CONSUMERS POWER COMPANY

APPLICATION FOR

REACTOR CONSTRUCTION PERMIT AND OPERATING LICENSE

DOCKET NO. 50-329
DOCKET NO. 50-330
AMENDMENT NO. 75

Enclosed herewith, revising and supplementing the above-entitled application, are revised pages for incorporation in the Final Safety Analysis Report. The Final Safety Analysis Report was submitted with Amendment 33 to the above dockets on November 18, 1977. The enclosed material consists of the following:

1) Revisions to various FSAR Sections and Staff Requests for Additional Information in response to certain Open Items associated with Staff review of the Midland Plant.

2) Additional information the FSAR stated would be submitted at this time.

3) Changes in various FSAR Sections resulting from routine design developments.

4) Changes in various FSAR Sections resulting from the FSAR Rereview Program.

5) Correction of minor errors and omissions.

6) Changes relating to the above (Tables of Contents, Figures, Tables, etc.).

These new and revised pages bear the notation "Revision 27 3/80," and are marked in the margin to indicate where changes have been made. Additional pages and figures have been added as reflected on the revised Midland Plant FSAR "List of Effective Pages."

Consumers Power Company

Dated: March 31, 1980

by _____
Stephen H. Howell, Senior Vice President

Sworn and subscribed to before me on this 31st day of March, 1980.

_____
Betty L. Bishop
Notary Public, Jackson County, Michigan
My commission expires September 21, 1982

8004090251

DISTRIBUTION AND ACKNOWLEDGEMENT FORM

Bechtel Associates Professional Corporation

TO NRC

HOLDER OF FSAR SET NUMBER 112

REVISION NUMBER 27

SUBJECT DISTRIBUTION AND ACKNOWLEDGEMENT

RETURN TO:
BECHTEL ASSOCIATES
PROFESSIONAL CORPORATION
P.O. BOX 1000
ANN ARBOR, MICHIGAN 48106

Attention: **Linda Hultquist**
Job 7220-FSAR

The enclosed material is considered part of a controlled Midland Plant FSAR. Revisions should be incorporated in the FSAR by following the collating instructions attached to the revision. If any revision material is missing, please indicate in the space provided below. The holder of the FSAR is held responsible for the upkeep of their volumes.

In order to verify receipt of the enclosed information, please sign the acknowledgement below and return the entire form within 30 days to me at the above location.

If you have transferred your assigned set(s), please indicate in the space below the set number(s), party(ies) and mailing address(es) so that further material can be sent directly to the new set holder(s).

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Address(es) _____

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The following material was missing from the revision(s):

REV. NO.	PAGE NO.	TABLE NO.	FIGURE NO.	TAB

I hereby certify that I have received the material, except as noted.

_____ _____

Signature of Set Holder Date

8005020248

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

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Mike

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TABLE 1.7-1

BOP NOTES, SYMBOLS, AND DETAILS

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-028	3	08-17-79	Symbols and General Notes for Single Lines and Schematics	Ref FSAR Tables 1.7-3, -4, -5, and -6	21
1	0				
2	0				
3	0				
4	1				
5	1				
6	2				
7	2				
9	0				18
10	0				
11	0				
12	0				
13	0				
14	0				
15	0				
16	0				
17	1				
18	1				
19	0				
E-039	8	12-03-79	Seismic Wire Supports Notes Symbols and Details		27
1	3				
2	1				18
3	1				
4	1				
5	1				21
7	1				
8	1				
9	1				18
11	2				
11A	0				
12	2				21
13	1				18
14	2				
15	4				25
16	3				
17	3				
17A	1				18
17B	0				

TABLE 1.7-1 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
18	0				
19	0				
19A	0				
19B	0				
20	3				
21	0				
22	1				18
23	1				
24	1				
26	2				
27	3				
28	5				25
28A	1				
29	0				18
30	3				
30A	1				21
30B	0				
31	1				18
32	2				
33	2				27
34	1				
34A	0				
35	1				18
35A	0				
36	2				27
37	0				
38	0				18
39	0				
40	1				27
41	0				21
E-042	44	02-20-80	Conduit and Tray Notes, Symbols and Details	Ref FSAR Table 1.7-7	
8	14				
10	11				27
10A	8				
11B	8				
18A	7				
33	4				
41	7				
46	2				18
51	3				
56	3				

TABLE 1.7-1 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
58	0				19
61	0				18
62	0				27
63	2				15
64	4				
65	2				
66	2				
67	0				18
68	6				
69	0				
69A	0				
69B	1				
69C	2				
69D	2				25
100	9				27
100A	2				
101	7				18
102	3				
103	2				
104	2				
105	6				19
106	8				
106A	1				27
107	7				
108	6				
108A	0				
109	3				
110	1				
111	2				
112	3				18
113	0				
114	2				
115	2				
116	0				
117	1				
118	1				
119	2				
120	1				
121	2				
122	2				19
123	1				
123A	0				
124	0				18

TABLE 1.7-1 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
125	0				
126	2				
127	0				
128	0				
129	0				
130	1				
131	2				
132	1				
133	0				
134	1				18
135	1				
136	0				
137	0				
138	2				
139	0				
140	0				
141	1				
142	2				
144	1				
145	3				27
146	2				25
147	2				
148	3				27
149	1				
300	0				19
301	0				18
302	1				27
303	1				21
304	0				18
305	0				
306	3				27
307	0				
308	0				
309	0				18
310	0				
311	1				27
312	0				18
313	0				
314	3				
314A	2				
315	1				27
316	1				
317	0				18

TABLE 1.7-1 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
318	2				21
318A	0				18
318B	1				27
319	1				
320	0				25
321	1				
322	0				19
323	0				18
324	3				27
325	1				25
326	0				
327	1				18
328	0				
329	4				21
330	1				18
331	1				25
332	3				
333	3				
334	2				
335	7				
336	6				27
337	3				
338	0				
339	2				25
340	0				
341	1				
342	2				
343	5				27
343A	2				
344	0				25
345	1				
346	1				
347	0				
348	0				
349	0				
350	0				18
351	0				
352	0				
353	0				
354	1				25
355	0				18
356	1				27
357	1				

TABLE 1.7-1 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
358	0				18
359	3				27
360	0				
361	1				25
362	2				
363	3				
364	2				
364A	2				
365	1				27
366	1				
367	0				
368	1				
500	0				
501	1				18
502	0				
503	1				27
504	0				
505	1				
506	0				
507	0				
507A	0				19
508	0				
509	0				
510	0				
511	0				
512	0				
513	3				27
514	0				25
515	1				
516	0				
517	0				19
518	0				
600	3				27
601	3				
602	1				25
603	2				
604	4				27
605	3				
606	0				18
607	0				
608	1				27
609	1				21
610	0				18

TABLE 1.7-1 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
611	0				
612	0				18
613	0				
614	0				
615	0				19
616	2				27
1000	2				
1001	2				21
1002	2				27
1003	0				19
1004	1				21
1005	0				19
E-047	2	12-28-79	Notes and Details for Separation of Class 1E Equipment and Circuits		27
					19
6	1				
7	0				
8	0				21
9	0				
10	1				27
11	0				
12	0				21
13	0				
13A	0				27

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MIDLAND PLANT

UNITS 1 AND 2

REVISION NO. 27
to
FINAL SAFETY ANALYSIS REPORT

UNIT 1 : DOCKET 50-329
UNIT 2 : DOCKET 50-330

CONSUMERS POWER COMPANY

CONSUMERS POWER COMPANY

APPLICATION FOR

REACTOR CONSTRUCTION PERMIT AND OPERATING LICENSE

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AMENDMENT NO. 75

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Consumers Power Company

Dated: March 31, 1980

by Stephen H. Howell
Stephen H. Howell, Senior Vice President

Sworn and subscribed to before me on this 31st day of March, 1980.

(S E A L)

Betty L. Bishop
Notary Public, Jackson County, Michigan
My commission expires September 21, 1982

INSTRUCTIONS FOR REVISION 27

Note: These are instructions for removing and inserting Revision 27 into the Midland Units 1 & 2 FSAR - Volumes 1 through 20
Also please note that some of the figures have been changed to read sh 1, sh 2, - these replace the ones that read A & B
If you have any questions, please call Linda Hultquist at x7340.

REMOVE	INSERT
VOLUME 1	
----------	Revision Submittal Letter (Behind Revision 26 Letter)
LOEP 1 thru 74	LOEP 1 thru 75
tbl 1.1-1 sh 19, 20, 37, 38, 43, 44, 49, 50, 51 to 62, 62a to h, 86a, 86b, 87, 88, 89, 90, 95 to 102, 102a to d, 103, 104	tbl 1.1-1 sh 19, 20, 37, 38, 43, 44, 49, 50, 51 to 62, 62a to h, 86a, 86b, 87, 88, 89, 90, 95 to 102, 102a to d, 103, 104
fig 1.1-1 to 3	fig 1.1-1 to 3
pg 1.2-17, 18	pg 1.2-17, 18
fig 1.2-2, 6, 20	fig 1.2-2, 6, 20
tbl 1.6-2 sh 5, 6	tbl 1.6-2 sh 5, 6
tbl 1.7-1 sh 1 to 7	tbl 1.7-1 sh 1 to 7
tbl 1.7-2 sh 1, 2	tbl 1.7-2 sh 1, 2
tbl 1.7-3 sh 1 to 3	tbl 1.7-3 sh 1 to 4
tbl 1.7-4, 5	tbl 1.7-4, 5
tbl 1.7-6 sh 1 to 4	tbl 1.7-6 sh 1 to 4
tbl 1.7-9 sh 1 to 4	tbl 1.7-9 sh 1 to 4
tbl 1.7-11 sh 1 to 9	tbl 1.7-11 sh 1 to 9
tbl 1.7-12 sh 1 to 4	tbl 1.7-12 sh 1 to 4
tbl 1.7-13 sh 1, 2	tbl 1.7-13 sh 1, 2
tbl 1.7-15 sh 1 to 21	tbl 1.7-15 sh 1 to 23
pg 2.1-3 to 6a, 6b	pg 2.1-3 to 6a, 6b
fig 2.1-1A	fig 2.1-1A

