comments.)

Response 040.55

Information on instrumentation and monitoring has been included in revised Section 9.5.6.2.

Question 040.56

In section 9.5.7 provide a typical lubrication P&ID that
indicates the basic components and instrumentation for a diesel
generator lubrication system. Discuss the parameters that will 10
be monitored and if a method for keeping the crankcase oil heated
above a minimum value during the standby mode will be used. (See
general comments.) (SRP 9.5.7, Part III, Item 1.)

Response 040.56

See revised Section 9.5.7 and Figure 9.5-9.

Question 040.57

Section 9.5.8 refers to Figure 9.5-6 as showing the combustion air and exhaust system components. This is in error, it should reference Figure 9.5-8. Correct this discrepancy.

10

Response 040.57

The discrepancy has been corrected. Revised Section 9.5.8 refers to Figure 9.5-8

Question 040.58

The combustion air intake and exhaust system description contained in section 9.5.8.2 is inadequate. Provide a mere detailed description of the system, its components, their arrangement and instrumentation employed in its design. (See general comments.) 10

Response 040.58

A detailed system description is provided in revised Section 9.5.8.2. A detailed arrangement is shown in revised Figure 9.5-8.

Question 040.59

General arrangement plan views of the diesel generator building are shown in Figures 1.2-4, 1.2-5 and 1.2-6 and an elevation view in Figure 1.2-10. Provide larger and more detailed plans and elevation views of the diesel generator building with sectional views that clearly show the details of the diesel generator arrangement. 10

Response 040.59

See figure 9.4-19.

Question 040.60

Provide a discussion to explain how the diesel engine combustion air intake and exhaust system is protected from: 1) possible clogging during operation, including standby, from atmospheric 10 conditions (heavy rain, freezing rain, dust storms, ice, and snow); 2) damage by tornado missiles that could prevent operation of the diesel generator on demand (SRP 9.5.8, Part III, Item 4 and 6b).

Response 040.60

See revised Section 9.5.8.3.

Question 040.61

Expand the discussion on safety evaluation in section 9.5.8 to include possibility of the accidental release of any of the stored gases mentioned in section 9.5.9 (carbon dioxide and nitrogen for the main generator) and the possible effects on diesel generator operation. 10

Response 040.61

Accidental release of any stored gases has no effect on diesel generator operation. See revised Section 9.5.8.3.

Question 040.62

Table 10.1-1 is not complete as it states that information on
description for the General Electric Co. Turbine Generator will 10
be provided later. This is not acceptable. Provide this
information. (See general comments.)

Response 040.62

See revised Table 10.1-1 and Figure 10.1-7.

Question 040.63

Expand the discussion of the (Westinghouse, Allis-Chalmers, and General Electric) turbine overspeed protection systems. For the turbine speed control system include explanation of the turbine and generator electrical load following capability. Tabulate the individual overspeed protection devices (normal, emergency and backup), the design speed (or percent of rated speed) that the operation performs its safeguard function and specify the valves or other components which are subsequently activated to complete 10
the turbine trip. Provide the results of a failure mode and effects analysis for each of the overspeed protection systems. Show that a single valve failure cannot disable the turbine overspeed trip functions (SRP 10.2 Part III, Items 1 and 2). If this information cannot be furnished by G&H at this time, indicate that the utility applicant will provide the detailed information in his SAR.

Response 040.63

This information will be provided in the Utility-Applicant's SAR.

Question 040.64

For each turbine generator manufacturer (Westinghouse, Allis-Chalmers and General Electric) provide a PND of the main Steam supply lines showing all the valves from the steam generator outlet to the turbine stop and control valves and all other steam loads supplied between the MSIV's and turbine stop valves. Also provide a typical P&ID for each turbine generator manufacturer showing extraction steam lines including the extraction heater non-return valves and reheat steam stop and intercept valves. Provide the closure times for all the turbine, reheat and extraction steam valves and show that stable turbine operation will result after a turbine trip (SRP 10.2, Part III, Item 4). 10

Response 040.64

This information will be provided in the Utility-Applicant's SAR.

Question 040.65

Provide a discussion on the inservice inspection program for the turbine, turbine stop and control valves, intermediate reheat stop main and intercept valves and extraction heater non-return valves and also on the capability for periodic testing while operating at rated load (SRP 10.2, Part III, Items 5 and 6). 10

Response 040.65

See revised section 10.2.3.6.

Question 040.66

Describe with the aid of drawings, the bulk hydrogen storage facility including its location and distribution system.

Response 040.66 10

The bulk hydrogen storage facility, if selected, will be located in the plant yard. The exact location will be provided in the Utility-Applicant's SAR. The distribution system is shown in Figure 9.5-7.

Question 040.67

Discuss the effects of a high and moderate energy piping failure or failure of the connection from the low pressure turbine to condenser on nearby safety related equipment or systems. Discuss what protection will be provided for the turbine overspeed
control system equipment, electrical wiring and hydraulic lines 10
from the effects of a high or moderate energy pipe failure so that the turbine overspeed protection system will not be damaged to preclude its safety function (SRP 10.2, Part III, Item 8).

Response 040.67

A response will be provided later.

Question 040.68

Discuss the measures taken to prevent corrosion/erosion of condenser tubes and components (SRP 10.4.1, Part III, Item 1). 10

Response 040.68

A response will be provided later.

Question 040.69

Discuss the means for detecting controlling leakage (SRP 10.4.1, Part III, Item 2). 10

Response 040.69

See revised Section 10.4.1.5.a.

Question 040.70

Indicate what design provisions have been made to preclude
failures of condenser tubes or components from turbine bypass 10
blowdown (SRP 10.4.1, Part III, Item 3).

Response 040.70

A response will be provided later.

Question 040.71 (10.4.1)

Discuss the effect of main condenser degradation (leakage, vacuum, loss) on reactor operation (SRP 10.4.1, Part III, Item 1). 10

Response 040.71

Condenser air leakage would cause a gradual loss of condenser vaccum and an increase in turbine back pressure. See Sections 10.4.1.3 and 10.4.2.5. Condenser vaccumm loss is discussed in Sections 10.4.1.3 and 15.2.5.

Question 040.72

Discuss the possible mechanisms for hydrogen production in the secondary side water and provide the expected production rate of 10
hydrogen in SFCM. Discuss the effectiveness of the means to prevent hydrogen buildup (SRP 10.4.1, Part III, Item 1).

Response 040.72

A response will be provided later.

Question 040.73

Assure that a high energy line failure of the turbine bypass system (TBS) will not have an adverse effect or preclude operation of any safety related components or systems located close to the TBS (SRP 10.4.4; Part III, Item 4). 10

Response 040.73

There are no safety related components or systems located close to the turbine bypass system.

Question 040.74

Provide additional description (with the aid of drawings) of the turbine bypass valves and associated controls. In your discussion include the number, size, principle of operations, construction, set points, and capacity of each valve total turbine bypass capacity and the malfunctions and/or modes of failure considered in the design of the turbine bypass system (SRP 10.4.4, Part III, Item 1). 10

Response 040.74

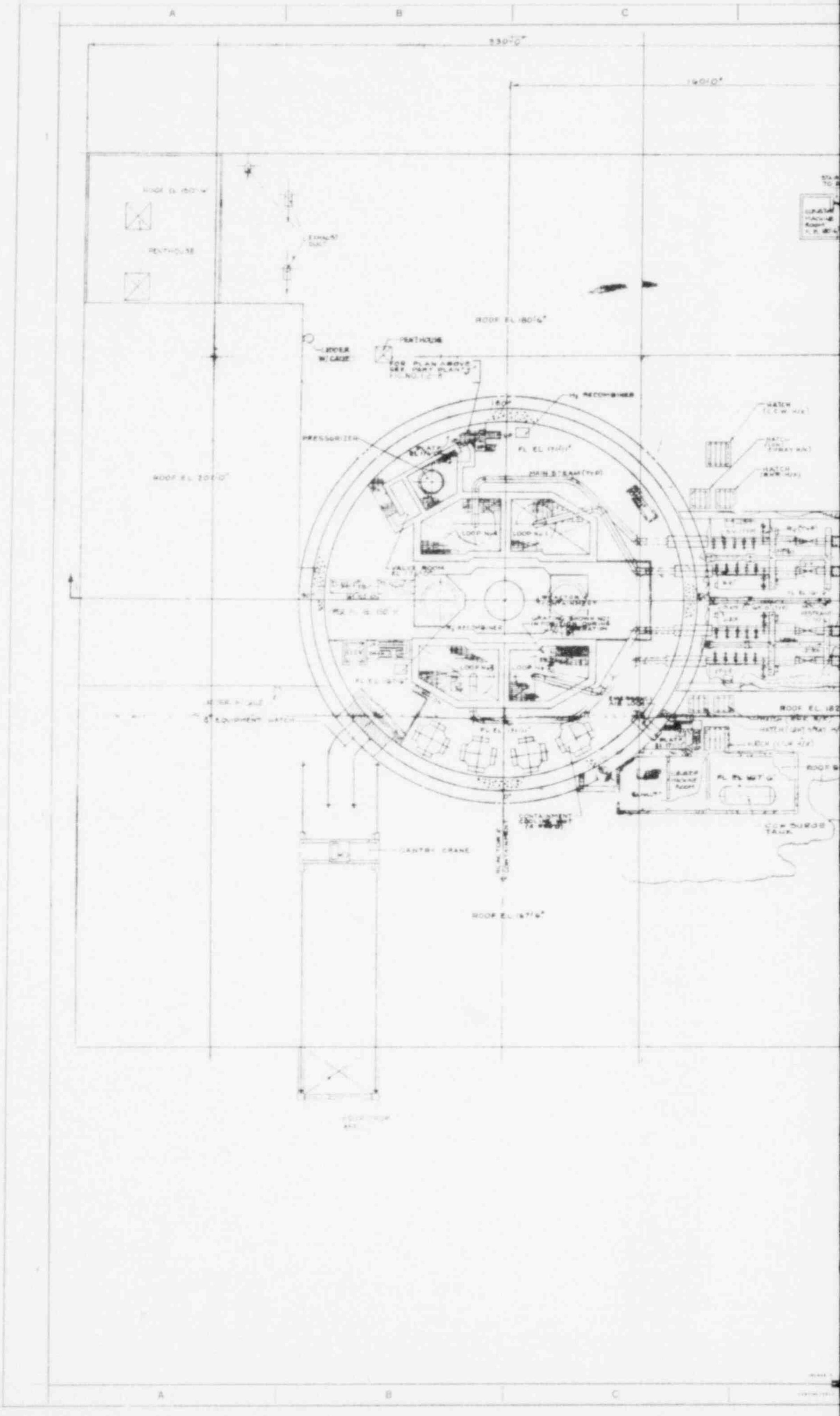
A response will be provided later.

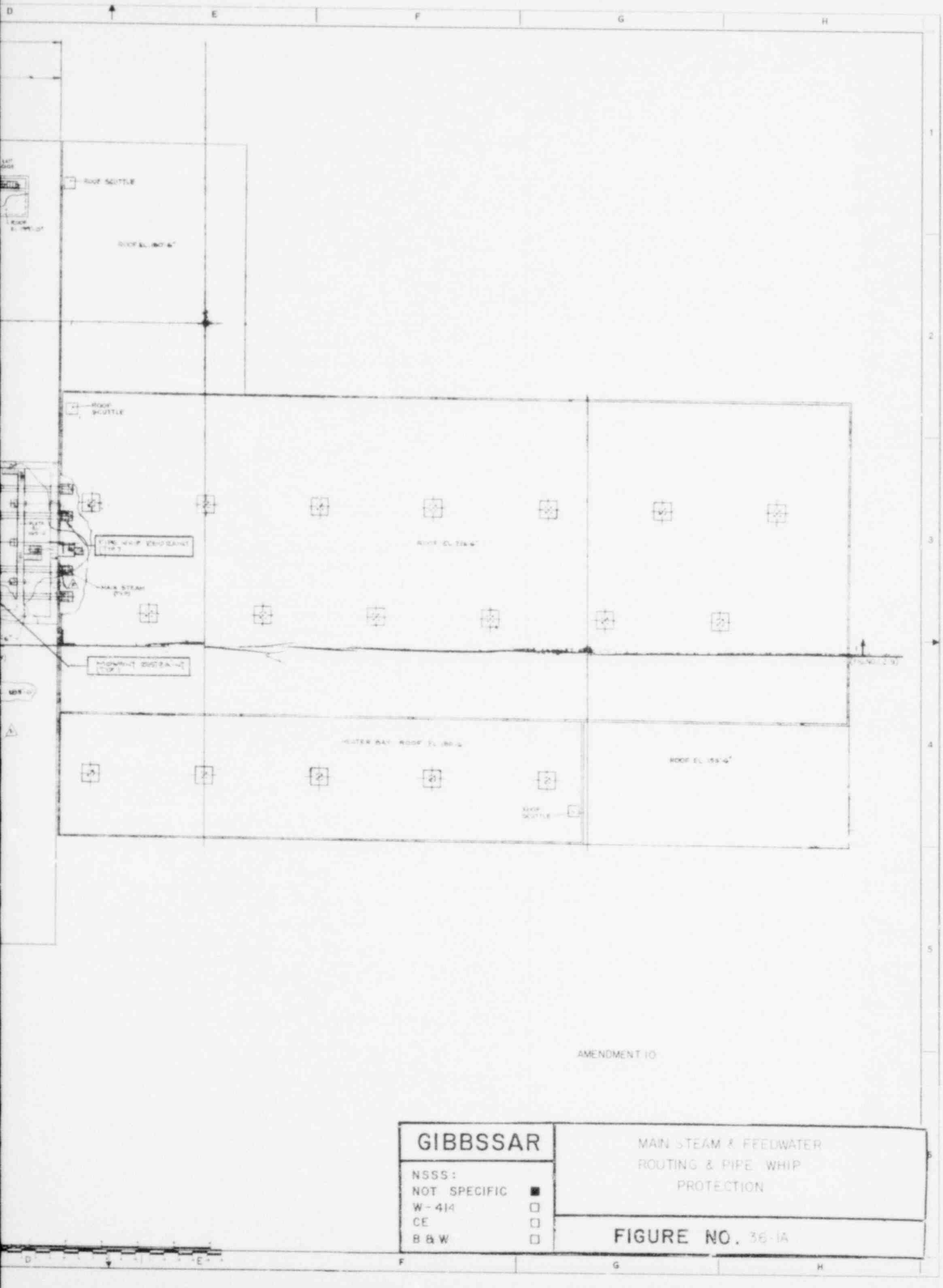
Question 040.75

Provide the results of a failure mode and effects analysis to determine the effect of malfunctions of the turbine bypass system on the operation of the reactor and main turbine generator unit (SRP 10.4.4, Part III, Item 4). 10

Response 040.75

A response will be provided later.


A
B
C
ROOF EL 180'-6"
PENTHOUSE
PRESSURIZER
ROOF EL 200'-0"
H₂ RECOMBINER
MAIN STEAM (TYP)
HATCH
GANTRY CRANE
CCW SURGE TANK



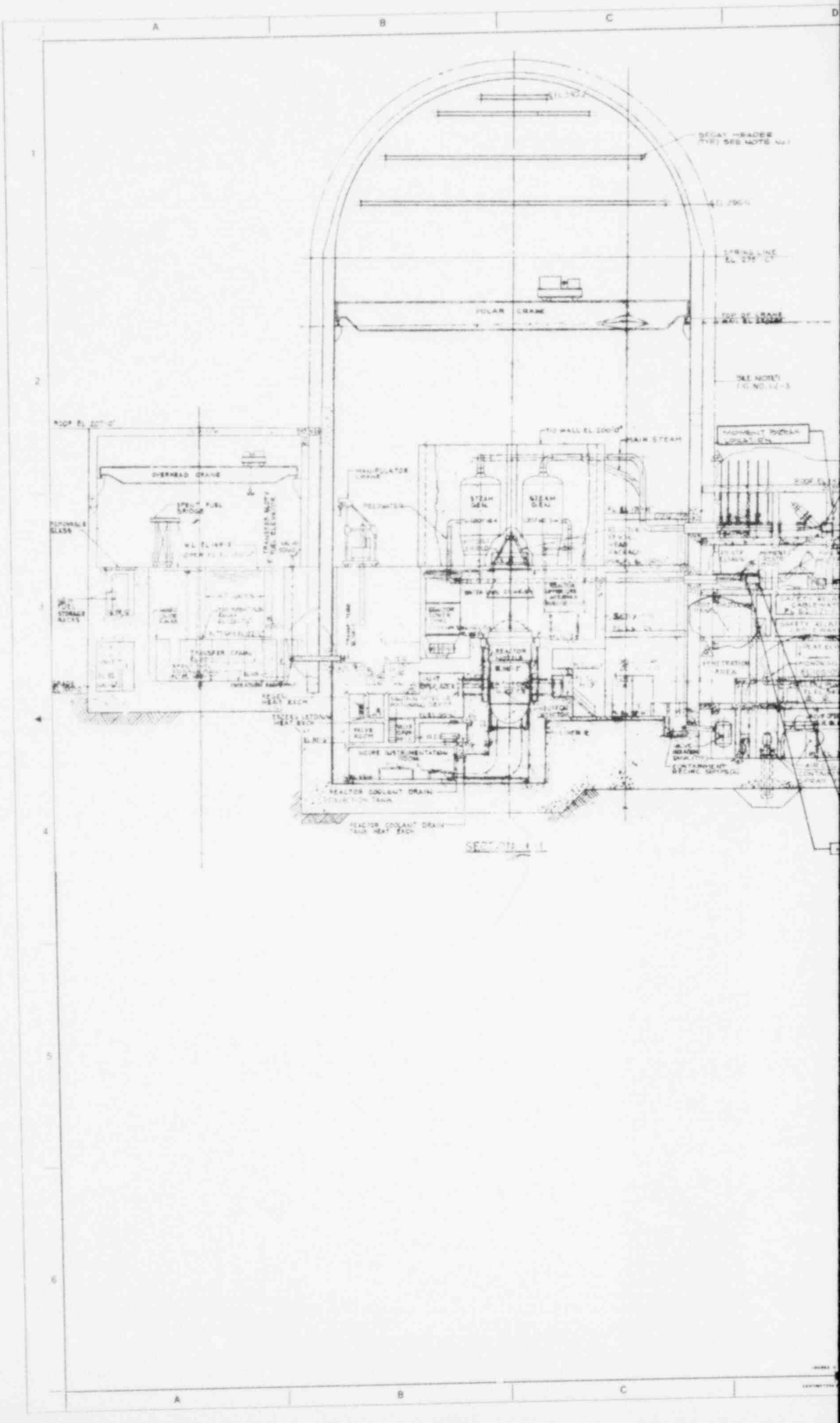
AMENDMENT 10

GIBBSSAR

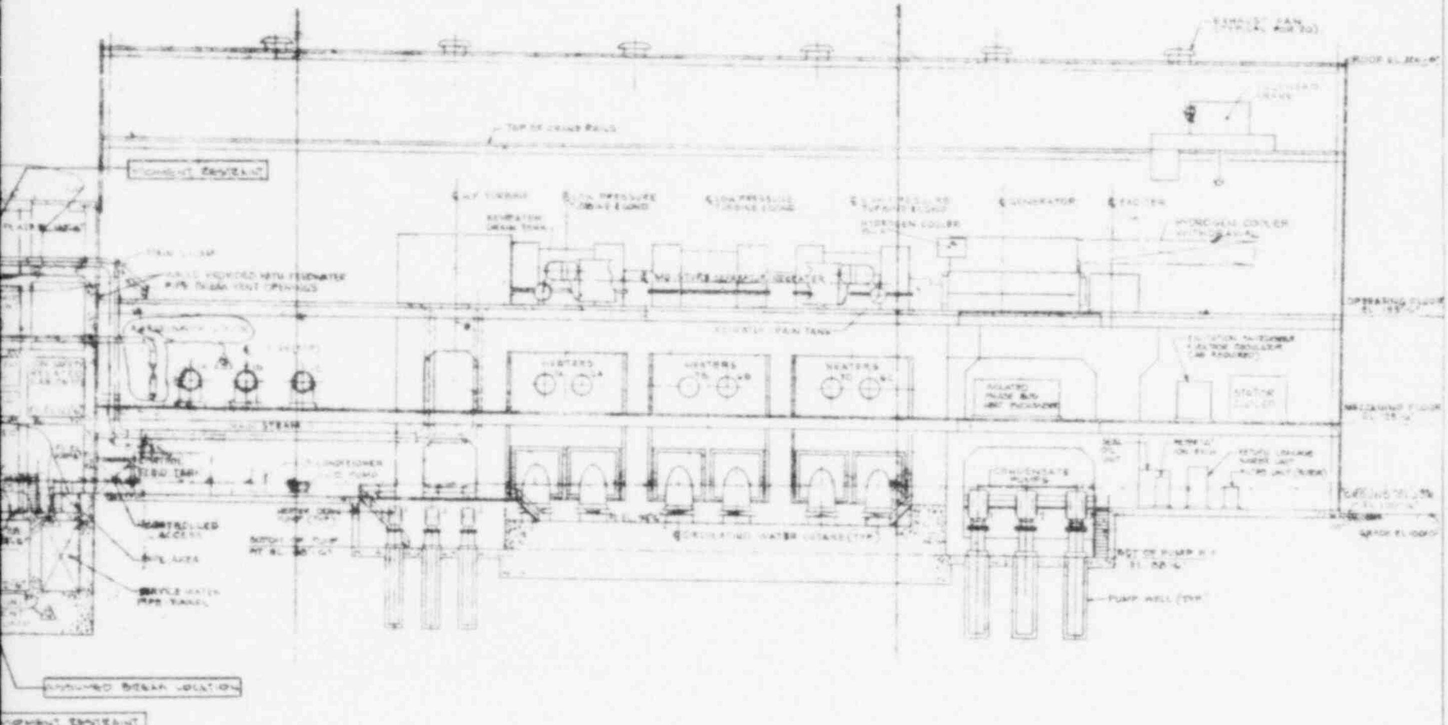
NSSS:
NOT SPECIFIC ■
W-414 □
CE □
B&W □

MAIN STEAM & FEEDWATER ROUTING & PIPE WHIP PROTECTION

FIGURE NO. 3.6-1A

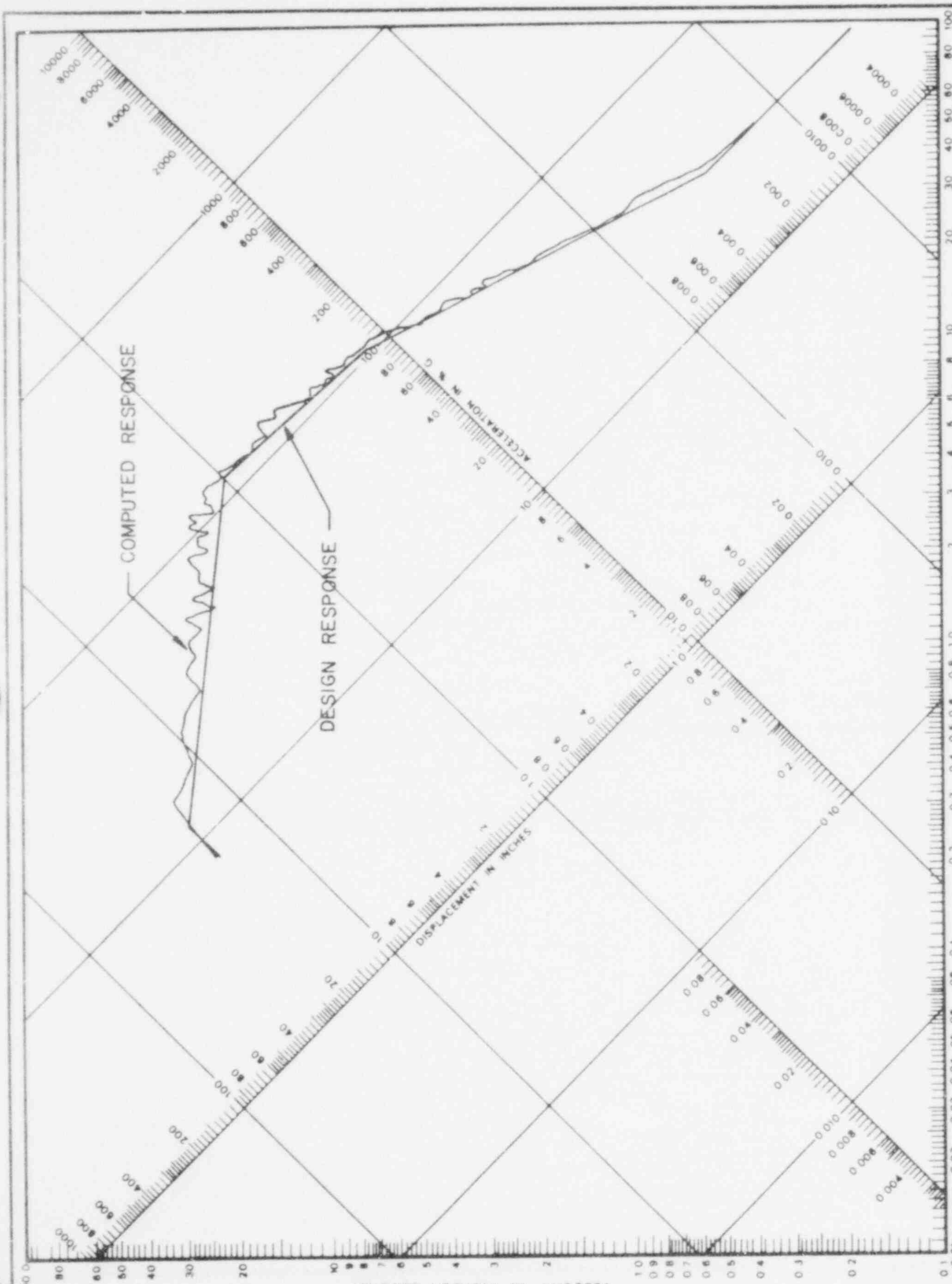


A
B
C
D
POLAR CRANE
OVERHEAD CRANE
STEAM GEN
STEAM GEN
MAIN STEAM
REACTOR
FEEDWATER
SPENT FUEL BRIDGE
MANIPULATOR CRANE
TRANSFER CANAL
PENETRATION AREA
REACTOR COOLANT DRAIN COLLECTION TANK
REACTOR COOLANT DRAIN TANK HEAT EXCH
CORE INSTRUMENTATION ROOM
VALVE ROOM
EXCESS LETDOWN HEAT EXCH
REGEN HEAT EXCH



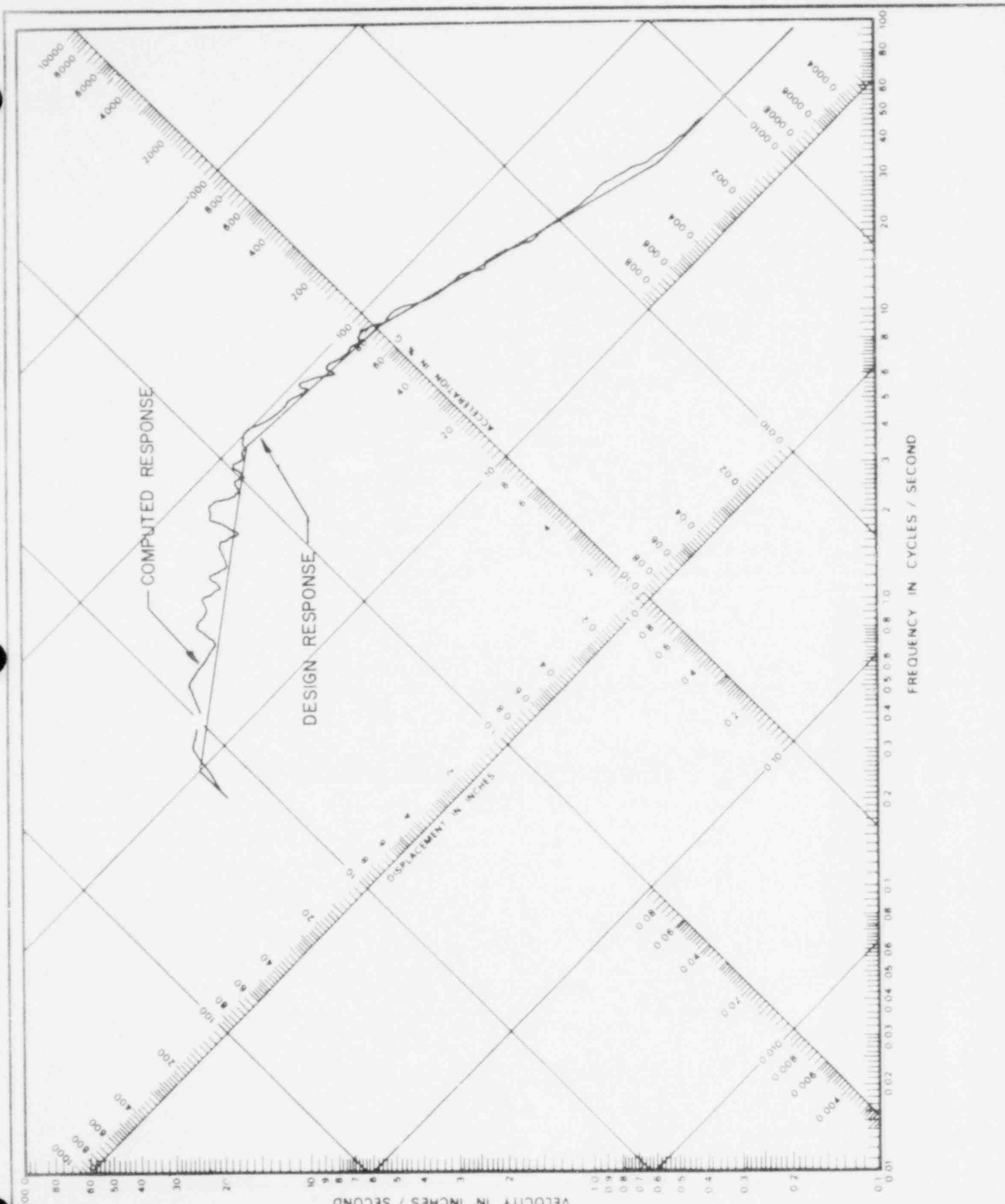
AMENDMENT 10

GIBBSSAR	MAIN STEAM & FEEDWATER ROUTING & PIPE WHIP PROTECTION
NSSS: NOT SPECIFIC ■ W-414 ☐ CE ☐ B&W ☐	FIGURE NO. 3E-18



GIBBSSAR	SSE VERTICAL RESPONSE SPECTRA AT 2 % DAMPING
NSSS: NOT SPECIFIC ■ W - 414 □ CE □ B & W □	FIGURE NO. 3.7 - 8

AMENDMENT 10



GIBBSSAR

NSSS:
NOT SPECIFIC ☒
W-414 ☐
CE ☐
B & W ☐

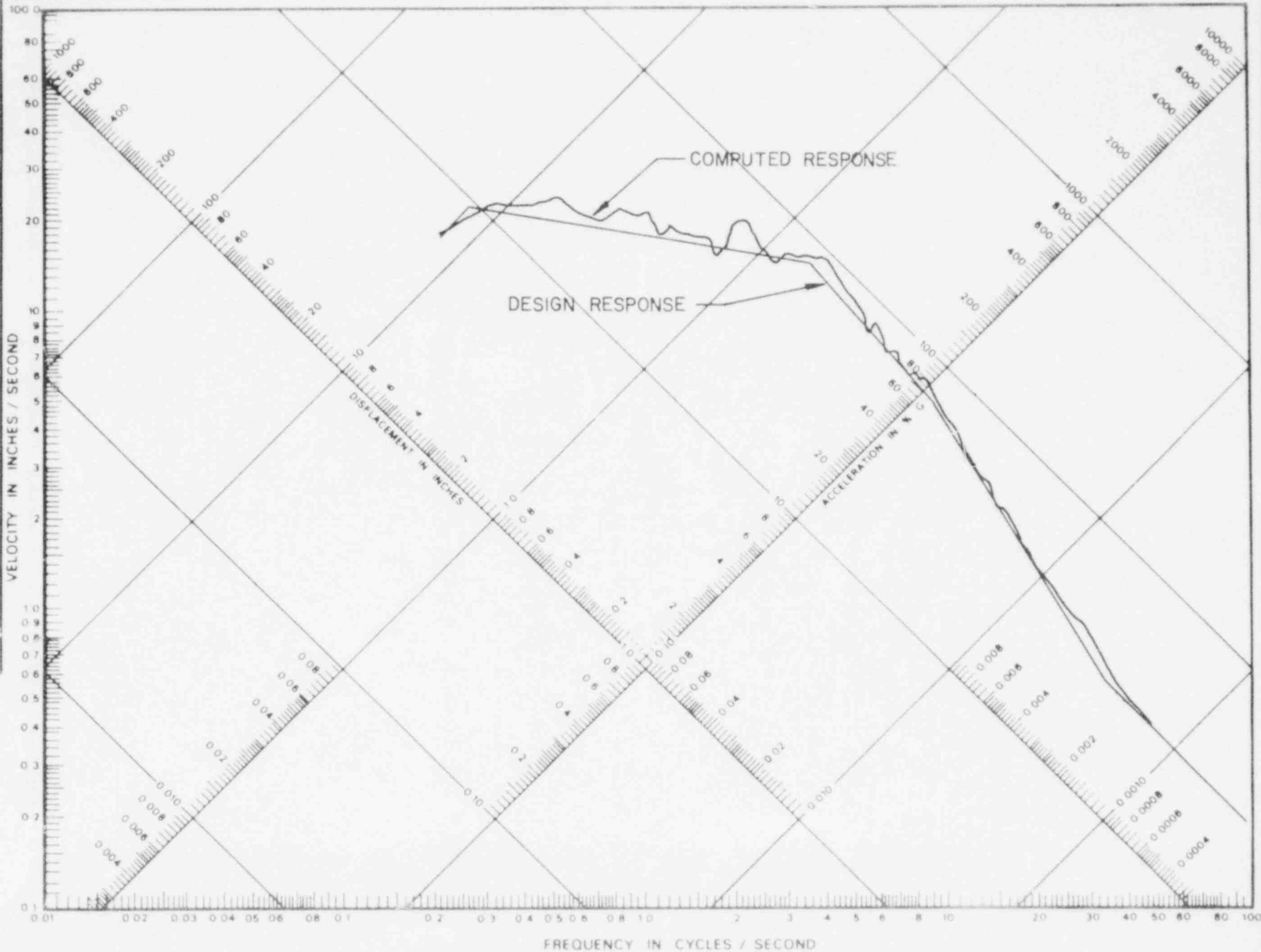
SSE VERTICAL RESPONSE SPECTRA AT 5% DAMPING

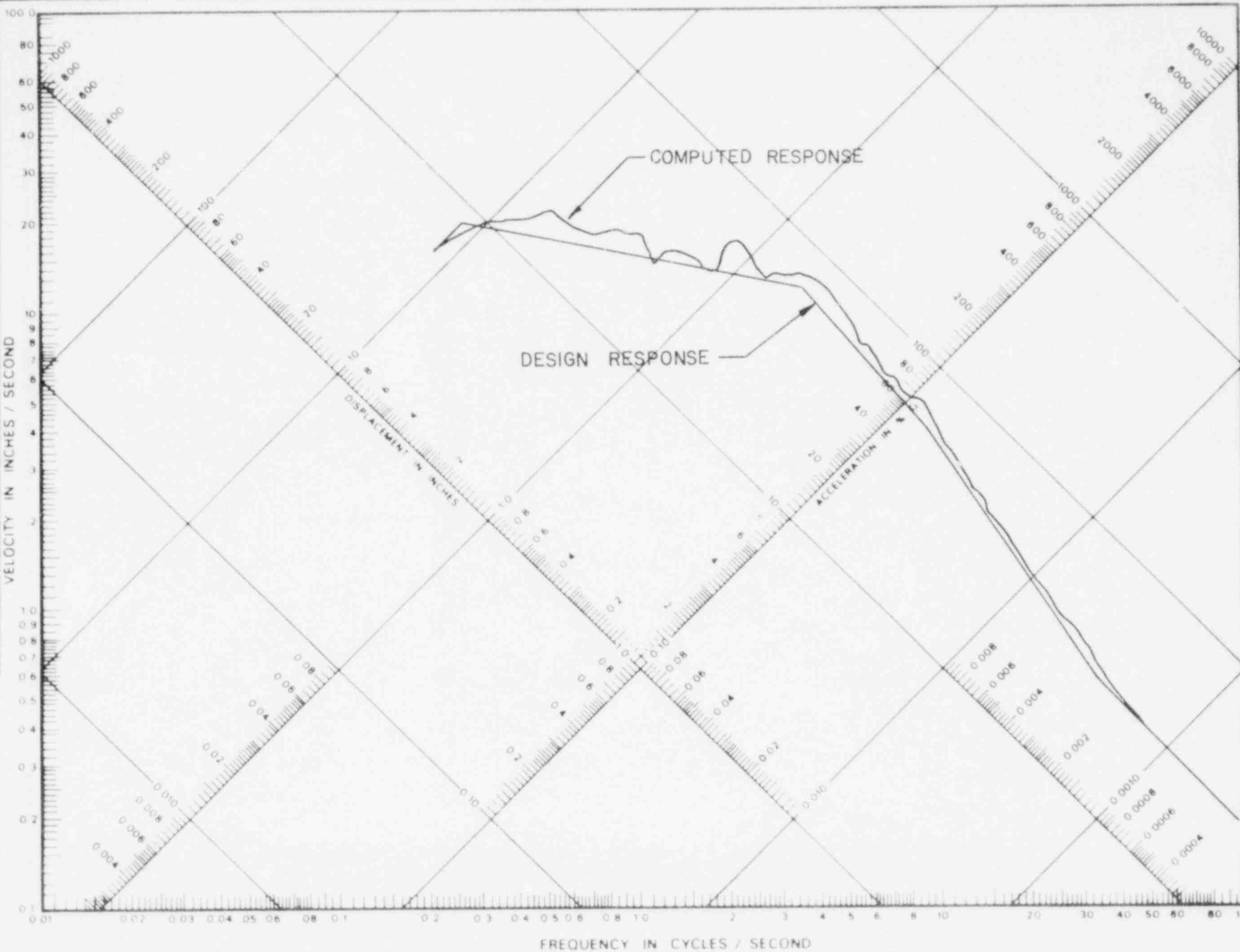
FIGURE NO. 3.7-9

AMENDMENT 10

SSE VERTICAL RESPONSE SPECTRA AT 7% DAMPING

FIGURE NO. 3.7-10





GIBBSSAR

NSSS:
NOT SPECIFIC ☒
W-414 ☐
CE ☐
B&W ☐

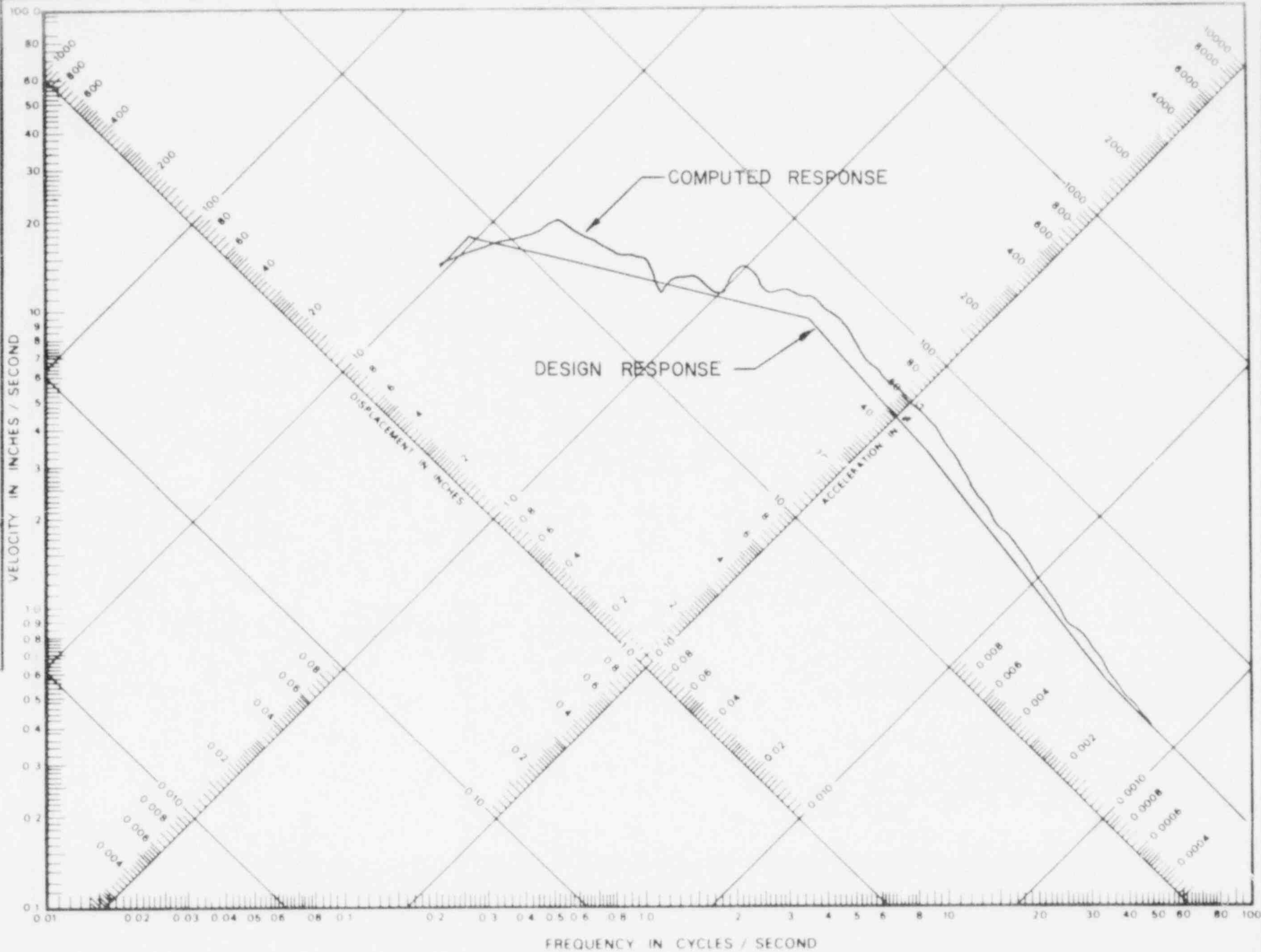
SSE VERTICAL RESPONSE
SPECTRA AT 10% DAMPING