REMOVE	INSERT
VOLUME 2	
tbl 2.2-4, 5	tbl 2.2-4, 5
pg 2.4-19, 20, 21, 22, 31, 32	pg 2.4-19, 20, 21, 22, 31, 32
VOLUME 3	
pg 2.5-69, 70	pg 2.5-69, 70
VOLUME 5	
pg 3-ix, x, xi, xii, xviiic, d	pg 3-ix, x, xi, xii, xviiic, d
pg 3.1-5, 6, 23, 24, 27, 28, 31, 32	pg 3.1-5, 6, 23, 24, 27, 28, 31, 32
tbl 3.2-1 sh 11, 12, 33, 34, 47, 48	tbl 3.2-1 sh 11, 12, 33, 34, 47, 48
VOLUME 6	
pg 3.6-47, 48	pg 3.6-47, 48
VOLUME 8	
pg 3.9-3, 4, 31, 32	pg 3.9-3, 4, 31, 32
tbl 3.9-1 sh 1, 2, 10a, 10b, 17, 18	tbl 3.9-1 sh 1, 2, 10a, 10b, 17, 18
tbl 3.9-10A sh 1, 2	tbl 3.9-10A sh 1, 2
tbl 3.9-17 sh 14m to p, 72a, 72b, 89, 90, 123, 124	tbl 3.9-17 sh 14m to p, 72a, 72b, 89, 90, 123, 124
tbl 3.9-28 sh 17, 18, 46c, 46d, 47, 48	tbl 3.9-28 sh 17, 18, 46c, 46d, 47, 48
tbl 3.9-46, 47	tbl 3.9-46, 47
VOLUME 9	
pg 3.10-27, 28, 29, 30, 36a, 36b, 37, 38, 38c, 38d, 55	pg 3.10-27, 28, 29, 30, 36a to d, 37, 38, 38c, 38d, 55
pg 3.11-1, 2	pg 3.11-1, 2
tbl 3.11-1 sh 1, 2, 9, 10, 23, 24, 27, 28, 30a, 30b, 37, 38	tbl 3.11-1 sh 1, 2, 9, 10, 23, 24, 27, 28, 37, 38
tbl 3.11-4 sh 111	tbl 3.11-4 sh 111

REMOVE	INSERT
pg 3A-1, 2, 25, 26, 27, 28, 29, 30, 95, 96, 115, 116	pg 3A-1, 2, 25, 26, 27, 28, 29, 30, 95, 96, 115, 116
VOLUME 11	
pg 4.3-29, 30, 37, 38, 43, 44	pg 4.3-29, 30, 37, 38, 43, 44
pg 4.6-3, 4	pg 4.6-3, 4
pg 5-via, vib	pg 5-via, vib
tbl 5.1-5 sh 1, 2	tbl 5.1-5 sh 1, 2
tbl 5.1-6 sh 2, 5.1-7 sh 1, 2	tbl 5.1-6 sh 2 5.1-7 sh 1, 2
fig 5.1-1A, 1B, 2A, 2B	fig 5.1-1 sh 1, 2 5.1-2 sh 1, 2
pg 5.2-16a, 16b	---
pg 5.4-1, 2, 3, 4, 5, 6, 6a to d, 11, 12	pg 5.4-1, 2, 3, 4, 5, 6, 6a to d, 11, 12
tbl 5.4-1, 3, 4	tbl 5.4-1, 3, 4
tbl 5.4-5 sh 1, 2	tbl 5.4-5 sh 1, 2
fig 5.4-2	fig 5.4-2
VOLUME 12	
pg 6-xxi, xxii, xxix	pg 6-xxi, xxii, xxix
pg 6.2-93, 94	pg 6.2-93, 94
tbl 6.2-6 sh 2, and 6.2-7	tbl 6.2-6 sh 2,and 6.2-7
tbl 6.2-24 sh 1, 2	tbl 6.2-24 sh 1, 2
fig 6.2-51A, B 6.2-52A, B	fig 6.2-51 sh 1, 2 6.2-52 sh 1, 2
VOLUME 13	
---	pg 6.3-10c, 10d
pg 6.3-11, 11a, 11b, 12	pg 6.3-11, 12
fig 6.3-1, 1A, 2	fig 6.3-1 sh 1, 2 6.3-2
tbl 6.5-2 sh 2	tbl 6.5-2 sh 2

REMOVE	INSERT
VOLUME 14	
pg 7.4-1, 2, 2a, 2b, 7, 8, 8a to d, 9, 10, 12a, 12b, 13, 14 to 16	pg 7.4-1, 2, 2a, 2b, 7, 8a to d, 9, 10, 12a, 12b, 13, 14 to 16
tbl 7.4-1 sh 1, 2	tbl 7.4-1 sh 1, 2
tbl 7.4-2, 3	tbl 7.4-2, 3
pg 7.5-3, 4	pg 7.5-3, 4
tbl 7.5-1 sh 1 to 5	tbl 7.5-1 sh 1 to 6
pg 7.6-9, 10	pg 7.6-9, 10
pg 7.7-21, 22	pg 7.7-21, 22
tbl 7.7-2 sh 2, 3	tbl 7.7-2 sh 2, 3
fig 7.7-8 to 11	fig 7.7-8 to 11
pg 8.1-1, 2	pg 8.1-1, 2
pg 8.2-7, 8, 9	pg 8.2-7, 8, 9
pg 8.3-19, 20, 36 e to h, 37, 38	pg 8.3-19, 20, 36e to f, 37, 38, 38a, 38b
tbl 8.3-6, 7	tbl 8.3-6, 7
fig 8.3-2, 3, 4, 54	fig 8.3-2A, B, 3, 8.3-4 sh 1, 2 8.3-54
VOLUME 15	
pg 9-xvii, xviii, xix, xx, xxi, xxii, xxiii, xxiv	pg 9-xvii, xviii, xix, xx, xxi, xxii, xxiii, xxiv
pg 9.1-3, 4, 7, 8, 9	pg 9.1-3, 4, 7, 8, 8a, 8b, 9, 10
fig 9.1-1A, B	fig 9.1-1 sh 1, 2
pg 9.2-11, 12, 53, 54, 55, 56, 57, 58	pg 9.2-11, 12, 53, 54, 55, 56, 57, 58
tbl 9.2-25 sh 3, 26 sh 1, 2, 3	tbl 9.2-25 sh 3, 26 sh 1, 2, 3
tbl 9.2-27, 28	tbl 9.2-27, 28

REMOVE	INSERT
fig 9.2-2A, B, 9.2-3A, B 9.2-4A, B 9.2-7A, B 9.2-8A, B 9.2-9A, B 9.2-10A, B 9.2-11A, B, C 9.2-18A, B	fig 9.2-2 sh 1, 2 9.2-3 sh 1, 2 9.2-4 sh 1, 2 9.2-7 sh 1, 2 9.2-8 sh 1, 2 9.2-9 sh 1, 2 9.2-10 sh 1, 2 9.2-11 sh 1, 2, 3 9.2-18 sh 1, 2
fig 9.2-21A, B	fig 9.2-21 sh 1, 2
fig 9.2-22B, 23	fig 9.2-22 sh 2 9.2-23
fig 9.2-24 sh 1, 2	fig 9.2-24 sh 1, 2
fig 9.3-3 to 6 9.3-17, 17A 9.3-18, 19	fig 9.3-3 to 6 9.3-17 sh 1, 2 9.3-18, 19
fig 9.3-31B 9.3-32A, B 9.3-33B 9.3-34A, B 9.3-35 9.3-37 sh 2 9.3-38 sh 1, 2 9.3-40A, B	fig 9.3-31 sh 2 9.3-32 sh 1, 2 9.3-33 sh 2 9.3-34 sh 1, 2 9.3-35 9.3-37 sh 2 9.3-38 sh 1, 2 9.3-40 sh 1, 2
VOLUME 16	
pg 9.4-21, 22, 31, 32, 57, 58	pg 9.4-21, 22, 31, 32, 57, 58
tbl 9.4-6 sh 1 to 4	tbl 9.4-6 sh 1 to 4
tbl 9.4-7, 8 sh 1, 2, 9, 10, 11	tbl 9.4-7 sh 1, 2, 9, 10, 11
fig 9.4-10, 10A, 11, 12 9.4-13A, B, C 9.4-14 sh 1, 2 9.4-15A, B 9.4-18, 18A 9.4-19	fig 9.4-10, 10A, 11, 12 9.4-13 sh 1, 2, 3 9.4-14 sh 1, 2 9.4-15 sh 1, 2 9.4-18 sh 1, 2 9.4-19 sh 1, 2
pg 9.5-21 to 24, 27, 28, 31, 32	pg 9.5-21 to 24, 24a, 24b, 27, 28, 31,32
fig 9.5-24, 24A 9.5-25 sh 1, 2 9.5-30A, B	fig 9.5-24 sh 1, 2 9.5-25 sh 1, 2 9.5-30 sh 1, 2
---	pg 9A-30 sh 3, 4

REMOVE	INSERT
VOLUME 17	
fig 10.3-2 sh 1, 2	fig 10.3-2 sh 1, 2 10.3-4 sh 1, 2
pg 10.4-35, 36, 36a, 36b	pg 10.4-35, 36, 36a, 36b
fig 10.4-3A, B 10.4-10 sh 1, 2 10.4-12 sh 1, 2 10.4-13 sh 1, 2 10.4-14 10.4-15	fig 10.4-3 sh 1, 2 10.4-10 sh 1, 2 10.4-12 sh 1, 2 10.4-13 sh 1, 2 10.4-14 sh 1, 2 10.4-15 sh 1, 2
fig 10.4-19, 22A, 24 10.4-25A, B 10.4-26A, B	fig 10.4-19, 22A, 24 10.4-25 sh 1, 2 10.4-26 sh 1, 2
pg 11.2-9, 10	pg 11.2-9, 10, 11
tbl 11.2-1 sh 3 to 8	tbl 11.2-1 sh 3 to 8
tbl 11.2-9, 10	tbl 11.2-9, 10
fig 11.2-1 sh 1 11.2-2 sh 1, 2 11.2-6	fig 11.2-1 sh 1 11.2-2 sh 1, 2 11.2-6
pg 11.3-1, 2, 3, 4, 8a, 8b	pg 11.3-1, 2, 3, 4, 8a, 8b
tbl 11.3-1, 2, 11, 12, 13, 14, 17, 18, 19, 20, 21, 22, 25	tbl 11.3-1, 2, 11, 12, 13, 14, 17, 18, 19, 20, 21, 22, 25
fig 11.3-2 sh 1, 2	fig 11.3-2 sh 1, 2
VOLUME 18	
pg 12.3-1, 2, 9, 10, 11, 12	pg 12.3-1, 2, 9, 10, 11, 12
tbl 12.3-5 sh 1 to 20	tbl 12.3-5 sh 1 to 21
fig 12.3-43	fig 12.3-43
pg 13.1-23, 24	pg 13.1-23, 24
VOLUME 19	
pg 14A.1-25, 26, 27, 28, 33, 34	pg 14A.1-25, 26, 27, 28, 33, 34, 75, 76

REMOVE	INSERT
pg 15B.1-1 to 8	pg 15B.1-1 to 8
pg 17.1-7, 8	pg 17.1-7, 8

THIS PAGE IS FOR INSERTING REVISION 27 INTO VOLUMES 1, 2, 3 OF THE O & R

REMOVE	INSERT
O&R LOEP-1 to 32	Q&R LOEP-1 to 32
Q&R CR-5, 6, 9, 10, 10a	Q&R CR-5, 6, 9, 10, 10a, 10b
O&R 3-i, ii, iii, iv	Q&R 3-i, ii, iii, iv
Q&R 3.8-9, 10, 13	Q&R 3.8-9, 10, 13
Q&R 3.9-37, 38, 47, 48	Q&R 3.9-37, 38, 47, 48
Q&R 3.11-24c, 24d	Q&R 3.11-24c, 24d
Q&R 6-i, ii	Q&R 6-i, ii
O&R 6.2-47, 48, 53, 54	O&R 6.2-47, 48, 53, 54
Q&R 7-i, ii	Q&R 7-i, ii
Q&R 7.4-1 to 4	Q&R 7.4-1 to 4
Q&R 7.5-3 to 6	Q&R 7.5-3 to 6
Q&R 8-i, ii	O&R 8-i, ii
O&R 8.3-25	O&R 8.3-25 to 34
Q&R 9-i, ii	Q&R 9-i, ii
Q&R 9.5-3, 4, 45, 46, 47, 48, 49	Q&R 9.5-3, 4, 45, 46, 47, 48, 49
Q&R 14-i	Q&R 14-i
Q&R 14.2-5, 6, 16a, 16b, 17, 18, 23, 24	Q&R 14.2-5, 6, 16a, 16b, 17, 18, 23, 24
Q&R 15-iii, iv	Q&R 15-iii, iv
Q&R 15D-11, 12	Q&R 15D-11, 12

THIS PAGE IS FOR INSERTING REVISION INTO THE SITE EMERGENCY PLAN (SEP)

REMOVE	INSERT
Q&R SEP-i	Q&R SEP-i
EP LOEP 1 to 4	EP LOEP 1 to 4
Q&R SEP 6.4-1, 2	Q&R SEP 6.4-1, 2

LIST OF EFFECTIVE PAGES

This List of Effective Pages identifies those text pages, tables, figures, and tabs that are currently effective in the FSAR.

Sheet ID	Latest Rev.
VOLUME 1	
i	12
ii	12
iii	21
iv	21
v	21
vi	21
vii	21
viii	21
ix	21
x	21
xi	21
xii	21
xiii	15
xiv	21
xv	21
xvi	12
xvii	12
xviii	21
xix	26
xx	26
xxi	12
xxii	26
xxiii	26
xxiv	26
xxv	26
xxvi	26
xxvii	26
xxviii	26
xxix	26
xxx	26
xxxi	26
xxxii	26
LOEP Tab	
LOEP 1	27
LOEP 2	27
LOEP 3	27
LOEP 4	27
LOEP 5	27
LOEP 6	27
LOEP 7	27
LOEP 8	27
LOEP 9	27
LOEP 10	27
LOEP 11	27
LOEP 12	27
LOEP 13	27
LOEP 14	27
LOEP 15	27
LOEP 16	27
LOEP 17	27
LOEP 18	27
LOEP 19	27
LOEP 20	27
LOEP 23	27
LOEP 23	27
LOEP 24	27
LOEP 24	27
LOEP 25	27
LOEP 26	27
LOEP 27	27
LOEP 28	27
LOEP 29	27
LOEP 30	27
LOEP 31	27
LOEP 32	27
LOEP 33	27
LOEP 34	27
LOEP 35	27
LOEP 36	27
LOEP 37	27
LOEP 38	27
LOEP 39	27
LOEP 40	27
LOEP 41	27
LOEP 42	27
LOEP 43	27
LOEP 44	27
LOEP 45	27
LOEP 46	27
LOEP 47	27
LOEP 48	27
LOEP 49	27
LOEP 50	27
LOEP 51	27
LOEP 52	27
LOEP 53	27
LOEP 54	27
LOEP 55	27
LOEP 56	27
LOEP 57	27
LOEP 58	27
LOEP 59	27
LOEP 60	27
LOEP 61	27
LOEP 62	27
LOEP 63	27
LOEP 64	27
LOEP 65	27
LOEP 66	27
LOEP 67	27
LOEP 68	27
LOEP 69	27
LOEP 70	27
LOEP 71	27
LOEP 72	27
LOEP 73	27
LOEP 74	27
Chapter 1 Tab	
1-i	26
1-ii	26
1-iii	0
1-iv	0
1-v	26
1-vi	26
1-vii	0
1-viii	0
1-ix	25
1.1 Tab	
1.1-1	1
1.1-2	23
1.1-3	0
1.1-4	0
1.1-5	0
1.1 Tbl Tab	
Tbl 1.1-1	
Sheet 1	15
Sheet 2	15
Sheet 3	25
Sheet 4	13
Sheet 5	13
Sheet 6	13
Sheet 7	13
Sheet 8	13
Sheet 9	18
Sheet 10	17
Sheet 11	17
Sheet 12	17
Sheet 12a	22
Sheet 12b	22

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Sheet 13	19	Sheet 50b	26	Sheet 81	26
Sheet 14	19	Sheet 50c	26	Sheet 82	26
Sheet 15	19	Sheet 50d	26	Sheet 82a	24
Sheet 16	19	Sheet 50e	26	Sheet 82b	24
Sheet 17	19	Sheet 50f	26	Sheet 83	24
Sheet 18	15	Sheet 50g	26	Sheet 84	21
Sheet 19	15	Sheet 50h	26	Sheet 85	21
Sheet 20	27	Sheet 51	27	Sheet 86	21
Sheet 21	21	Sheet 52	27	Sheet 86a	27
Sheet 22	19	Sheet 53	27	Sheet 86b	27
Sheet 23	19	Sheet 54	27	Sheet 87	27
Sheet 24	24	Sheet 55	27	Sheet 88	25
Sheet 25	19	Sheet 56	27	Sheet 89	27
Sheet 26	19	Sheet 57	27	Sheet 90	25
Sheet 27	19	Sheet 58	27	Sheet 91	25
Sheet 28	21	Sheet 59	27	Sheet 92	17
Sheet 28a	19	Sheet 60	27	Sheet 93	21
Sheet 28b	19	Sheet 61	27	Sheet 94	21
Sheet 28c	19	Sheet 62	27	Sheet 95	27
Sheet 28d	19	Sheet 62a	27	Sheet 96	27
Sheet 29	13	Sheet 62b	27	Sheet 97	27
Sheet 30	13	Sheet 62c	27	Sheet 98	27
Sheet 31	13	Sheet 62d	27	Sheet 99	26
Sheet 32	13	Sheet 62e	27	Sheet 100	27
Sheet 33	13	Sheet 62f	27	Sheet 101	27
Sheet 34	13	Sheet 62g	27	Sheet 102	27
Sheet 35	13	Sheet 62h	27	Sheet 102a	27
Sheet 36	13	Sheet 63	25	Sheet 102b	27
Sheet 37	13	Sheet 64	26	Sheet 102c	27
Sheet 38	27	Sheet 64a	24	Sheet 102d	27
Sheet 38a	27	Sheet 64b	24	Sheet 103	27
Sheet 38b	27	Sheet 65	17	Sheet 104	27
Sheet 39	18	Sheet 66	17	Sheet 105	15
Sheet 40	26	Sheet 67	17	Sheet 106	15
Sheet 41	24	Sheet 68	14	Sheet 107	15
Sheet 42	18	Sheet 69	16	Sheet 108	15
Sheet 43	18	Sheet 70	13	Sheet 109	15
Sheet 44	27	Sheet 71	13	Sheet 110	18
Sheet 45	25	Sheet 72	13	Sheet 111	21
Sheet 46	25	Sheet 73	13	1.1 Fig. Tab	
Sheet 46a	25	Sheet 74	13	Fig. 1.1-1	27
Sheet 46b	13	Sheet 75	17	Fig. 1.1-2	27
Sheet 47	13	Sheet 76	13	Fig. 1.1-3	27
Sheet 48	14	Sheet 77	13	Fig. 1.1-4	0
Sheet 49	27	Sheet 78	13	Fig. 1.1-5	0
Sheet 50	20	Sheet 79	13	Fig. 1.1-6	0
Sheet 50a	22	Sheet 80	18	Fig. 1.1-7	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
1.2 Tab		Fig. 1.2-13	21	Sheet 12	18
1.2-1	0	Fig. 1.2-14	18	Sheet 13	26
1.2-2	27	Fig. 1.2-15	21	Sheet 14	18
1.2-3	9	Fig. 1.2-16	26	Sheet 15	26
1.2-4	18	Fig. 1.2-17	26	1.4 Tab	
1.2-4a	18	Fig. 1.2-18	26	1.4-1	26
1.2-4b	9	Fig. 1.2-19	17	1.4-2	26
1.2-5	0	Fig. 1.2-20	26	1.4-3	0
1.2-6	27	Fig. 1.2-21	26	1.4-4	0
1.2-7	25	Fig. 1.2-22	22	1.5 Tab	
1.2-8	25	Fig. 1.2-23	15	1.5-1	26
1.2-9	0	Fig. 1.2-24	4	1.5-2	26
1.2-10	0	Fig. 1.2-25	0	1.5-3	26
1.2-11	15	Fig. 1.2-26	9	1.6 Tab	
1.2-12	0	Fig. 1.2-27	18	1.6-1	20
1.2-13	26	Fig. 1.2-28	25	1.6 Tbl Tab	
1.2-14	13	Fig. 1.2-29	18	Tbl 1.6-1	
1.2-15	26	Fig. 1.2-30	18	Sheet 1	23
1.2-16	3	Fig. 1.2-31	24	Sheet 2	24
1.2-17	23	Fig. 1.2-32	14	Tbl 1.6-2	
1.2-18	27	Fig. 1.2-33	14	Sheet 1	26
1.2-18A	25	1.3 Tab		Sheet 2	26
1.2-18B	25	1.3-1	18	Sheet 3	26
1.2-19	25	1.3 Tbl Tab		Sheet 4	26
1.2-20	27	Tbl 1.3-1		Sheet 5	26
1.2-21	0	Sheet 1	16	Sheet 6	27
1.2-22	0	Sheet 2	15	Sheet 7	26
1.2-23	0	Sheet 3	15	Tbl 1.6-3	10
1.2-24	0	Sheet 4	15	Tbl 1.6-4	22
1.2 Tbl Tab		Sheet 5	15	1.7 Tab	
Tbl 1.2-1		Sheet 6	15	1.7-1	25
Sheet 1	18	Sheet 7	15	1.7-2	4
Sheet 2	18	Sheet 8	15	1.7 Tbl Tab	
Sheet 3	18	Sheet 9	15	Tbl 1.7-1	
1.2 Fig. Tab		Sheet 10	15	Sheet 1	27
Fig. 1.2-1	18	Tbl 1.3-2		Sheet 2	27
Fig. 1.2-2	26	Sheet 1	18	Sheet 3	27
Fig. 1.2-3	26	Sheet 2	19	Sheet 4	27
Fig. 1.2-4	25	Sheet 3	19	Sheet 5	27
Fig. 1.2-5	26	Sheet 4	19	Sheet 6	27
Fig. 1.2-6	26	Sheet 5	19	Sheet 7	27
Fig. 1.2-7	26	Sheet 6	19	Tbl 1.7-2	
Fig. 1.2-8	26	Sheet 7	19	Sheet 1	27
Fig. 1.2-9	15	Sheet 8	26	Sheet 2	27
Fig. 1.2-10	18	Sheet 9	18	Tbl 1.7-3	
Fig. 1.2-11	18	Sheet 10	26	Sheet 1	27
Fig. 1.2-12	7	Sheet 11	18	Sheet 2	27