FIGURE NO. 3.7-11

AMENDMENT 10

GIBBSSAR

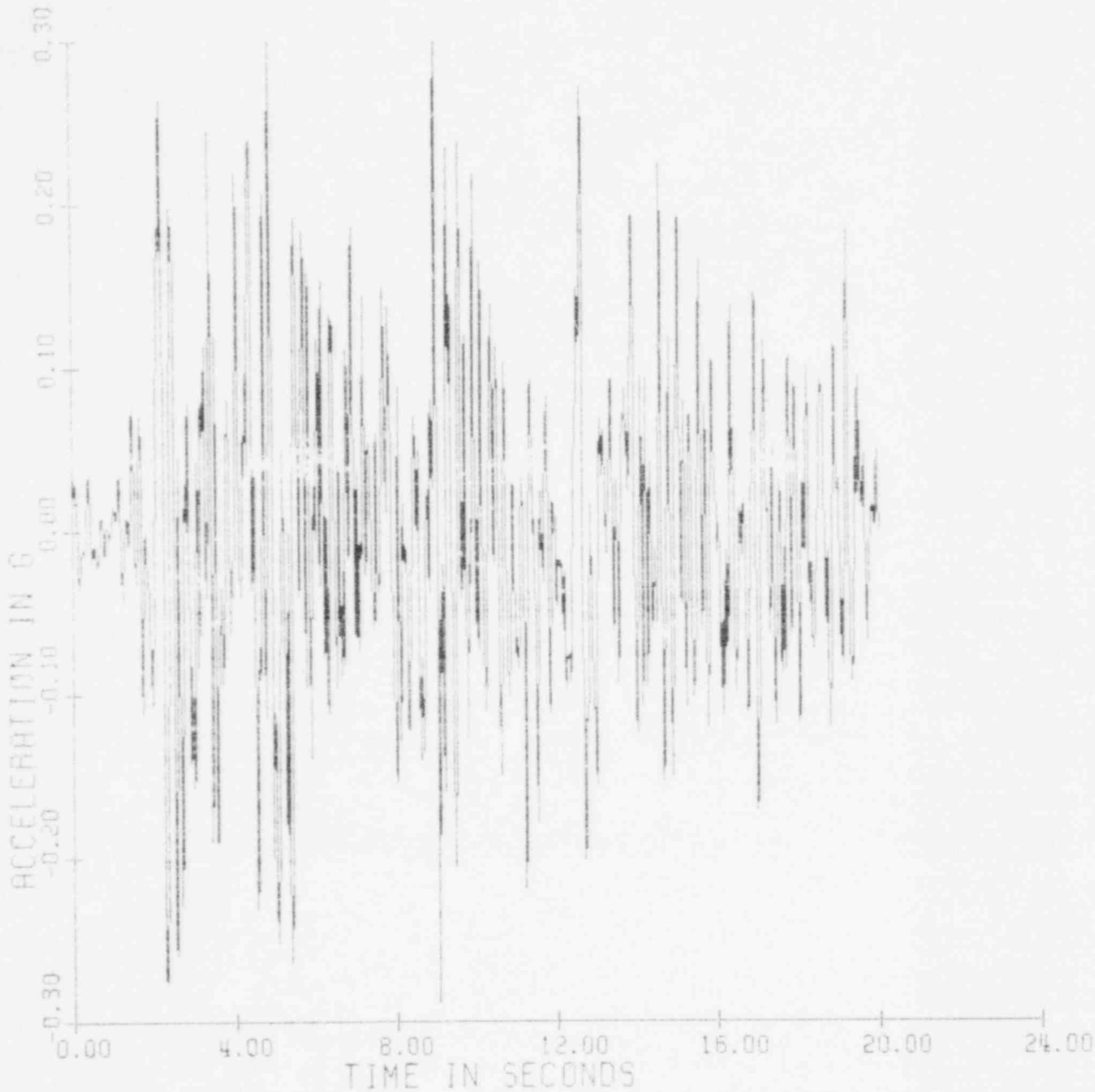
NSSS:
NOT SPECIFIC
W-414
CE
B&W



SSE VERTICAL RESPONSE SPECTRA AT 15% DAMPING

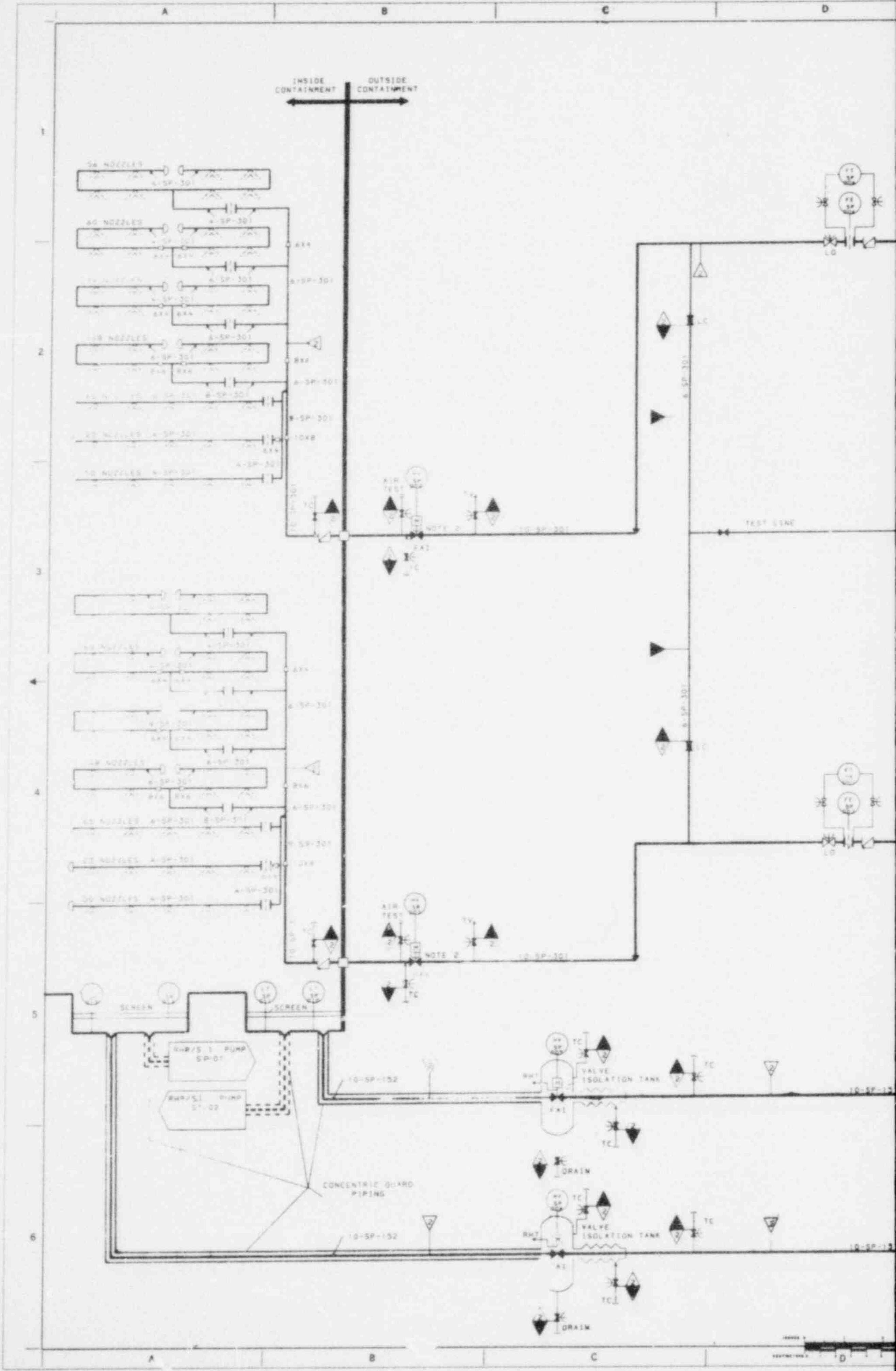
FIGURE NO. 3.7-12

AMENDMENT 10

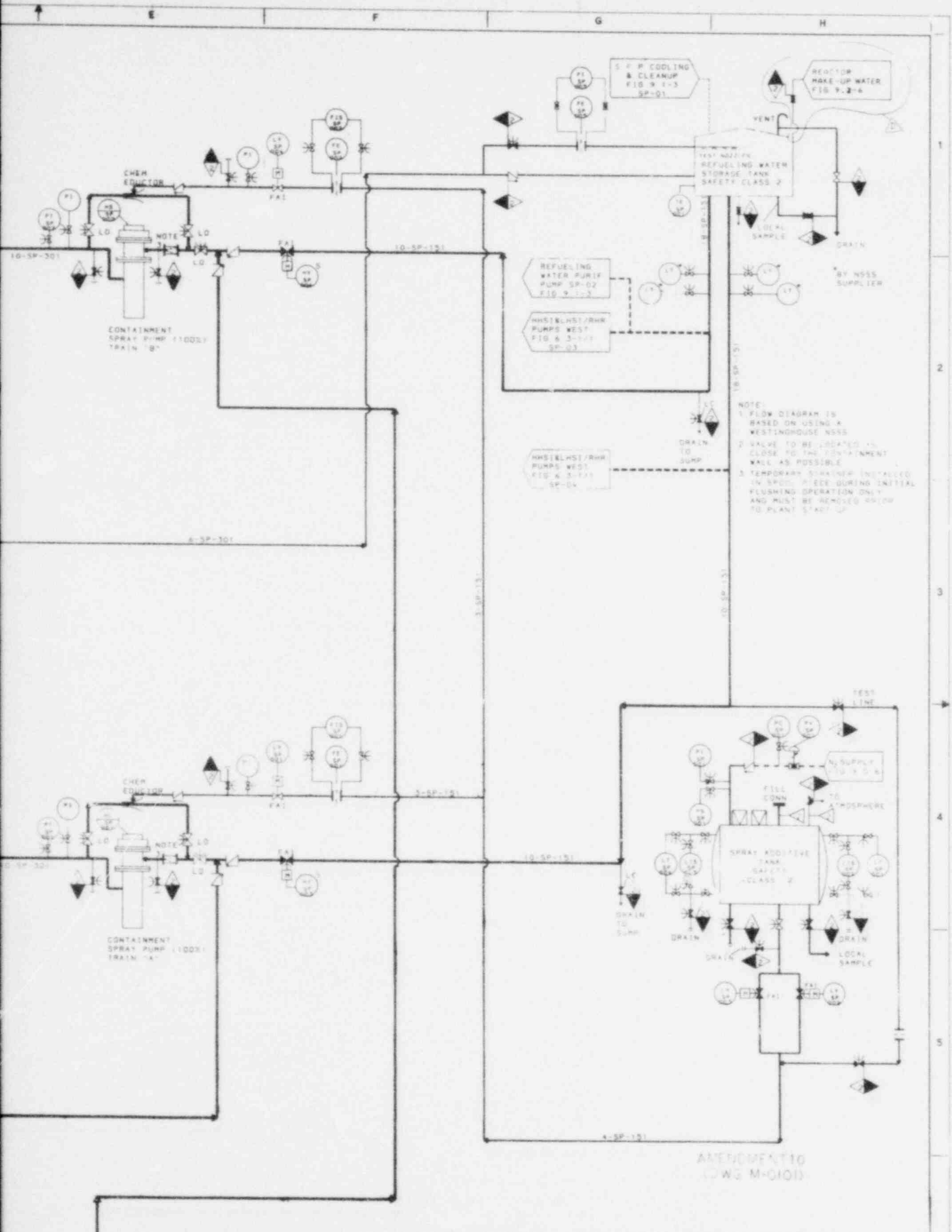


AMENDMENT 10

GIBBSSAR	SSE VERTICAL ARTIFICIAL TIME HISTORY
NSSS NOT SPECIFIC ■ W-4,4 □ CE □ B&W □	FIGURE NO. 3.7-14



A
B
C
D
INSIDE CONTAINMENT
OUTSIDE CONTAINMENT
TEST LINE
AIR TEST
NOTE 2
SCREEN
RHR/SI PUMP SP-01
RHR/SI PUMP SP-02
10-SP-152
VALVE ISOLATION TANK
DRAIN
CONCENTRIC GUARD PIPING

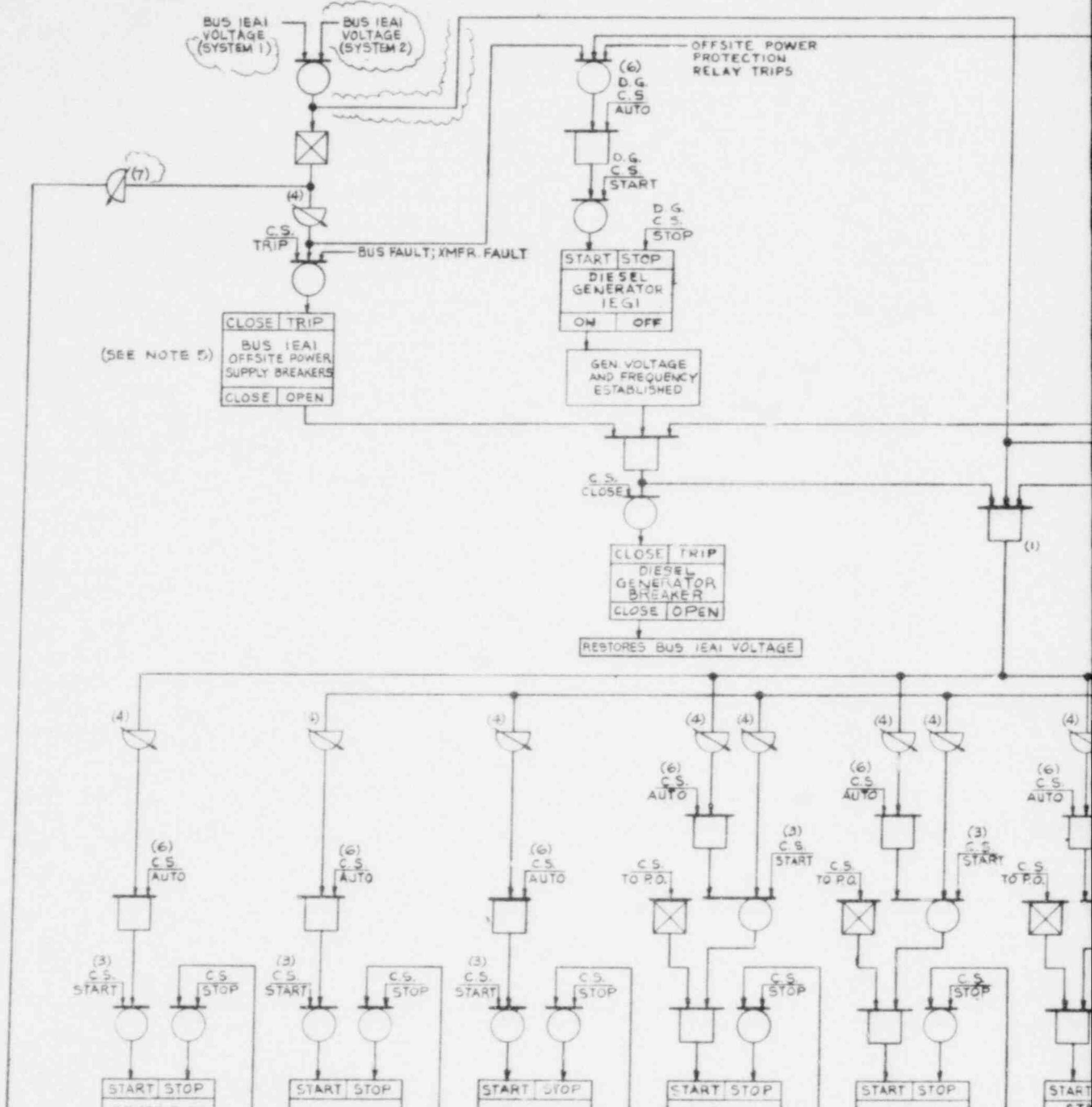


GIBBSSAR

NSSS:
NOT SPECIFIC ☐
W-414 ■
CE ☐
B&W ☐

FLOW DIAGRAM CONTAINMENT SPRAY SYSTEM

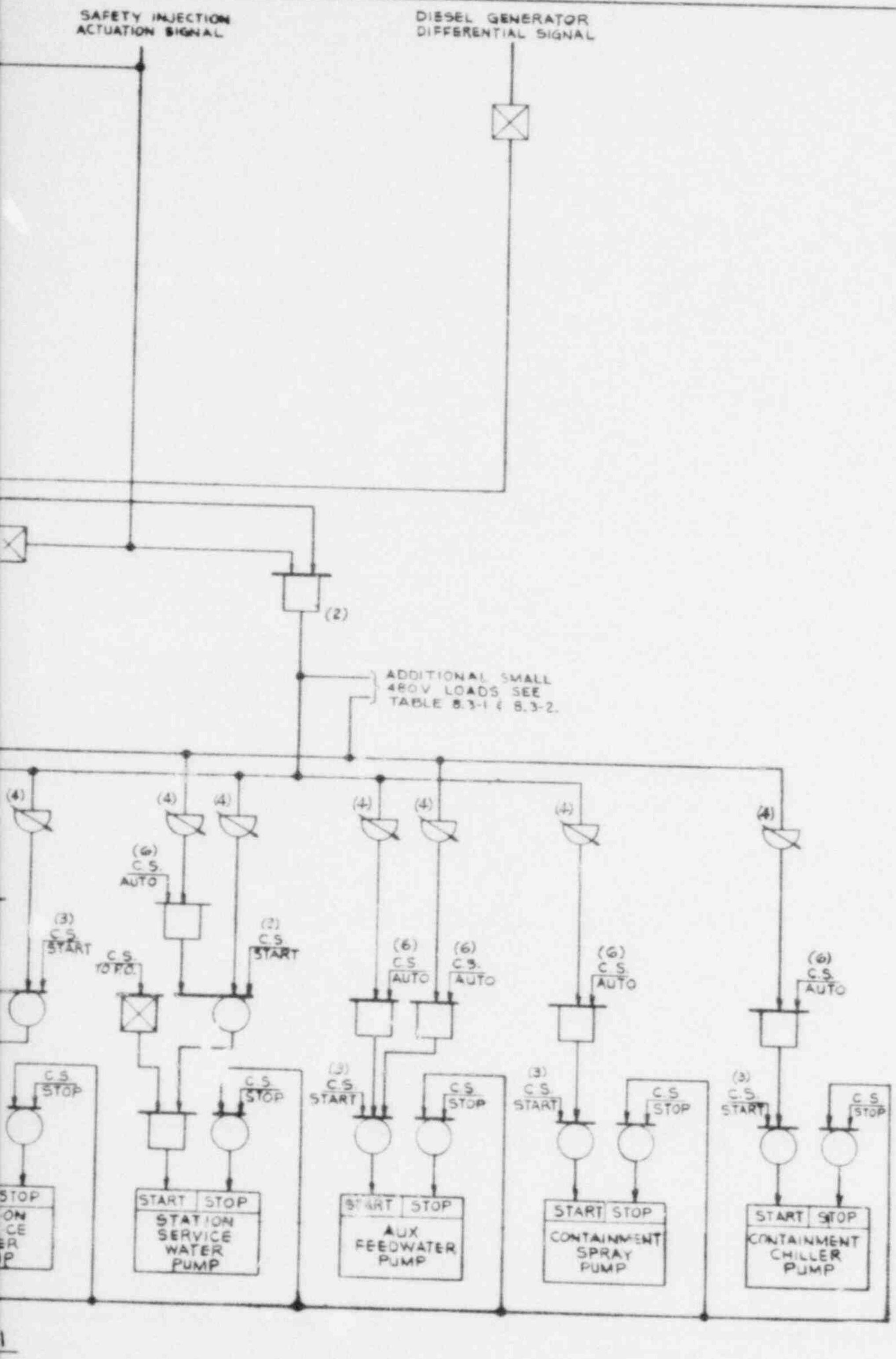
FIGURE NO. 6.2-25



LOGIC START DIAGRAM - DIESEL GENERATOR 1E

TRAIN A

(TYPICAL FOR DIESEL GENERATOR 1EG2)



LEGEND

- ⊠ — NOT
- — ADJUSTABLE TIME DELAY
- — OR
- — AND
- — CIRCUIT BREAKER WITH CONTROL FUNCTIONS AS SHOWN ON DIAGRAM

C.S. — CONTROL SWITCH

D.G. — DIESEL GENERATOR

P.O. — PULL OUT

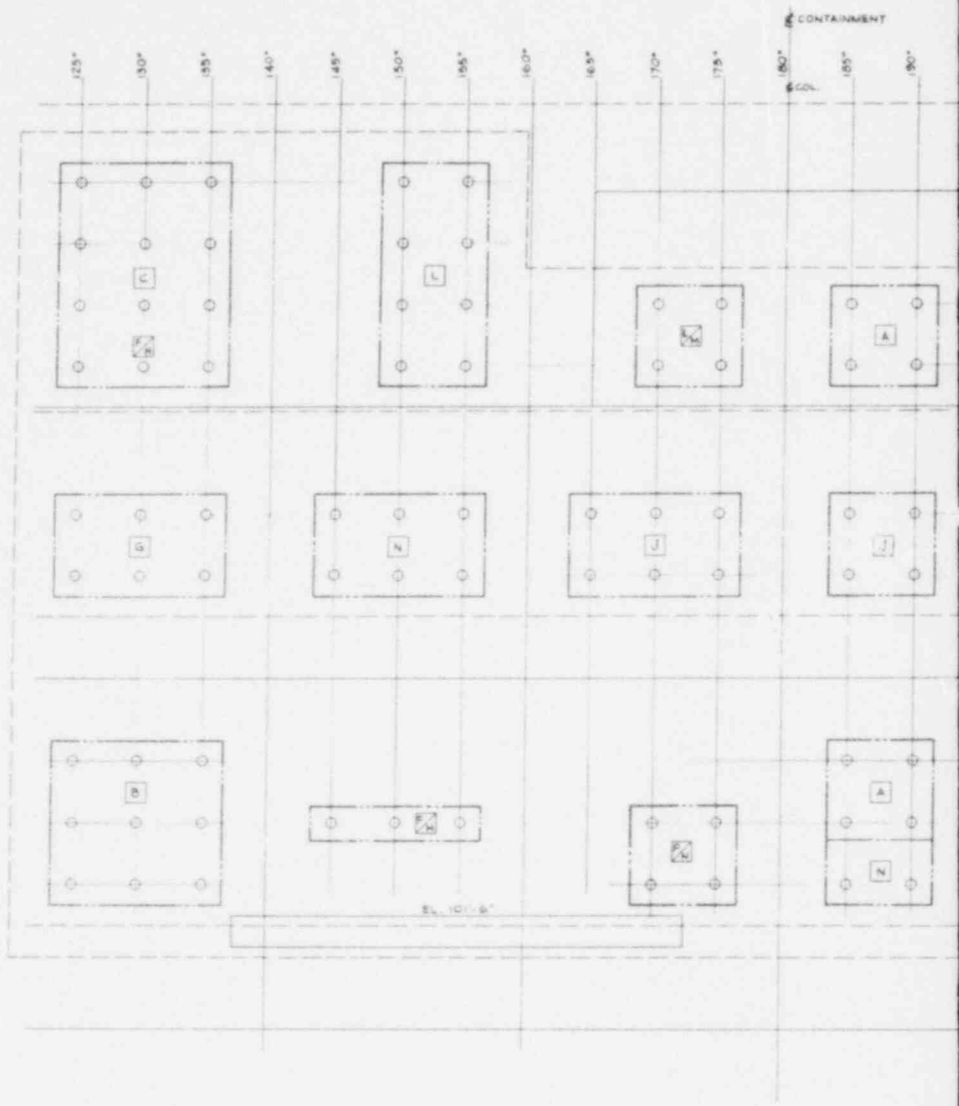
NOTES

1. DIAGRAM SHOWS THE AUTOMATIC SEQUENCE OF THE DIESEL-GENERATOR STARTING AND LOADING SEQUENCE. OTHER FUNCTIONS OPERATING ON THE CIRCUIT BREAKERS SHOWN ARE OMITTED FOR SIMPLICITY.
2. FOR THE ELECTRICAL ONE LINE DIAGRAM SEE FIGURE 8.3-1.
3. INDICATES THAT MANUAL STARTING IS BLOCKED DURING AUTOMATIC SEQUENCING. INDICATES THAT AUTOMATIC STARTING IS BLOCKED DURING SEQUENCING AND UNTIL THE SEQUENCER IS RESET.
4. FOR TIME SEQUENCE SEE TABLE 8.3-1 & 8.3-2.
5. RESTORATION OF BUS 1EA1 VOLTAGE BY DIESEL GENERATOR WILL NOT RECLOSE OFFSITE POWER SUPPLY BREAKERS OR INTERRUPT LOADING SEQUENCE.
6. WILL ALARM IN CONTROL ROOM WHEN CONTROL SWITCH IS NOT IN AUTO POSITION.
7. LOAD SHED WILL BE INITIATED AFTER TIME DELAY. LOAD SHED WILL BE AUTOMATICALLY BLOCKED DURING SEQUENCER CYCLE AND AUTOMATICALLY REINSTATED AT THE COMPLETION OF THE SEQUENCER CYCLE.

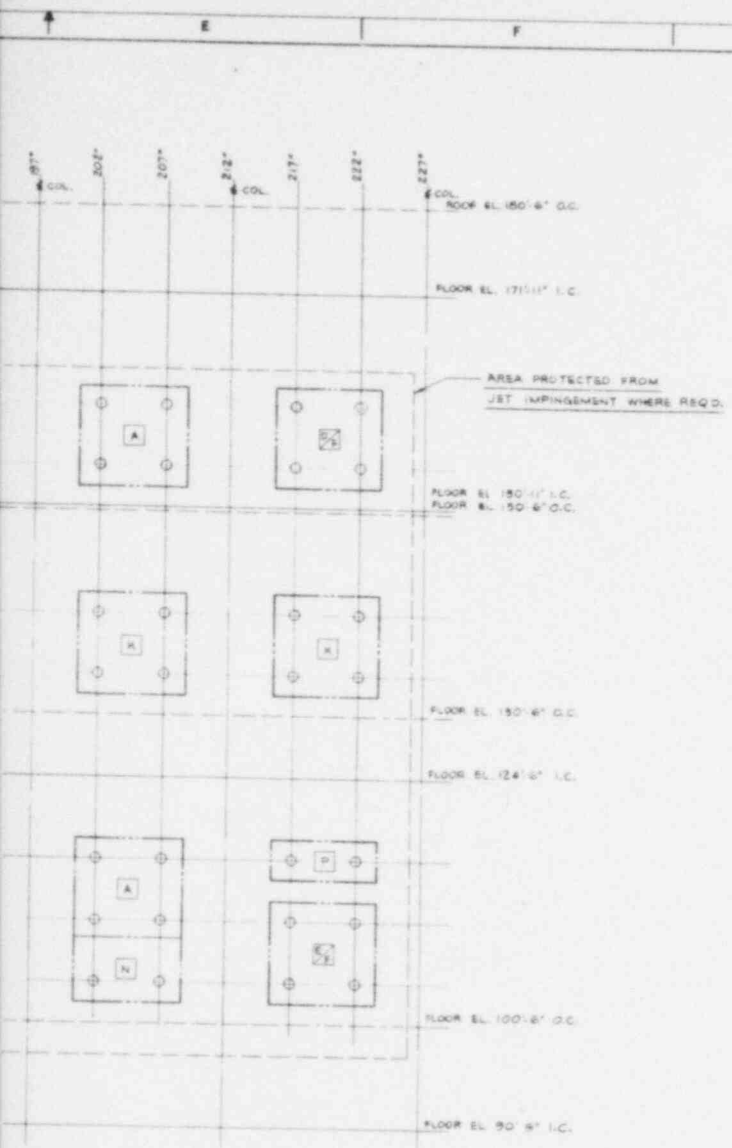
AMENDMENT 10

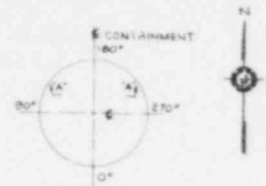
GIBBSSAR	STANDBY DIESEL GENERATOR AUTOMATIC STARTING & LOADING SEQUENCE
NSSS: NOT SPECIFIC ☐ W-414 ☒ CE ☐ B&W ☐	FIGURE NO. 8.3-2

FIG. Nº 8.3-2



SECTION "A-A"
(PRELIMINARY NOZZLE LOCATIONS FOR ELECTRICAL PENETRATIONS)

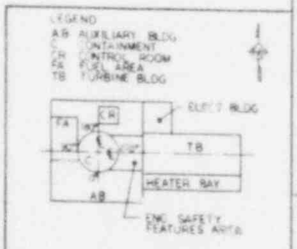




SECTION PLAN

TABLE FOR CONTAINMENT PENETRATION REQUIREMENTS				
PENETRATION ASSIGNMENTS		PENETRATIONS REQUIRED		
ASSIGNMENT	DESCRIPTION	USED	SPARES	TOTAL
A	6.9KV POWER	8	8	16
B	TRAIN "A" & CHANNEL I	8	1	9
C	TRAIN "B" & CHANNEL II	8	1	9
D	CHANNEL IV	2	—	2
E	CHANNEL III	2	—	2
F	N.I.S.	8	—	8
G	INCORE FLUX MAPP. & RAD. MON.	5	1	6
H	FIXED INCORE (FUT.)	—	2	2
J	PRESSURIZER HEATERS	5	5	10
K	CRDM POWER	6	2	8
L	NON-CLASS IE	8	2	10
M	MISCELLANEOUS	2	—	2
N	NON-CLASS IE	8	4	12
P	MISCELLANEOUS	2	2	4
TOTAL		72	28	100

NOTE
1- ALL PENETRATION NOZZLE DIAMETERS ARE 12".



KEY PLAN

AMENDMENT 10

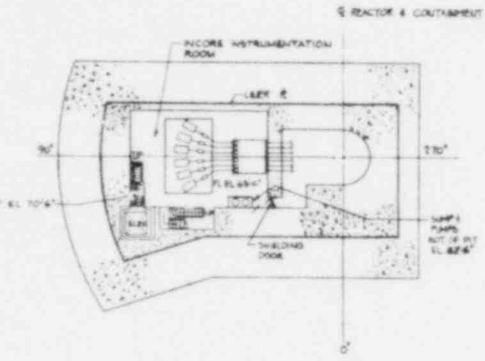
GIBBSSAR

NSSS:
NOT SPECIFIC ☐
W-414 ■
CE ☐
B & W ☐

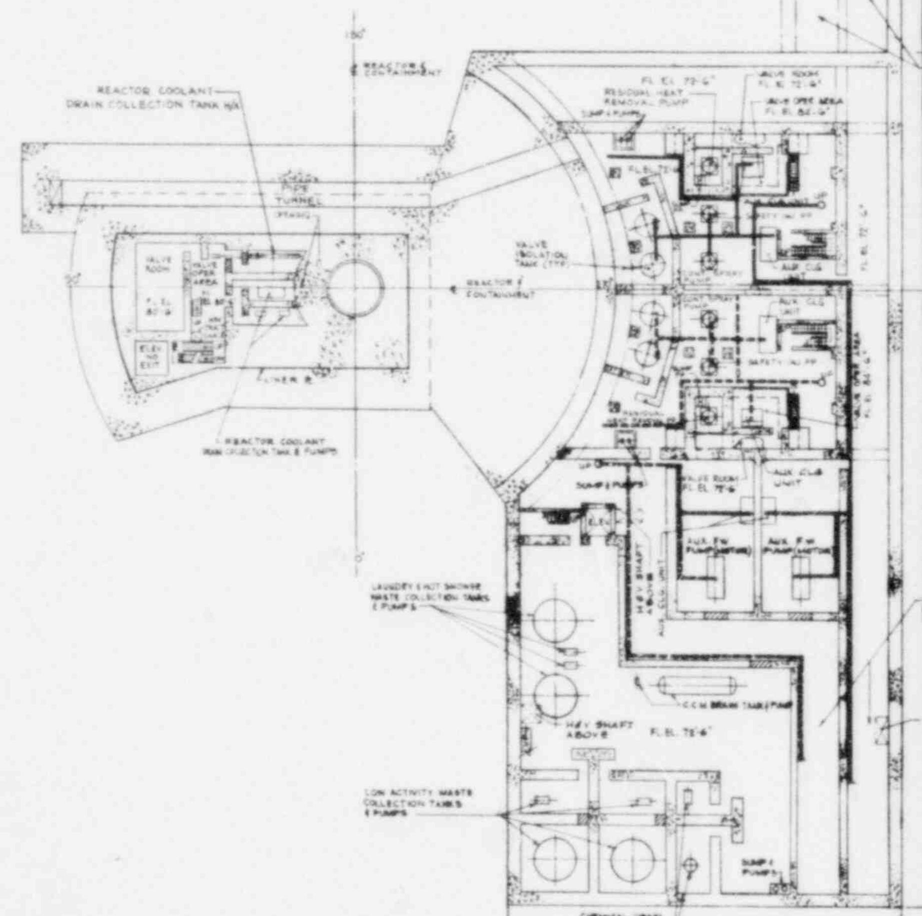
CONTAINMENT
ELECTRICAL PENETRATIONS

FIGURE NO. 8.3-3

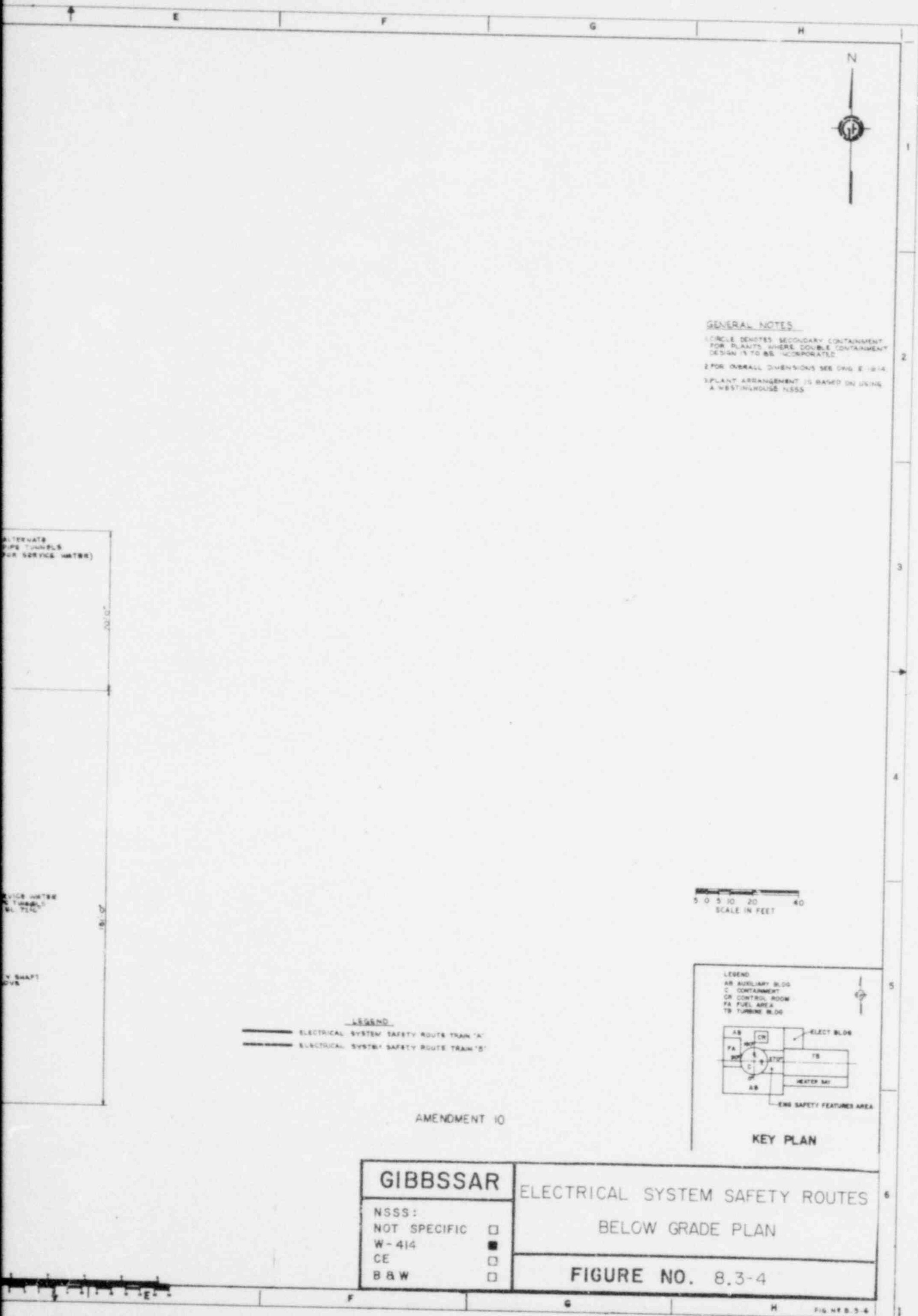
FIG. NO. 8.3-3



PLAN AT EL. 65'-6"



PLAN AT EL. 72'-6", 80'-6"