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.
Sheet 3	27
Sheet 4	27
Tbl 1.7-4	27
Tbl 1.7-5	27
Tbl 1.7-6	
Sheet 1	25
Sheet 2	27
Sheet 3	25
Sheet 4	25
Tbl 1.7-7	
Sheet 1	20
Sheet 2	20
Sheet 3	19
Sheet 4	19
Sheet 5	19
Sheet 6	19
Sheet 7	19
Sheet 8	19
Sheet 9	19
Sheet 10	19
Sheet 11	19
Tbl 1.7-8	
Sheet 1	20
Sheet 2	20
Sheet 3	18
Sheet 4	19
Sheet 5	19
Sheet 6	19
Sheet 7	19
Sheet 8	19
Tbl 1.7-8a	
Sheet 1	25
Sheet 2	25
Sheet 3	25
Sheet 4	25
Tbl 1.7-9	
Sheet 1	27
Sheet 2	25
Sheet 3	27
Sheet 4	19
Tbl 1.7-10	25
Tbl 1.7-11	
Sheet 1	25
Sheet 2	18
Sheet 3	27
Sheet 4	18
Sheet 5	27
Sheet 6	25
Sheet 7	27
Sheet 8	21
Sheet 9	27
Tbl 1.7-12	
Sheet 1	27
Sheet 2	27
Sheet 3	27
Sheet 4	27
Tbl 1.7-13	
Sheet 1	27
Sheet 2	27
Tbl 1.7-14	
Sheet 1	20
Sheet 2	19
Sheet 3	18
Sheet 4	18
Sheet 5	18
Sheet 6	18
Sheet 7	18
Sheet 8	18
Sheet 9	18
Sheet 10	18
Tbl 1.7-15	
Sheet 1	27
Sheet 2	27
Sheet 3	27
Sheet 4	27
Sheet 5	27
Sheet 6	27
Sheet 7	27
Sheet 8	27
Sheet 9	27
Sheet 10	27
Sheet 11	27
Sheet 12	27
Sheet 13	27
Sheet 14	27
Sheet 15	27
Sheet 16	27
Sheet 17	27
Sheet 18	27
Sheet 19	27
Sheet 20	27
Sheet 21	27
Sheet 22	27
Sheet 23	27
Tbl 1.7-16	
Sheet 1	19
Sheet 2	19
Sheet 3	19
Sheet 4	19
Tbl 1.7-17	2
Tbl 1.7-18	2
Tbl 1.7-19	
Sheet 1	2
Sheet 2	2
Sheet 3	2
Sheet 4	2
Tbl 1.7-20	2
Tbl 1.7-21	2
Chapter 2 Tab	
2-i	1
2-ii	26
2-iii	7
2-iv	3
2-v	26
2-vi	18
2-vii	18
2-viii	0
2-ix	0
2-x	0
2-xi	15
2-xii	15
2-xiii	18
2-xiv	18
2-xv	14
2-xvi	1
2-xvii	0
2-xviii	0
2-xix	7
2-xx	19
2-xxa	19
2-xxb	19
2-xxi	15
2-xxii	15
2-xxiii	15
2-xxiv	19
2.1 Tab	
2.1-1	0
2.1-2	0
2.1-3	27
2.1-4	27
2.1-5	27

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
2.1-6	27	Fig. 2.1-11	0	2.2-8	13
2.1-6a	27	Fig. 2.1-12	0	2.2-9	3
2.1-6b	3			2.2-10	13
2.1-7	0	VOLUME 2		2.2-10a	3
2.1-8	0			2.2-10b	3
2.1-9	0	i	12	2.2-11	1
2.1-10	0	ii	12	2.2-12	0
2.1 Tbl Tab		iii	21	2.2-13	1
Tbl 2.1-1	0	iv	21	2.2-14	12
Tbl 2.1-2		v	21	2.2-15	11
Sheet 1	0	vi	21	2.2-16	11
Sheet 2	0	vii	21	2.2-17	11
Sheet 3	0	viii	21	2.2-18	11
Tbl 2.1-3		ix	21	2.2-19	11
Sheet 1	0	x	21	2.2-20	3
Sheet 2	0	xi	21	2.2-21	11
Tbl 2.1-4	0	xii	21	2.2-22	12
Tbl 2.1-5	0	xiii	15	2.2-23	12
Tbl 2.1-6		xiv	21	2.2 Tbl Tab	
Sheet 1	0	xv	21	Tbl 2.2-1	
Sheet 2	0	xvi	12	Sheet 1	1
Sheet 3	0	xvii	12	Sheet 2	0
Sheet 4	0	xviii	21	Tbl 2.2-2	0
Tbl 2.1-7	0	xix	26	Tbl 2.2-3	1
Tbl 2.1-8		xx	26	Tbl 2.2-4	27
Sheet 1	0	xxi	12	Tbl 2.2-5	12
Sheet 2	0	xxii	26	Tbl 2.2-6	1
Sheet 3	0	xxiii	26	Tbl 2.2-7	12
Sheet 4	0	xxiv	26	Tbl 2.2-8	3
Tbl 2.1-9		xxv	26	Tbl 2.2-9	3
Sheet 1	0	xxvi	26	2.2 Fig. Tab	
Sheet 2	0	xxvii	26	Fig. 2.2-1	1
Sheet 3	0	xxviii	26	Fig. 2.2-2	1
Tbl 2.1-10	0	xxix	26	Fig. 2.2-3	0
Tbl 2.1-11	0	xxx	26	Fig. 2.2-4	1
2.1 Fig. Tab		xxxi	26	Fig. 2.2-5	1
Fig. 2.1-1	0	xxxii	26	Fig. 2.2-6	3
Fig. 2.1-1A	27	2.2 Tab		Fig. 2.2-7	0
Fig. 2.1-2	18	2.2-1	3	Fig. 2.2-8	0
Fig. 2.1-3	1	2.2-2	3	Fig. 2.2-9	1
Fig. 2.1-4	0	2.2-2a	3	Fig. 2.2-10	7
Fig. 2.1-5	0	2.2-2b	3	Fig. 2.2-11	0
Fig. 2.1-6	0	2.2-3	26	Fig. 2.2-12	0
Fig. 2.1-7	0	2.2-4	26	Fig. 2.2-13	0
Fig. 2.1-8	0	2.2-5	1	Fig. 2.2-14	0
Fig. 2.1-9	0	2.2-6	1	Fig. 2.2-15	0
Fig. 2.1-10	0	2.2-7	13	Fig. 2.2-16	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Fig. 2.2-17	0	2.3-45	7	Sheet 7	7
Fig. 2.2-18	1	2.3 Tbl Tab		Sheet 8	7
2.3 Tab		Tbl 2.3-1	0	Sheet 9	7
2.3-1	0	Tbl 2.3-2	0	Sheet 10	7
2.3-2	7	Tbl 2.3-3	0	Sheet 11	7
2.3-3	14	Tbl 2.3-4	0	Sheet 12	7
2.3-4	7	Tbl 2.3-5	0	Sheet 13	7
2.3-5	7	Tbl 2.3-6	0	Sheet 14	7
2.3-6	7	Tbl 2.3-7	0	Sheet 15	7
2.3-7	21	Tbl 2.3-8	0	Sheet 16	7
2.3-8	9	Tbl 2.3-9		Sheet 17	7
2.3-9	21	Sheet 1	0	Sheet 18	7
2.3-10	9	Sheet 2	0	Sheet 19	7
2.3-11	7	Tbl 2.3-10		Sheet 20	7
2.3-12	7	Sheet 1	0	Sheet 21	7
2.3-13	9	Sheet 2	0	Sheet 22	7
2.3-14	7	Tbl 2.3-11		Sheet 23	7
2.3-15	11	Sheet 1	0	Sheet 24	7
2.3-16	11	Sheet 2	0	Sheet 25	7
2.3-17	7	Tbl 2.3-12		Sheet 26	7
2.3-18	7	Sheet 1	0	Sheet 27	7
2.3-19	7	Sheet 2	0	Sheet 28	7
2.3-20	7	Tbl 2.3-13		Sheet 29	7
2.3-21	7	Sheet 1	0	Sheet 30	7
2.3-22	7	Sheet 2	0	Sheet 31	7
2.3-23	7	Tbl 2.3-14	7	Sheet 32	7
2.3-24	7	Tbl 2.3-15	7	Sheet 33	7
2.3-25	7	Tbl 2.3-16	0	Sheet 34	7
2.3-26	7	Tbl 2.3-17	7	Sheet 35	7
2.3-27	7	Tbl 2.3-18	7	Tbl 2.3-22	
2.3-28	7	Tbl 2.3-19	7	Sheet 1	7
2.3-29	7	Tbl 2.3-20		Sheet 2	7
2.3-30	7	Sheet 1	10	Sheet 3	7
2.3-31	7	Sheet 2	10	Sheet 4	7
2.3-32	7	Sheet 3	10	Sheet 5	7
2.3-33	7	Sheet 4	10	Sheet 6	7
2.3-34	7	Sheet 5	10	Sheet 7	7
2.3-35	7	Sheet 6	15	Sheet 8	7
2.3-36	7	Sheet 7	10	Sheet 9	7
2.3-37	9	Sheet 8	10	Sheet 10	7
2.3-38	7	Tbl 2.3-21		Sheet 11	7
2.3-39	7	Sheet 1	7	Sheet 12	7
2.3-40	9	Sheet 2	7	Sheet 13	7
2.3-41	7	Sheet 3	7	Sheet 14	7
2.3-42	9	Sheet 4	7	Sheet 15	7
2.3-43	7	Sheet 5	7	Sheet 16	7
2.3-44	7	Sheet 6	7	Sheet 17	7

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Sheet 18	7	Tbl 2.3-39		2.4-14	8
Sheet 19	7	Sheet 1	11	2.4-15	23
Sheet 20	7	Sheet 2	11	2.4-16	20
Sheet 21	7	Sheet 3	11	2.4-17	20
Sheet 22	7	Sheet 4	11	2.4-18	0
Sheet 23	7	Sheet 5	11	2.4-19	18
Sheet 24	7	Sheet 6	11	2.4-20	27
Sheet 25	7	Sheet 7	11	2.4-21	27
Sheet 26	7	2.3 Fig. Tab		2.4-22	27
Sheet 27	7	Fig. 2.3-1	0	2.4-23	0
Sheet 28	7	Fig. 2.3-2	0	2.4-24	0
Sheet 29	7	Fig. 2.3-3	0	2.4-25	0
Sheet 30	7	Fig. 2.3-4	0	2.4-26	0
Sheet 31	7	Fig. 2.3-5	0	2.4-27	1
Sheet 32	7	Fig. 2.3-6	0	2.4-28	0
Sheet 33	7	Fig. 2.3-7	0	2.4-29	1
Sheet 34	7	Fig. 2.3-8	0	2.4-30	1
Sheet 35	7	Fig. 2.3-9	0	2.4-31	0
Tbl 2.3-23	0	Fig. 2.3-10	0	2.4-32	27
Tbl 2.3-24	0	Fig. 2.3-11	0	2.4 Tbl Tab	
Tbl 2.3-25	0	Fig. 2.3-12	7	Tbl 2.4-1	
Tbl 2.3-26	0	Fig. 2.3-13	7	Sheet 1	0
Tbl 2.3-27	7	Fig. 2.3-14	7	Sheet 2	0
Tbl 2.3-28	7	Fig. 2.3-15	7	Sheet 3	0
Tbl 2.3-29	7	Fig. 2.3-16	7	Sheet 4	0
Tbl 2.3-30	0	Fig. 2.3-17	7	Tbl 2.4-2	0
Tbl 2.3-31		Fig. 2.3-18	0	Tbl 2.4-3	0
Sheet 1	7	Fig. 2.3-19	0	Tbl 2.4-4	0
Sheet 2	7	Fig. 2.3-20	0	Tbl 2.4-5	0
Tbl 2.3-32		Fig. 2.3-21	7	Tbl 2.4-6	0
Sheet 1	7	Fig. 2.3-22	0	Tbl 2.4-7	0
Sheet 2	7	2.4 Tab		Tbl 2.4-8	
Tbl 2.3-33		2.4-1	23	Sheet 1	1
Sheet 1	7	2.4-2	0	Sheet 2	1
Sheet 2	7	2.4-3	8	Sheet 3	1
Tbl 2.3-34		2.4-4	3	Sheet 4	1
Sheet 1	7	2.4-4a	3	Tbl 2.4-9	
Sheet 2	7	2.4-4b	3	Sheet 1	0
Tbl 2.3-35	0	2.4-5	0	Sheet 2	0
Tbl 2.3-36	0	2.4-6	0	Sheet 3	0
Tbl 2.3-37	7	2.4-7	0	Tbl 2.4-10	0
Tbl 2.3-38		2.4-8	0	Tbl 2.4-11	
Sheet 1	3	2.4-9	0	Sheet 1	0
Sheet 2	3	2.4-10	0	Sheet 2	0
Sheet 3	3	2.4-11	0	Tbl 2.4-12	0
Sheet 4	3	2.4-12	0	Tbl 2.4-13	0
Sheet 5	3	2.4-13	8	Tbl 2.4-14	

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Sheet 1	7	iii	21	2.5-11	0
Sheet 2	7	iv	21	2.5-12	0
Sheet 3	7	v	21	2.5-13	0
2.4 Fig. Tab		vi	21	2.5-14	0
Fig. 2.4-1	21	vii	21	2.5-15	18
Fig. 2.4-2	1	viii	21	2.5-16	18
Fig. 2.4-3	21	ix	21	2.5-17	18
Fig. 2.4-4	1	x	21	2.5-18	18
Fig. 2.4-5	21	xi	21	2.5-19	18
Fig. 2.4-6	1	xii	21	2.5-20	0
Fig. 2.4-7	1	xiii	15	2.5-21	0
Fig. 2.4-8	1	xiv	21	2.5-22	0
Fig. 2.4-9	1	xv	21	2.5-23	0
Fig. 2.4-10	1	xvi	12	2.5-24	0
Fig. 2.4-11	12	xvii	12	2.5-25	18
Fig. 2.4-12	1	xviii	21	2.5-26	18
Fig. 2.4-13	1	xix	26	2.5-27	18
Fig. 2.4-14	1	xx	26	2.5-28	18
Fig. 2.4-15	1	xxi	12	2.5-28a	18
Fig. 2.4-16	1	xxii	26	2.5-28b	18
Fig. 2.4-17	1	xxiii	26	2.5-29	14
Fig. 2.4-18	1	xxiv	26	2.5-30	0
Fig. 2.4-19	1	xxv	26	2.5-31	14
Fig. 2.4-20	1	xxvi	26	2.5-32	14
Fig. 2.4-21	1	xxvii	26	2.5-33	14
Fig. 2.4-22	1	xxviii	26	2.5-34	14
Fig. 2.4-23	1	xxix	26	2.5-34a	14
Fig. 2.4-24	1	xxx	26	2.5-34b	14
Fig. 2.4-25	1	xxxi	26	2.5-35	5
Fig. 2.4-26	1	xxxii	26	2.5-36	5
Fig. 2.4-27	1	2.5 Tab		2.5-37	5
Fig. 2.4-28	1	2.5-1	0	2.5-38	5
Fig. 2.4-29	1	2.5-2	0	2.5-38a	5
Fig. 2.4-30	1	2.5-3	0	2.5-38b	5
Fig. 2.4-31	1	2.5-4	0	2.5-39	1
Fig. 2.4-32	1	2.5-5	14	2.5-40	1
Fig. 2.4-33	21	2.5-6	14	2.5-41	0
Fig. 2.4-34	1	2.5-6a	14	2.5-42	0
Fig. 2.4-35	21	2.5-6b	14	2.5-43	0
Fig. 2.4-36	21	2.5-6c	14	2.5-44	0
Fig. 2.4-37	7	2.5-6d	14	2.5-45	18
Fig. 2.4-38	8	2.5-7	5	2.5-46	18
		2.5-8	5	2.5-46a	18
VOLUME 3		2.5-9	5	2.5-46b	17
		2.5-10	5	2.5-47	1
i	12	2.5-10a	5	2.5-48	0
ii	12	2.5-10b	5	2.5-49	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
2.5-50	1	2.5-89	0	Sheet 2	0
2.5-51	18	2.5-90	14	Tbl 2.5-18	18
2.5-52	18	2.5-91	14	Tbl 2.5-19	18
2.5-53	18	2.5 Tbl Tab		Tbl 2.5-20	8
2.5-54	18	Tbl 2.5-1		Tbl 2.5-21	18
2.5-55	0	Sheet 1	0	Tbl 2.5-22	18
2.5-56	0	Sheet 2	0	Tbl 2.5-23	18
2.5-57	1	Tbl 2.5-2		Tbl 2.5-24	0
2.5-58	1	Sheet 1	14	Tbl 2.5-25	
2.5-59	1	Sheet 2	14	Sheet 1	15
2.5-60	1	Sheet 3	14	Sheet 2	15
2.5-61	18	Tbl 2.5-3		Sheet 3	15
2.5-62	18	Sheet 1	0	Sheet 4	18
2.5-63	0	Sheet 2	0	Sheet 5	18
2.5-64	0	Sheet 3	0	Sheet 6	18
2.5-65	1	Tbl 2.5-4		Sheet 7	18
2.5-66	0	Sheet 1	0	Sheet 8	18
2.5-67	0	Sheet 2	0	Sheet 9	18
2.5-68	14	Sheet 3	0	Tbl 2.5-26	18
2.5-69	27	Tbl 2.5-5	0	2.5 Fig. Tab	
2.5-70	27	Tbl 2.5-6		Fig. 2.5-1	1
2.5-70a	15	Sheet 1	0	Fig. 2.5-2	21
2.5-70b	15	Sheet 2	0	Fig. 2.5-3	21
2.5-71	18	Sheet 3	0	Fig. 2.5-4	21
2.5-72	18	Sheet 4	0	Fig. 2.5-5	21
2.5-73	1	Tbl 2.5-7	19	Fig. 2.5-6	5
2.5-74	18	Tbl 2.5-8		Fig. 2.5-7	1
2.5-75	0	Sheet 1	19	Fig. 2.5-8	1
2.5-76	1	Sheet 2	19	Fig. 2.5-9	1
2.5-77	18	Sheet 3	19	Fig. 2.5-10	1
2.5-78	18	Sheet 4	19	Fig. 2.5-11	21
2.5-78a	18	Sheet 5	19	Fig. 2.5-12	21
2.5-78b	18	Tbl 2.5-9	18	Fig. 2.5-13	21
2.5-78c	18	Tbl 2.5-10		Fig. 2.5-14	1
2.5-78d	18	Sheet 1	18	Fig. 2.5-15	1
2.5-78e	18	Sheet 2	18	Fig. 2.5-16	21
2.5-78f	18	Tbl 2.5-11	18	Fig. 2.5-17	18
2.5-79	8	Tbl 2.5-12	0	Fig. 2.5-18	1
2.5-80	8	Tbl 2.5-13	0	Fig. 2.5-19	1
2.5-81	8	Tbl 2.5-14		Fig. 2.5-20	18
2.5-82	8	Sheet 1	18	Fig. 2.5-21	18
2.5-83	8	Sheet 2	26	Fig. 2.5-22	1
2.5-84	8	Tbl 2.5-14A	14	Fig. 2.5-22A	18
2.5-85	1	Tbl 2.5-15	0	Fig. 2.5-22B	18
2.5-86	0	Tbl 2.5-16	26	Fig. 2.5-23	21
2.5-87	1	Tbl 2.5-17		Fig. 2.5-24	21
2.5-88	0	Sheet 1	18	Fig. 2.5-25	21