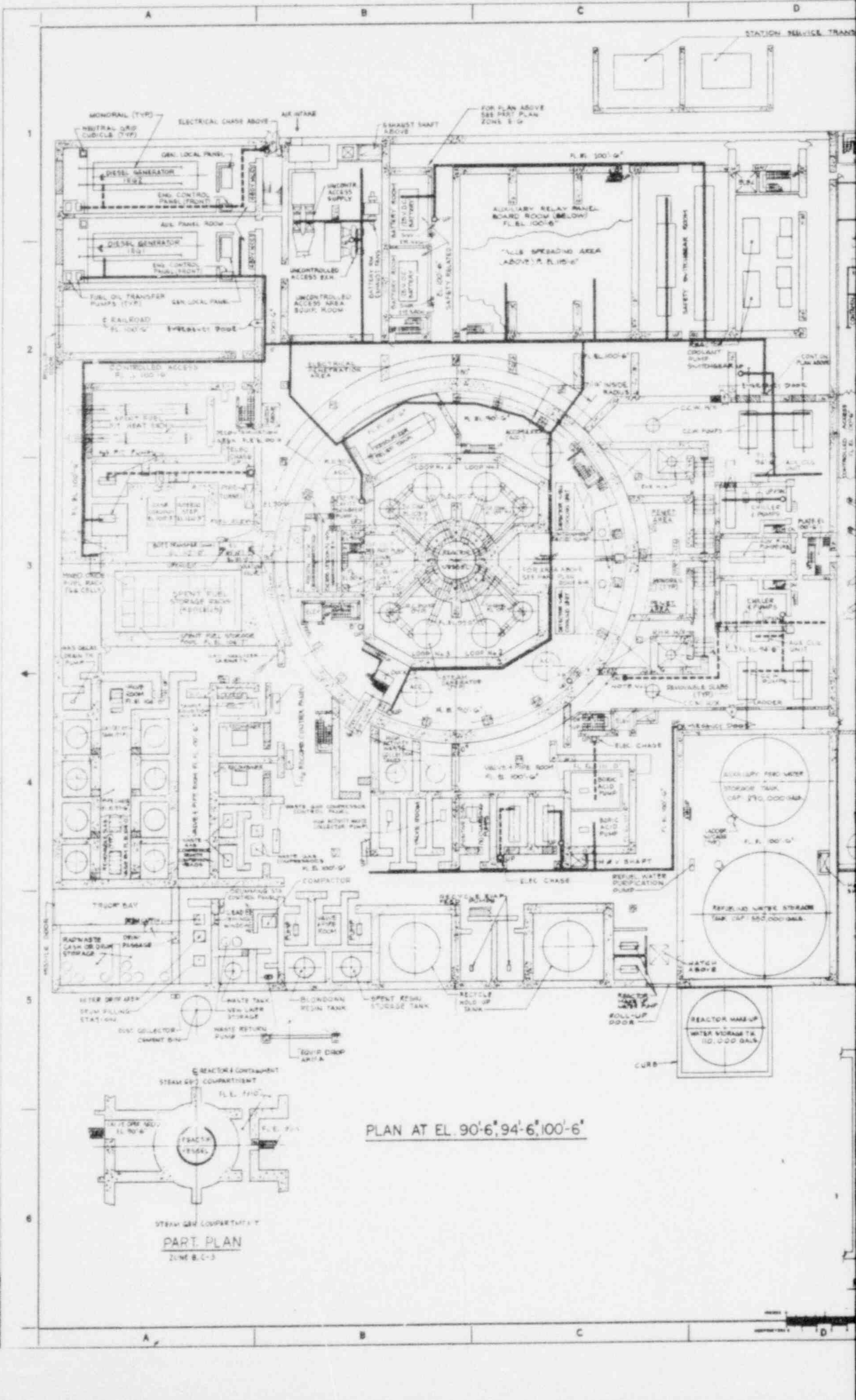


GIBBSSAR

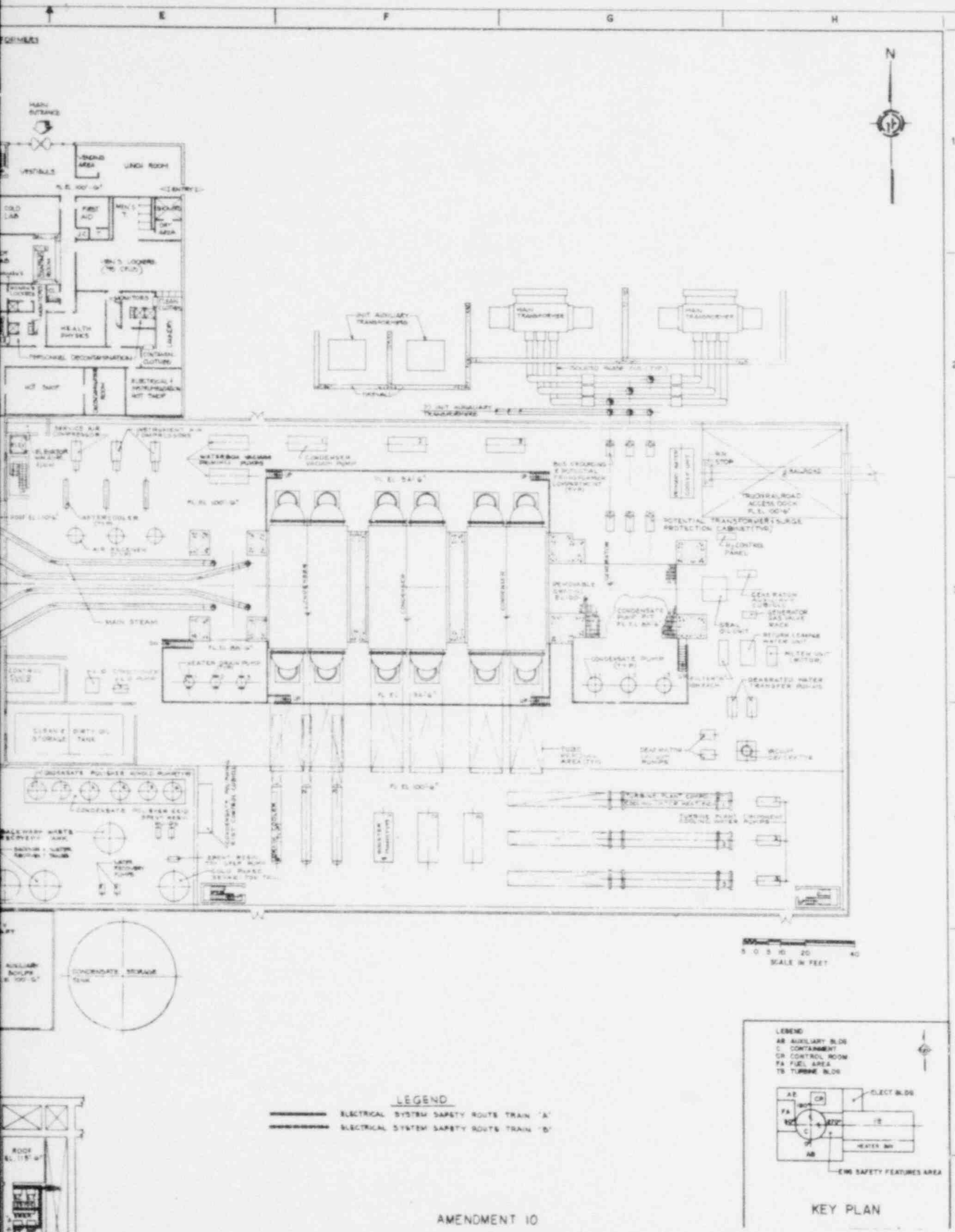
NSSS:
NOT SPECIFIC ☐
W-414 ■
CE ☐
B&W ☐

ELECTRICAL SYSTEM SAFETY ROUTES
BELOW GRADE PLAN

FIGURE NO. 8.3-4

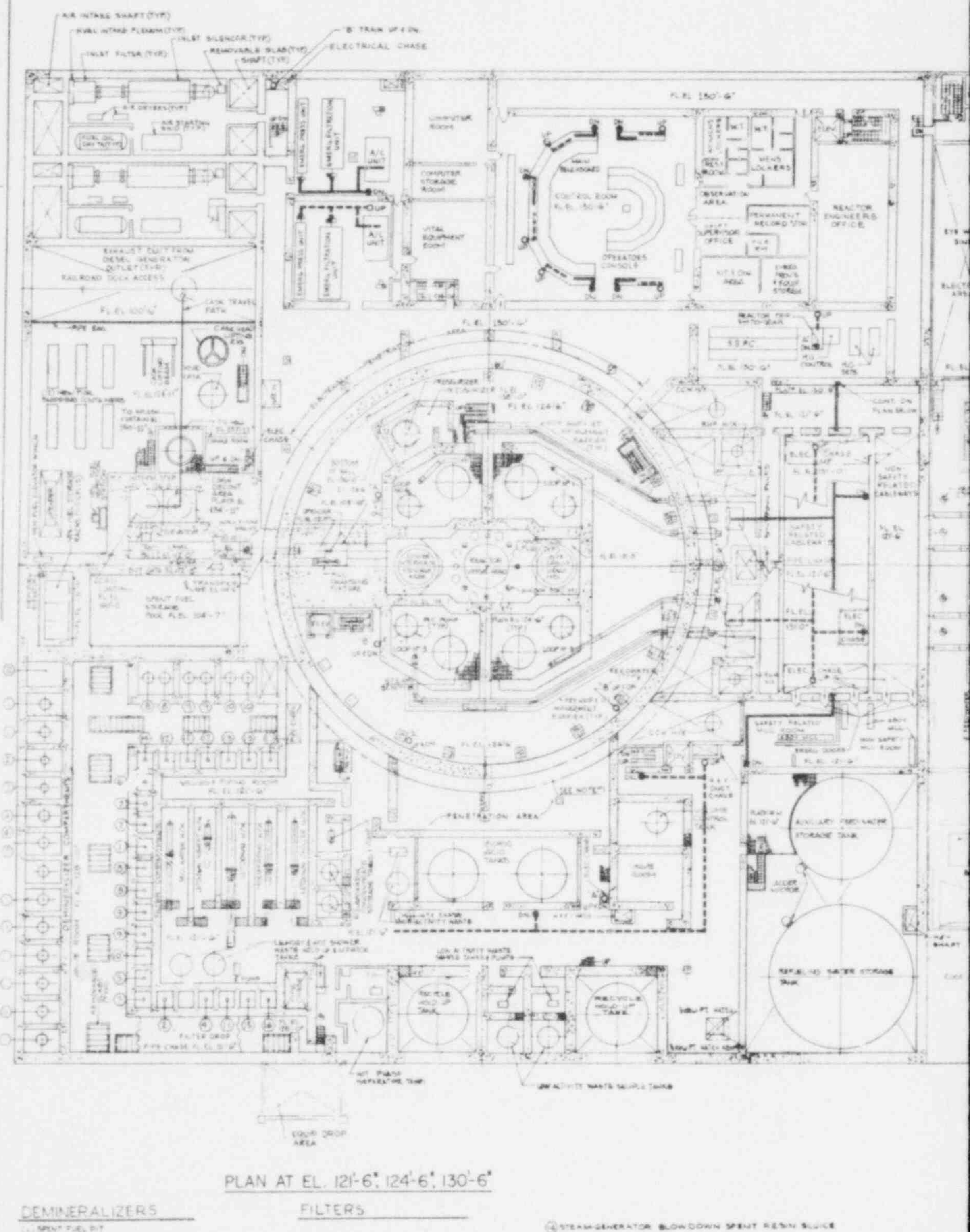


STATION SERVICE TRANS
MONORAIL (TYP)
NEUTRAL GRID CUBICLE (TYP)
ELECTRICAL CHASE ABOVE
AIR INTAKE
EXHAUST SHAFT ABOVE
FOR PLAN ABOVE SEE PART PLAN ZONE B-C-3
DIESEL GENERATOR
FUEL OIL TRANSFER PUMPS (TYP)
AUXILIARY RELAY PANEL BOARD ROOM (BELOW)
SAFETY SWITCHGEAR ROOM
ELECTRICAL PENETRATION AREA
CONTROLLED ACCESS
SPENT FUEL PIT HEAT EXCH.
SPENT FUEL STORAGE ROOM
SPENT FUEL STORAGE POOL
REACTOR VESSEL
LOOP No. 1
LOOP No. 2
LOOP No. 3
LOOP No. 4
STEAM GENERATOR
CHILLER & PUMPS
AUXILIARY FEED WATER STORAGE TANK
REFUELING WATER STORAGE TANK
REFUEL WATER PURIFICATION PUMP
BORIC ACID PUMP
ELEC CHASE
TRUCK BAY
RADWASTE CASK OR DRUM STORAGE
COMPACTOR
BLOWDOWN RESIN TANK
SPENT RESIN STORAGE TANK
RECYCLE HOLD UP TANK
HATCH ABOVE
ROLL-UP DOOR
REACTOR MAKE-UP WATER STORAGE TK. 110,000 GALS.
CURB
DRUM FILLING STATION
DUST COLLECTOR
CEMENT BIN
WASTE RETURN PUMP
EQUIP DROP AREA
PLAN AT EL. 90'-6", 94'-6", 100'-6"
℄ REACTOR & CONTAINMENT
STEAM GEN COMPARTMENT
REACTOR VESSEL
STEAM GEN COMPARTMENT
PART PLAN
ZONE B, C-3
A
B
C
D
1
2
3
4
5
6



AMENDMENT 10

GIBBSSAR	ELECTRICAL SYSTEM SAFETY ROUTES GROUND FLOOR PLAN
NSSS: NOT SPECIFIC ☐ W-414 ■ CE ☐ B&W ☐	FIGURE NO. 8.3-5



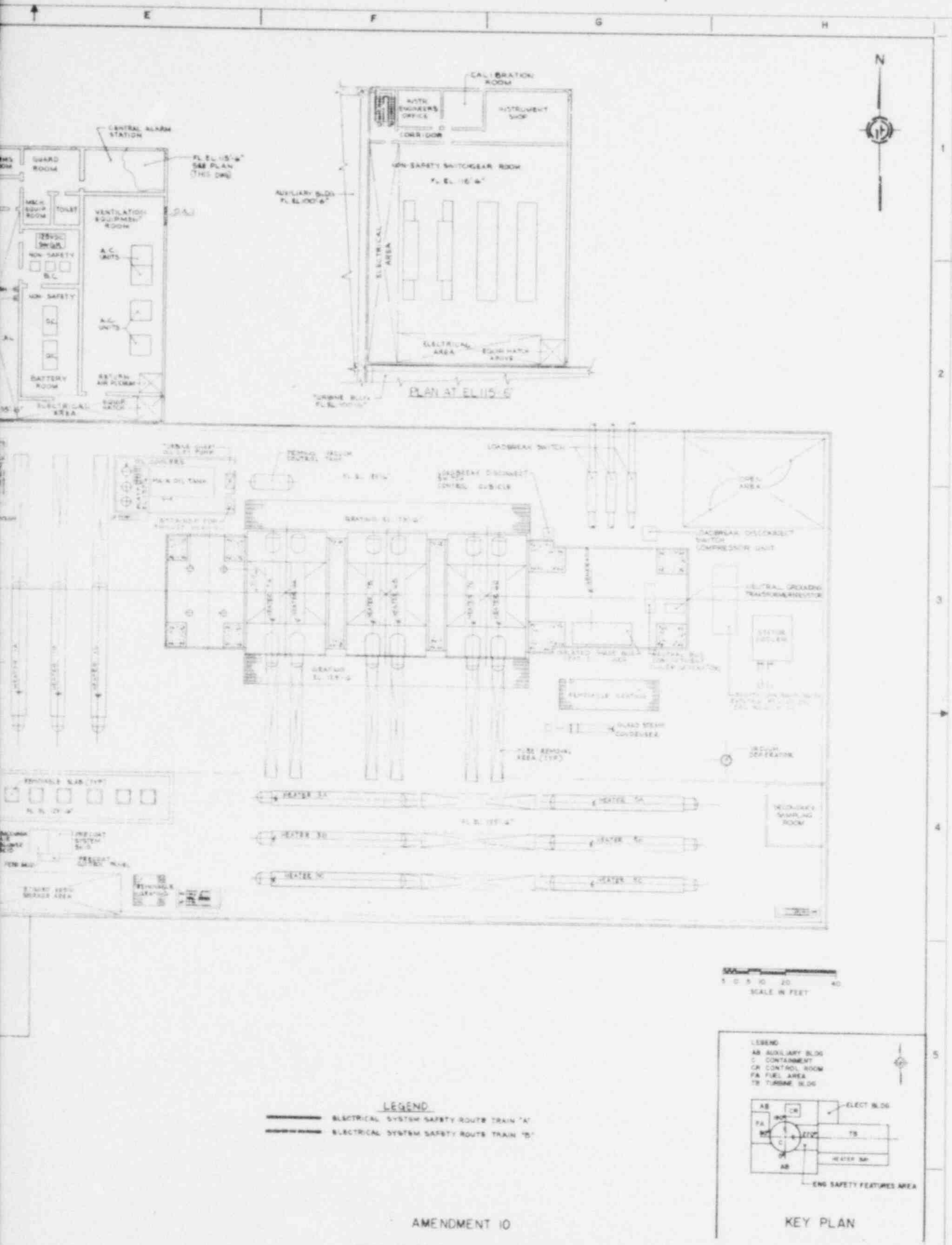
PLAN AT EL. 121'-6", 124'-6", 130'-6"

DEMINERALIZERS

1. SPENT FUEL PIT
2. HIGH ACTIVITY WASTE RECYCLE
3. LOW ACTIVITY WASTE SAMPLE
4. MIXED BED
5. THERMAL REGENERATION
6. RECYCLE EVAPORATOR FEED
7. RECYCLE EVAPORATOR CONDENSATE
8. CATION BED
9. STEAM GENERATOR BLOWDOWN CATION
10. STEAM GENERATOR BLOWDOWN MIXED BED
11. SPARE COMPARTMENT

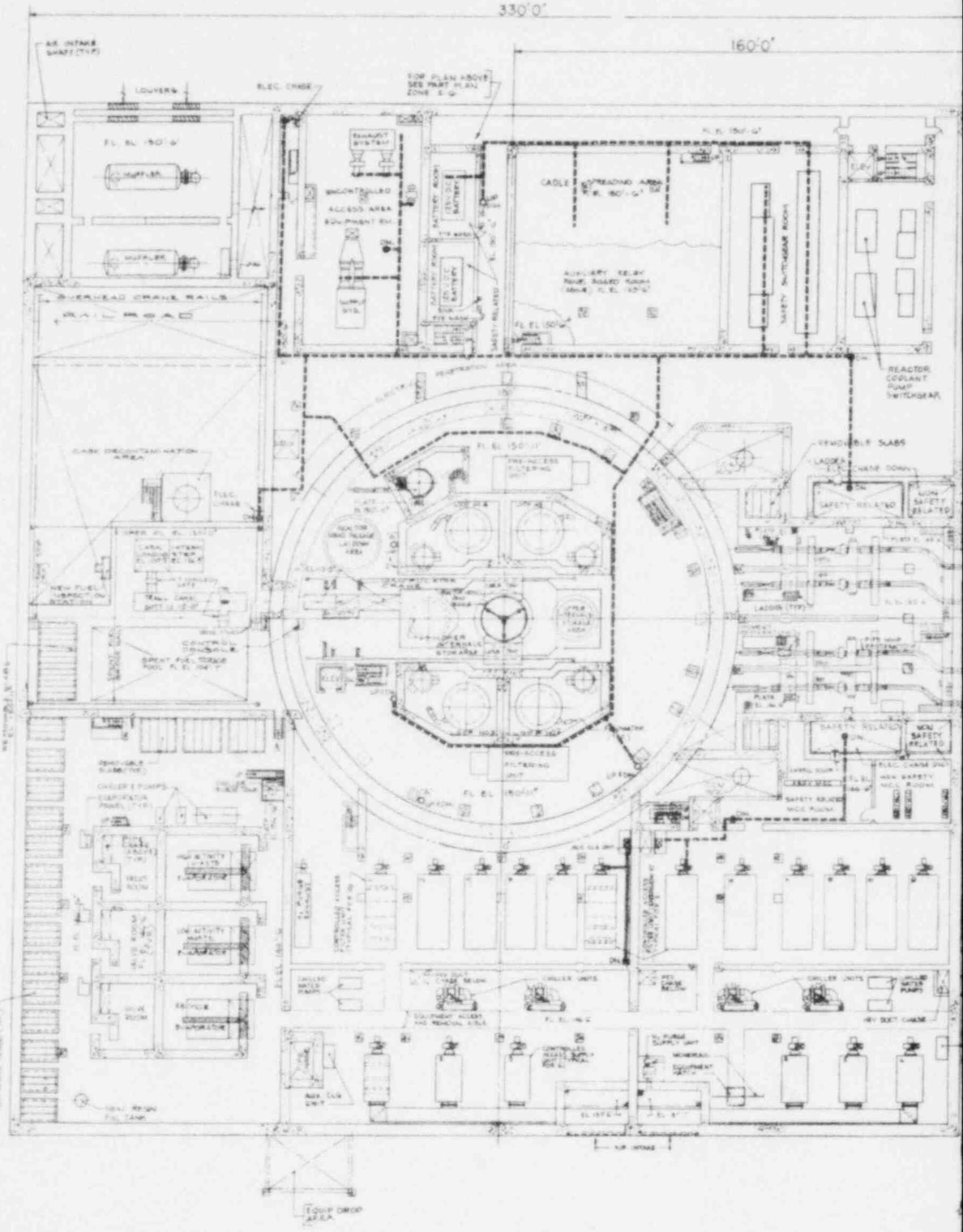
FILTERS

1. HIGH ACTIVITY WASTE
2. LOW ACTIVITY WASTE
3. LAUNDRY & HOT SHOWER WASTE
4. SPENT RESIN SLUICE
5. WASTE GAS DRAIN
6. SPENT FUEL POOL SKIMMER
7. SPENT FUEL POOL
8. REACTOR COOLANT
9. SEAL WATER INJECTION
10. SEAL WATER RETURN
11. BORIC ACID
12. STEAM GENERATOR BLOWDOWN INLET
13. STEAM GENERATOR BLOWDOWN OUTLET
14. STEAM GENERATOR BLOWDOWN SPENT RESIN SLUICE
15. RECYCLE EVAPORATOR FEED
16. RECYCLE EVAPORATOR CONDENSATE

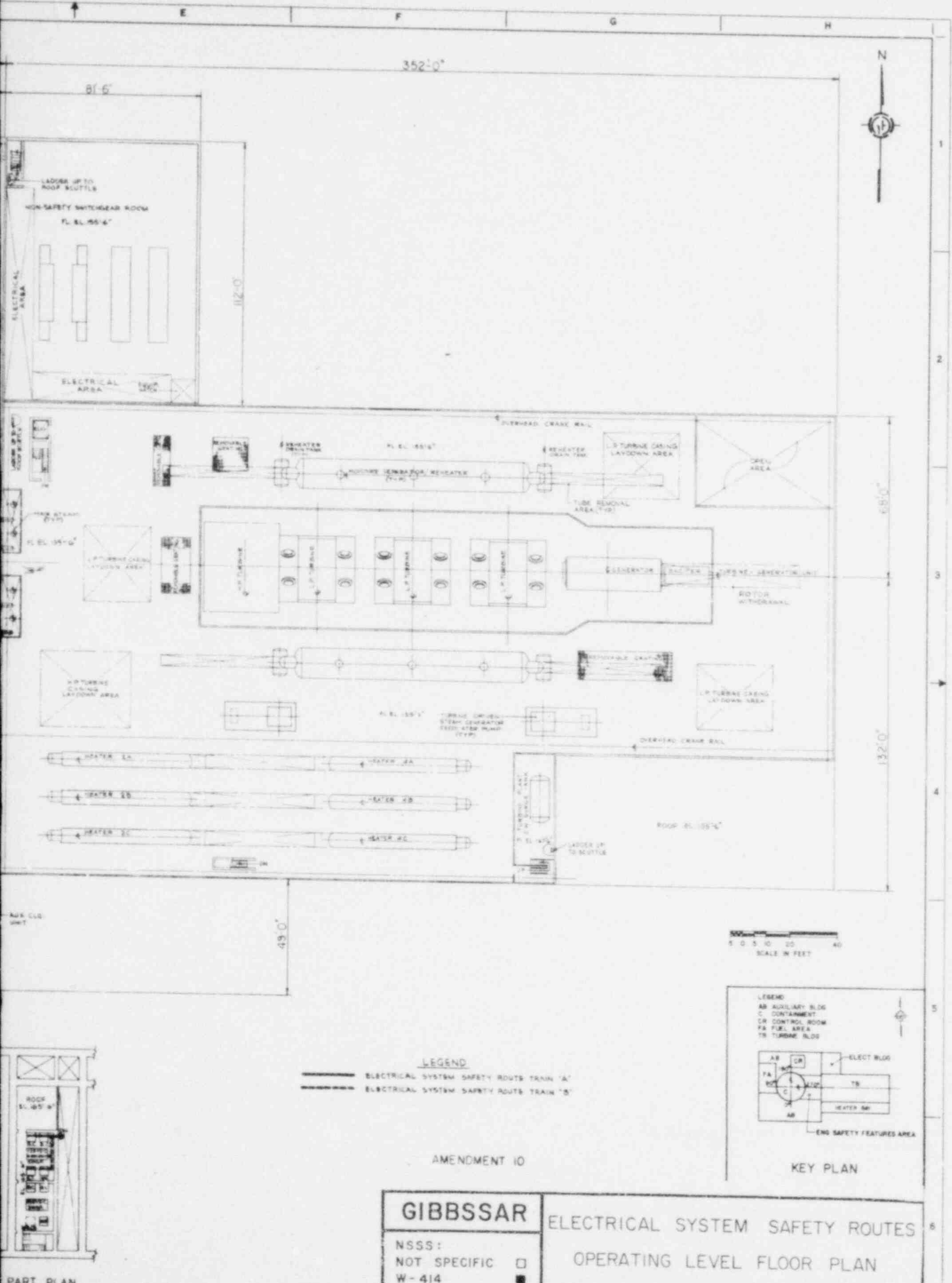


AMENDMENT 10

GIBBSSAR	ELECTRICAL SYSTEM SAFETY ROUTES MEZZANINE FLOOR PLAN
NSSS: NOT SPECIFIC ☐ W-414 ■ CE ☐ B&W ☐	FIGURE NO. 8.3-6

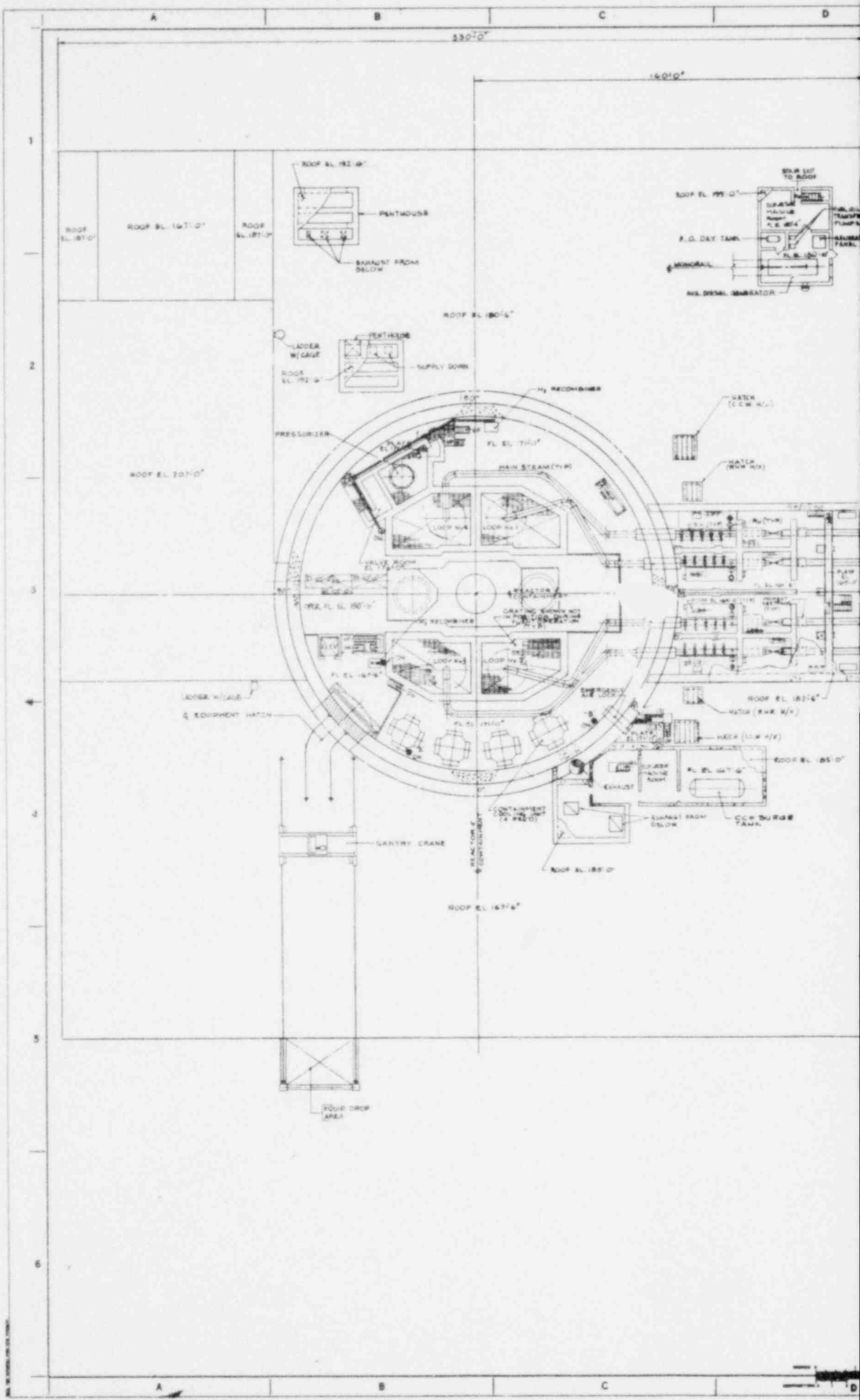


PLAN AT EL. 140'-6", 146'-6", 150'-6", 150'-11"

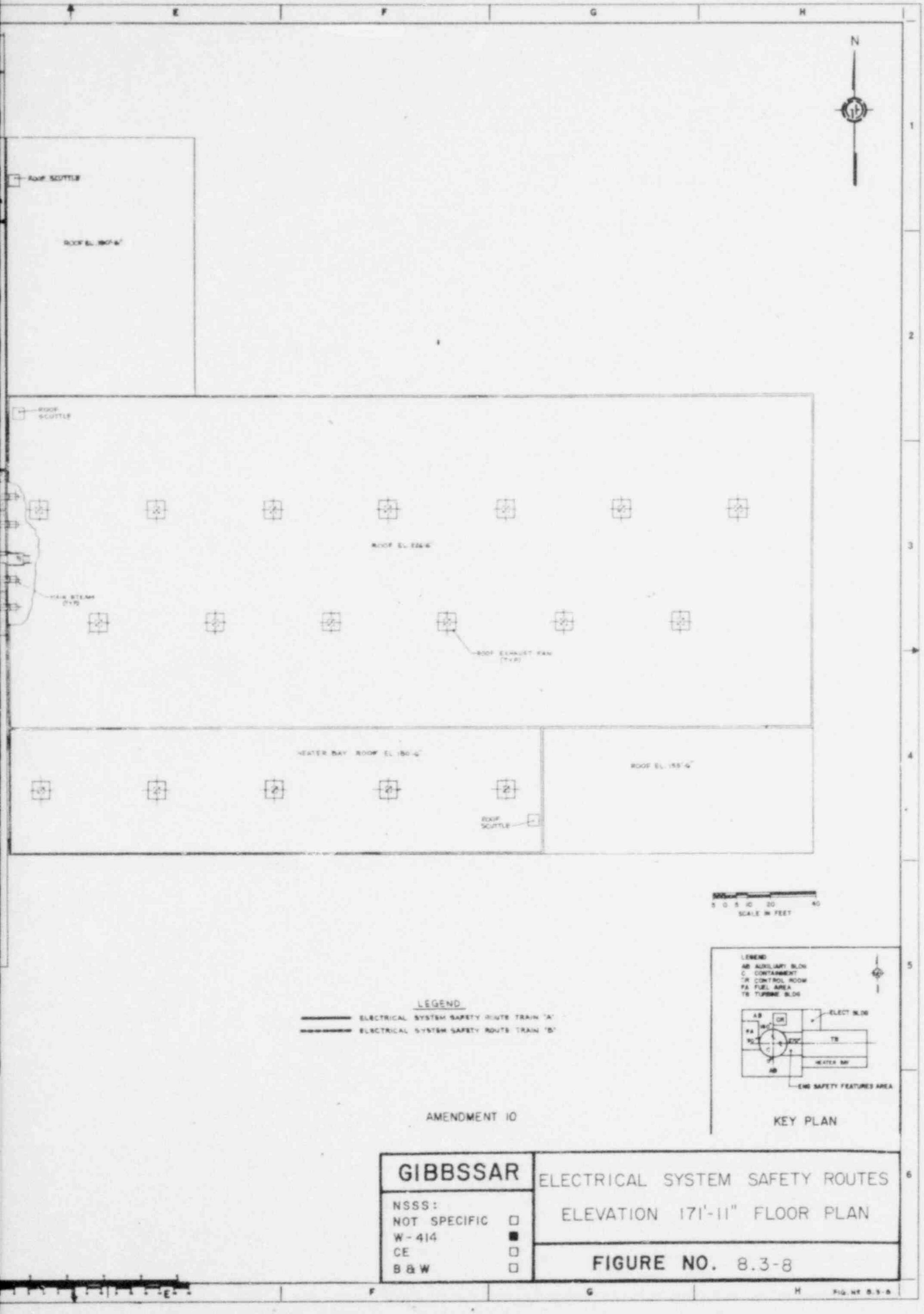


AMENDMENT 10

GIBBSSAR	ELECTRICAL SYSTEM SAFETY ROUTES OPERATING LEVEL FLOOR PLAN
NSSS: NOT SPECIFIC ☐ W-414 ■ CE ☐ B & W ☐	FIGURE NO. 8.3-7



A
B
C
D
1
2
3
4
5
6
330'-0"
140'-0"
PENTHOUSE
EXHAUST FROM BELOW
ROOF EL. 180'-6"
LADDER W/ CAGE
SUPPLY DOWN
H2 RECOMBINER
PRESSURIZER
MAIN STEAM (TYP)
ROOF EL. 207'-0"
F.O. DAY TANK
MONORAIL
HATCH
EQUIPMENT HATCH
GANTRY CRANE
EXHAUST
CCW SURGE TANK
ROOF EL. 185'-0"
ROOF EL. 167'-6"



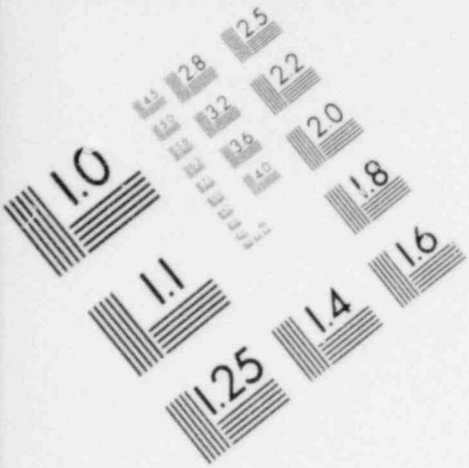
AMENDMENT 10

GIBBSSAR

NSSS:
NOT SPECIFIC ☐
W-414 ■
CE ☐
B & W ☐

ELECTRICAL SYSTEM SAFETY ROUTES
ELEVATION 171'-11" FLOOR PLAN

FIGURE NO. 8.3-8



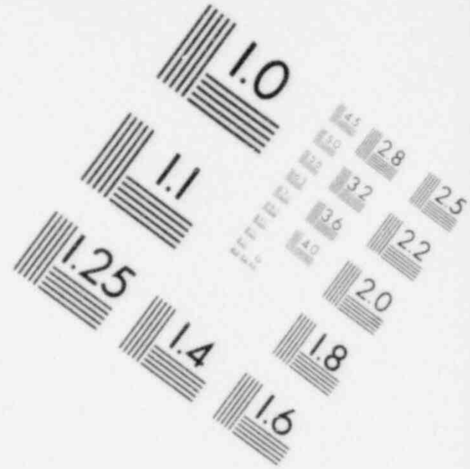
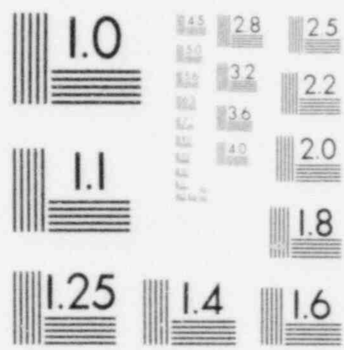
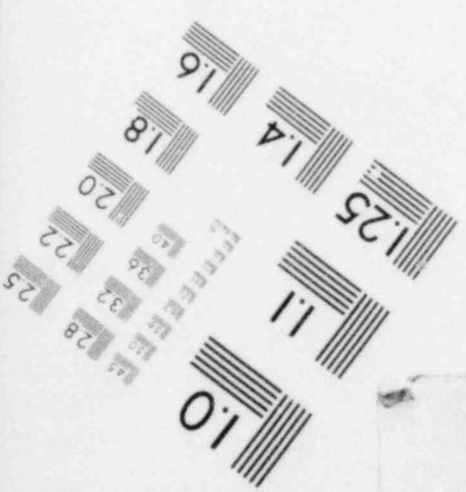


IMAGE EVALUATION TEST TARGET (MT-3)



6″

MICROCOPY RESOLUTION TEST CHART



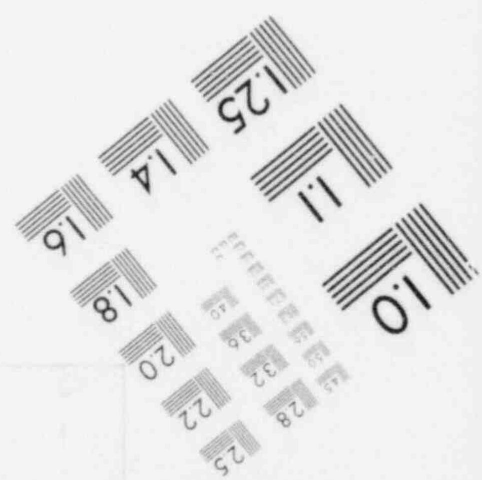
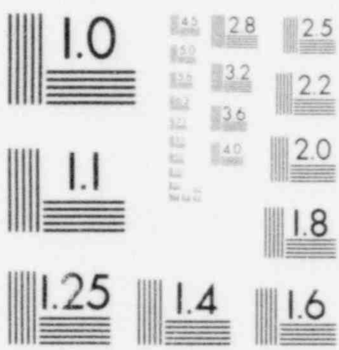


IMAGE EVALUATION TEST TARGET (MT-3)