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Fig. 2.5-26	21	Fig. 2.5-71	8	xxii	26
Fig. 2.5-27	14	Fig. 2.5-72	8	xxiii	26
Fig. 2.5-28	1	Fig. 2.5-73	8	xxiv	26
Fig. 2.5-29	1	Fig. 2.5-74	8	xxv	26
Fig. 2.5-30	1	Fig. 2.5-75	8	xxvi	26
Fig. 2.5-31	1	Fig. 2.5-76	8	xxvii	26
Fig. 2.5-32	1	Fig. 2.5-77	8	xxviii	26
Fig. 2.5-33	1	Fig. 2.5-78	18	xxix	26
Fig. 2.5-34	21	Fig. 2.5-79	8	xxx	26
Fig. 2.5-35	21	Fig. 2.5-80	8	xxxi	26
Fig. 2.5-36	21	Fig. 2.5-81	18	xxxii	26
Fig. 2.5-37	26	Fig. 2.5-82	18	App 2A Tab	
Fig. 2.5-38	1	Fig. 2.5-83	16	2A-i	0
Fig. 2.5-39	1	Fig. 2.5-84	9	2A-ii	0
Fig. 2.5-40	1	Fig. 2.5-85	9	2A-1	0
Fig. 2.5-40A	15	Fig. 2.5-86	14	2A-2	0
Fig. 2.5-41	1	Fig. 2.5-87	14	2A-3	0
Fig. 2.5-42	1	Fig. 2.5-88	15	2A-4	0
Fig. 2.5-43	1	Fig. 2.5-89	19	2A-5	0
Fig. 2.5-44	1	Fig. 2.5-90	18	2A-6	0
Fig. 2.5-45	1	Fig. 2.5-91	18	2A-7	0
Fig. 2.5-46	18	Fig. 2.5-92	19	2A-8	0
Fig. 2.5-47	18	Fig. 2.5-93	19	2A-9	0
Fig. 2.5-48	18			2A-10	0
Fig. 2.5-48A	14	VOLUME 4		2A-11	0
Fig. 2.5-49	1			2A-12	0
Fig. 2.5-50	1	i	12	2A-13	0
Fig. 2.5-51	1	ii	12	2A-14	0
Fig. 2.5-52	1	iii	21	2A-15	0
Fig. 2.5-53	18	iv	21	2A-16	0
Fig. 2.5-54	1	v	21	2A-17	0
Fig. 2.5-55	1	vi	21	2A-18	0
Fig. 2.5-56	1	vii	21	2A-19	0
Fig. 2.5-57	1	viii	21	2A-20	0
Fig. 2.5-58	1	ix	21	2A-21	0
Fig. 2.5-59	1	x	21	2A-22	0
Fig. 2.5-60	18	xi	21	2A-23	0
Fig. 2.5-61	1	xii	21	2A-24	0
Fig. 2.5-62	0	xiii	15	2A-25	0
Fig. 2.5-63	1	xiv	21	2A-26	0
Fig. 2.5-64	1	xv	21	2A-27	0
Fig. 2.5-65	1	xvi	12	2A-28	0
Fig. 2.5-66	8	xvii	12	2A-29	0
Fig. 2.5-67	8	xviii	21	2A-30	0
Fig. 2.5-68	8	xix	26	2A-31	0
Fig. 2.5-69	8	xx	26	2A-32	0
Fig. 2.5-70	8	xxi	12	2A-33	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
2A-34	0	2A-66	0	2A-113	0
2A-35	0	2A-67	0	2A-114	0
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2A-37	0	2A-69	0	2A-116	0
2A-38	18	2A-70	0	2A-117	0
2A-38-1	18	2A-71	0	2A-118	0
2A-38-2	18	2A-72	0	2A-119	0
2A-38-3	18	2A-73	0	2A-120	0
2A-38-4	18	2A-74	0	2A-121	0
2A-38-5	18	2A-75	0	2A-122	0
2A-38-6	18	2A-76	0	2A-123	0
2A-38-7	18	2A-77	0	2A-124	0
2A-38-8	18	2A-78	0	2A-125	0
2A-38-9	18	2A-79	0	2A-126	0
2A-38-10	18	2A-80	0	2A-127	0
2A-38-11	18	2A-81	0	2A-128	0
2A-38-12	21	2A-82	0	2A-129	0
2A-38-13	21	2A-83	0	2A-130	0
2A-38-14	21	2A-84	0	2A-131	0
2A-38-15	21	2A-85	0	2A-132	0
2A-39	0	2A-86	0	2A-133	0
2A-40	0	2A-87	0	2A-134	0
2A-41	0	2A-88	0	2A-135	0
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2A-43	0	2A-90	0	2A-137	0
2A-44	0	2A-91	0	2A-138	0
2A-45	0	2A-92	0	2A-139	0
2A-46	0	2A-93	0	2A-140	0
2A-47	0	2A-94	0	2A-141	0
2A-48	0	2A-95	0	2A-142	0
2A-49	0	2A-96	0	2A-143	0
2A-50	0	2A-97	0	2A-144	0
2A-51	0	2A-98	0	2A-145	0
2A-52	0	2A-99	0	2A-146	0
2A-53	0	2A-100	0	2A-147	0
2A-54	0	2A-101	0	2A-148	0
2A-55	0	2A-102	0	2A-149	0
2A-56	0	2A-103	0	2A-150	0
2A-57	0	2A-104	0	2A-151	0
2A-58	0	2A-105	0	2A-152	0
2A-59	0	2A-106	0	2A-153	0
2A-60	0	2A-107	0	2A-154	0
2A-61	0	2A-108	0	2A-155	0
2A-62	0	2A-109	0	2A-156	0
2A-63	0	2A-110	0	2A-157	0
2A-64	0	2A-111	0	2A-158	0
2A-65	0	2A-112	0	2A-159	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
2A-160	0	2A-207	0	2A-210-44	18
2A-161	0	2A-208	0	2A-210-45	18
2A-162	0	2A-209	0	2A-210-46	18
2A-163	0	2A-210	0	2A-210-47	18
2A-164	0	2A-210-1	18	2A-210-48	18
2A-165	0	2A-210-2	18	2A-210-49	18
2A-166	0	2A-210-3	18	2A-210-50	18
2A-167	0	2A-210-4	18	2A-210-51	18
2A-168	0	2A-210-5	18	2A-210-52	18
2A-169	0	2A-210-6	18	2A-210-53	18
2A-170	0	2A-210-7	18	2A-210-54	18
2A-171	0	2A-210-8	18	2A-210-55	18
2A-172	0	2A-210-9	18	2A-210-56	18
2A-173	0	2A-210-10	18	2A-210-57	18
2A-174	0	2A-210-11	18	2A-210-58	18
2A-175	0	2A-210-12	18	2A-210-59	18
2A-176	0	2A-210-13	18	2A-210-60	18
2A-177	0	2A-210-14	18	2A-210-61	18
2A-178	0	2A-210-15	18	2A-210-62	18
2A-179	0	2A-210-16	18	2A-210-63	18
2A-180	0	2A-210-17	18	2A-210-64	18
2A-181	0	2A-210-18	18	2A-210-65	18
2A-182	0	2A-210-19	18	2A-210-66	18
2A-183	0	2A-210-20	18	2A-210-67	18
2A-184	0	2A-210-21	18	2A-210-68	18
2A-185	0	2A-210-22	18	2A-210-69	18
2A-186	0	2A-210-23	18	2A-210-70	18
2A-187	0	2A-210-24	18	2A-210-71	18
2A-188	0	2A-210-25	18	2A-210-72	18
2A-189	0	2A-210-26	18	2A-210-73	18
2A-190	0	2A-210-27	18	2A-210-74	18
2A-191	0	2A-210-28	18	2A-210-75	18
2A-192	0	2A-210-29	18	2A-210-76	18
2A-193	0	2A-210-30	18	2A-210-77	18
2A-194	0	2A-210-31	18	2A-210-78	18
2A-195	0	2A-210-32	18	2A-210-79	18
2A-196	0	2A-210-33	18	2A-210-80	18
2A-197	0	2A-210-34	18	2A-210-81	18
2A-198	0	2A-210-35	18	2A-210-82	18
2A-199	0	2A-210-36	18	2A-210-83	18
2A-200	0	2A-210-37	18	2A-210-84	18
2A-201	0	2A-210-38	18	2A-210-85	18
2A-202	0	2A-210-39	18	2A-210-86	18
2A-203	0	2A-210-40	18	2A-210-87	18
2A-204	0	2A-210-41	18	2A-210-88	18
2A-205	0	2A-210-42	18	2A-210-89	18
2A-206	0	2A-210-43	18	2A-210-90	18

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
2A-210-91	18	2A-210-138	18	2A-210-185	18
2A-210-92	18	2A-210-139	18	2A-210-186	18
2A-210-93	18	2A-210-140	18	2A-210-187	18
2A-210-94	18	2A-210-141	18	2A-210-188	18
2A-210-95	18	2A-210-142	18	2A-210-189	18
2A-210-96	18	2A-210-143	18	2A-210-190	18
2A-210-97	18	2A-210-144	18	2A-210-191	18
2A-210-98	18	2A-210-145	18	2A-210-192	18
2A-210-99	18	2A-210-146	18	2A-210-192a	18
2A-210-100	18	2A-210-147	18	2A-210-192b	18
2A-210-101	18	2A-210-148	18	2A-210-193	18
2A-210-102	18	2A-210-149	18	2A-210-194	18
2A-210-103	18	2A-210-150	18	2A-210-195	18
2A-210-104	18	2A-210-151	18	2A-210-196	18
2A-210-105	18	2A-210-152	18	2A-210-197	18
2A-210-106	18	2A-210-153	18	2A-210-198	18
2A-210-107	18	2A-210-154	18	2A-210-199	18
2A-210-108	18	2A-210-155	18	2A-210-200	18
2A-210-109	18	2A-210-156	18	2A-210-201	18
2A-210-110	18	2A-210-157	18	2A-210-202	18
2A-210-111	18	2A-210-158	18	2A-210-203	18
2A-210-112	18	2A-210-159	18	2A-210-204	18
2A-210-113	18	2A-210-160	18	2A-210-205	18
2A-210-114	18	2A-210-161	18	2A-210-206	18
2A-210-115	18	2A-210-162	18	2A-210-207	18
2A-210-116	18	2A-210-163	18	2A-210-208	18
2A-210-117	18	2A-210-164	18	2A-210-209	18
2A-210-118	18	2A-210-165	18	2A-210-210	18
2A-210-119	18	2A-210-166	18	2A-210-211	18
2A-210-120	18	2A-210-167	18	2A-210-212	18
2A-210-121	18	2A-210-168	18	2A-210-213	18
2A-210-122	18	2A-210-169	18	2A-210-214	18
2A-210-123	18	2A-210-170	18	2A-210-215	18
2A-210-124	18	2A-210-171	18	2A-210-216	18
2A-210-125	18	2A-210-172	18	2A-210-217	18
2A-210-126	18	2A-210-173	18	2A-210-218	18
2A-210-127	18	2A-210-174	18	2A-210-219	18
2A-210-128	18	2A-210-175	18	2A-210-220	18
2A-210-129	18	2A-210-176	18	2A-210-221	18
2A-210-130	18	2A-210-177	18	2A-210-222	18
2A-210-131	18	2A-210-178	18	2A-210-223	18
2A-210-132	18	2A-210-179	18	2A-210-224	18
2A-210-133	18	2A-210-180	18	2A-210-225	18
2A-210-134	18	2A-210-181	18	2A-210-226	18
2A-210-135	18	2A-210-182	18	2A-210-227	18
2A-210-136	18	2A-210-183	18	2A-210-228	18
2A-210-137	18	2A-210-184	18	2A-210-229	18

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
2A-210-230	18	2A-210-277	21	2A-210-324	21
2A-210-231	18	2A-210-278	21	2A-210-325	21
2A-210-232	18	2A-210-279	21	2A-210-326	21
2A-210-233	18	2A-210-280	21	2A-210-327	21
2A-210-234	18	2A-210-281	21	2A-210-328	21
2A-210-235	18	2A-210-282	21	2A-210-329	21
2A-210-236	18	2A-210-283	21	2A-210-330	21
2A-210-237	21	2A-210-284	21	2A-210-331	21
2A-210-238	21	2A-210-285	21	2A-210-332	21
2A-210-239	21	2A-210-286	21	2A-210-333	21
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2A-210-245	21	2A-210-292	21	2A-215	0
2A-210-246	21	2A-210-293	21	2A-216	0
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2A-210-257	21	2A-210-304	21	2A-227	0
2A-210-258	21	2A-210-305	21	2A-228	0
2A-210-259	21	2A-210-306	21	2A-229	0
2A-210-260	21	2A-210-307	21	2A-230	0
2A-210-261	21	2A-210-308	21	2A-231	0
2A-210-262	21	2A-210-309	21	2A-232	0
2A-210-263	21	2A-210-310	21	2A-233	0
2A-210-264	21	2A-210-311	21	2A-234	0
2A-210-265	21	2A-210-312	21	2A-235	0
2A-210-266	21	2A-210-313	21	2A-236	0
2A-210-267	21	2A-210-314	21	2A-237	0
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2A-210-275	21	2A-210-322	21	2A-245	0
2A-210-276	21	2A-210-323	21	2A-246	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
2A-247	0	2A-294	0	2B-38	0
2A-248	0	2A-295	0	2B-39	0
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2A-251	0	2A-298	0	2B-42	0
2A-252	0	2A-299	0	2B-43	0
2A-253	0	2A-300	0	2B-44	0
2A-254	0	App 2B Tab		2B-45	0
2A-255	0	2B-i	0	2B-46	0
2A-256	0	2B-ii	0	2B-47	0
2A-257	0	2B-1	0	2B-48	0
2A-258	0	2B-2	0	2B-49	0
2A-259	0	2B-3	0	2B-50	0
2A-260	0	2B-4	0	2B-51	0
2A-261	0	2B-5	0	2B-52	0
2A-262	0	2B-6	0	2B-53	0
2A-263	0	2B-7	0	2B-54	0
2A-264	0	2B-8	0	2B-55	0
2A-265	0	2B-9	0	2B-56	0
2A-266	0	2B-10	0	2B-57	0
2A-267	0	2B-11	0	2B-58	0
2A-268	0	2B-12	0	2B-59	0
2A-269	0	2B-13	0	2B-60	0
2A-270	0	2B-14	0	2B-61	0
2A-271	0	2B-15	0	2B-62	0
2A-272	0	2B-16	0	2B-63	0
2A-273	0	2B-17	0	2B-64	0
2A-274	0	2B-18	0	2B-65	0
2A-275	0	2B-19	0	2B-66	0
2A-276	0	2B-20	0	2B-67	0
2A-277	0	2B-21	0	2B-68	0
2A-278	0	2B-22	0	2B-69	0
2A-279	0	2B-23	0	2B-70	0
2A-280	0	2B-24	0	2B-71	0
2A-281	0	2B-25	0	2B-72	0
2A-282	0	2B-26	0	2B-73	0
2A-283	0	2B-27	0	2B-74	0
2A-284	0	2B-28	0	2B-75	0
2A-285	0	2B-29	0	2B-76	0
2A-286	0	2B-30	0	2B-77	0
2A-287	0	2B-31	0	2B-78	0
2A-288	0	2B-32	0	2B-79	0
2A-289	0	2B-33	0	2B-80	0
2A-290	0	2B-34	0	2B-81	0
2A-291	0	2B-35	0	2B-82	0
2A-292	0	2B-36	0	2B-83	0
2A-293	0	2B-37	0	2B-84	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
2B-85	0	xi	21	3-xviiie	26
2B-86	0	xii	21	3-xviiif	24
2B-87	0	xiii	15	3-xix	22
2B-88	0	xiv	21	3-xx	19
2B-89	0	xv	21	3-xxa	19
2B-90	0	xvi	12	3-xxb	19
2B-91	0	xvii	12	3-xxi	16
2B-92	0	xviii	21	3-xxii	16
2B-93	0	xix	26	3-xxiii	17
2B-94	0	xx	26	3-xxiv	17
2B-95	0	xxi	12	3-xxiva	14
2B-96	0	xxii	26	3-xxivb	21
2B-97	0	xxiii	26	3-xxivc	21
2B-98	0	xxiv	26	3-xxivd	21
2B-99	0	xxv	26	3-xxv	0
2B-100	0	xxvi	26	3-xxvi	19
2B-101	0	xxvii	26	3-xxvii	19
2B-102	0	xxviii	26	3-xxviii	19
2B-103	0	xxix	26	3-xxix	24
App 2C Tab		xxx	26	3-xxx	19
2C-i	0	xxxi	26	3-xxxi	19
2C-1	0	xxxii	26	3-xxxii	19
2C-2	0	Chapter 3 Tab		3-xxxiii	19
2C-3	0	3-i	26	3-xxxiv	19
2C-4	0	3-ii	8	3.1 Tab	
2C-5	0	3-iii	26	3.1-1	0
2C-6	0	3-iv	26	3.1-2	26
2C-7	0	3-v	8	3.1-3	0
2C-8	0	3-vi	8	3.1-4	25
2C-9	0	3-vii	8	3.1-5	0
2C-10	0	3-viii	19	3.1-6	27
2C-11	0	3-ix	26	3.1-7	0
2C-12	0	3-x	27	3.1-8	0
2C-13	0	3-xi	27	3.1-9	0
		3-xii	8	3.1-10	0
VOLUME 5		3-xiii	26	3.1-11	0
		3-xiv	26	3.1-12	0
i	12	3-xiva	26	3.1-13	0
ii	12	3-xivb	26	3.1-14	0
iii	21	3-xv	8	3.1-15	0
iv	21	3-xvi	8	3.1-16	0
v	21	3-xvii	17	3.1-17	0
vi	21	3-xviii	17	3.1-18	0
vii	21	3-xviiia	19	3.1-19	0
viii	21	3-xviiib	26	3.1-20	0
ix	21	3-xviiic	26	3.1-21	0
x	21	3-xviiid	26	3.1-22	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
3.1-23	0	3.2 Tab		Sheet 36	21
3.1-24	27	3.2-1	0	Sheet 37	0
3.1-25	0	3.2-2	0	Sheet 38	9
3.1-26	0	3.2-3	1	Sheet 39	0
3.1-27	27	3.2-4	0	Sheet 40	0
3.1-28	0	3.2-5	0	Sheet 41	0
3.1-29	13	3.2-6	0	Sheet 42	0
3.1-30	0	3.2-7	0	Sheet 43	0
3.1-31	0	3.2-8	13	Sheet 44	0
3.1-32	27	3.2-9	13	Sheet 45	0
3.1-33	0	3.2 Tbl Tab		Sheet 46	0
3.1-34	0	Tbl 3.2-1		Sheet 47	0
3.1-35	26	Sheet 1	0	Sheet 48	27
3.1-36	26	Sheet 2	13	Tbl 3.2-2	
3.1-37	0	Sheet 3	21	Sheet 1	0
3.1-38	0	Sheet 4	0	Sheet 2	0
3.1-39	0	Sheet 5	0	Tbl 3.2-3	
3.1-40	0	Sheet 6	8	Sheet 1	19
3.1-41	0	Sheet 7	0	Sheet 2	13
3.1-42	0	Sheet 8	13	Sheet 3	13
3.1-43	0	Sheet 9	0	Sheet 4	15
3.1-44	0	Sheet 10	0	Sheet 5	13
3.1-45	0	Sheet 11	27	Tbl 3.2-4	
3.1-46	0	Sheet 12	0	Sheet 1	0
3.1-47	0	Sheet 13	0	Sheet 2	0
3.1-48	0	Sheet 14	10	Tbl 3.2-5	
3.1-49	0	Sheet 15	10	Sheet 1	0
3.1-50	0	Sheet 16	0	Sheet 2	0
3.1-51	0	Sheet 17	21	Tbl 3.2-6	
3.1-52	0	Sheet 18	0	Sheet 1	25
3.1-53	0	Sheet 19	0	Sheet 2	0
3.1-54	0	Sheet 20	0	Sheet 3	0
3.1-55	0	Sheet 21	0	Sheet 4	0
3.1-56	0	Sheet 22	0	Sheet 5	0
3.1-57	0	Sheet 23	22	Sheet 6	0
3.1-58	0	Sheet 24	9	3.3 Tab	
3.1-59	0	Sheet 25	9	3.3-1	0
3.1-60	0	Sheet 26	7	3.3-2	3
3.1-61	8	Sheet 27	0	3.3-3	0
3.1-62	8	Sheet 28	0	3.3-4	0
3.1-63	8	Sheet 29	0	3.3 Tbl Tab	
3.1-64	0	Sheet 30	0	Tbl 3.3-1	0
3.1-65	0	Sheet 31	0	3.3 Fig. Tab	
3.1-66	26	Sheet 32	0	Fig. 3.3-1	0
3.1-67	0	Sheet 33	15	Fig. 3.3-2	2
3.1-68	0	Sheet 34	27	3.4 Tab	
3.1-69	0	Sheet 35	15	3.4-1	3