6″

MICROCOPY RESOLUTION TEST CHART

FIGURE 8.3-9

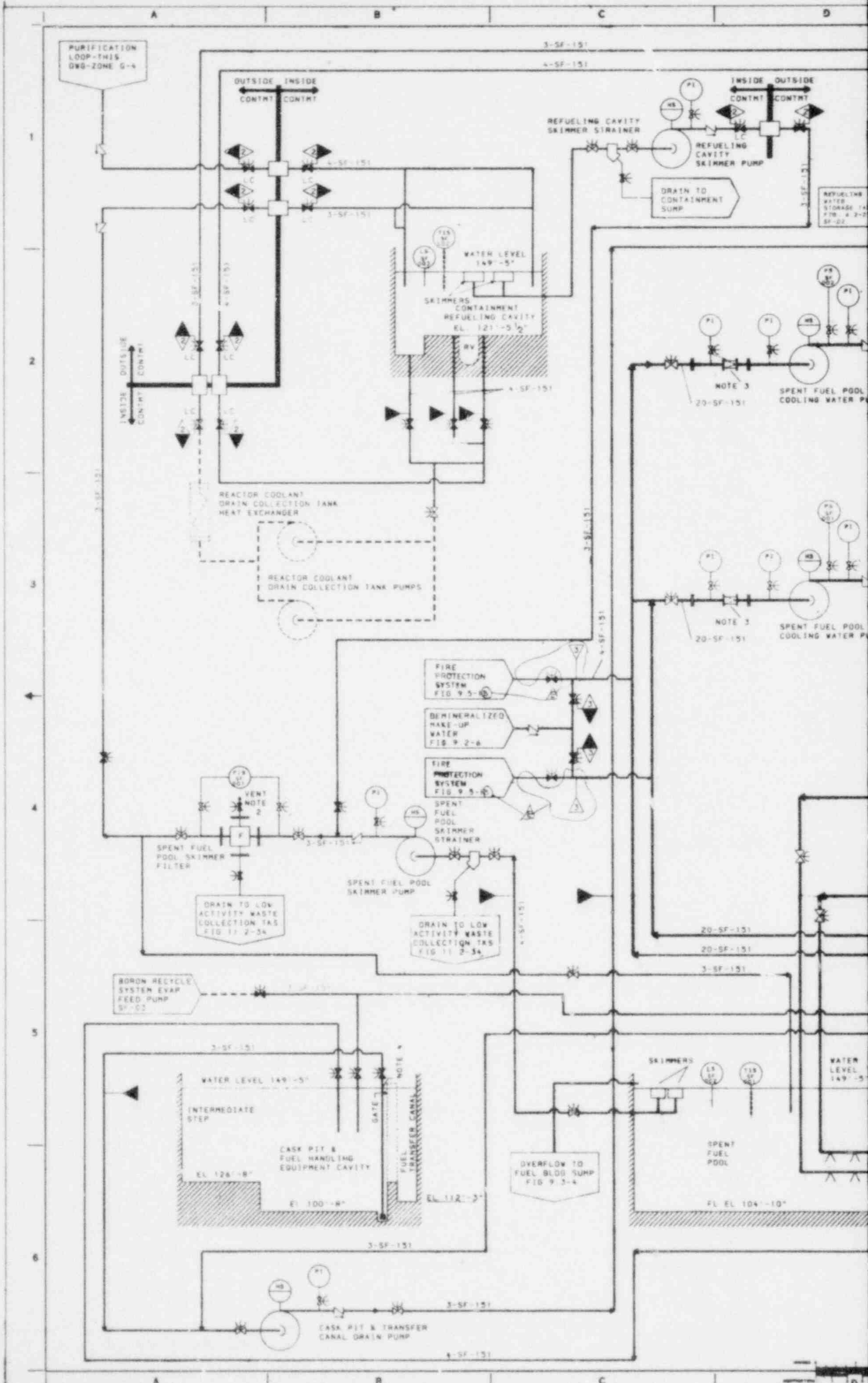
DELETED

FIGURE 8.3-10

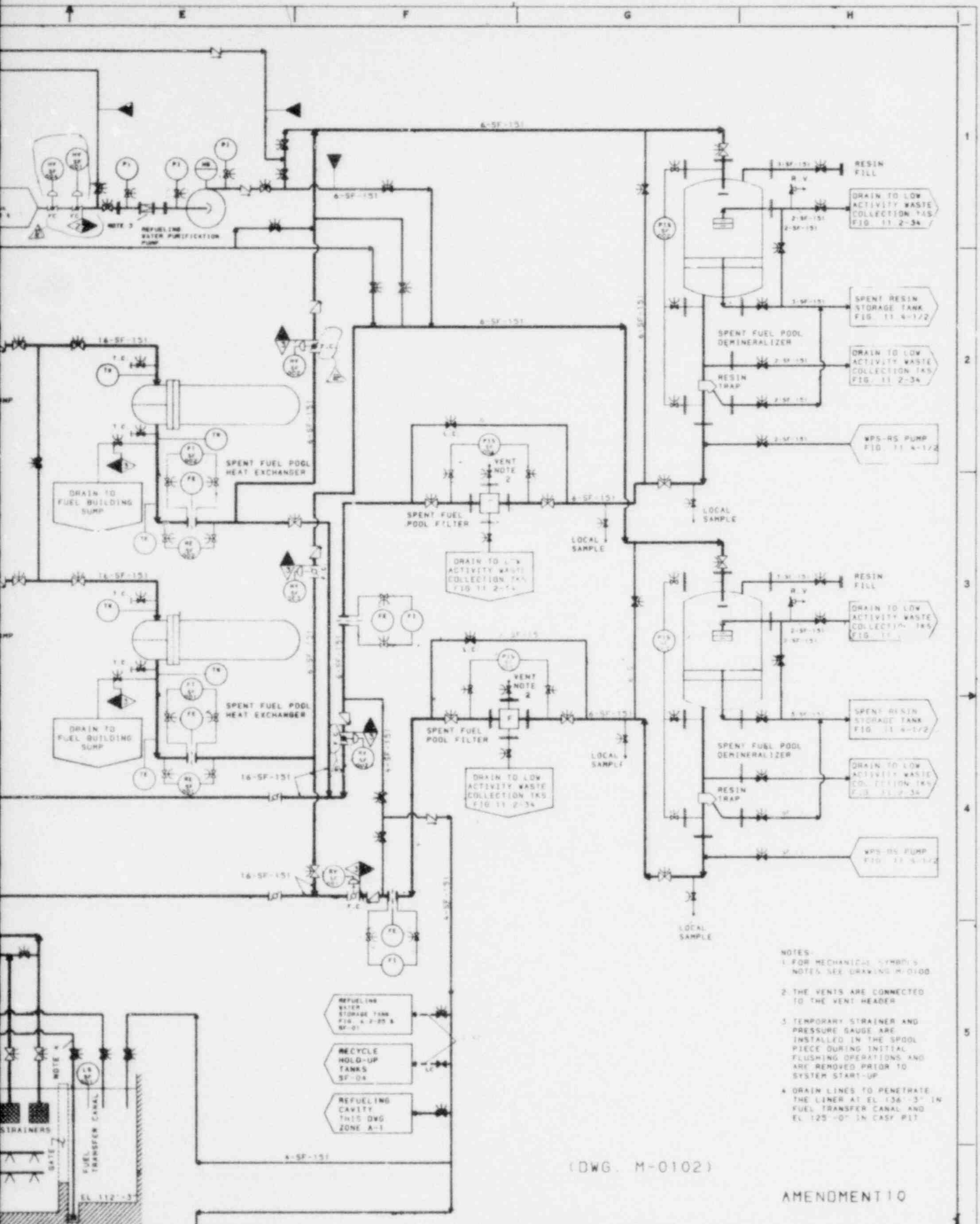
DELETED

FIGURE 8.3-11

DELETED



A
B
C
D
1
2
3
4
5
6
PURIFICATION LOOP-THIS DWG-ZONE G-4
OUTSIDE CONTMT
INSIDE CONTMT
3-SF-151
4-SF-151
LC
REFUELING CAVITY SKIMMER STRAINER
PI
HS
INSIDE CONTMT
OUTSIDE CONTMT
REFUELING CAVITY SKIMMER PUMP
DRAIN TO CONTAINMENT SUMP
WATER LEVEL 149'-5"
SKIMMERS
CONTAINMENT REFUELING CAVITY EL. 121'-5 1/2"
RV
NOTE 3
20-SF-151
SPENT FUEL POOL COOLING WATER P
REACTOR COOLANT DRAIN COLLECTION TANK HEAT EXCHANGER
REACTOR COOLANT DRAIN COLLECTION TANK PUMPS
FIRE PROTECTION SYSTEM FIG 9.5-6
DEMINERALIZED MAKE-UP WATER FIG 9.2-6
FIRE PROTECTION SYSTEM FIG 9.5-6
VENT NOTE 2
SPENT FUEL POOL SKIMMER STRAINER
SPENT FUEL POOL SKIMMER FILTER
SPENT FUEL POOL SKIMMER PUMP
DRAIN TO LOW ACTIVITY WASTE COLLECTION TKS FIG 11.2-3A
DRAIN TO LOW ACTIVITY WASTE COLLECTION TKS FIG 11.2-3A
BORON RECYCLE SYSTEM EVAP FEED PUMP SF-02
WATER LEVEL 149'-5"
INTERMEDIATE STEP
CASK PIT & FUEL HANDLING EQUIPMENT CAVITY
EL 126'-8"
EL 100'-8"
GATE
NOTE 4
FUEL TRANSFER CANAL
EL 112'-3"
SKIMMERS
OVERFLOW TO FUEL BLDG SUMP FIG 9.3-4
SPENT FUEL POOL
WATER LEVEL 149'-5"
FL EL 104'-10"
CASK PIT & TRANSFER CANAL DRAIN PUMP



GIBBSSAR

NSSS:
NOT SPECIFIC ☐
W-414 ■
CE ☐
B&W ☐

FLOW DIAGRAM
SPENT FUEL POOL COOLING AND CLEANING SYSTEM

FIGURE NO. 9.1-3

FIGURE 9.1-3a

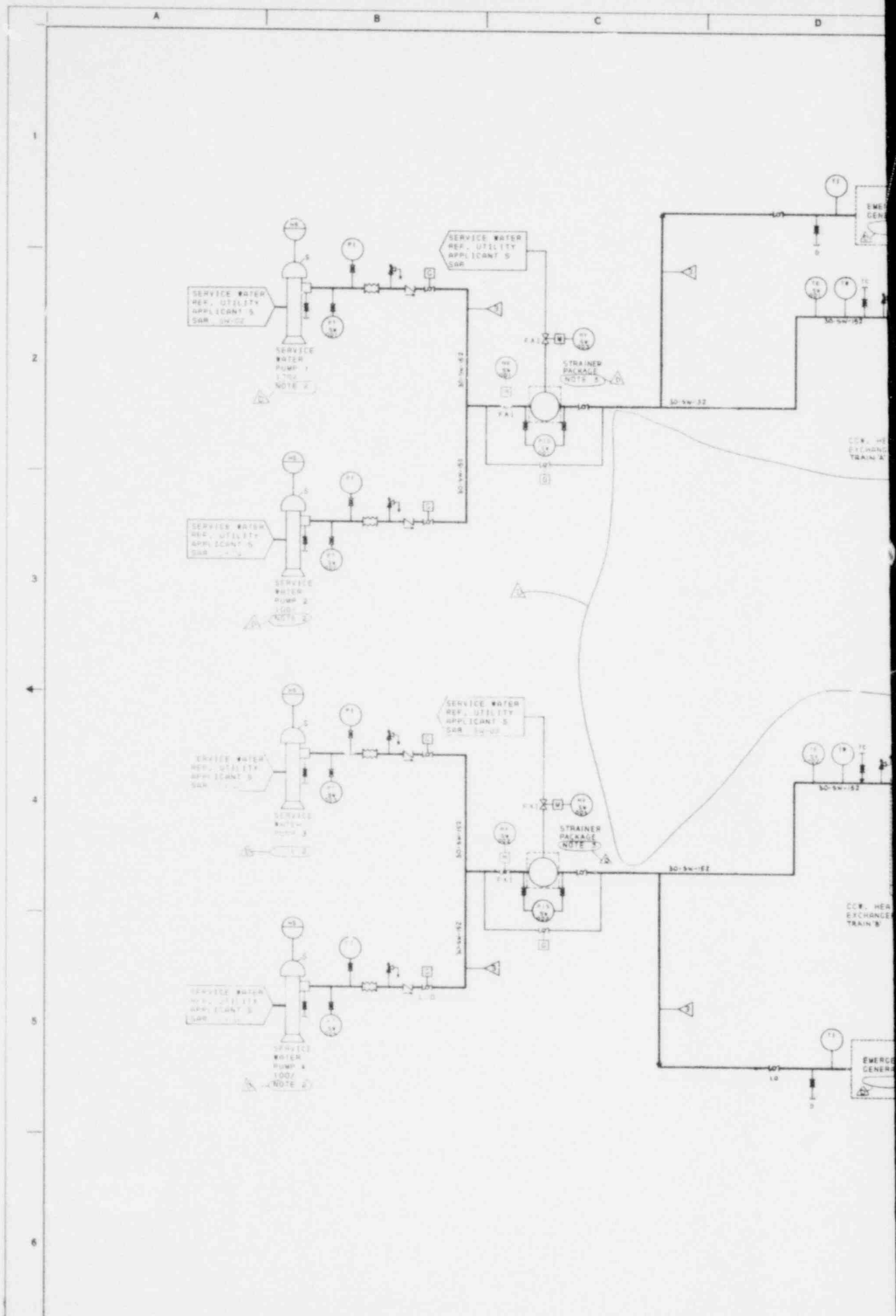
SHEET 2 of 2

INSTRUMENT & CONTROL FUNCTION

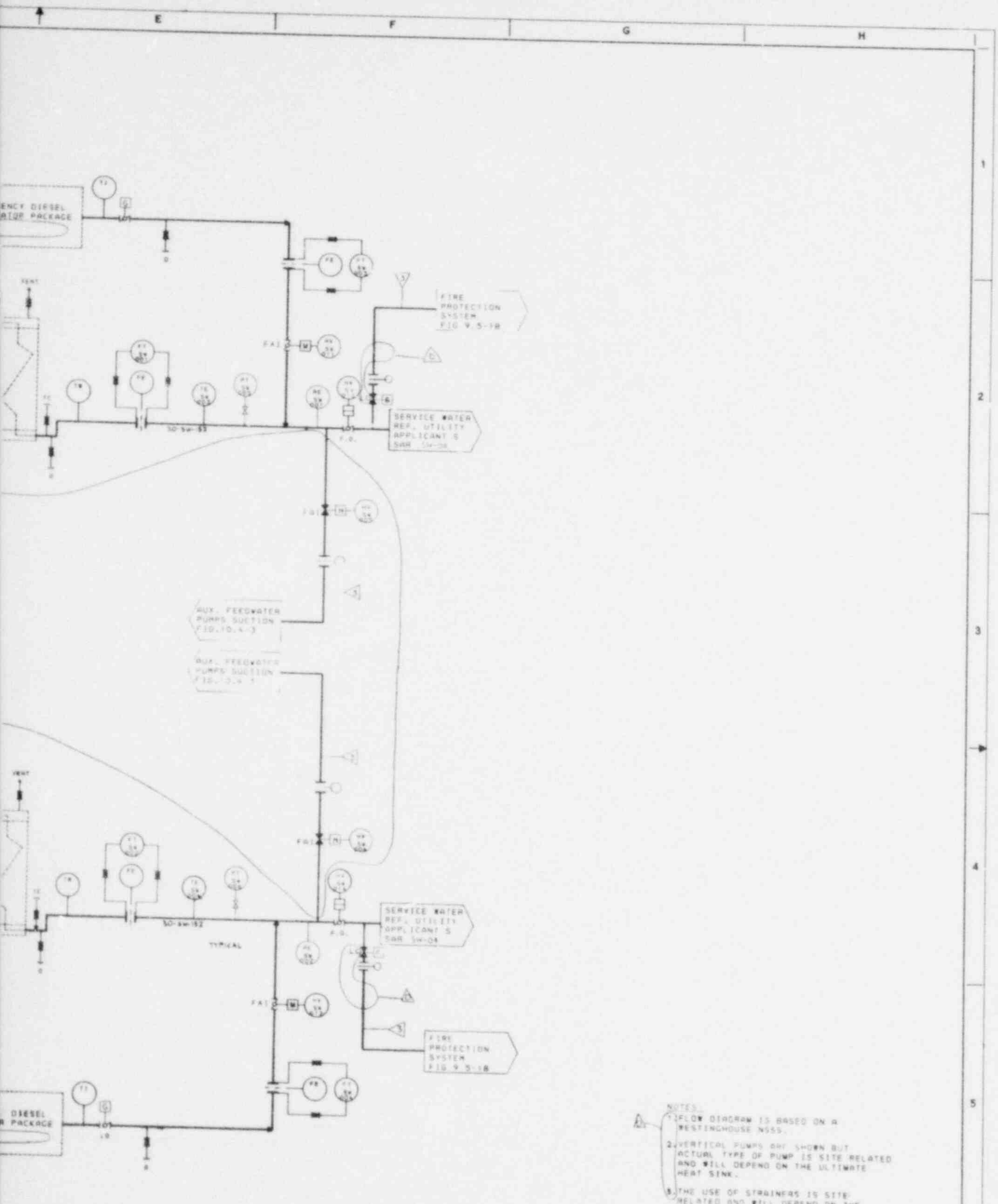
SPENT FUEL POOL COOLING AND CLEANING SYSTEM

PUMPS & VALVES

SAFETY TRAIN	TAG NO.	REMOTE CONTROL CON-TROL ROOM	HSD	INTERLOCK WITH	SAFETY INTER-LOCK	REMARKS
A	HV-SF-001	-	-			Control Switch Located on Local Auxiliary Panel
B	HV-SF-002	-	-			Control Switch Located on Local Auxiliary Panel
A	HV-SF-003	-	-			Control Switch Located on Local Auxiliary Panel
B	HV-SF-004	-	-			Control Switch Located on Local Auxiliary Panel



SERVICE WATER
REF. UTILITY
APPLICANT'S
SAR
SERVICE WATER PUMP 1
SERVICE WATER PUMP 2
SERVICE WATER PUMP 4
STRAINER PACKAGE NOTE 5
30-SW-152



NOTES:

1. FLOW DIAGRAM IS BASED ON A WESTINGHOUSE NSSS.
2. VERTICAL PUMPS ARE SHOWN BUT ACTUAL TYPE OF PUMP IS SITE RELATED AND WILL DEPEND ON THE ULTIMATE HEAT SINK.
3. THE USE OF STRAINERS IS SITE RELATED AND WILL DEPEND ON THE ULTIMATE HEAT SINK.

(DWG. M-0104)

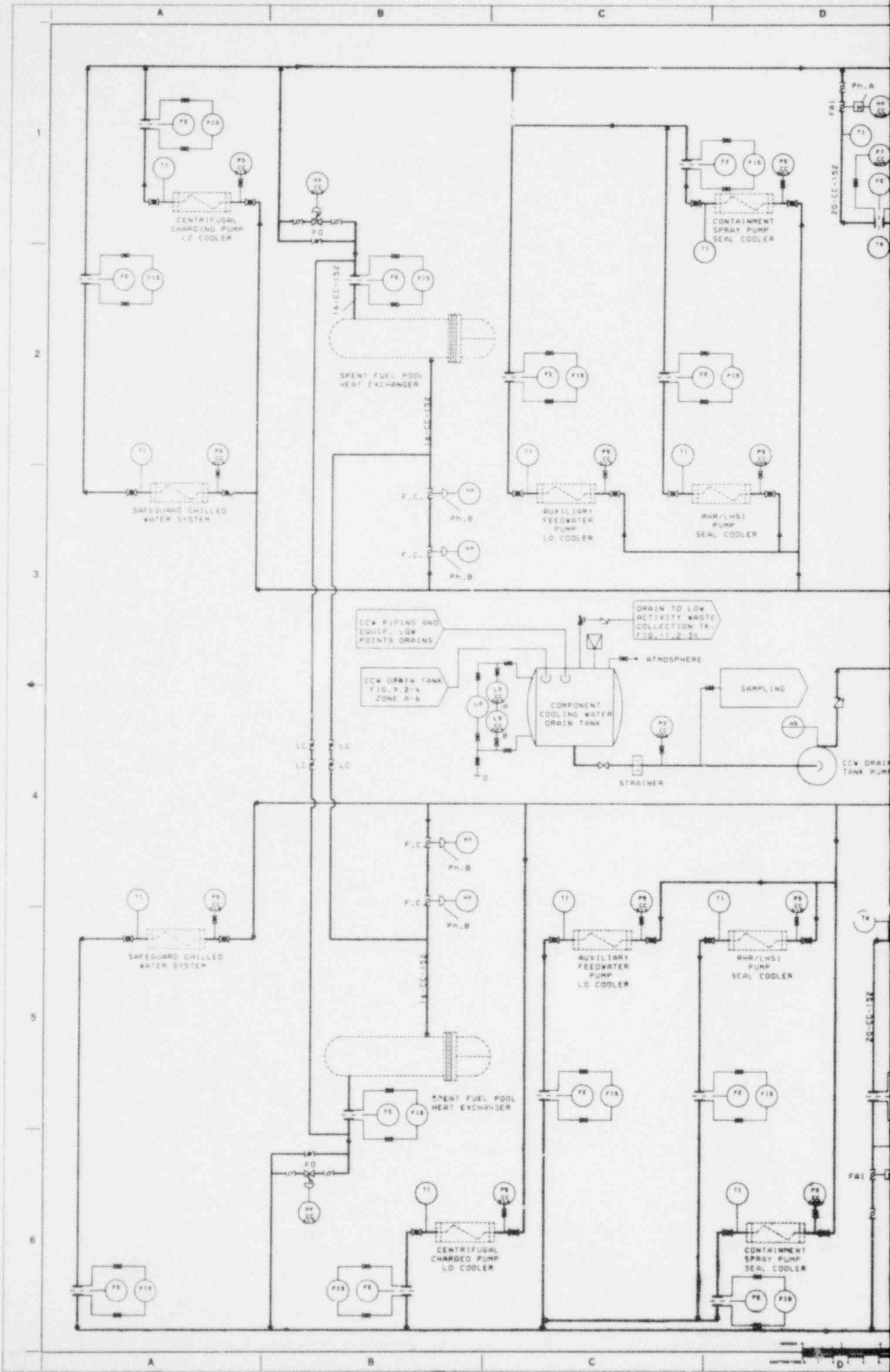
AMENDMENT 1C

GIBBSSAR

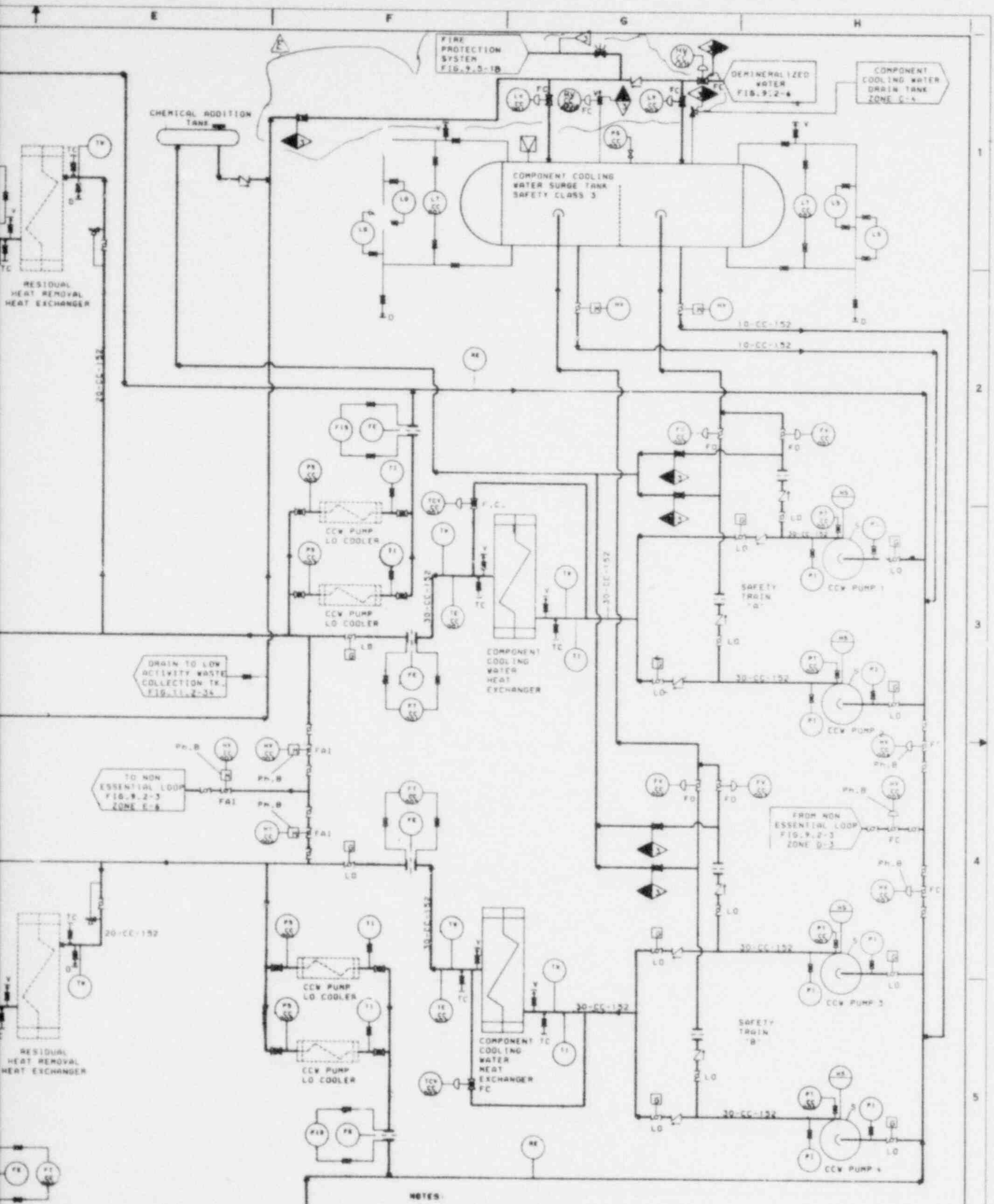
NSSS:
NOT SPECIFIC ☐
W-414 ■
CE ☐
B&W ☐

FLOW DIAGRAM SERVICE WATER SYSTEM

FIGURE NO. 9.2-1



A
B
C
D
1
2
3
4
5
6
CENTRIFUGAL CHARGING PUMP LO COOLER
SPENT FUEL POOL HEAT EXCHANGER
CONTAINMENT SPRAY PUMP SEAL COOLER
SAFEGUARD CHILLED WATER SYSTEM
AUXILIARY FEEDWATER PUMP LO COOLER
RHR/LHSI PUMP SEAL COOLER
14-CC-152
20-CC-152
F.C.
Ph.B
Ph.A
FO
CCW PIPING AND EQUIP. LOW POINTS DRAINS
DRAIN TO LOW ACTIVITY WASTE COLLECTION TK. FIG.11.2-3
ATMOSPHERE
CCW DRAIN TANK FIG.9.2-4 ZONE A-6
COMPONENT COOLING WATER DRAIN TANK
SAMPLING
STRAINER
CCW DRAIN TANK PUMP
CENTRIFUGAL CHARGED PUMP LO COOLER



NOTES:

1. TOTAL SYSTEM IS SAFETY CLASS 3. EXCEPT AS NOTED.
2. FLOW DIAGRAM IS BASED ON USING A WESTINGHOUSE NSSS.

AMENDMENT 10
(DWG.M-0103 SH.1)

GIBBSSAR	FLOW DIAGRAM COMPONENT COOLING WATER SYSTEM
NSSS: NOT SPECIFIC ☐ W-414 ■ CE ☐ B&W ☐	FIGURE NO. 9.2-2

FIGURE 9.2-4a

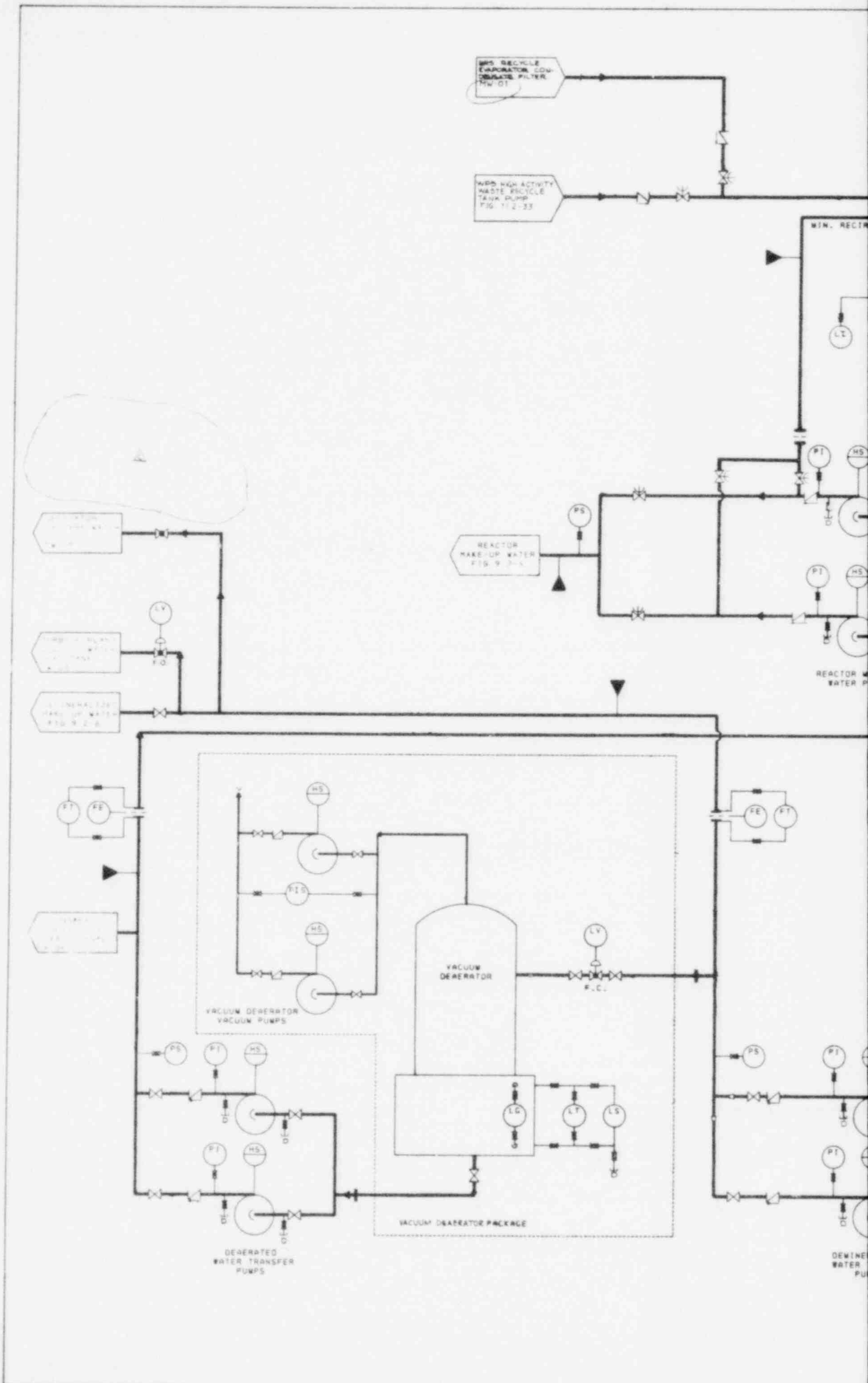
SHEET 1 of 3

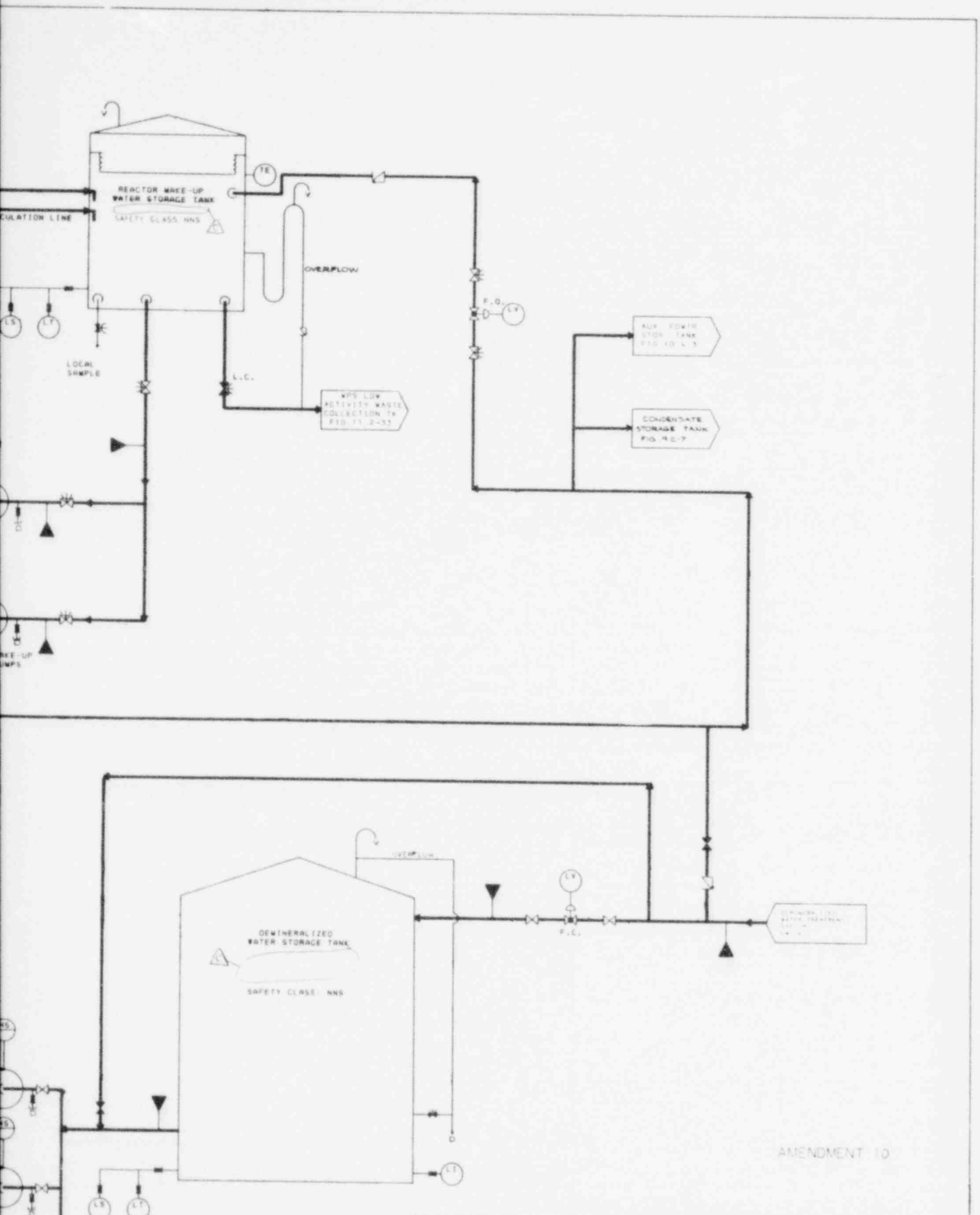
INSTRUMENT & CONTROL FUNCTION

COMPONENT COOLING WATER

PUMPS & VALVES

SAFETY TRAIN	TAG NO.	REMOTE CONTROL CON-TROL ROOM	REMOTE CONTROL HSD	INTERLOCK WITH	SAFETY INTER-LOCK	REMARKS
-	HV-CC-001	x				
A	LV-CC-001	x		LT-CC-001		
B	LV-CC-002	x		LT-CC-002		
-	RV-CC-001	x		Radiation Monitoring System		Radiation Detectors (3) Located in CCW Return
A	FV-CC-001			FT-CC-001		
A	FV-CC-002			FT-CC-001		
B	FV-CC-003			FT-CC-002		
B	FV-CC-004			FT-CC-002		
A	TCV-CC-001			TE-CC-001		
B	TCV-CC-002			TE-CC-002		
B	HV-CC-002	x			x	Same train as HV-CC-005 Close on Phase B Signal
A	HV-CC-003	x			x	Same train as HV-CC-005 Close on Phase B Signal
B	HV-CC-004	x			x	Same train as HV-CC-005 Close on Phase B Signal
A	CCW PUMP 1	x	x	PUMP 2 & 3 or 4	x	Start on "S" Signal
A	CCW PUMP 2	x	x	PUMP 1 & 4 or 3	x	Start on "S" Signal & Pump #1 Not Running
B	CCW PUMP 3	x	x	PUMP 4 & 1 or 2	x	Start On "S" Signal
B	CCW PUMP 4	x	x	PUMP 3 & 2 or 1	x	Start on "S" Signal & Pump #3 Not Running
B	HV-CC-005	x			x	Same train as HV-CC-002 Close on Phase B Signal


WRS RECYCLE EVAPORATOR CON-DENSATE FILTER
WPS HIGH ACTIVITY WASTE RECYCLE TANK PUMP
MIN. RECIR
LI
PS
PI
HS
REACTOR MAKE-UP WATER
REACTOR
WATER P
LV
F.O.
DEMINERALIZED MAKE-UP WATER
FT
FE
PIS
VACUUM DEAERATOR
F.C.
VACUUM DEAERATOR VACUUM PUMPS
LG
LT
LS
VACUUM DEAERATOR PACKAGE
DEAERATED WATER TRANSFER PUMPS



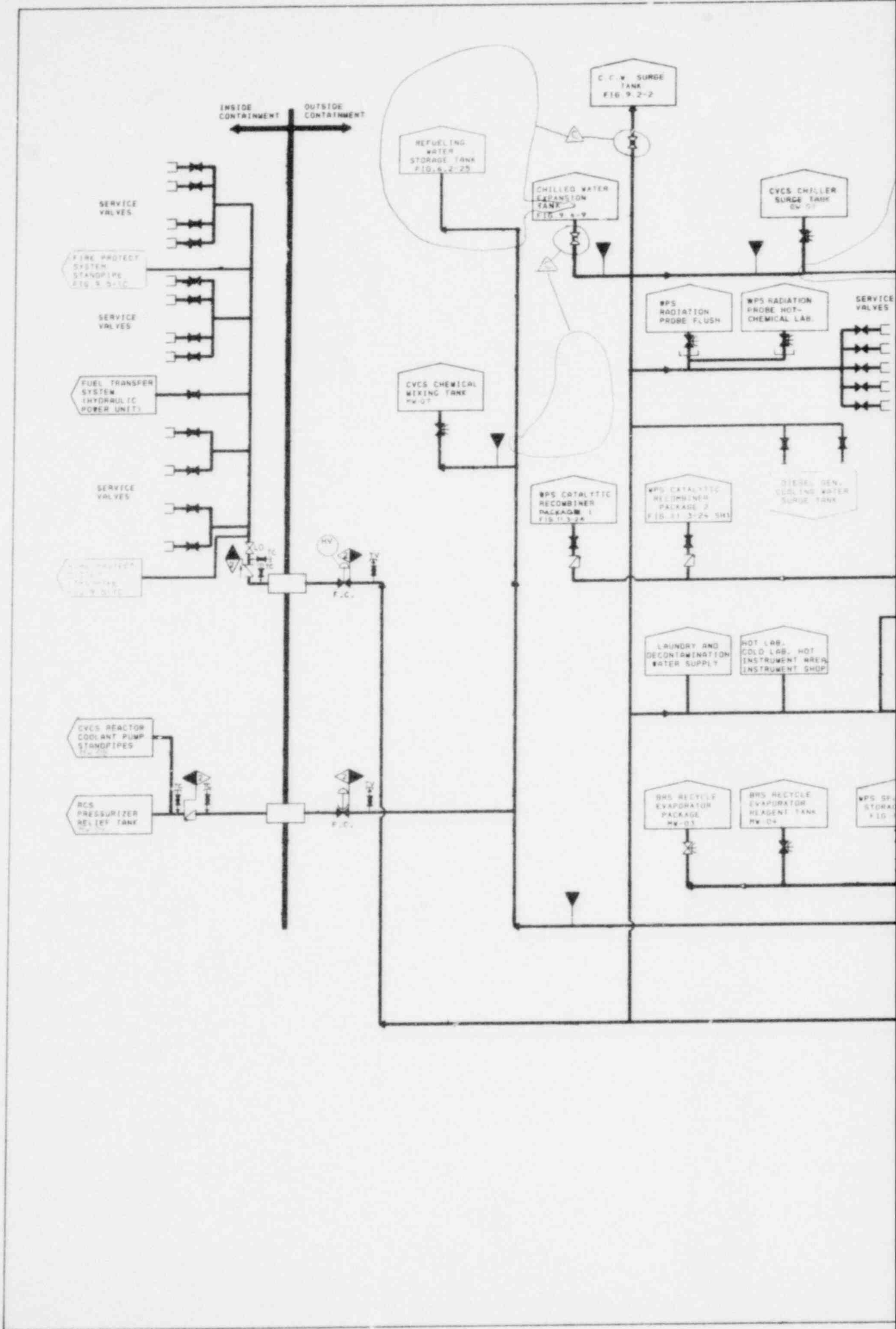
GIBBSSAR

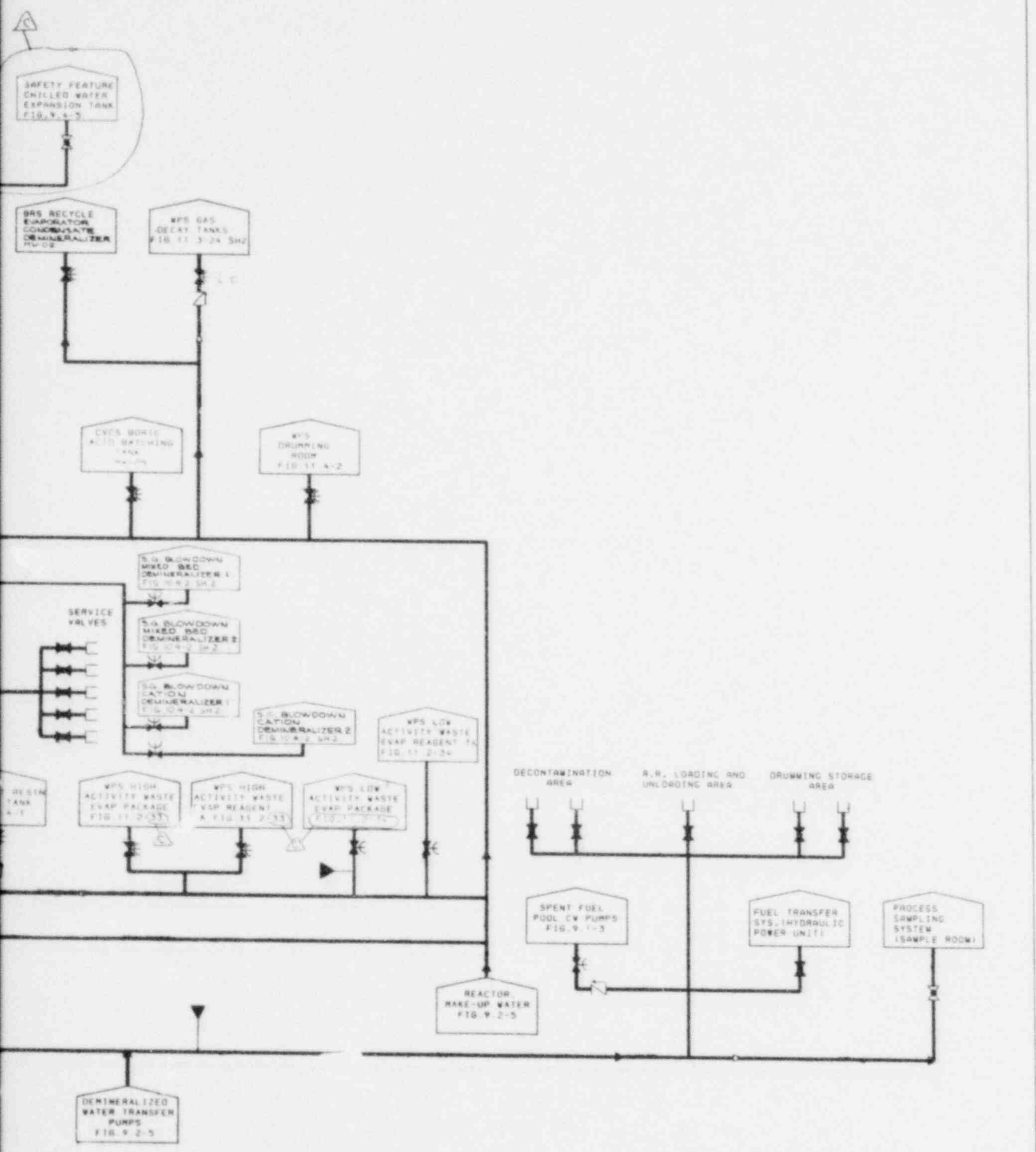
NSSS:

NOT SPECIFIC	■
W-414	□
CE	□
B&W	□

DEMINERALIZED WATER STORAGE AND DEAERATION FLOW DIAGRAM

FIGURE NO. 9.2-5


INSIDE CONTAINMENT
OUTSIDE CONTAINMENT
SERVICE VALVES
FIRE PROTECT SYSTEM STANDPIPE
FUEL TRANSFER SYSTEM (HYDRAULIC POWER UNIT)
SERVICE VALVES
SERVICE VALVES
CVCS REACTOR COOLANT PUMP STANDPIPES
RCS PRESSURIZER RELIEF TANK
F.C.
F.C.
C.C.W. SURGE TANK FIG. 9.2-2
REFUELING WATER STORAGE TANK FIG. 6.2-25
CHILLED WATER EXPANSION TANK
CVCS CHILLER SURGE TANK
WPS RADIATION PROBE FLUSH
WPS RADIATION PROBE HOT-CHEMICAL LAB.
SERVICE VALVES
CVCS CHEMICAL MIXING TANK
WPS CATALYTIC RECOMBINER PACKAGE 1
WPS CATALYTIC RECOMBINER PACKAGE 2
DIESEL GEN. COOLING WATER SURGE TANK
LAUNDRY AND DECONTAMINATION WATER SUPPLY
HOT LAB, COLD LAB, HOT INSTRUMENT AREA, INSTRUMENT SHOP
BRS RECYCLE EVAPORATOR PACKAGE
BRS RECYCLE EVAPORATOR REAGENT TANK



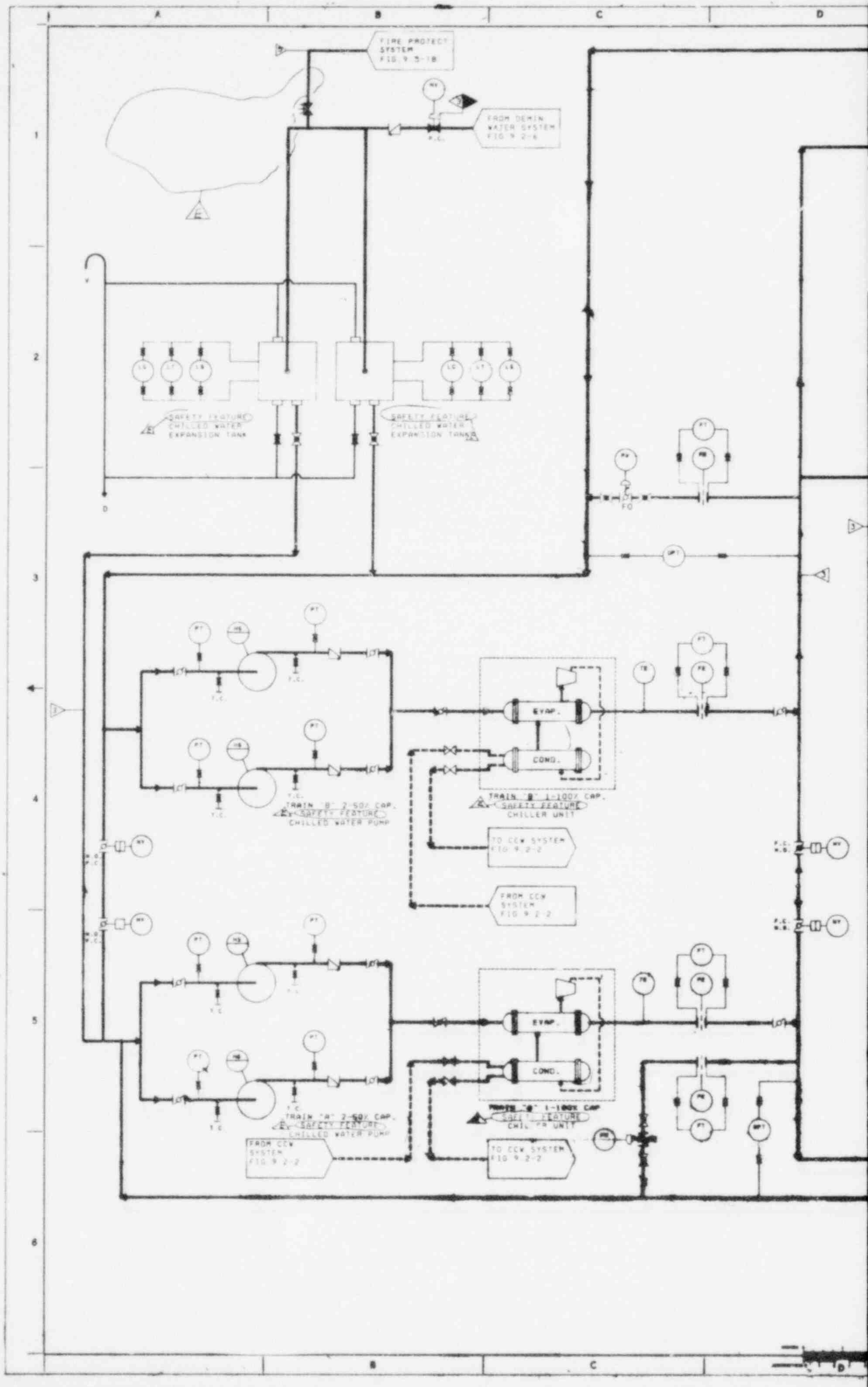
AMENDMENT 1
N 1106

GIBBSSAR	DEMINERALIZED WATER MAKE-UP SYSTEM FLOW DIAGRAM
NSSS: NOT SPECIFIC ☐ W-414 ■ CE ☐ B&W ☐	FIGURE NO. 9.2-6

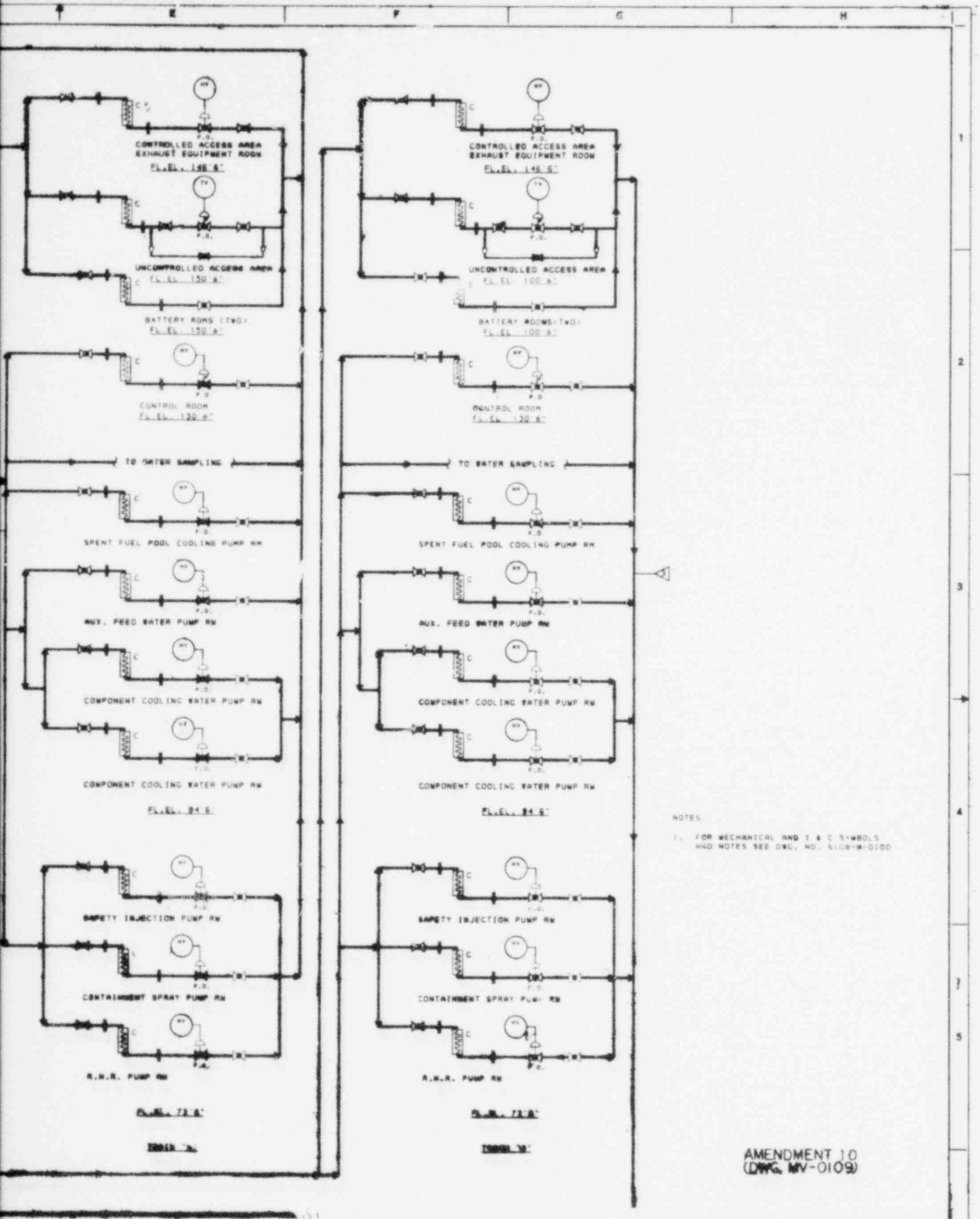
DELETED

AMENDMENT 10

GIBBSSAR	
NSSS: NOT SPECIFIC ■ W-414 □ CE □ B&W □	FIGURE NO. 9.4-4



FIRE PROTECT SYSTEM
FROM DEMIN WATER SYSTEM FIG 9.2-6
SAFETY FEATURE CHILLED WATER EXPANSION TANK
SAFETY FEATURE CHILLED WATER EXPANSION TANK
EVAP.
COND.
TRAIN "B" 2-50% CAP.
SAFETY FEATURE CHILLED WATER PUMP
TRAIN "B" 1-100% CAP.
SAFETY FEATURE CHILLER UNIT
TO CCW SYSTEM FIG 9.2-2
FROM CCW SYSTEM FIG 9.2-2
EVAP.
COND.
TRAIN "A" 2-50% CAP.
SAFETY FEATURE CHILLED WATER PUMP
FROM CCW SYSTEM FIG 9.2-2
TO CCW SYSTEM FIG 9.2-2

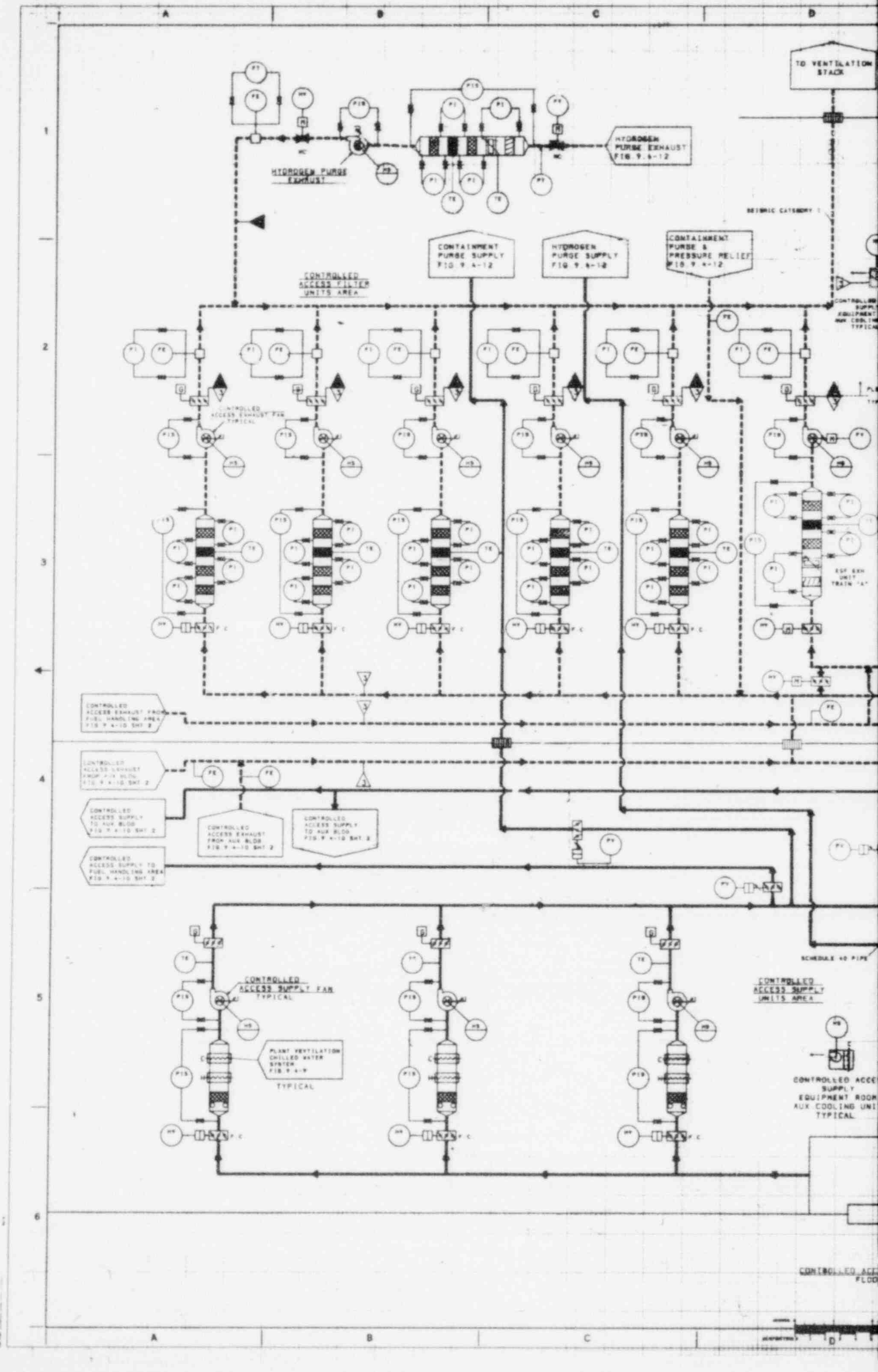


NOTES

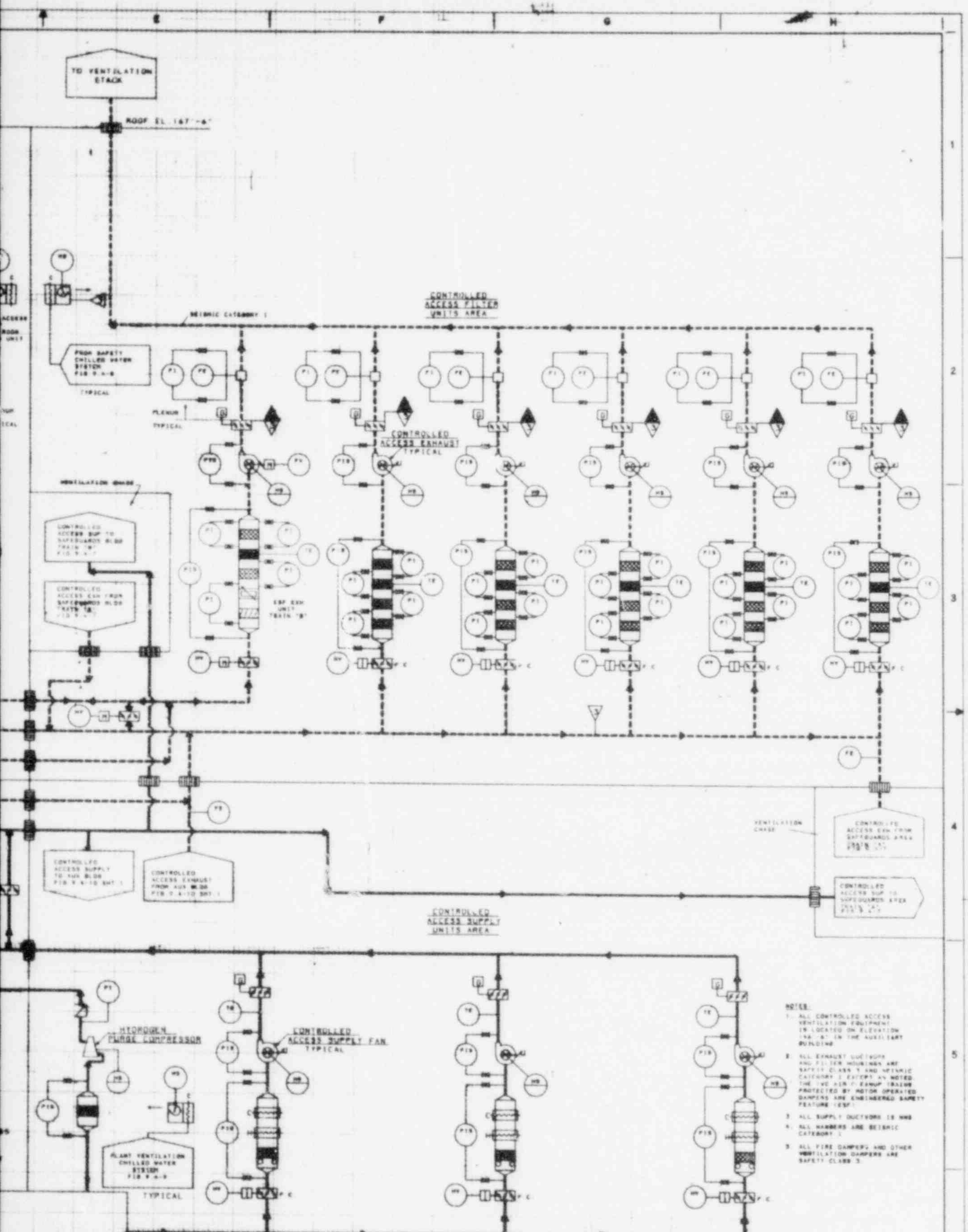
1. FOR MECHANICAL AND I & C SYMBOLS AND NOTES SEE DWG. NO. 6108-M-0100

AMENDMENT 10
(DWG. MV-0109)

GIBBSSAR	VENTILATION SAFETY FEATURE CHILLED WATER SYSTEM FLOW DIAGRAM
NSSS: NOT SPECIFIC ■ W-414 □ CE □ B&W □	FIGURE NO. 9.4-5



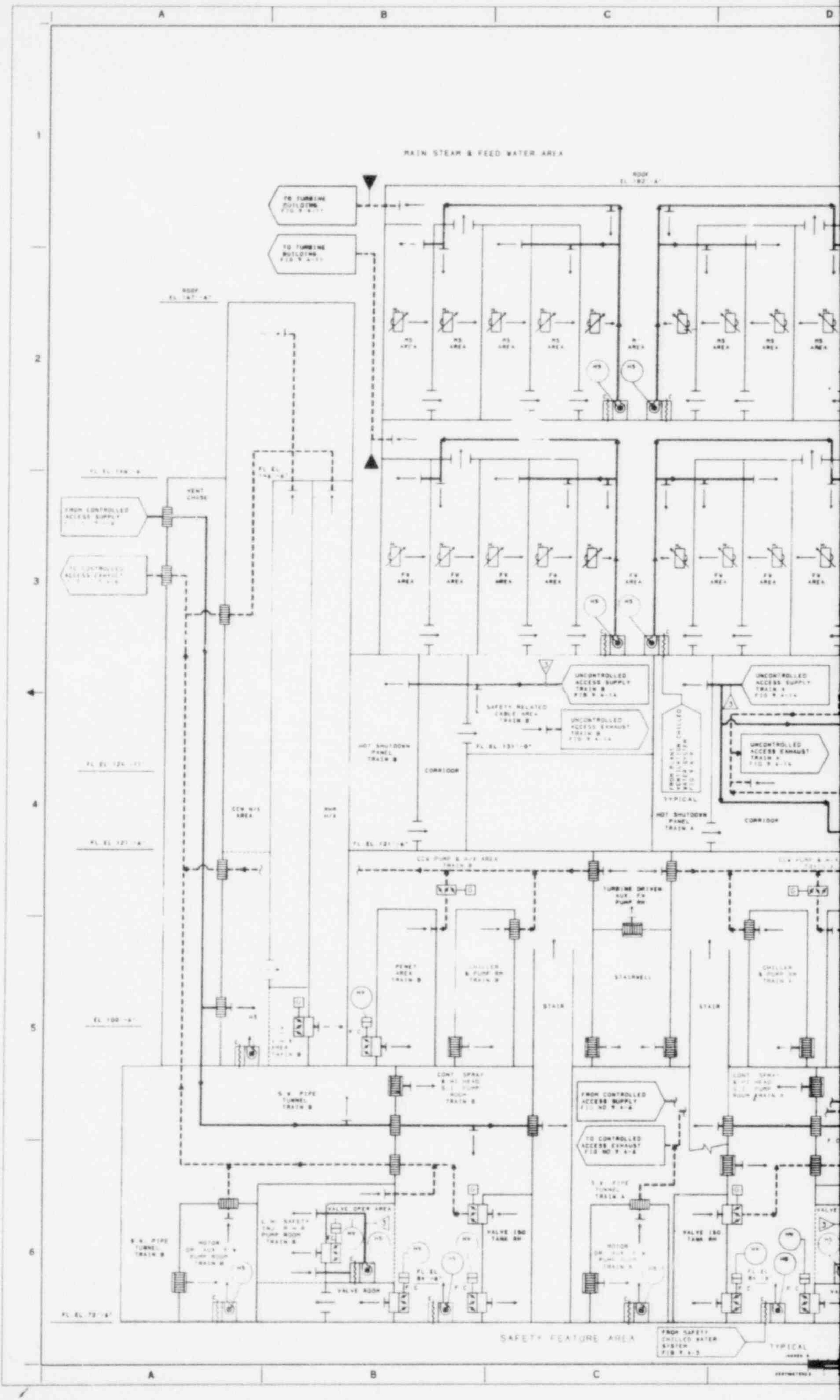
TO VENTILATION STACK
HYDROGEN PURGE EXHAUST
HYDROGEN PURGE EXHAUST FIG 9.4-12
SEISMIC CATEGORY I
CONTAINMENT PURGE SUPPLY FIG 9.4-12
HYDROGEN PURGE SUPPLY FIG 9.4-12
CONTAINMENT PURGE & PRESSURE RELIEF FIG 9.4-12
CONTROLLED ACCESS FILTER UNITS AREA
CONTROLLED ACCESS EXHAUST FAN TYPICAL
ESF EXH UNIT TRAIN "A"
CONTROLLED ACCESS EXHAUST FROM FUEL HANDLING AREA FIG 9.4-10 SHT 2
CONTROLLED ACCESS EXHAUST FROM AUX BLDG FIG 9.4-10 SHT 2
CONTROLLED ACCESS SUPPLY TO AUX BLDG FIG 9.4-10 SHT 2
CONTROLLED ACCESS EXHAUST FROM AUX BLDG FIG 9.4-10 SHT 2
CONTROLLED ACCESS SUPPLY TO AUX BLDG FIG 9.4-10 SHT 2
CONTROLLED ACCESS SUPPLY TO FUEL HANDLING AREA FIG 9.4-10 SHT 2
SCHEDULE 40 PIPE
CONTROLLED ACCESS SUPPLY FAN TYPICAL
CONTROLLED ACCESS SUPPLY UNITS AREA
PLANT VENTILATION CHILLED WATER SYSTEM FIG 9.4-9
TYPICAL
CONTROLLED ACCESS SUPPLY EQUIPMENT ROOM AUX COOLING UNIT TYPICAL



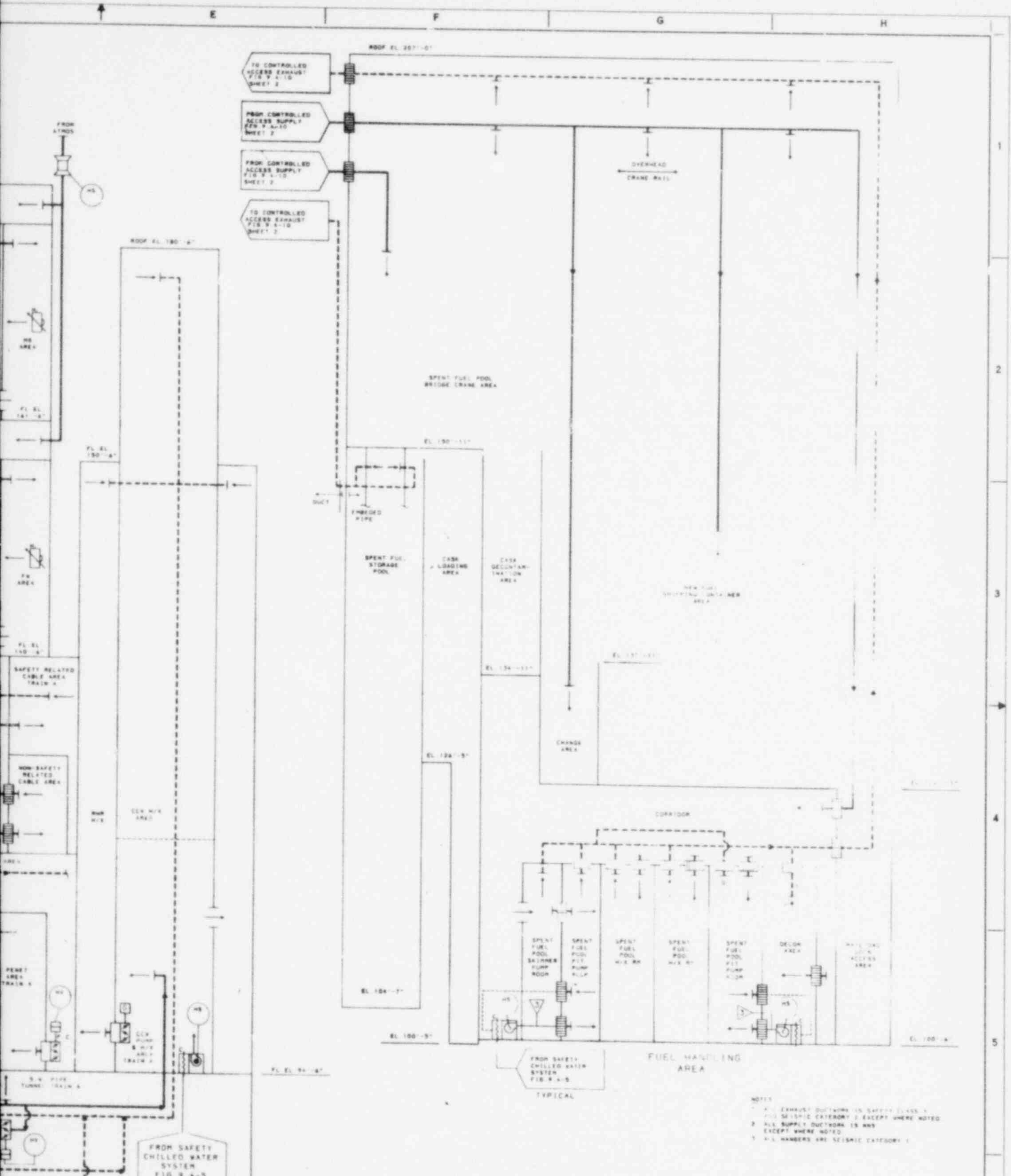
AMENDMENT 10 (MV-0107)

GIBBSSAR	CONTROLLED ACCESS AREA VENTILATION EQUIPMENT ARRANGEMENT
NSSS: NOT SPECIFIC ■ W-414 □ CE □ B&W □	FIGURE NO. 9.4-6

FIG. NO. 9.4-6



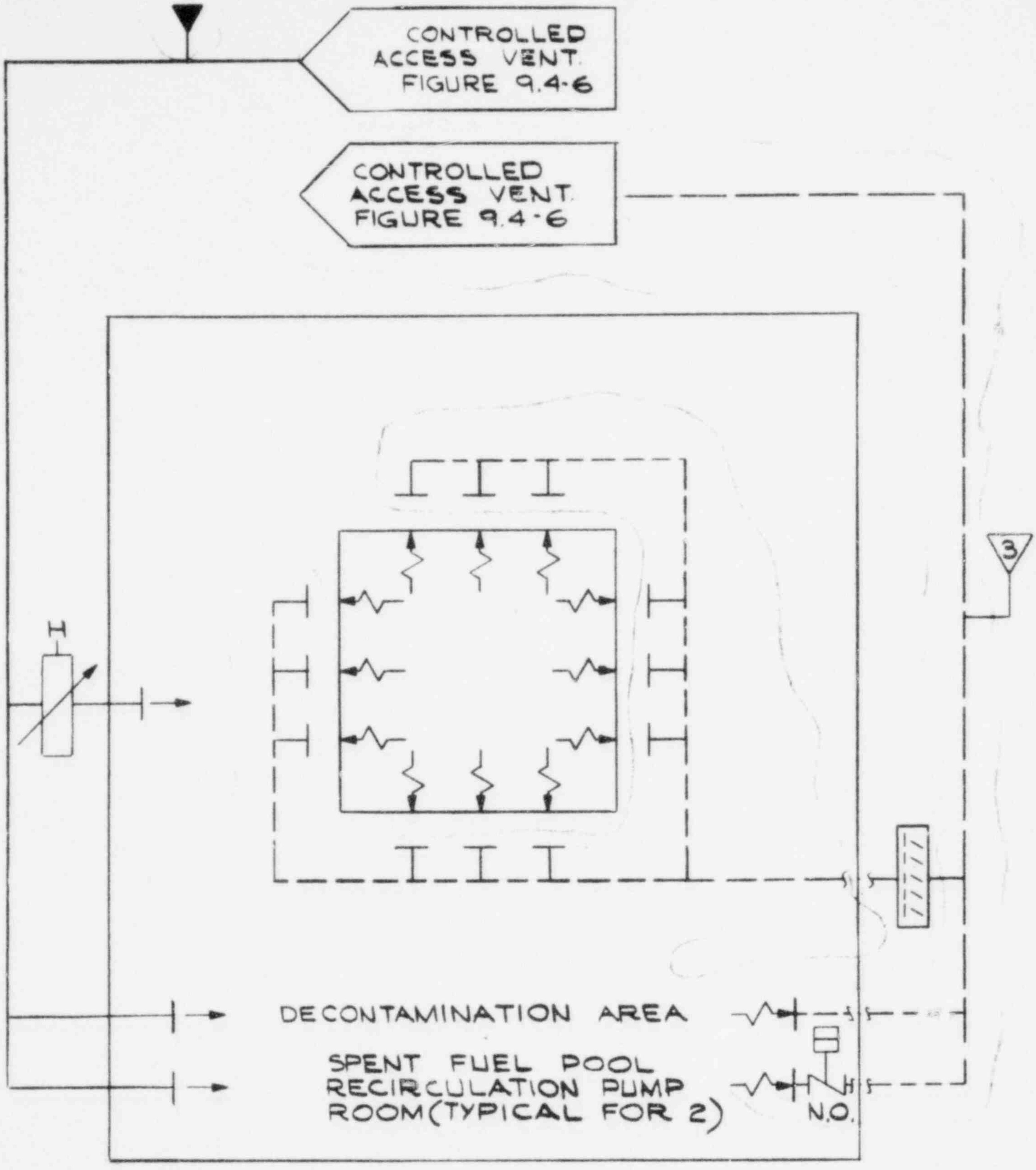
MAIN STEAM & FEED WATER AREA
TO TURBINE BUILDING
FROM CONTROLLED ACCESS SUPPLY
TO CONTROLLED ACCESS EXHAUST
VENT CHASE
UNCONTROLLED ACCESS SUPPLY TRAIN B
UNCONTROLLED ACCESS EXHAUST TRAIN B
SAFETY RELATED CABLE AREA TRAIN B
HOT SHUTDOWN PANEL TRAIN B
CORRIDOR
UNCONTROLLED ACCESS SUPPLY TRAIN A
UNCONTROLLED ACCESS EXHAUST TRAIN A
TYPICAL
HOT SHUTDOWN PANEL TRAIN A
CORRIDOR
TURBINE DRIVEN AUX FW PUMP RM
STAIRWELL
STAIR
STAIR
FROM CONTROLLED ACCESS SUPPLY
TO CONTROLLED ACCESS EXHAUST
S.W. PIPE TUNNEL TRAIN B
VALVE ROOM
VALVE ISO TANK RM
SAFETY FEATURE AREA
FROM SAFETY CHILLED WATER SYSTEM
TYPICAL



AMENDMENT 10 (MV-0102)

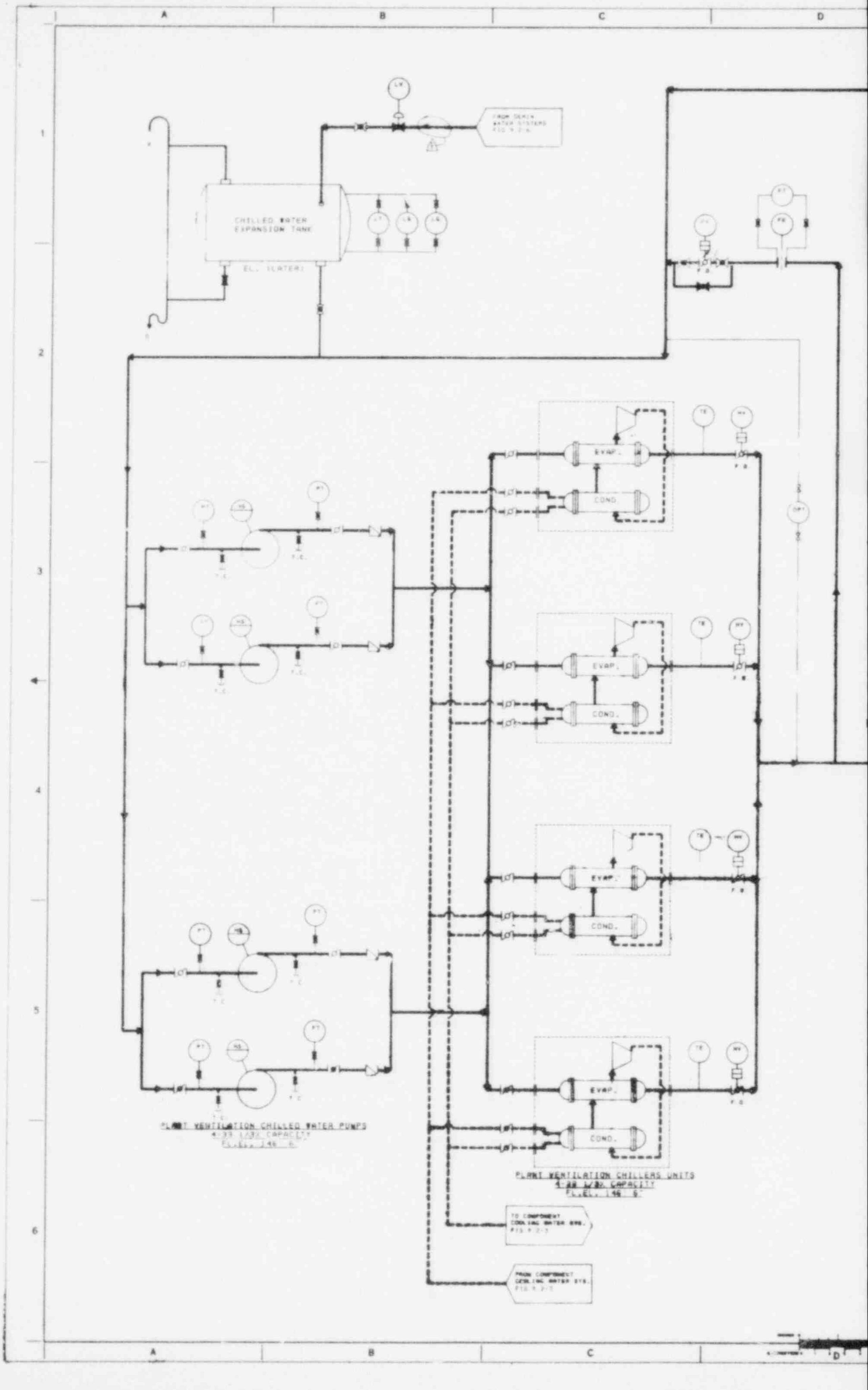
GIBBSSAR	FLOW DIAGRAM SAFETY FEATURE & FUEL HANDLING AREA VENTILATION SYSTEM
NSSS: NOT SPECIFIC ■ W-414 □ CE □ B&W □	FIGURE NO. 9.4-7

FIG NO 9.4-7

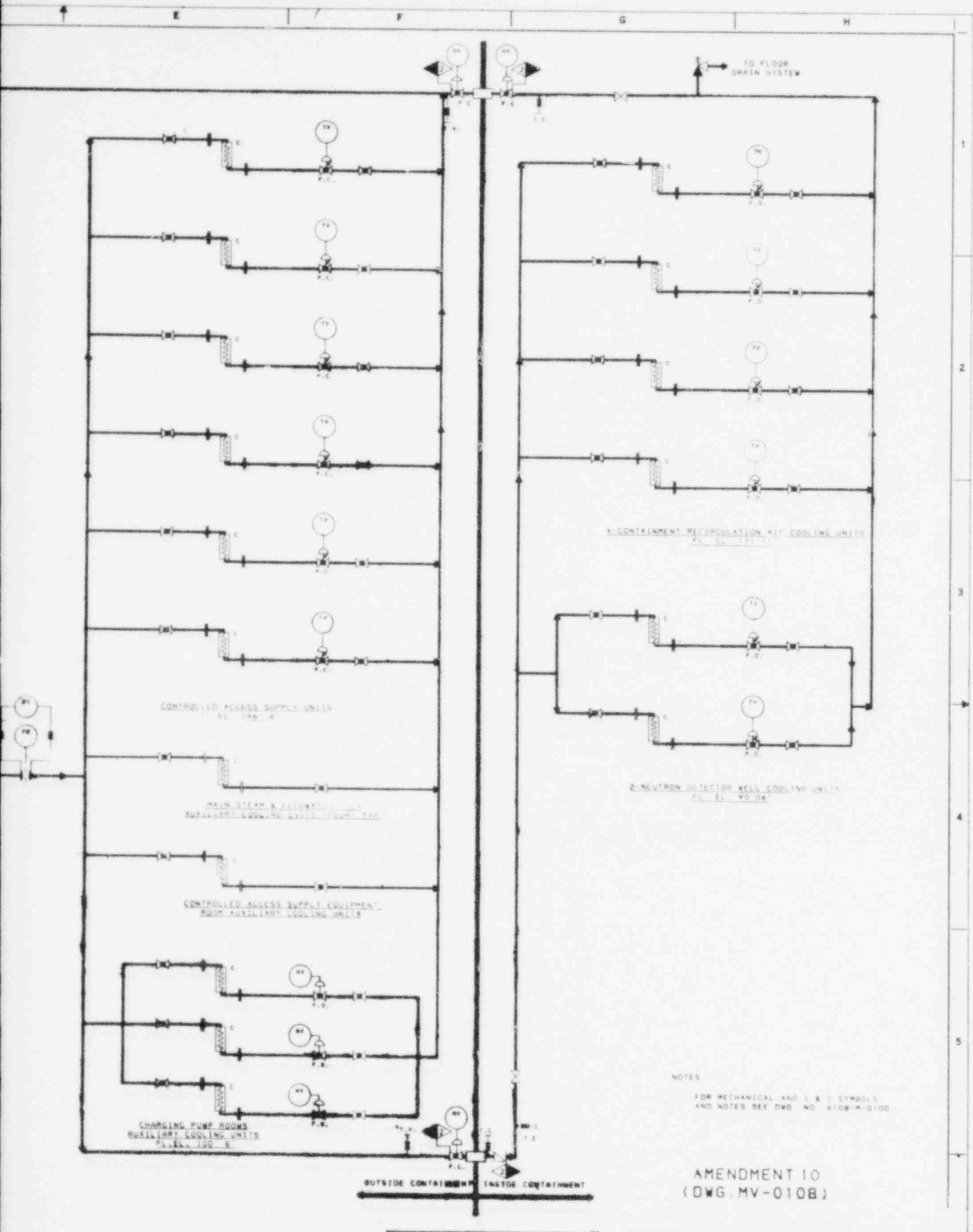


AMENDMENT 10

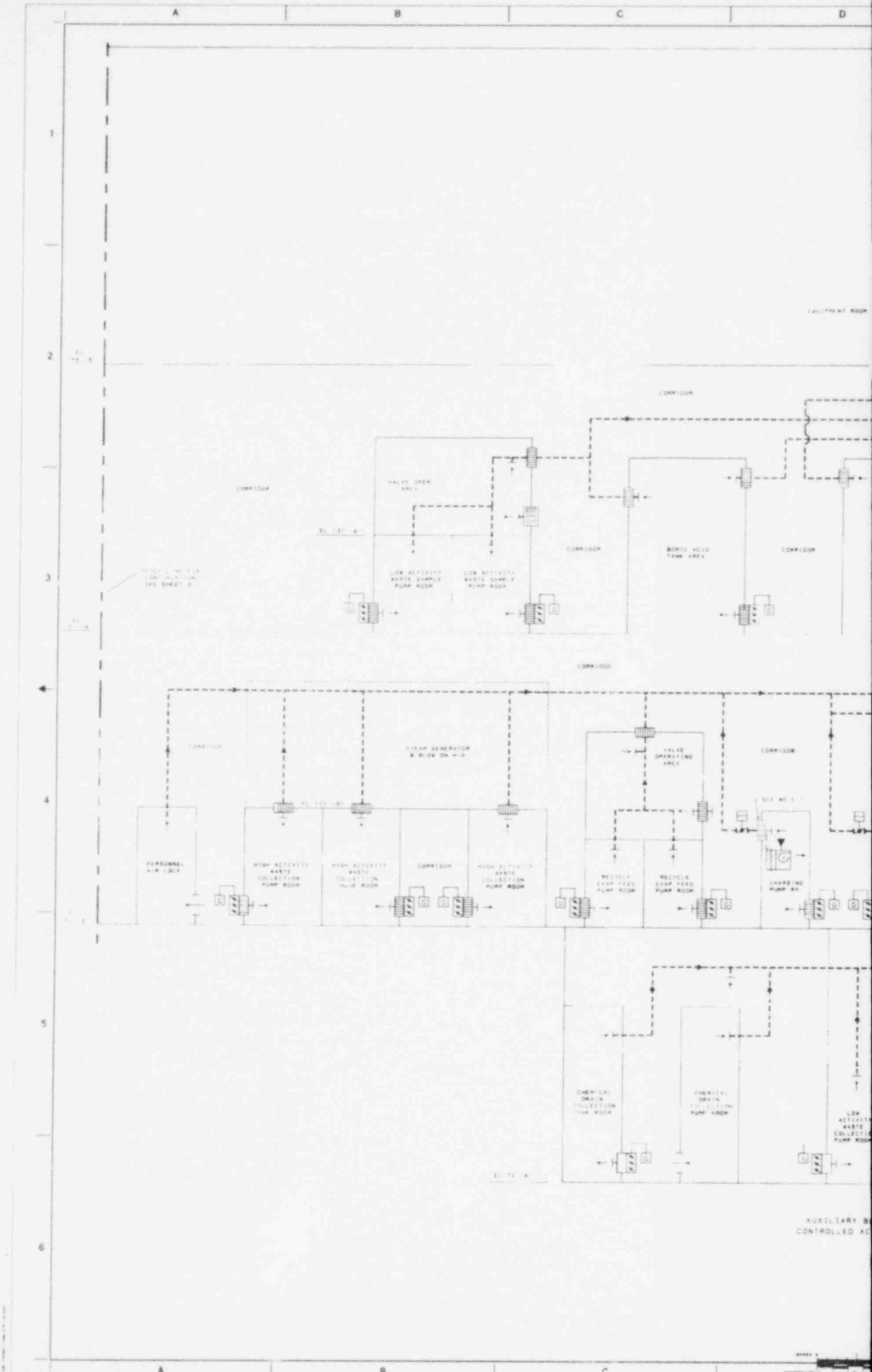
GIBBSSAR	FUEL HANDLING AREA SUPPLY AND EXHAUST DUCTWORK
NSSS NOT SPECIFIC ■ W-414 □ CE □ B&W □	FIGURE NO. 9.4-8



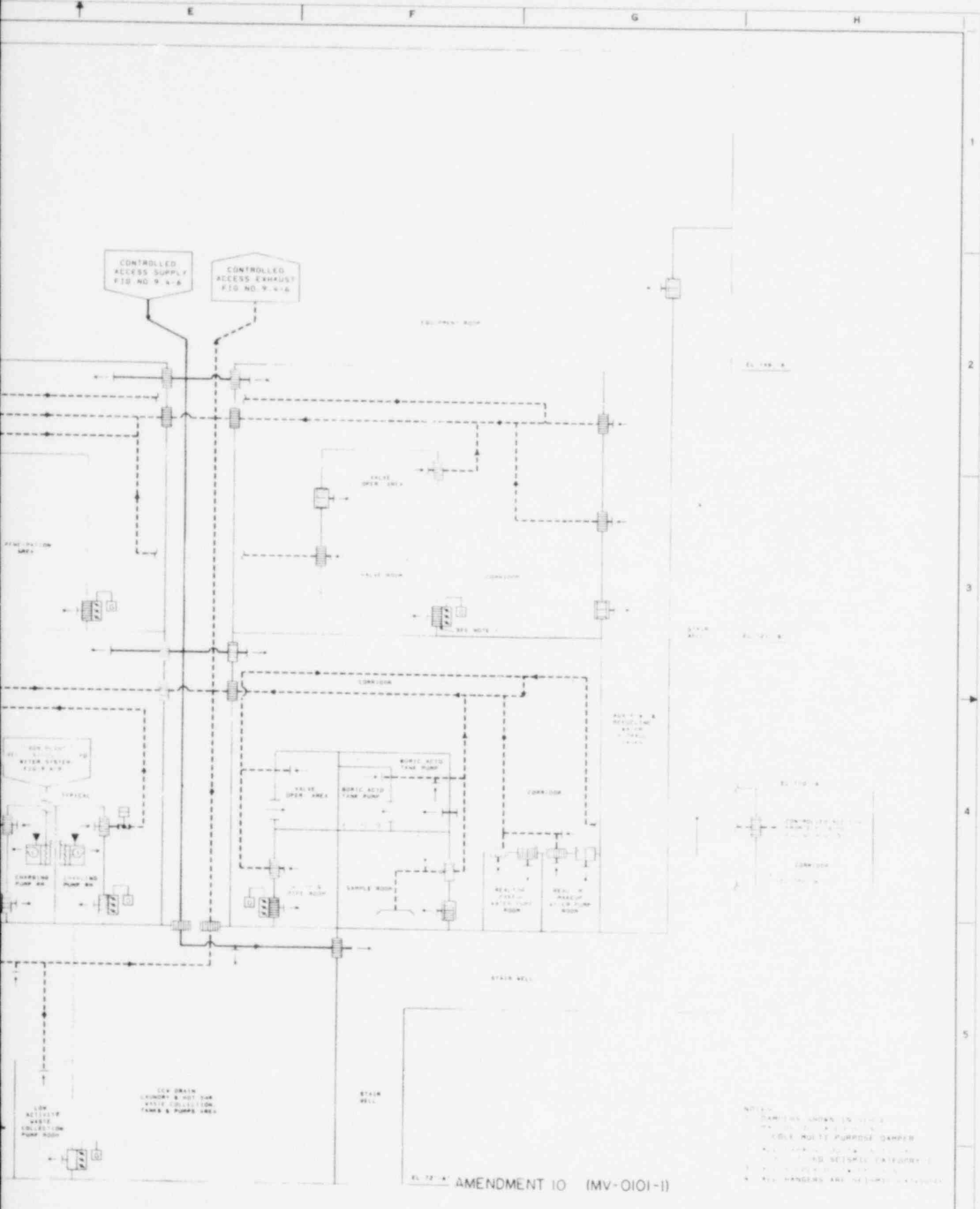
CHILLED WATER EXPANSION TANK
EL. (LATER)
FROM DEMIN WATER SYSTEMS
EVAP.
COND.
PLANT VENTILATION CHILLED WATER PUMPS
PLANT VENTILATION CHILLERS UNITS
TO COMPONENT COOLING WATER SYS.
FROM COMPONENT COOLING WATER SYS.



GIBBSSAR	PLANT VENTILATION CHILLED WATER SYSTEM FLOW DIAGRAM
NSSS: NOT SPECIFIC ■ W-414 □ CE □ B&W □	FIGURE NO. 9.4-9



A
B
C
D
CORRIDOR
BORIC ACID TANK AREA
LOW ACTIVITY WASTE SAMPLE PUMP ROOM
LOW ACTIVITY WASTE SAMPLE PUMP ROOM
STEAM GENERATOR B BLOW DN HX
VALVE OPERATING AREA
PERSONNEL AIR LOCK
HIGH ACTIVITY WASTE COLLECTION PUMP ROOM
HIGH ACTIVITY WASTE COLLECTION VALVE ROOM
HIGH ACTIVITY WASTE COLLECTION PUMP ROOM
RECYCLE EVAP FEED PUMP ROOM
RECYCLE EVAP FEED PUMP ROOM
CHARGING PUMP RM
CHEMICAL DRAIN COLLECTION TANK ROOM
CHEMICAL DRAIN COLLECTION PUMP ROOM
AUXILIARY B
CONTROLLED AC



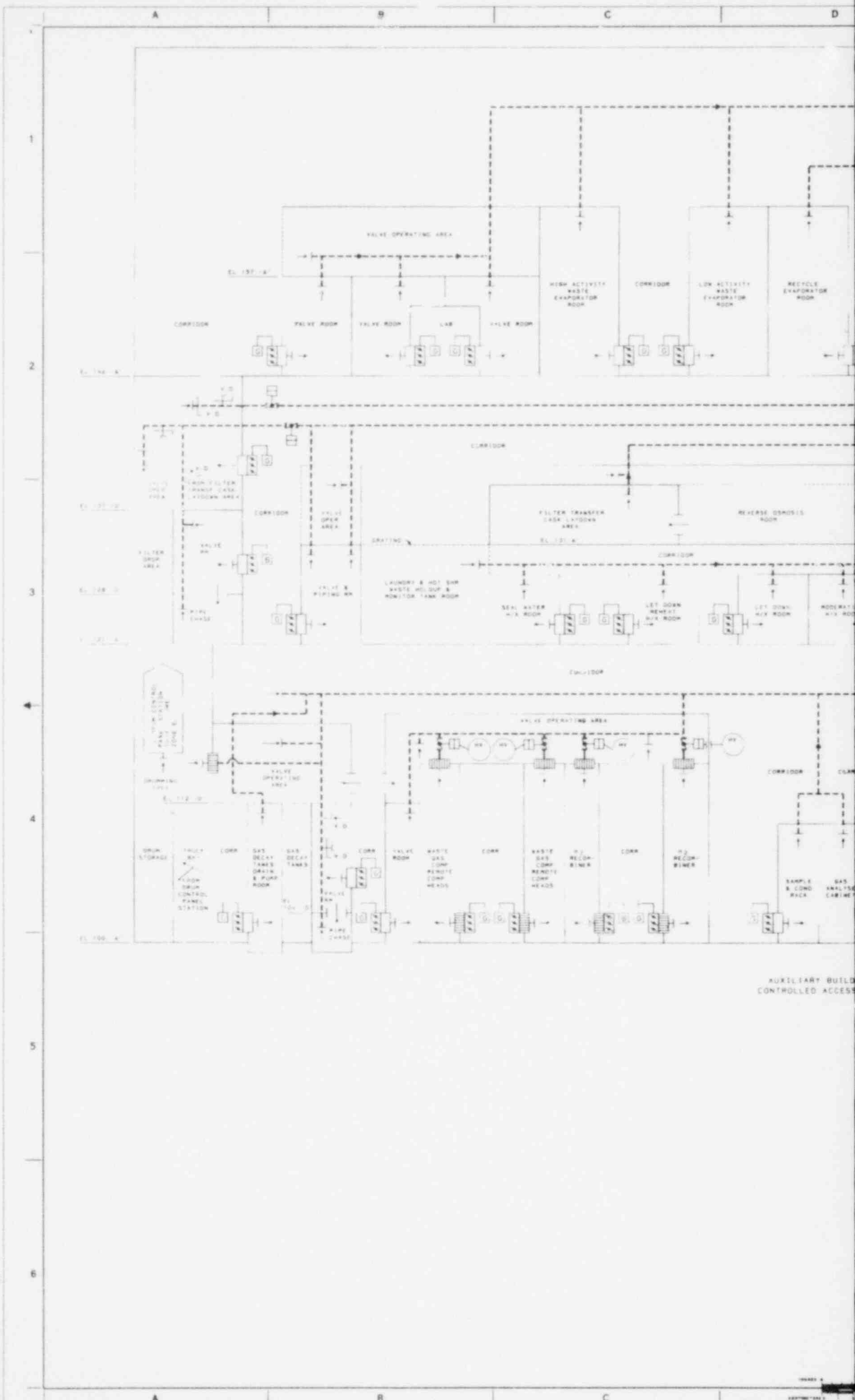
GIBBSSAR

NSSS:
NOT SPECIFIC ■
W-414 □
CE □
B&W □

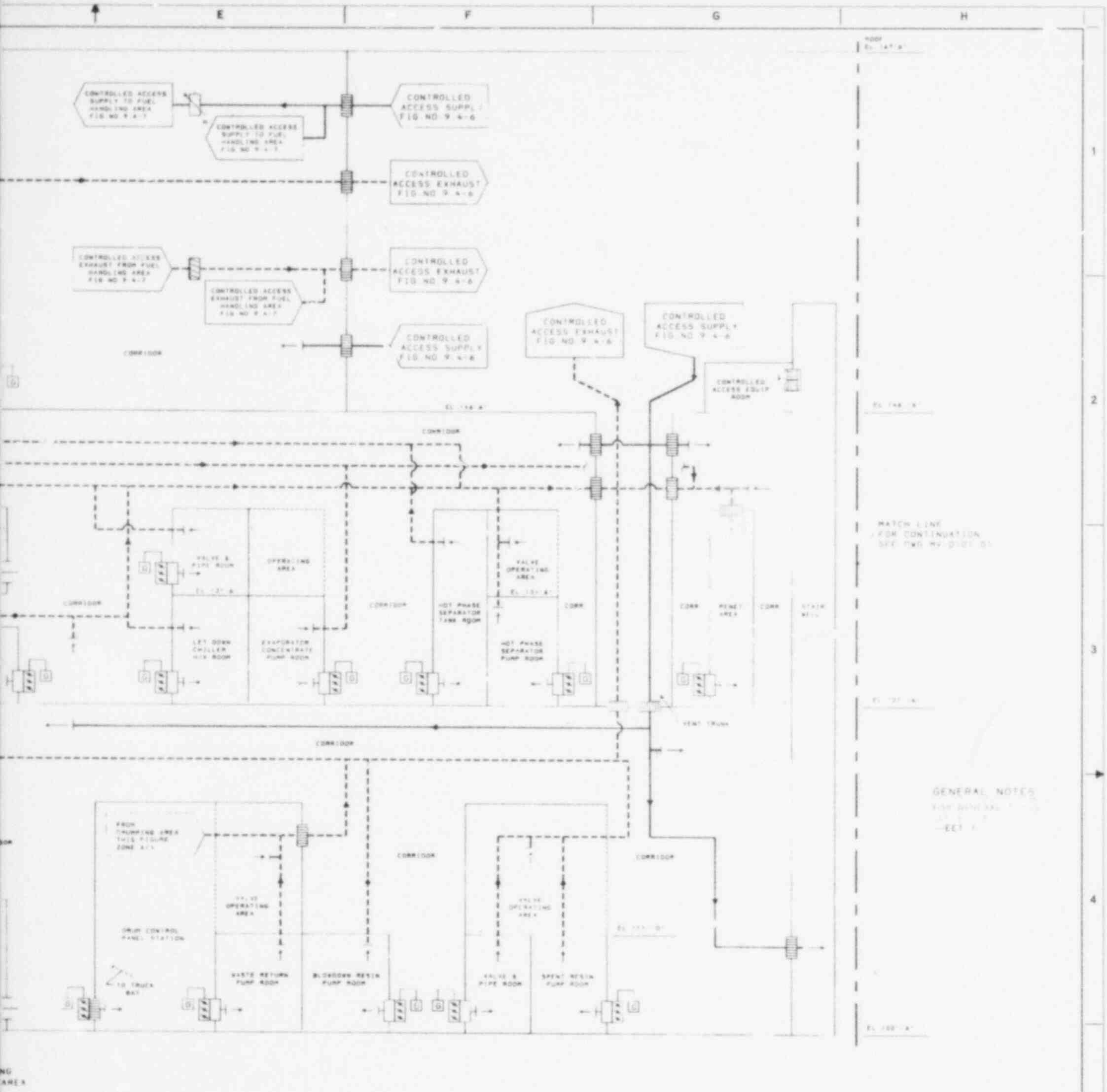
FLOW DIAGRAM
AUXILIARY BUILDING
CONTROLLED ACCESS AREA
VENTILATION SYSTEM

FIGURE NO. 9.4-10 SHEET 1

FIG. NO. 9.4-10 SHEET 1

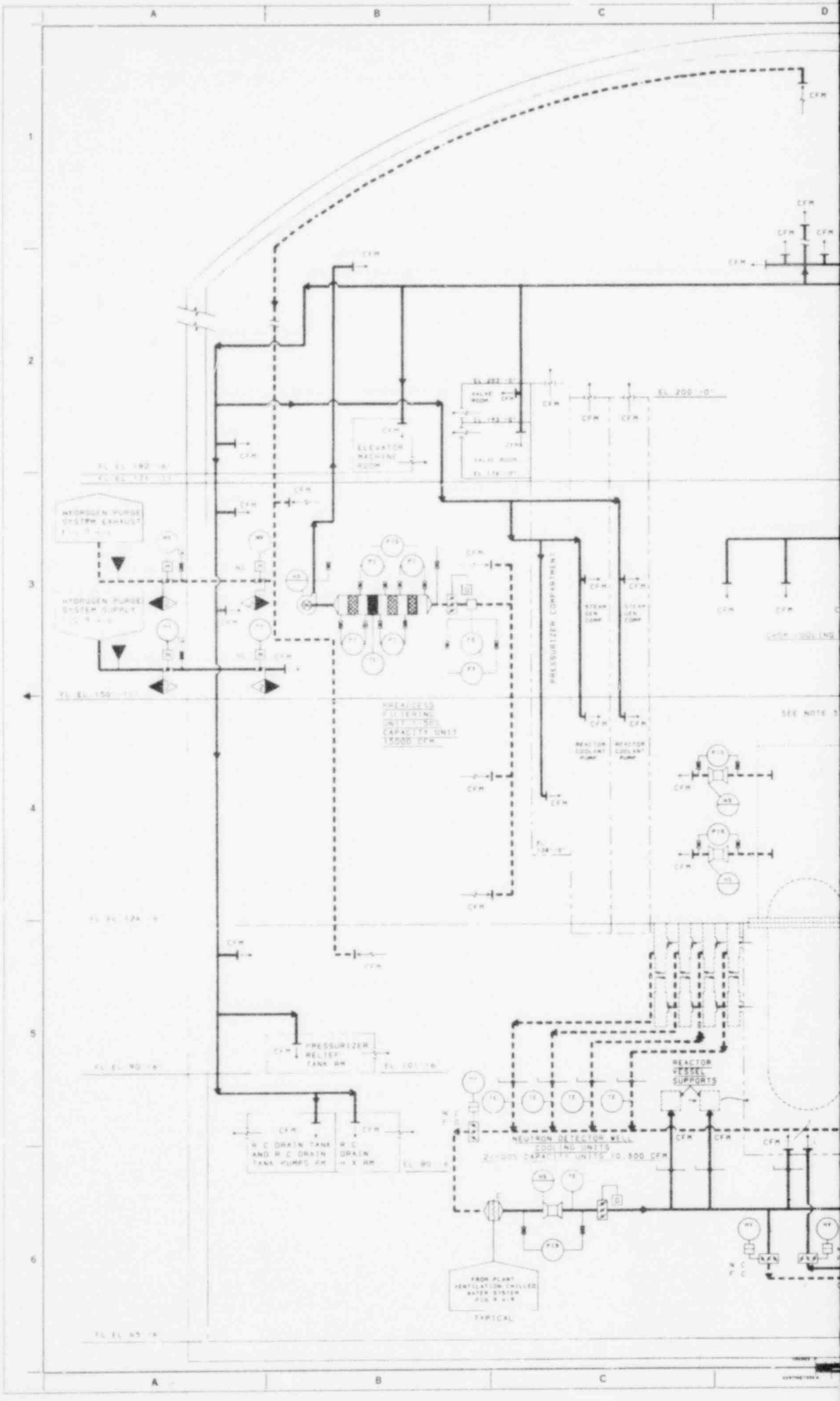


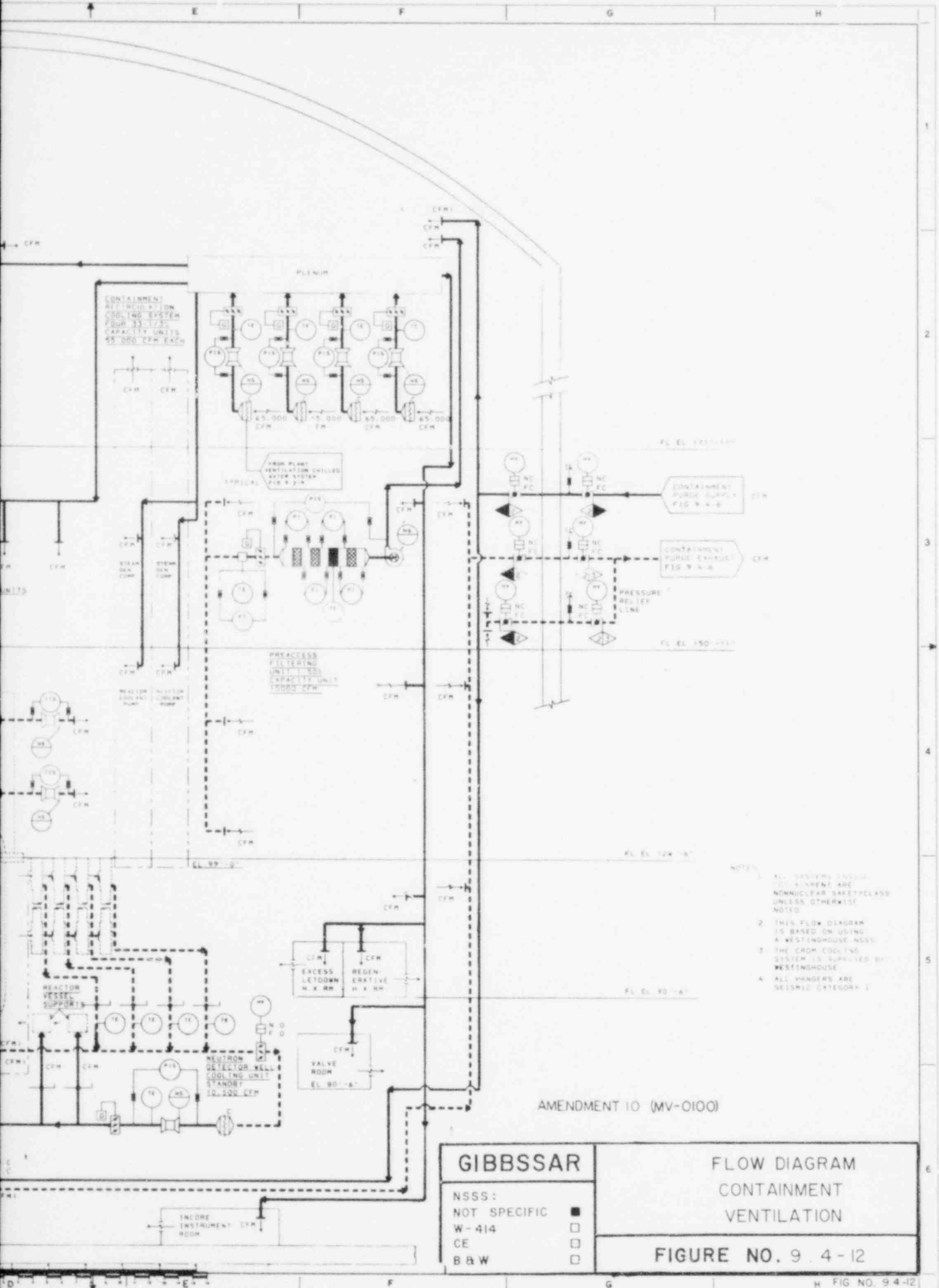
A
B
C
D
1
2
3
4
5
6
VALVE OPERATING AREA
CORRIDOR
VALVE ROOM
LAB
HIGH ACTIVITY WASTE EVAPORATOR ROOM
LOW ACTIVITY WASTE EVAPORATOR ROOM
RECYCLE EVAPORATOR ROOM
FILTER TRANSFER CASK LAYDOWN AREA
REVERSE OSMOSIS ROOM
GRATING
LAUNDRY & HOT SHR WASTE HOLDUP & MONITOR TANK ROOM
SEAL WATER H/X ROOM
LET DOWN REHEAT H/X ROOM
LET DOWN H/X ROOM
VALVE & PIPING RM
PIPE CHASE
FILTER DROP AREA
DRUMMING AREA
DRUM STORAGE
GAS DECAY TANKS
WASTE GAS COMP REMOTE COMP HEADS
H2 RECOMBINER
SAMPLE & COND RACK
VALVE OPERATING AREA
AUXILIARY BUILD
CONTROLLED ACCESS



AMENDMENT 10 (MV-0101-02)

GIBBSSAR	FLOW DIAGRAM AUXILIARY BUILDING CONTROLLED ACCESS AREA VENTILATION SYSTEM
NSSS: NOT SPECIFIC ■ W-414 □ CE □ B & W □	FIGURE NO. 9.4-10 SHEET 2


A
B
C
D
1
2
3
4
5
6
CFM
ELEVATOR MACHINE ROOM
VALVE ROOM
EL 200'-0"
HYDROGEN PURGE SYSTEM EXHAUST
HYDROGEN PURGE SYSTEM SUPPLY
PRESSURIZER COMPARTMENT
STEAM GEN COMP
REACTOR COOLANT PUMP
SEE NOTE 3
PRESSURIZER RELIEF TANK RM
R.C. DRAIN TANK AND R.C. DRAIN TANK PUMPS RM
R.C. DRAIN H.X. RM
REACTOR VESSEL SUPPORTS
NEUTRON DETECTOR WELL COOLING UNITS
FROM PLANT VENTILATION CHILLED WATER SYSTEM
TYPICAL



NOTES:
1. ALL SYSTEMS INSIDE CONTAINMENT ARE NONNUCLEAR SAFETY CLASS UNLESS OTHERWISE NOTED.
2. THIS FLOW DIAGRAM IS BASED ON USING A WESTINGHOUSE NSSS.
3. THE CRDM COOLING SYSTEM IS SUPPLIED BY WESTINGHOUSE.
4. ALL HANGERS ARE SEISMIC CATEGORY I.

AMENDMENT 10 (MV-0100)

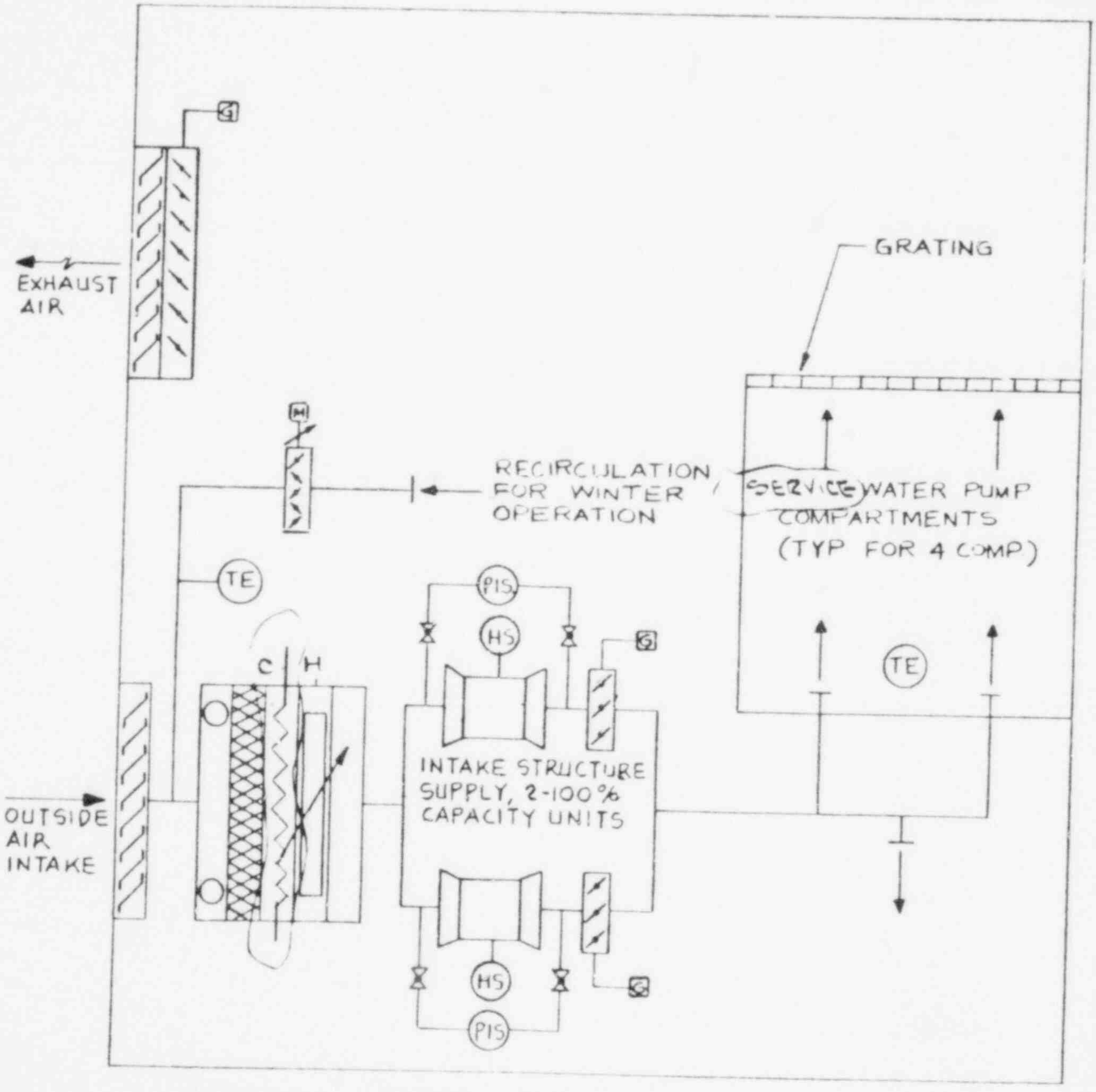
GIBBSSAR

NSS:
- NOT SPECIFIC ■
- W-414 □
- CE □
- B&W □

FLOW DIAGRAM CONTAINMENT VENTILATION

FIGURE NO. 9.4-12

FIG NO. 9.4-12

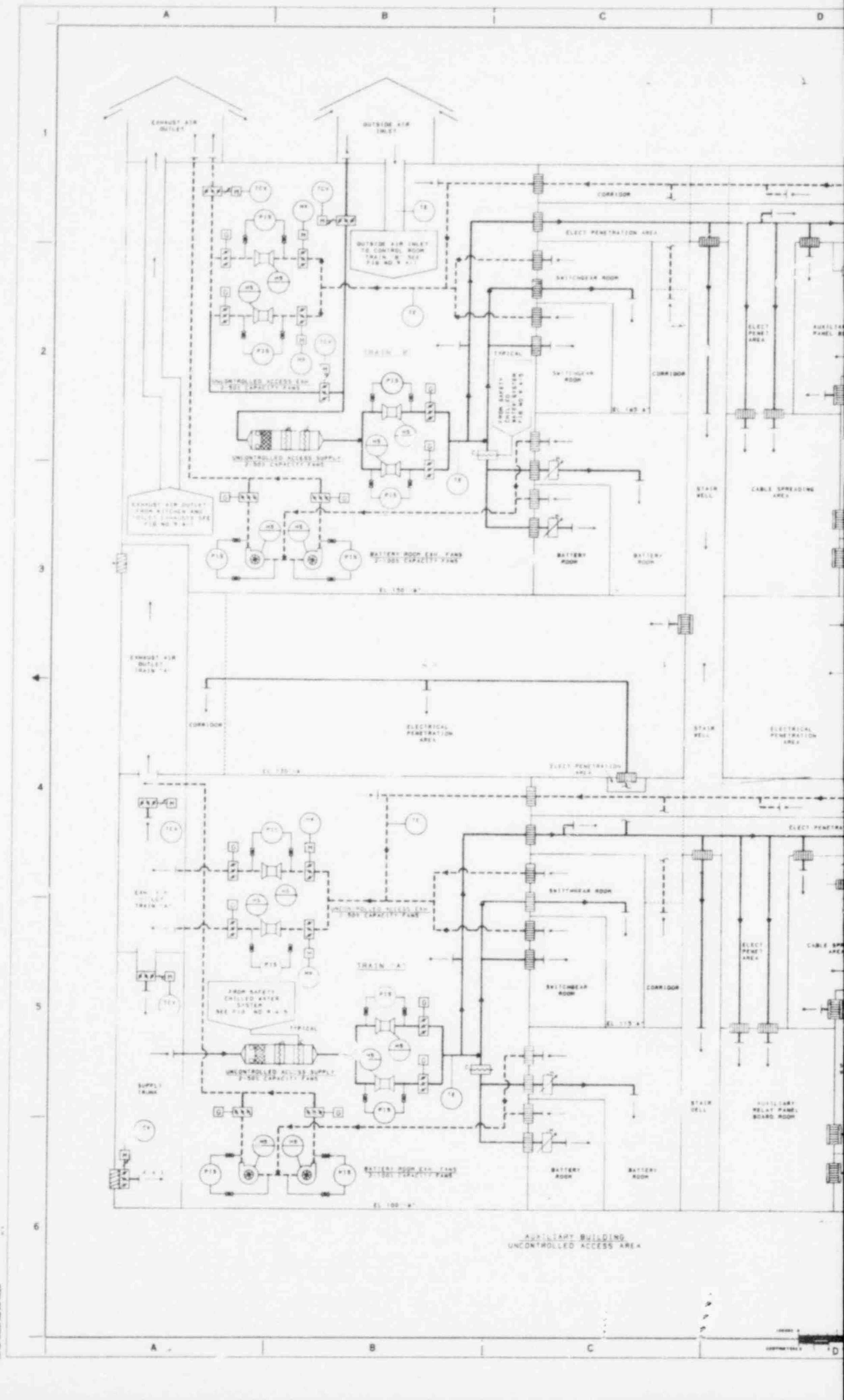


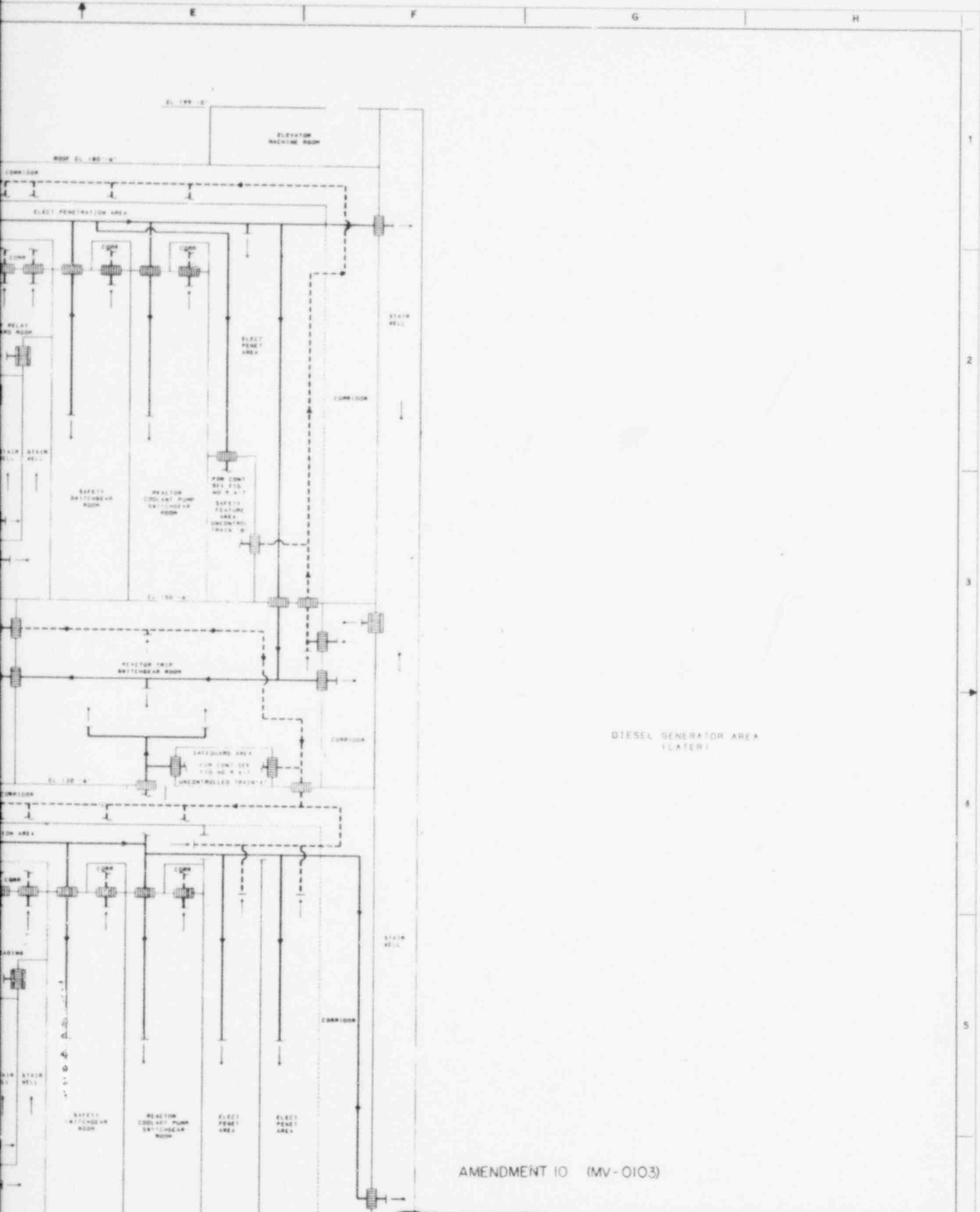
SERVICE WATER INTAKE STRUCTURE

NOTE ALL STRUCTURES, EQUIPMENT & SYSTEMS SAFETY CLASS 3, UNLESS OTHERWISE NOTED.

AMENDMENT 9

GIBBSSAR	SERVICE WATER INTAKE STRUCTURE VENTILATION SYSTEM
NSSS: NOT SPECIFIC ■ W- 4;4 □ CE □ B&W □	FIGURE NO. 9.4-13

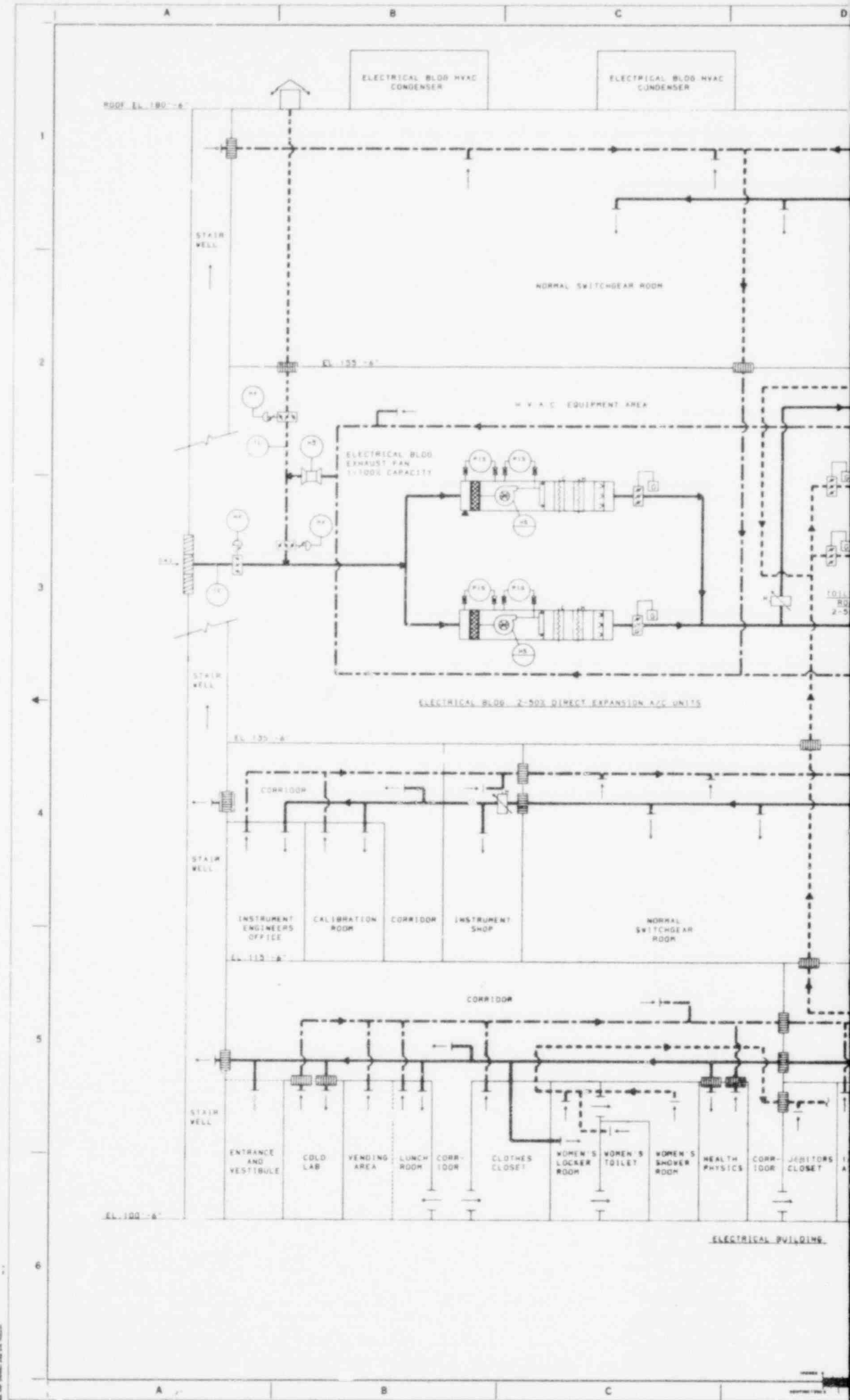

EXHAUST AIR OUTLET
OUTSIDE AIR INLET
CORRIDOR
ELECT PENETRATION AREA
SWITCHGEAR ROOM
TRAIN "B"
UNCONTROLLED ACCESS SUPPLY 2-50% CAPACITY FANS
BATTERY ROOM EXH. FANS 2-100% CAPACITY FANS
BATTERY ROOM
STAIR WELL
CABLE SPREADING AREA
ELECTRICAL PENETRATION AREA
TRAIN "A"
SUPPLY TRUNK
AUXILIARY RELAY PANEL BOARD ROOM
AUXILIARY BUILDING
UNCONTROLLED ACCESS AREA



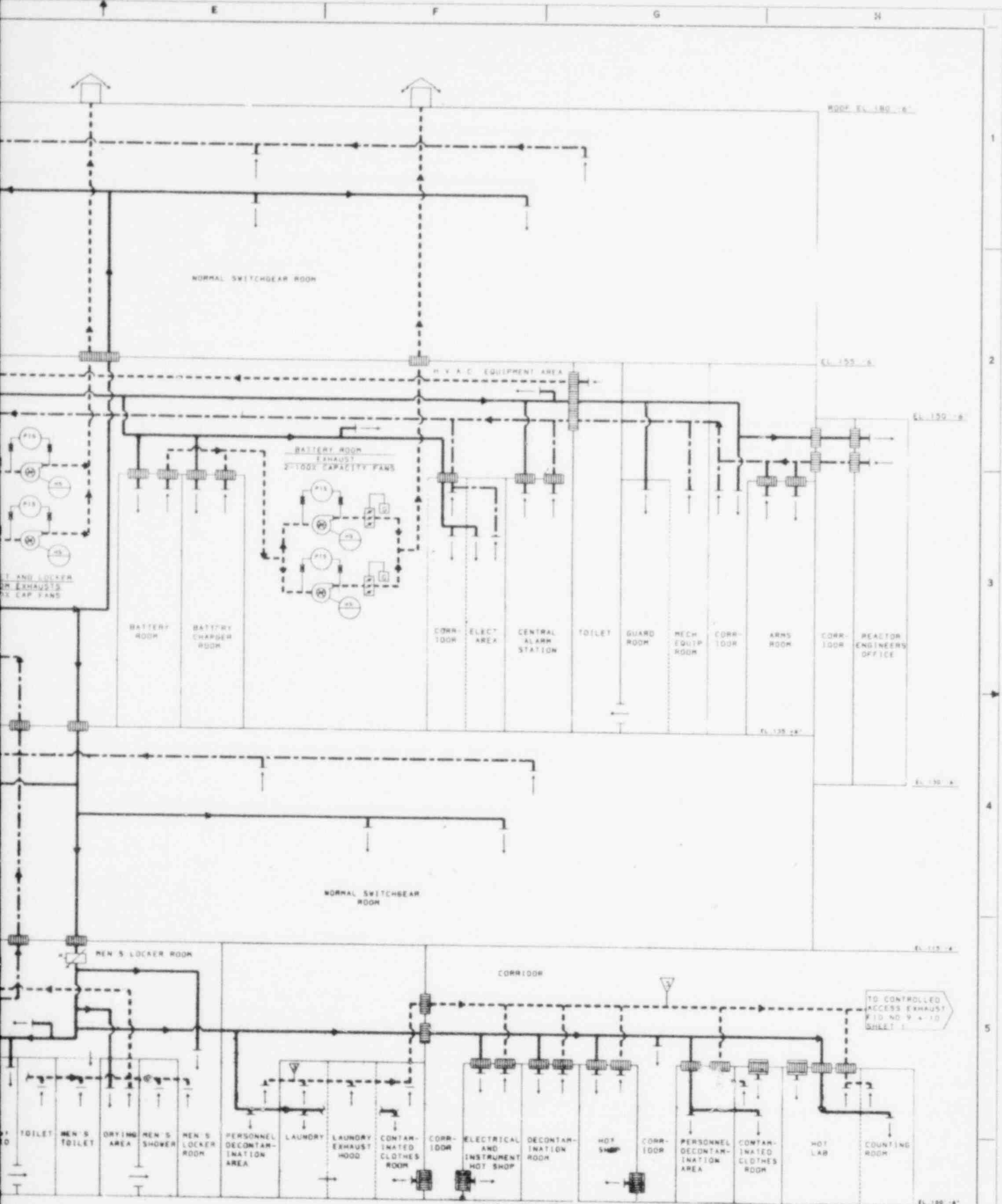
NOTES:
1. ALL SUPPLY AND EXHAUST DUCTWORK FANS AND DAMPERS ARE SAFETY CLASS 3 AND SEISMIC CATEGORY I

GIBBSSAR	FLOW DIAGRAM UNCONTROLLED ACCESS & DIESEL GENERATOR AREA VENTILATION SYSTEM
NSSS: NOT SPECIFIC ■ W-414 □ CE □ B & W □	FIGURE NO. 9.4-14

FIG NO 9.4-14



A
B
C
D
ELECTRICAL BLDG HVAC CONDENSER
ELECTRICAL BLDG HVAC CONDENSER
ROOF EL 180'-6"
STAIR WELL
NORMAL SWITCHGEAR ROOM
EL 155'-6"
H.V.A.C. EQUIPMENT AREA
ELECTRICAL BLDG EXHAUST FAN 1-100% CAPACITY
STAIR WELL
ELECTRICAL BLDG. 2-50% DIRECT EXPANSION A/C UNITS
EL 135'-6"
CORRIDOR
STAIR WELL
INSTRUMENT ENGINEERS OFFICE
CALIBRATION ROOM
CORRIDOR
INSTRUMENT SHOP
NORMAL SWITCHGEAR ROOM
EL 115'-6"
CORRIDOR
STAIR WELL
ENTRANCE AND VESTIBULE
COLD LAB
VENDING AREA
LUNCH ROOM
CORR-IDOR
CLOTHES CLOSET
WOMEN'S LOCKER ROOM
WOMEN'S TOILET
WOMEN'S SHOWER ROOM
HEALTH PHYSICS
CORR-IDOR
JANITORS CLOSET
EL 100'-6"
ELECTRICAL BUILDING
1
2
3
4
5
6



AMENDMENT 10 (MV-0106)

NOTES:
1. ALL DUCTWORK, FANS AND DAMPERS ARE NNS EXCEPT WHERE NOTED.

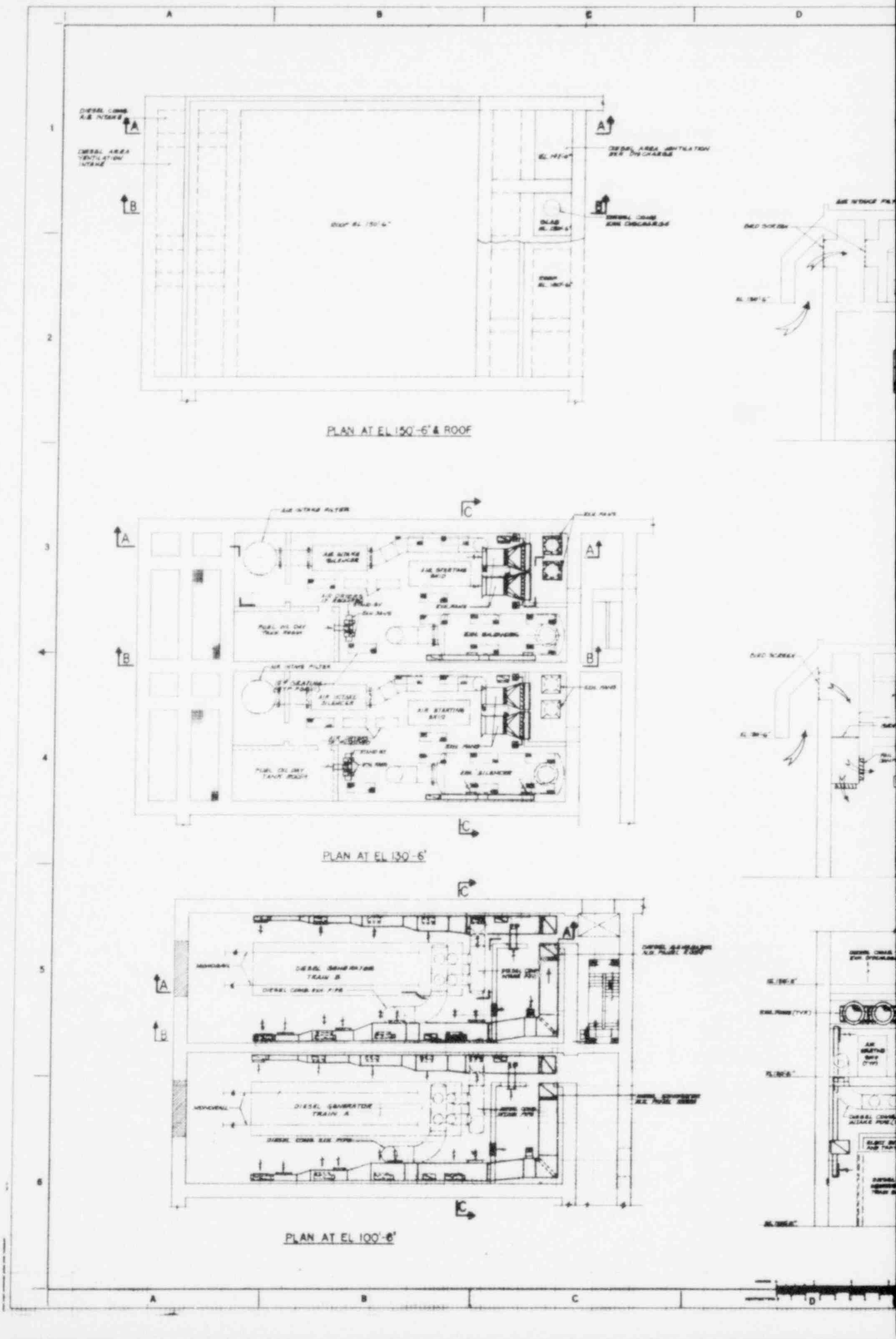
GIBBSSAR

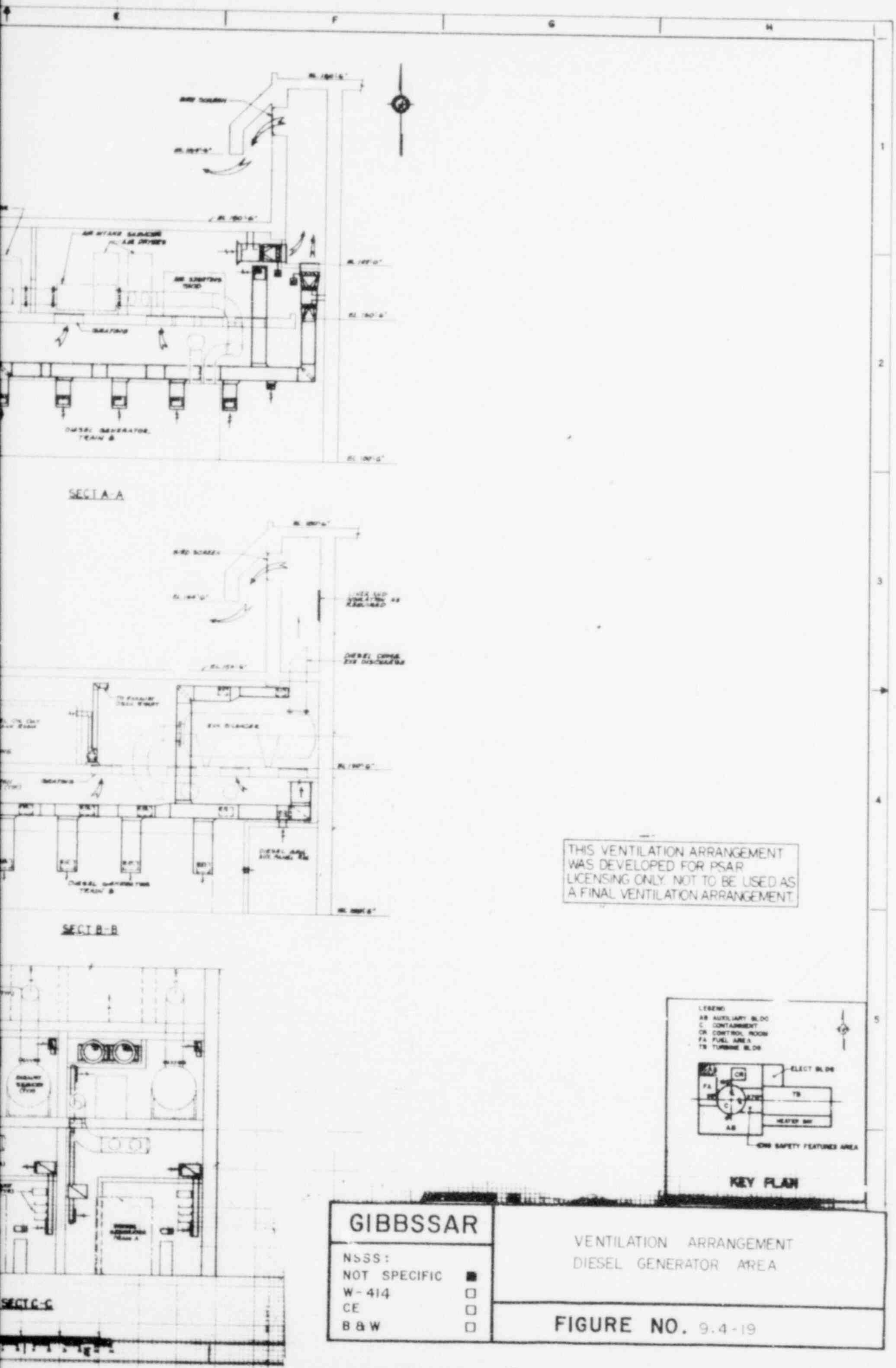
NSSS:
- NOT SPECIFIC ■
- W-414 □
- CE □
- B&W □

FLOW DIAGRAM
ELECTRICAL BUILDING

FIGURE NO. 9.4-15

FIG. NO. 9.4-15


A
B
C
D
1
2
3
4
5
6
DIESEL AREA VENTILATION INTAKE
PLAN AT EL 150'-6" & ROOF
AIR INTAKE FILTER
AIR INTAKE SILENCER
AIR STARTING SKID
FUEL OIL DAY TANK ROOM
PLAN AT EL 130'-6"
DIESEL GENERATOR TRAIN B
DIESEL GENERATOR TRAIN A
PLAN AT EL 100'-6"



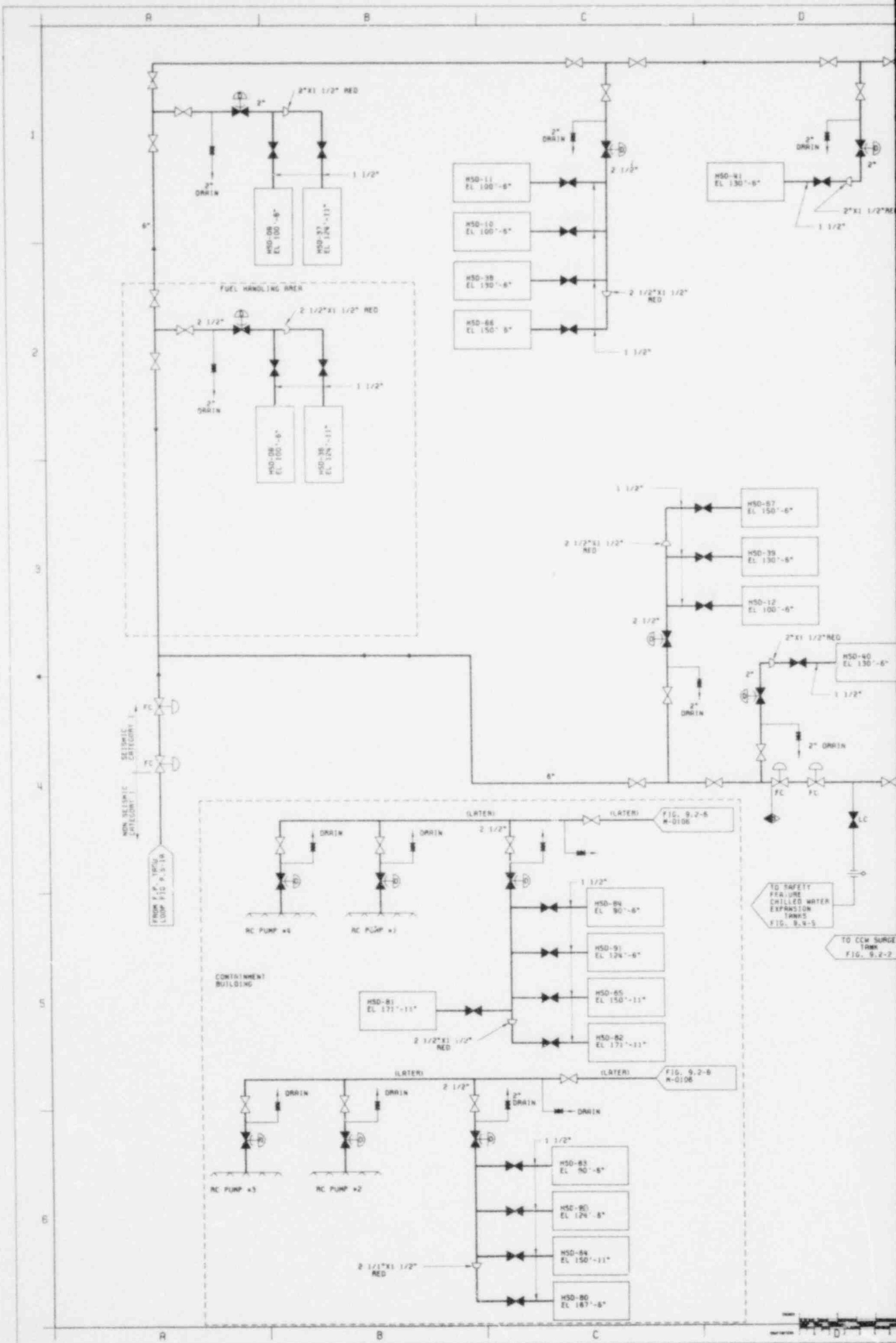
THIS VENTILATION ARRANGEMENT WAS DEVELOPED FOR PSAR LICENSING ONLY. NOT TO BE USED AS A FINAL VENTILATION ARRANGEMENT.

GIBBSSAR

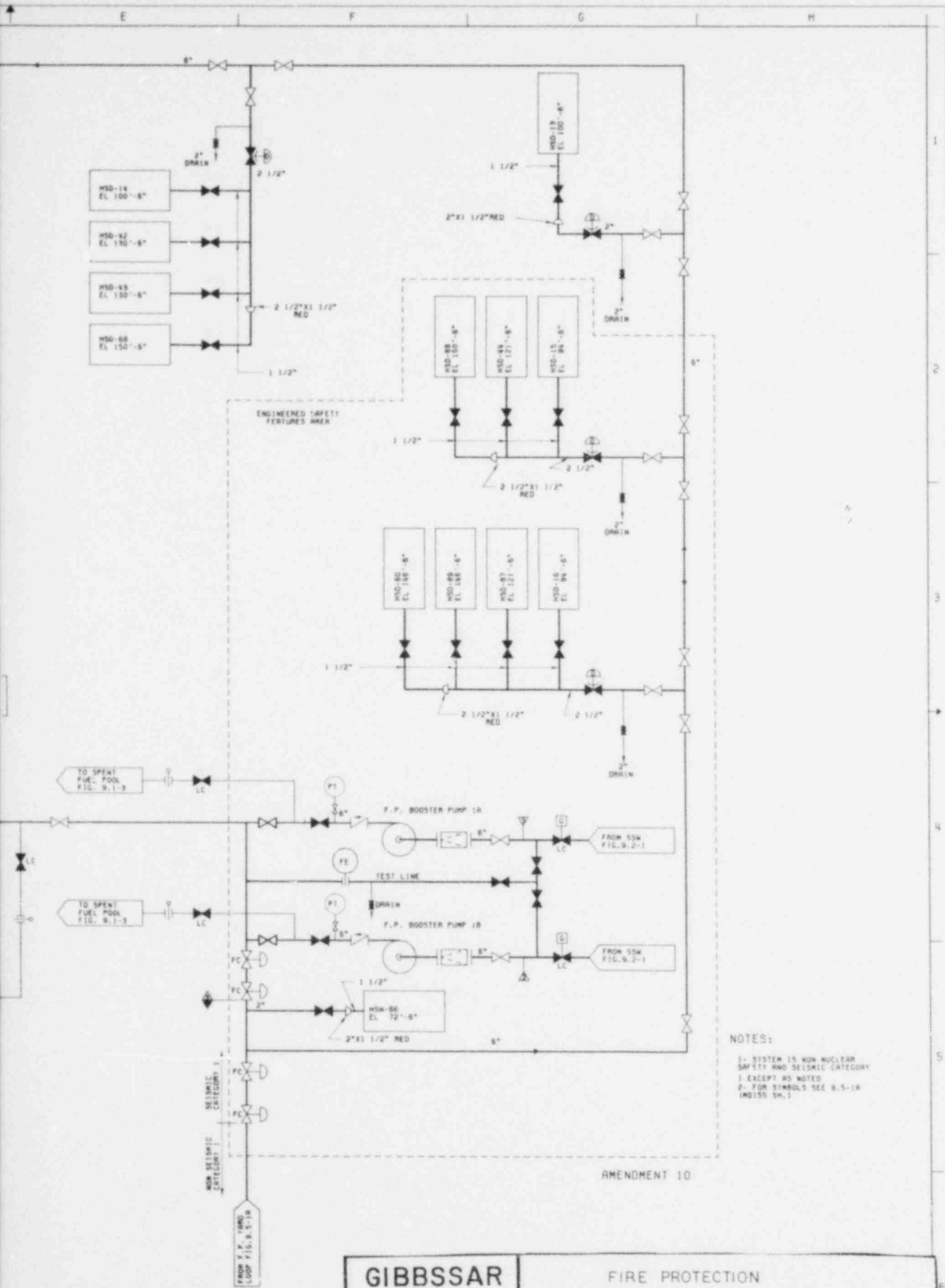
NSSS:
NOT SPECIFIC ■
W-414 □
CE □
B&W □

VENTILATION ARRANGEMENT
DIESEL GENERATOR AREA

FIGURE NO. 9.4-19



FUEL HANDLING AREA
CONTAINMENT BUILDING
2"X1 1/2" RED
2 1/2"X1 1/2" RED
2" DRAIN
1 1/2"
HSD-08 EL 100'-6"
HSD-37 EL 124'-11"
HSD-36 EL 124'-11"
HSD-11 EL 100'-6"
HSD-10 EL 100'-6"
HSD-38 EL 130'-6"
HSD-66 EL 150'-6"
HSD-41 EL 130'-6"
HSD-67 EL 150'-6"
HSD-39 EL 130'-6"
HSD-12 EL 100'-6"
HSD-40 EL 130'-6"
SEISMIC CATEGORY I
NON SEISMIC CATEGORY I
FC
LC
6"
(LATER)
FIG. 9.2-8 M-0106
DRAIN
RC PUMP #4
RC PUMP #1
RC PUMP #3
RC PUMP #2
HSD-84 EL 90'-6"
HSD-91 EL 124'-6"
HSD-65 EL 150'-11"
HSD-82 EL 171'-11"
HSD-81 EL 171'-11"
HSD-83 EL 90'-6"
HSD-80 EL 124'-6"
HSD-64 EL 150'-11"
HSD-80 EL 167'-6"
TO SAFETY FEATURE CHILLED WATER EXPANSION TANKS FIG. 9.4-5
TO CCW SURGE TANK FIG. 9.2-2
FROM F.P. YARD LOOP FIG 9.5-1A
A
B
C
D
1
2
3
4
5
6

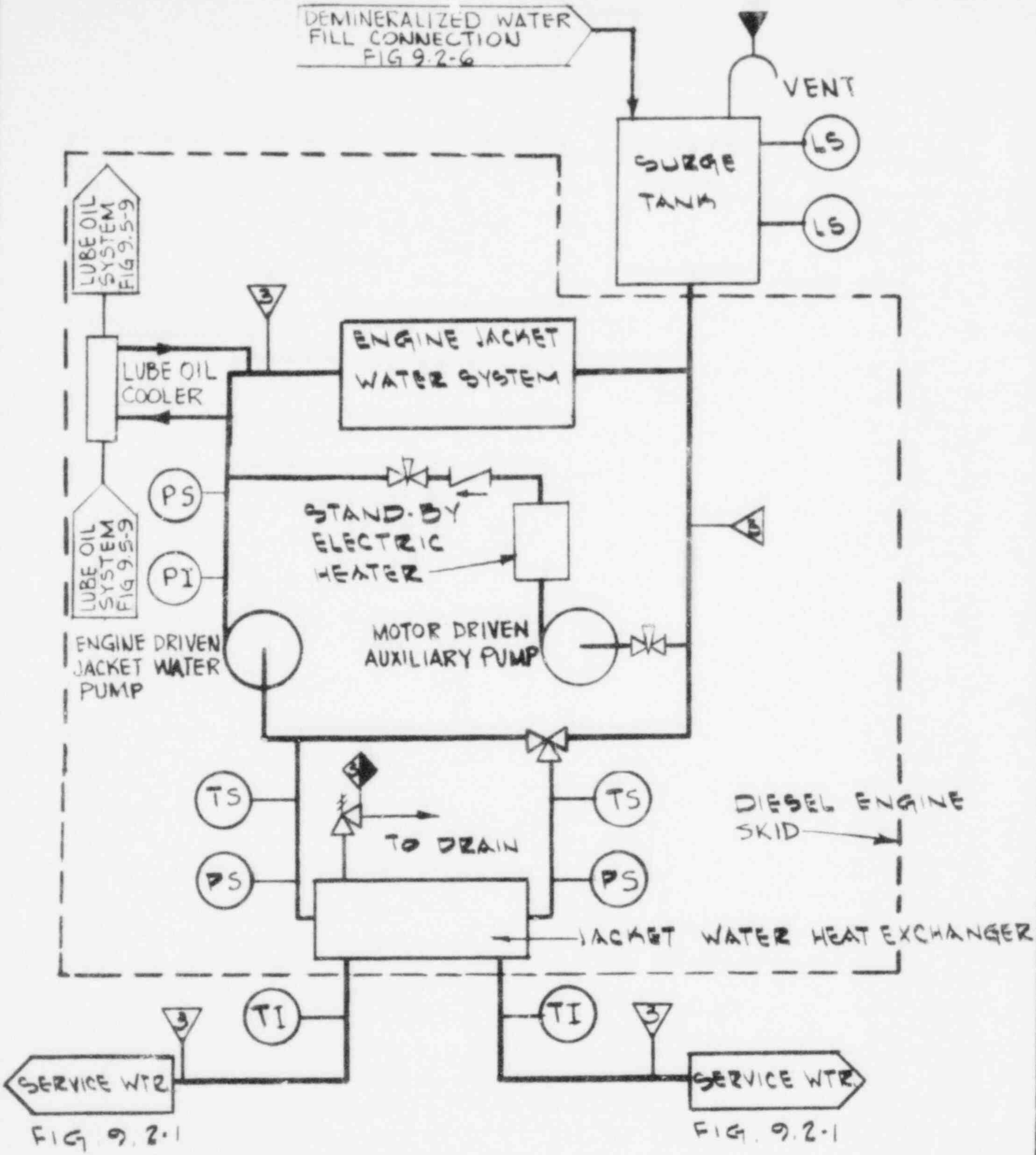


NOTES:

1- SYSTEM IS NON NUCLEAR SAFETY AND SEISMIC CATEGORY I EXCEPT AS NOTED
2- FOR SYMBOLS SEE 9.5-1A (MOISS SH.1

AMENDMENT 10

GIBBSSAR	FIRE PROTECTION SYSTEM FLOW DIAGRAM
NSSS: NOT SPECIFIC ☐ W-414 ■ CE ☐ B&W ☐	FIGURE NO. 9.5-1B

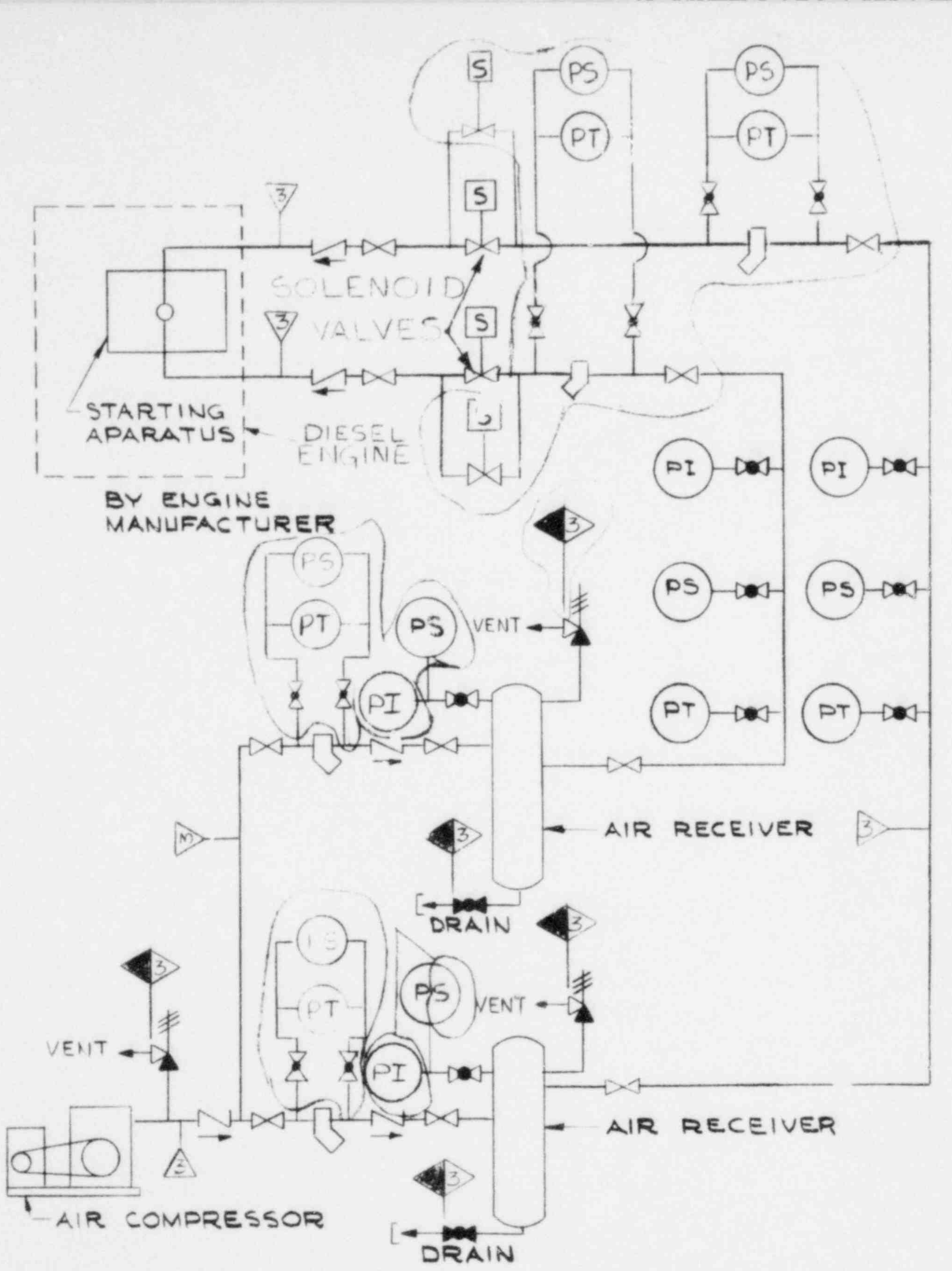


AMENDMENT 10

GIBBSSAR	EMERGENCY GENERATOR COOLING WATER SYSTEM
NSSS: NOT SPECIFIC ■ W-414 □ CE □ B&W □	FIGURE NO. 9.5-4

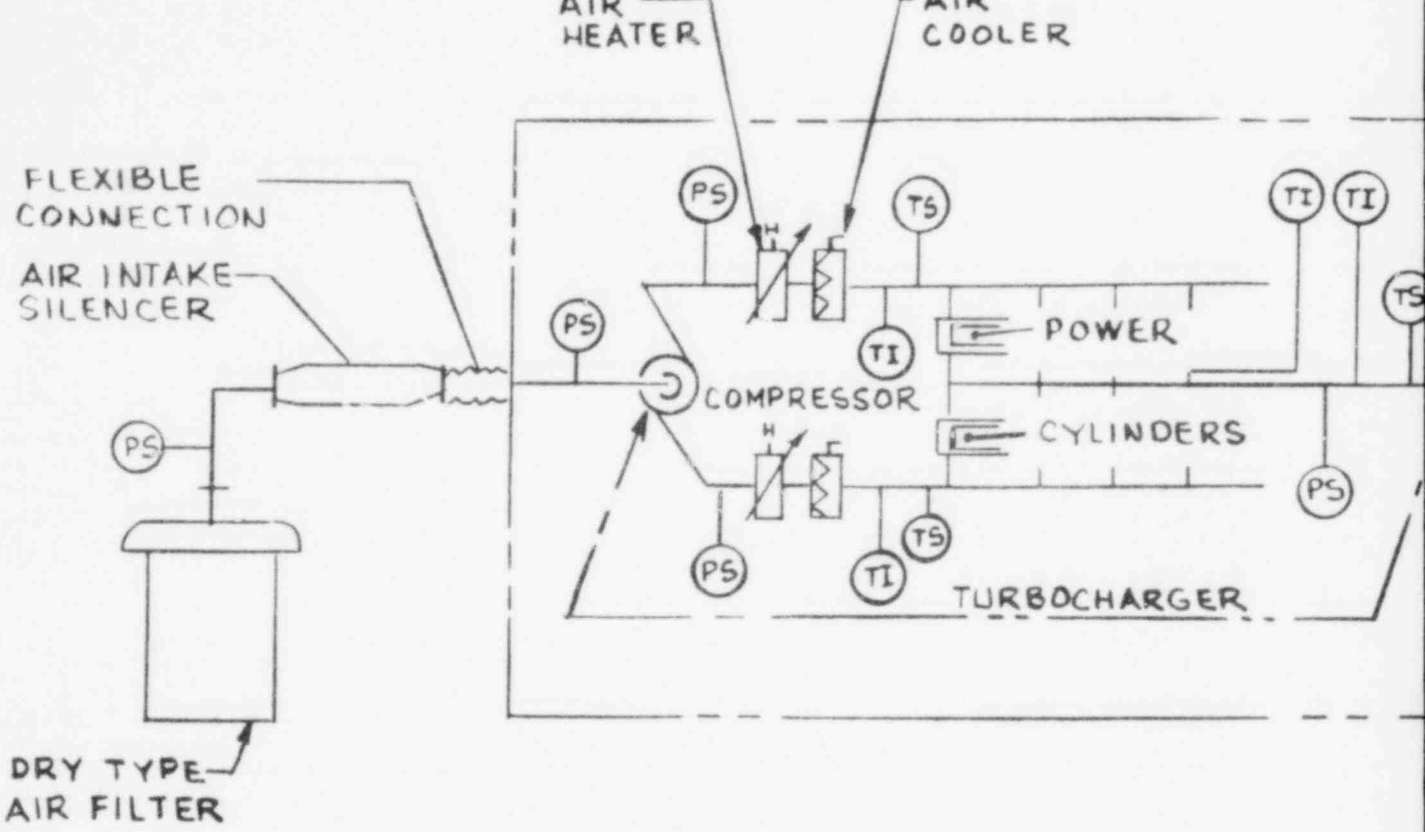
5/78

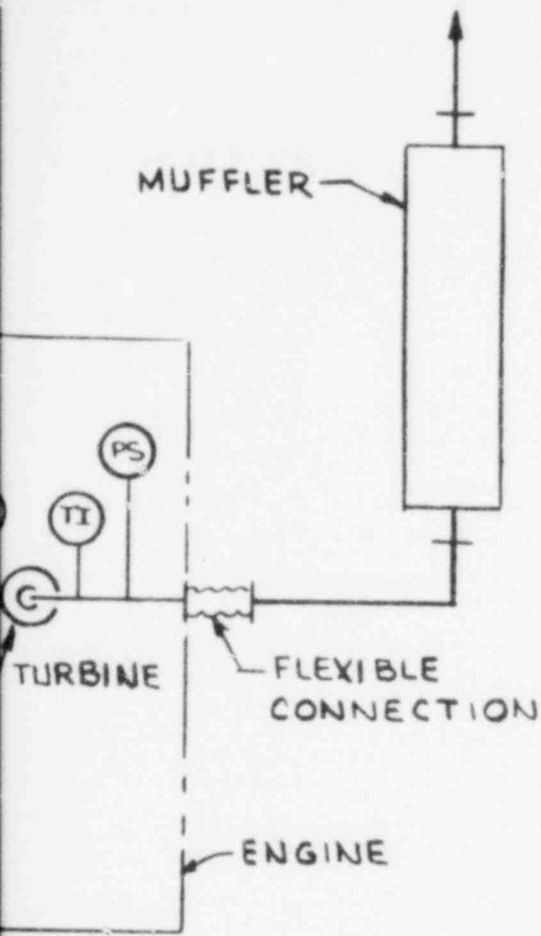
6108



AMENDMENT 10

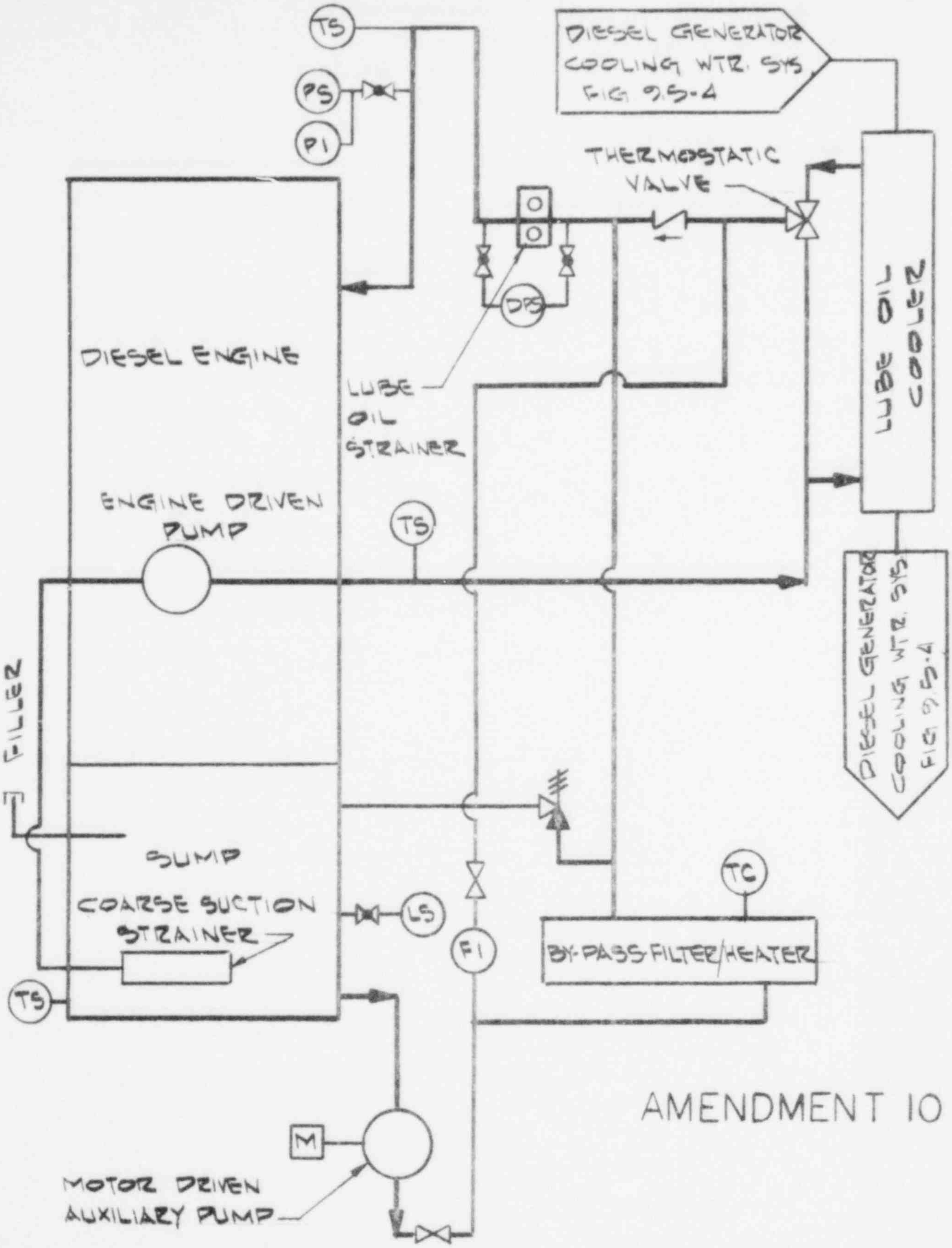
GIBBSSAR	EMERGENCY DIESEL GENERATOR STARTING AIR SYSTEM
NSSS: NOT SPECIFIC ☐ W-414 ■ CE ☐ B&W ☐	FIGURE NO. 9.5-5


AIR HEATER
AIR COOLER
FLEXIBLE CONNECTION
AIR INTAKE SILENCER
PS
TS
TI
POWER
COMPRESSOR
CYLINDERS
TURBOCHARGER
DRY TYPE AIR FILTER



AMENDMENT 10

GIBBSSAR	EMERGENCY GENERATOR COMBUSTION AIR INTAKE AND EXHAUST SYSTEM
NSSS: NOT SPECIFIC ■ W-41 □ CE □ B & W □	FIGURE NO. 9.5-8



AMENDMENT 10

GIBBSSAR	TYPICAL DIESEL GENERATOR LUBRICATION SYSTEM
NSSS: NOT SPECIFIC ☒ W-414 ☐ CE ☐ B&W ☐	FIGURE NO. 9.5-9

DELETED

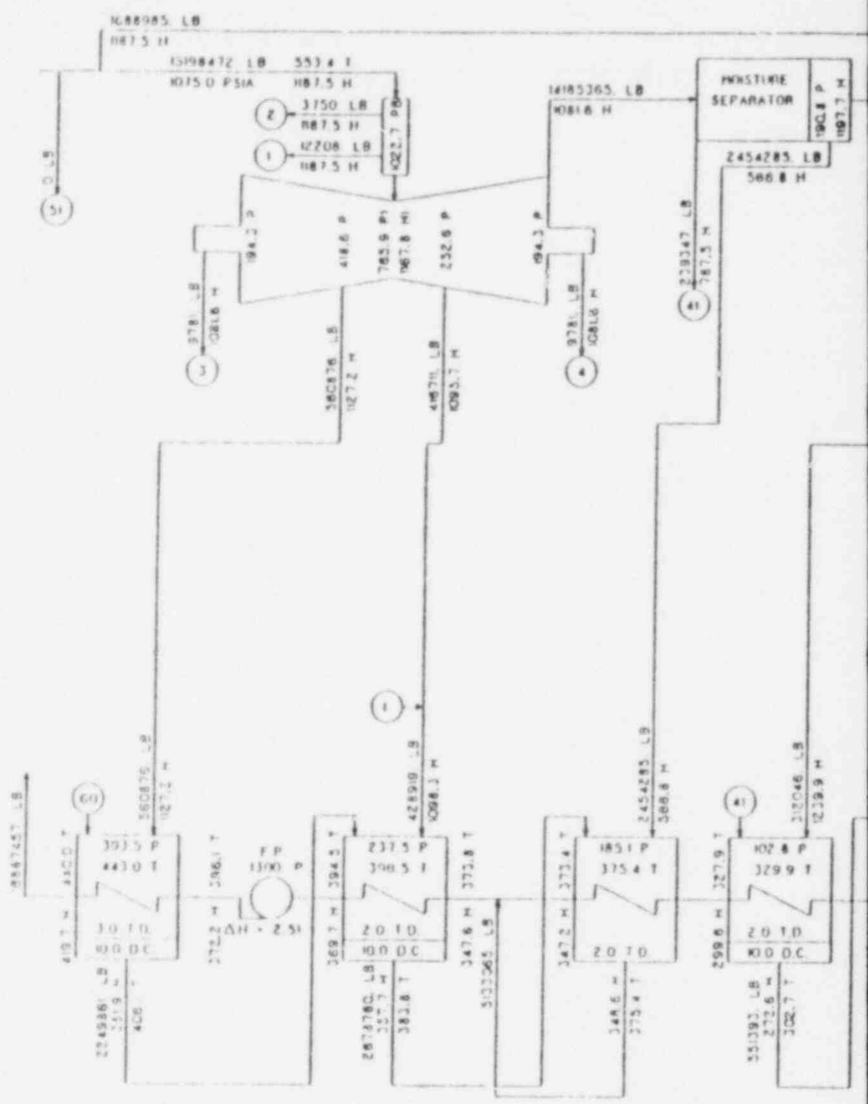
AMENDMENT 10

GIBBSSAR	
NSSS: NOT SPECIFIC ■ W-414 □ CE □ B&W □	
	FIGURE NO. 10.1-1

DELETED

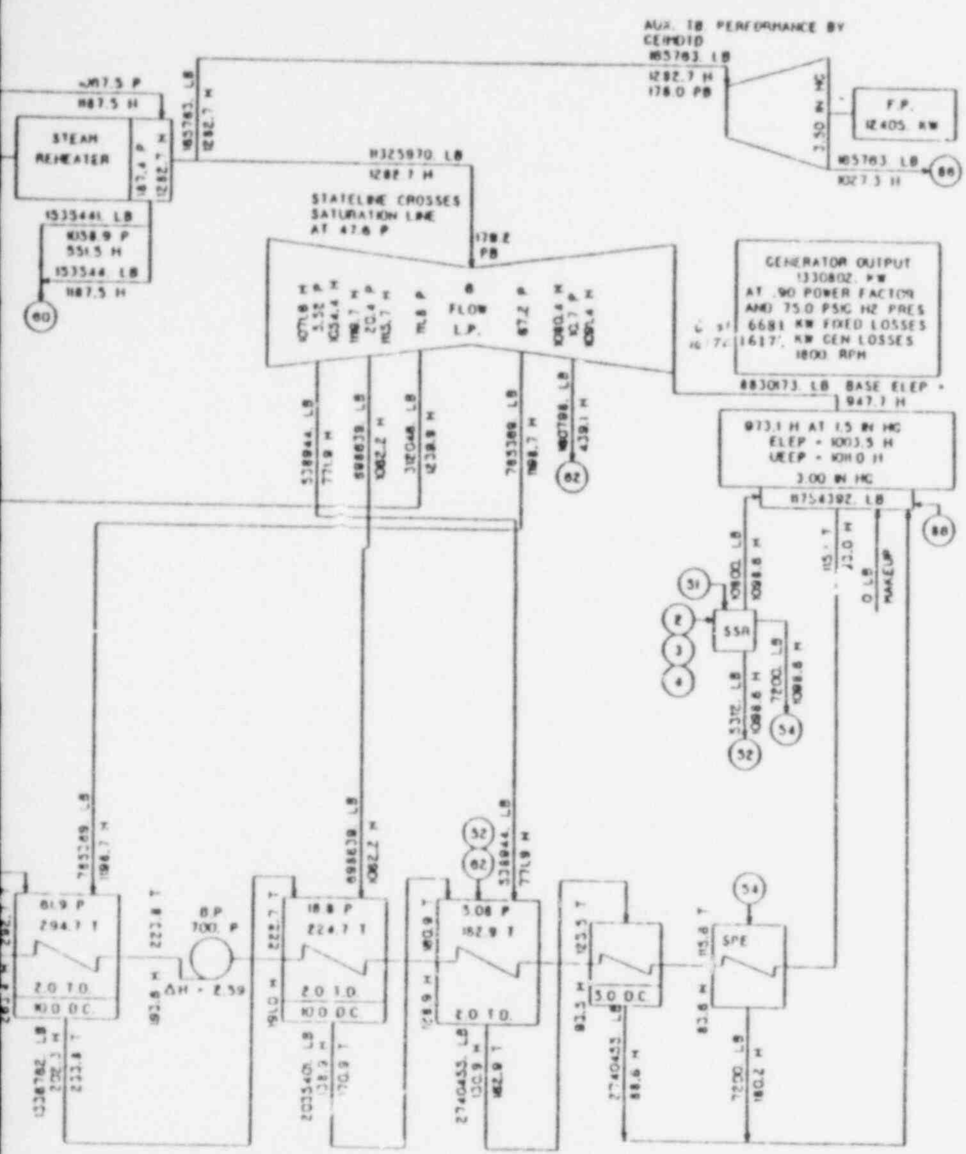
AMENDMENT 10

GIBBSSAR	
NSSS: NOT SPECIFIC ■ W-414 □ CE □ B&W □	FIGURE NO. 10.1-4



VALVE BEST POINT NET HEAT RATE = $\frac{11887457 \ (1187.5 - 419.7)}{1110802}$ = 9743 $\frac{BTU}{KW\ HR}$

EXTRACTION ARRANGEMENT IS SCHEMATIC ONLY

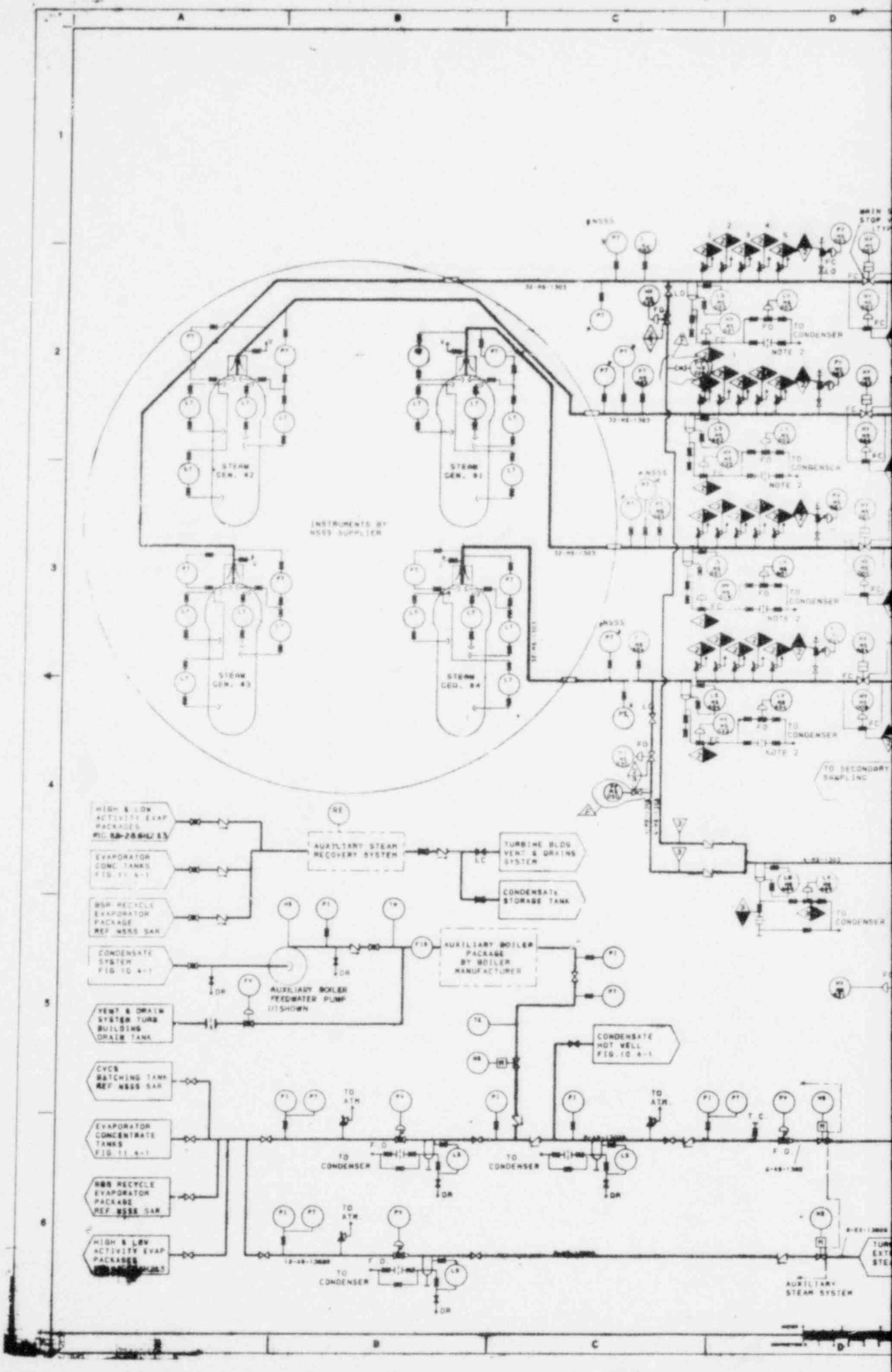


LEGEND - CALCULATIONS BASED ON 1967 ASME STEAM TABLES
LB - FLOW LB/HR
P - PRESSURE-PSIA
H - ENTHALPY-BTU/LB
T - TEMPERATURE-F DEGREES

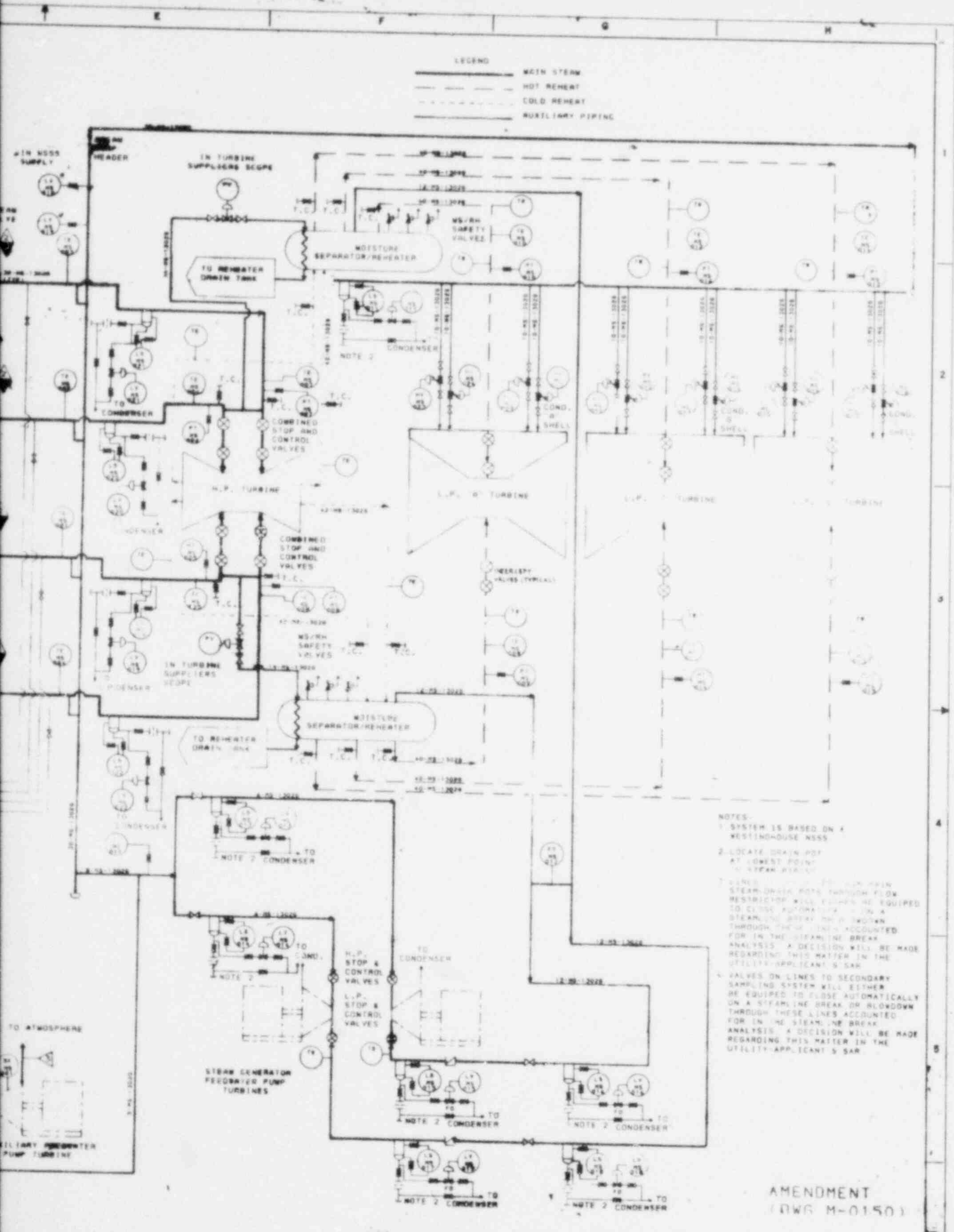
1330802. KW 3.00 IN HG ABS. 0 PCT MU
TC6F 43.0 IN LSB 1800 RPM
1075. PSIA 1187.5 BTU/LB 1 STAGE REHEAT
GEN 1539900. KVA 75.0 PSIG H2 PRES .90 PF LIQ

AMENDMENT 10

GIBBSSAR	HEAT BALANCE 3800MWT (GE)
NSSS: NOT SPECIFIC ☐ W-414 ■ CE ☐ B&W ☐	FIGURE NO. 10.i-7



A
B
C
D
STEAM GEN. #2
STEAM GEN. #1
STEAM GEN. #3
STEAM GEN. #4
INSTRUMENTS BY NSSS SUPPLIER
NSSS
NOTE 2
TO CONDENSER
TO SECONDARY SAMPLING
HIGH & LOW ACTIVITY EVAP PACKAGES
EVAPORATOR CONC TANKS FIG. 11.4-1
REF NSSS SAR
AUXILIARY STEAM RECOVERY SYSTEM
TURBINE BLDG VENT & DRAINS SYSTEM
CONDENSATE STORAGE TANK
CONDENSATE SYSTEM FIG. 10.4-1
AUXILIARY BOILER FEEDWATER PUMP
AUXILIARY BOILER PACKAGE BY BOILER MANUFACTURER
VENT & DRAIN SYSTEM TURB BUILDING DRAIN TANK
CONDENSATE HOT WELL FIG. 10.4-1
CVCS BATCHING TANK REF NSSS SAR
EVAPORATOR CONCENTRATE TANKS FIG. 11.4-1
EVAPORATOR PACKAGE REF NSSS SAR
TO ATM
DR
AUXILIARY STEAM SYSTEM



GIBBSSAR

NSSS:
NOT SPECIFIC ☐
W-414 ■
CE ☐
B&W ☐

FLOW DIAGRAM
MAIN STEAM REHEAT
& STEAM DUMP

FIGURE NO. 10.3-1

FIGURE 10.3-1a

SHEET 2 of 2

INSTRUMENT & CONTROL FUNCTION

MAIN STEAM REHEAT
& STEAM DUMP

PUMPS & VALVES

SAFETY TRAIN	TAG NO.	REMOTE CONTROL CON-TROL ROOM	HSD	INTERLOCK WITH	SAFETY INTER-LOCK	REMARKS
-	HV-MS-017	-	-	-	Reactor Coolant System Controls	Pos. Lights (MCB)
-	HV-MS-018	-	-	-	"	"
-	HV-MS-019	x	-	STEAM LINE ISO.	-	Pos. & Monitor Lights (MCB)
-	HV-MS-020	x	-	"	-	"
-	HV-MS-021	x	-	"	-	"
-	HV-MS-022	x	-	"	-	"
-	LV-MS-009	x	-	LS-MS-009	-	Pos. Lights & Alarm (MCB)
						"
-	LV-MS-011	x	-	LS-MS-011	-	"
-	LV-MS-012	x	-	LS-MS-012	-	"
-	LV-MS-013	x	-	LS-MS-013	-	"
-	LV-MS-014	x	-	LS-MS-014	-	"
						"
-	LV-MS-015	x	-	LS-MS-015	-	"
						"
-	LV-MS-016	x	-	LS-MS-016	-	"
-	LV-MS-017	x	-	LS-MS-017	-	"
-	LV-MS-018	x	-	LS-MS-018	-	"
-	LV-MS-019	x	-	LS-MS-019	-	"
-	LV-MS-020	x	-	LS-MS-020	-	"
-	LV-MS-021	x	-	LS-MS-021	-	"
-	LV-MS-022	x	-	LS-MS-022	-	"
A	HV-MS-029	x	-	PT-MS-029	-	Provided with Air Accumulators
B	HV-MS-030	x	-	PT-MS-030	-	Provided with Air Accumulators
A&B	HV-MS-031	x	-	-	-	Provided with Air Accumulators

FIGURE 10.3-1b

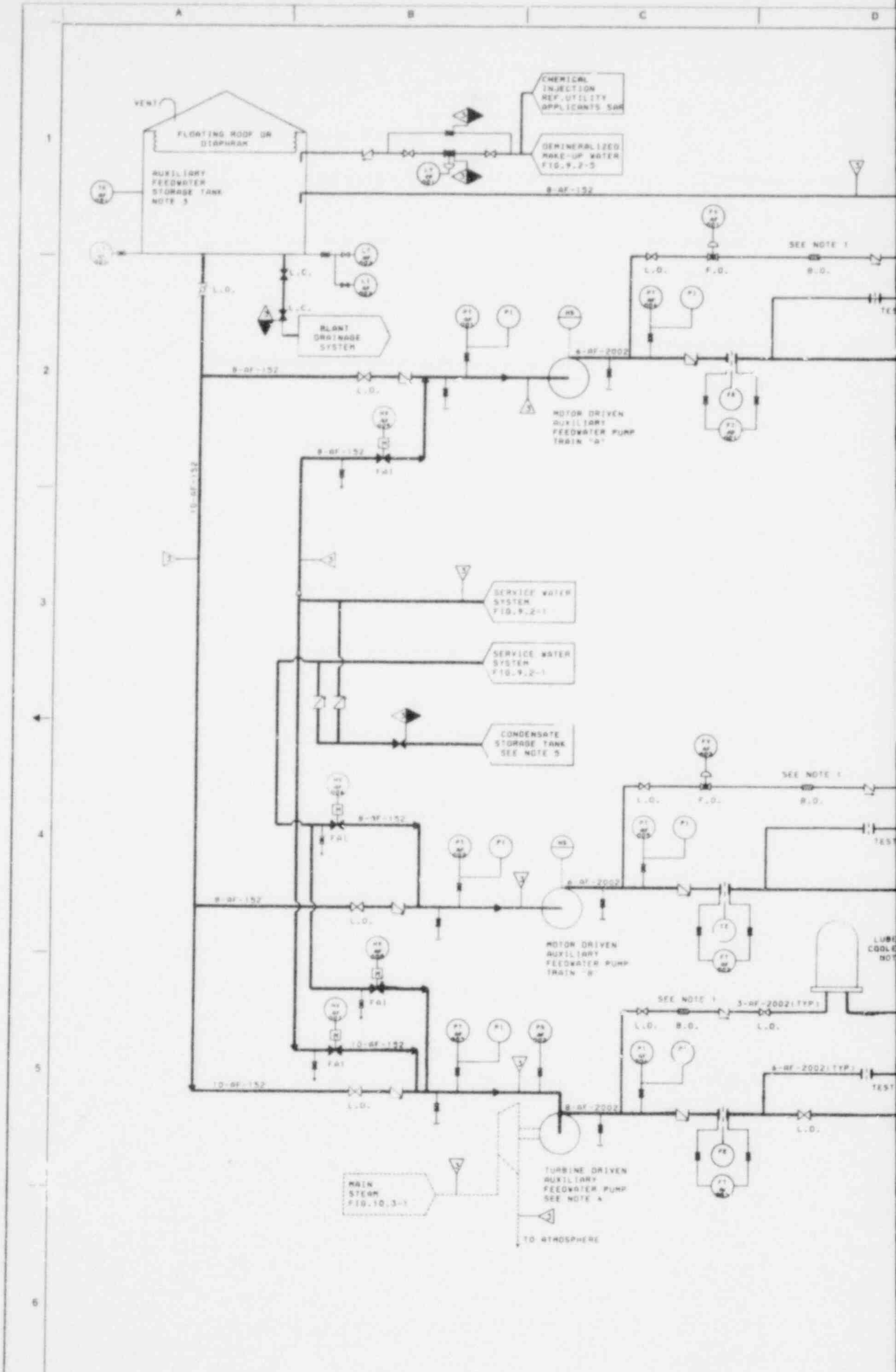
SHEET 2 of 2

INSTRUMENT & CONTROL FUNCTION

MAIN STEAM REHEAT
& STEAM DUMP

INSTRUMENTS

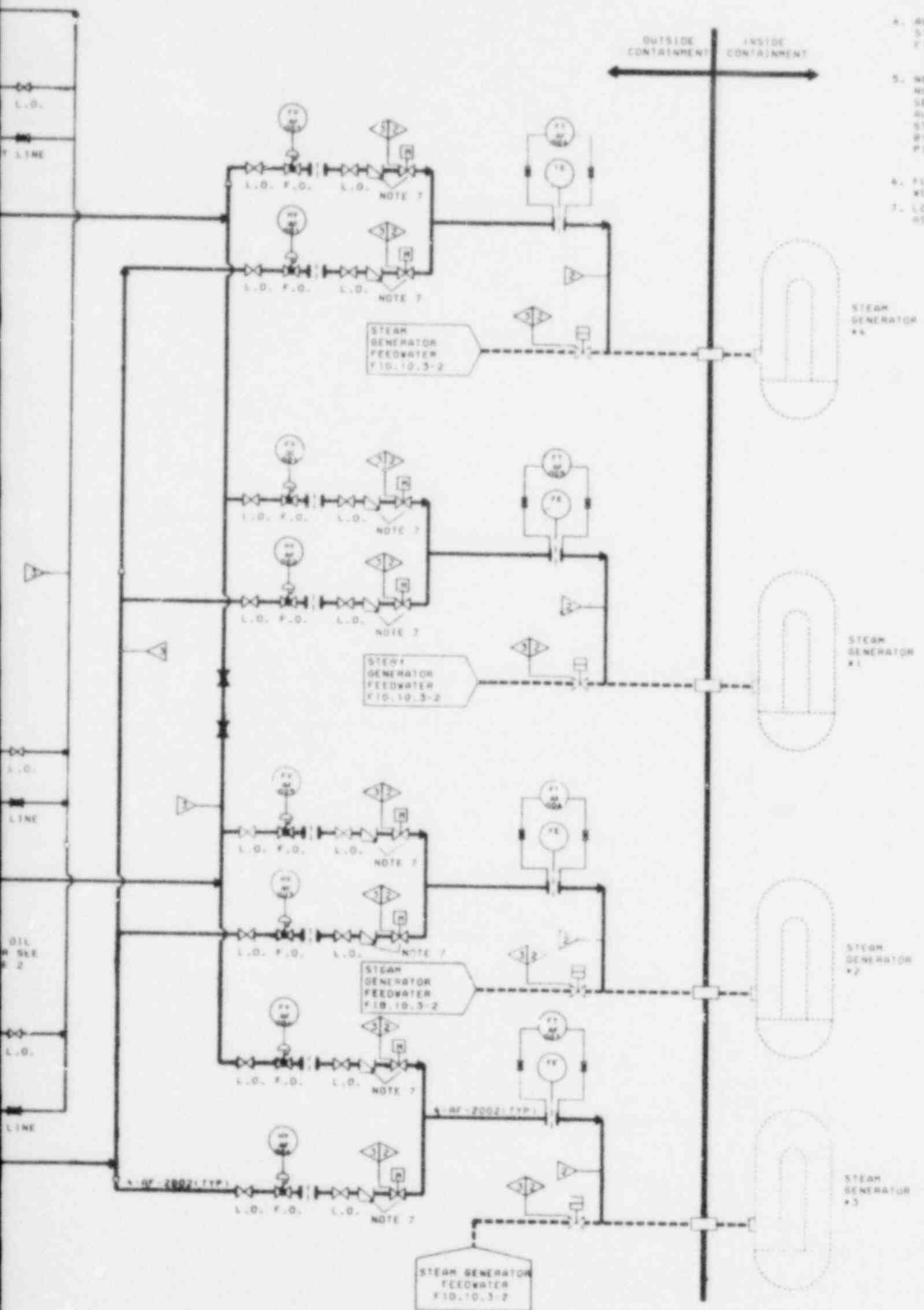
SAFETY TRAIN	TAG NO.	REMOTE CONTROL CON-TROL ROOM	HSD	ALARM	INTERLOCK WITH	REMARKS
A	PT-MS-029	x		x	HV-MS-029	
B	PT-MS-030	x		x	HV-MS-030	SIGNALS LOSS OF PRESSURE IN STEAM SUPPLY LINE TO TURBINE DRIVEN AUX. FEEDWATER PUMP



VENT
FLOATING ROOF OR DIAPHRAM
AUXILIARY FEEDWATER STORAGE TANK NOTE 3
CHEMICAL INJECTION REF. UTILITY APPLICANTS SAR
DEMINERALIZED MAKE-UP WATER FIG.9.2-5
PLANT DRAINAGE SYSTEM
MOTOR DRIVEN AUXILIARY FEEDWATER PUMP TRAIN 'A'
SERVICE WATER SYSTEM FIG.9.2-1
SERVICE WATER SYSTEM FIG.9.2-1
CONDENSATE STORAGE TANK SEE NOTE 5
MOTOR DRIVEN AUXILIARY FEEDWATER PUMP TRAIN 'B'
TURBINE DRIVEN AUXILIARY FEEDWATER PUMP SEE NOTE 4
MAIN STEAM FIG.10.3-1
TO ATMOSPHERE
SEE NOTE 1
3-AF-2002(TYP)
6-AF-2002(TYP)
8-AF-152
10-AF-152
6-AF-2002
L.O.
L.C.
F.O.
B.O.
FAI
TEST

NOTES:

1. BREAKDOWN ORIFICE TO BE SUPPLIED BY PUMP MANUFACTURER.
2. TURBINE-DRIVEN AUXILIARY FEEDWATER PUMP LUBRICATING OIL COOLER TO BE SUPPLIED BY PUMP MANUFACTURER.
3. AUXILIARY FEEDWATER STORAGE TANK IS SEISMIC CATEGORY I STRUCTURE NUCLEAR SAFETY CLASS 3.
4. AUXILIARY FEEDWATER PUMP TURBINE DRIVER STEAM SUPPLY SYSTEM SHOWN ON FIG.M-0150
5. NORMALLY THE CONDENSATE STORAGE TANK IS NONSAFETY CLASS. FOR PLANTS WHERE THE SERVICE WATER IS UNACCEPTABLE AS AN ALTERNATIVE WATER SUPPLY THE CONDENSATE STORAGE TANK WILL BE USED IN TH'S CAPACITY BY CLASSIFYING THE TANK AND RELATED PIPING TO SAFETY CLASS 3.
6. FLOW DIAGRAM IS BASED ON USING A WESTINGHOUSE NSSS.
7. LOCATE AS CLOSE TO CONTAINMENT AS POSSIBLE.



AMENDMENT 10

GIBBSSAR	FLOW DIAGRAM AUXILIARY FEEDWATER SYSTEM
NSSS: NOT SPECIFIC ☐ W-414 ■ CE ☐ B&W ☐	FIGURE NO. 10.4-3

FIGURE 10.4-3a

SHEET 1 of 2

INSTRUMENT & CONTROL FUNCTION

AUXILIARY FEEDWATER SYSTEM

PUMPS & VALVES

SAFETY TRAIN	TAG NO.	REMOTE CONTROL CONTROL ROOM	REMOTE CONTROL HSD	INTERLOCK WITH	SAFETY INTERLOCK	REMARKS
A	Auxiliary F.W. Motor Driven Pump	x	x	See Remarks	x	Pump Start Signals
B	Auxiliary F.W. Motor Driven Pump	x	x	See Remarks	x	Listed in GIBBSSAR
B	Turbine Driven Pump	x	x	See Remarks	x	Section 7.3.1.1h
A	LV-AF-001	x	-	LT-AF-001		
A	FV-AF-001	x	-	FT-AF-001		
B	FV-AF-002	x	-	FT-AF-002		
A	FV-AF-003	x	x			Manually Modulated From MCB and HSD
A	FV-AF-004	x	x			Manually Modulated From MCB and HSD
B	FV-AF-005	x	x			Manually Modulated From MCB and HSD
B	FV-AF-006	x	x			Manually Modulated From MCB and HSD
A	HV-AF-001	x	x			Manually Modulated From MCB and HSD
A	HV-AF-002	x	x			Manually Modulated From MCB and HSD
B	HV-AF-003	x	x			Manually Modulated From MCB and HSD

FIGURE 10.4-3a

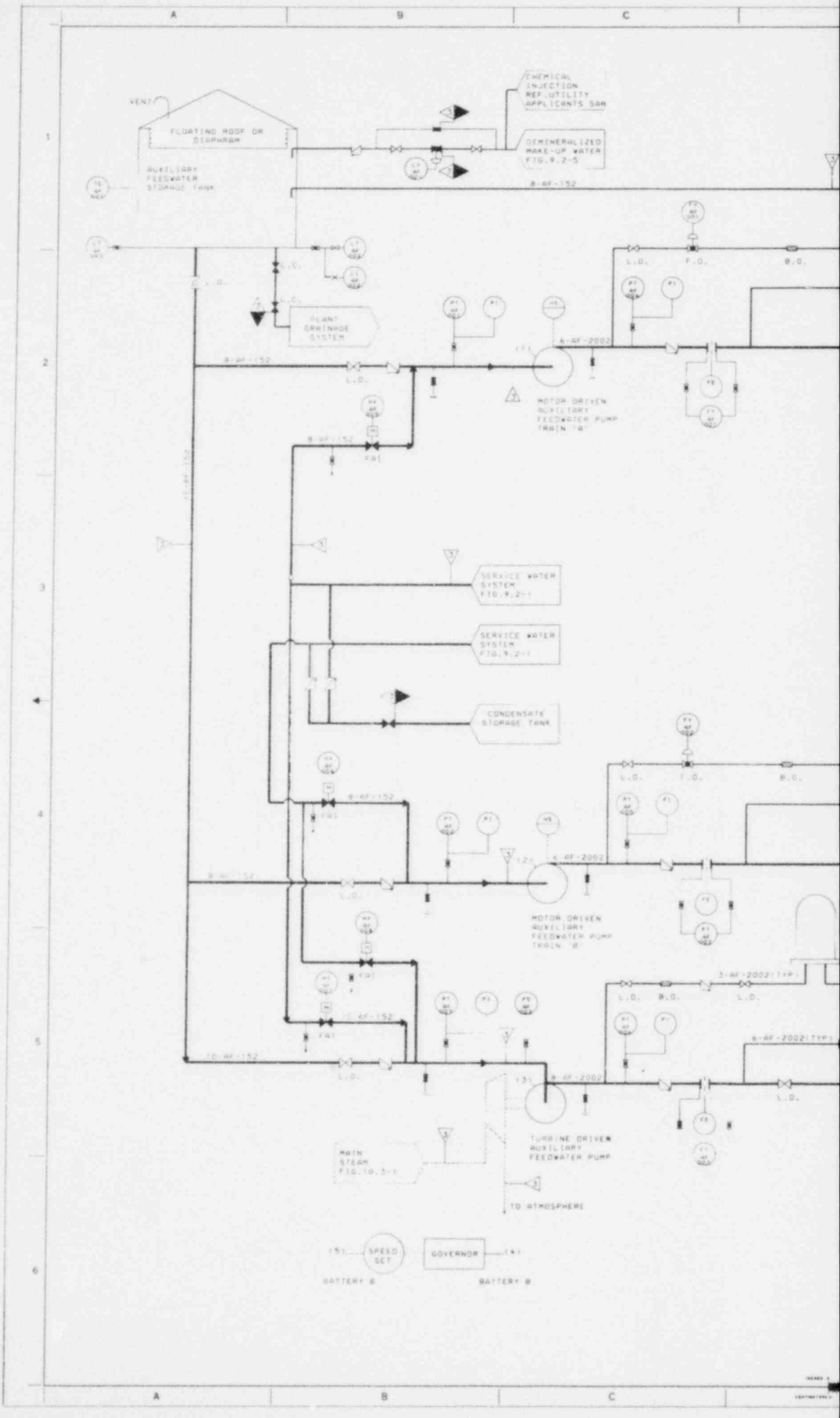
SHEET 2 of 2

INSTRUMENT & CONTROL FUNCTION

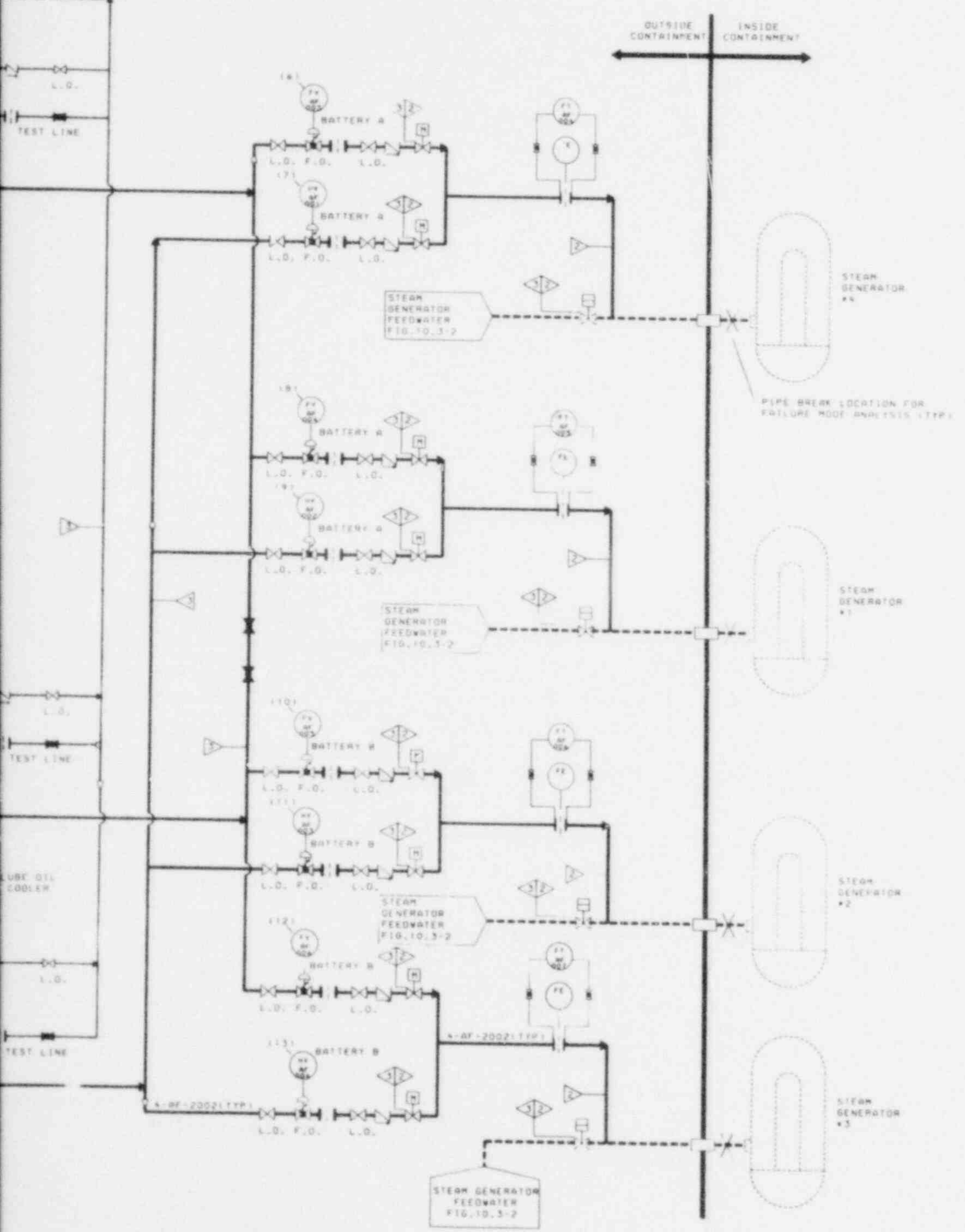
AUXILIARY FEEDWATER SYSTEM

PUMPS & VALVES

SAFETY TRAIN	TAG NO.	REMOTE CONTROL CONTROL ROOM	REMOTE CONTROL HSD	INTERLOCK WITH	SAFETY INTERLOCK	REMARKS
B	HV-AF-004	x	x			Manually Modulated From MCB and HSD
A	HV-AF-005	x	-			
B	HV-AF-006	x	-			
A	HV-AF-007	x	-			
B	HV-AF-008	x	-			



A
B
C
1
2
3
4
5
6
VENT
FLOATING ROOF OR DIAPHRAM
AUXILIARY FEEDWATER STORAGE TANK
CHEMICAL INJECTION REF. UTILITY APPLICANTS SAR
DEMINERALIZED MAKE-UP WATER FIG.9.2-5
8-AF-152
L.O.
F.O.
B.O.
PLANT DRAINAGE SYSTEM
4-AF-2002
MOTOR DRIVEN AUXILIARY FEEDWATER PUMP TRAIN 'A'
FAI
SERVICE WATER SYSTEM FIG.9.2-1
SERVICE WATER SYSTEM FIG.9.2-1
CONDENSATE STORAGE TANK
MOTOR DRIVEN AUXILIARY FEEDWATER PUMP TRAIN 'B'
3-AF-2002(TYP)
6-AF-2002(TYP)
10-AF-152
TURBINE DRIVEN AUXILIARY FEEDWATER PUMP
MAIN STEAM FIG.10.3-1
TO ATMOSPHERE
SPEED SET
GOVERNOR
BATTERY B
BATTERY B



(DWG.M-0153)

AMENDMENT 10

GIBBSSAR

NSSS:
NOT SPECIFIC ☐
W-414 ■
CE ☐
B&W ☐

AUXILIARY FEEDWATER SYSTEM FAILURE MODE ANALYSIS

FIGURE NO. 10.4-4