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.
3.4-2	25
3.4-3	22
3.4-4	8
3.4-4a	8
3.4-4b	8
3.4-5	0
3.4-6	8
3.4-7	8
3.4 Tbl Tab	
Tbl 3.4-1	0
Tbl 3.4-2	0
Tbl 3.4-3	
Sheet 1	8
Sheet 2	8
Sheet 3	8
3.4 Fig. Tab	
Fig. 3.4-1	20
Fig. 3.4-2	22
3.5 Tab	
3.5-1	0
3.5-2	0
3.5-3	15
3.5-4	15
3.5-4a	15
3.5-4b	15
3.5-5	1
3.5-6	0
3.5-7	0
3.5-8	0
3.5-9	26
3.5-10	26
3.5-11	0
3.5-12	0
3.5-13	0
3.5-14	26
3.5-15	0
3.5-16	0
3.5-17	0
3.5-18	0
3.5-19	8
3.5-20	15
3.5-20a	8
3.5-20b	8
3.5-21	16
3.5-22	7
3.5-23	15
3.5-24	15
3.5-25	7
3.5-26	18
3.5-27	18
3.5-28	26
3.5-29	26
3.5-30	7
3.5-31	26
3.5 Tbl Tab	
Tbl 3.5-1	9
Tbl 3.5-2	
Sheet 1	0
Sheet 2	0
Sheet 3	0
Tbl 3.5-3	
Sheet 1	8
Sheet 2	1
Sheet 3	1
Sheet 4	1
Sheet 5	1
Tbl 3.5-4	18
Tbl 3.5-5	0
Tbl 3.5-6	0
Tbl 3.5-7	0
Tbl 3.5-8	
Sheet 1	8
Sheet 2	1
Sheet 3	1
Sheet 4	1
Tbl 3.5-9	0
Tbl 3.5-10	15
Tbl 3.5-11	15
Tbl 3.5-12	15
Tbl 3.5-13	7
Tbl 3.5-14	7
Tbl 3.5-15	7
Tbl 3.5-16	
Sheet 1	8
Sheet 2	8
Sheet 3	8
Sheet 4	8
Sheet 5	8
Sheet 6	8
Sheet 7	8
Sheet 8	8
Sheet 9	8
Sheet 10	8
Tbl 3.5-17	
Sheet 1	8
Sheet 2	8
Sheet 3	8
Sheet 4	8
Sheet 5	8
Sheet 6	8
Sheet 7	8
Sheet 8	8
Sheet 9	8
Tbl 3.5-18	26
Tbl 3.5-19	
Sheet 1	18
Sheet 2	18
Sheet 3	18
Sheet 4	18
Sheet 5	18
Sheet 6	18
Sheet 7	18
Sheet 8	18
Sheet 9	18
Sheet 10	18
Sheet 11	19
Sheet 12	19
Sheet 13	19
Sheet 14	19
Sheet 15	18
Sheet 16	18
TBL 3.5-20	26
3.5 Fig. Tab	
Fig. 3.5-1	0
Fig. 3.5-2	26
Fig. 3.5-3	0
Fig. 3.5-4	0
Fig. 3.5-5	0
Fig. 3.5-6	15
Fig. 3.5-7	15
Fig. 3.5-8	15
Fig. 3.5-9	15
Fig. 3.5-10	26
Fig. 3.5-11	26
Fig. 3.5-12	19
Fig. 3.5-13	26
Fig. 3.5-14	19

VOLUME 6

i	12

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
ii	12	3.6-14	15	3.6-50c	19
iii	21	3.6-14a	15	3.6-50d	19
iv	21	3.6-14b	15	3.6-51	0
v	21	3.6-15	0	3.6-52	0
vi	21	3.6-16	0	3.6-53	0
vii	21	3.6-17	0	3.6-54	21
viii	21	3.6-18	0	3.6-55	26
ix	21	3.6-19	0	3.6-56	21
x	21	3.6-20	0	3.6-57	18
xi	21	3.6-21	0	3.6-58	18
xii	21	3.6-22	0	3.6 Tbl Tab	
xiii	15	3.6-23	0	Tbl 3.6-1	
xiv	21	3.6-24	0	Sheet 1	0
xv	21	3.6-25	0	Sheet 2	0
xvi	12	3.6-26	0	Sheet 3	0
xvii	12	3.6-27	0	Sheet 4	0
xviii	21	3.6-28	0	Sheet 5	0
xix	26	3.6-29	0	Sheet 6	0
xx	26	3.6-30	0	Sheet 7	0
xxi	12	3.6-31	0	Tbl 3.6-2	
xxii	26	3.6-32	0	Sheet 1	15
xxiii	26	3.6-33	18	Sheet 2	15
xxiv	26	3.6-34	1	Sheet 3	15
xxv	26	3.6-35	18	Sheet 4	15
xxvi	26	3.6-36	18	Sheet 5	15
xxvii	26	3.6-37	14	Sheet 6	15
xxviii	26	3.6-38	14	Sheet 7	15
xxix	26	3.6-38a	14	Sheet 8	15
xxx	26	3.6-38b	9	Sheet 9	15
xxxi	26	3.6-39	0	Sheet 10	15
xxxii	26	3.6-40	0	Sheet 11	15
3.6 Tab		3.6-41	14	Tbl 3.6-3	
3.6-1	0	3.6-42	14	Sheet 1	9
3.6-2	0	3.6-42a	14	Sheet 2	9
3.6-3	8	3.6-42b	14	Sheet 3	9
3.6-4	14	3.6-43	19	Sheet 4	9
3.6-4a	14	3.6-44	19	Tbl 3.6-4	
3.6-4b	8	3.6-45	19	Sheet 1	9
3.6-5	0	3.6-46	19	Sheet 2	9
3.6-6	0	3.6-46a	19	Tbl 3.6-5	
3.6-7	10	3.6-46b	19	Sheet 1	0
3.6-8	10	3.6-47	0	Sheet 2	9
3.6-9	17	3.6-48	27	Sheet 3	0
3.6-10	0	3.6-49	9	Tbl 3.6-6	
3.6-11	14	3.6-50	19	Sheet 1	9
3.6-12	15	3.6-50a	19	Sheet 2	9
3.6-13	15	3.6-50b	19	Sheet 3	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Tbl 3.6-7		Sheet 3	17	Fig. 3.6-36	14
Sheet 1	0	Sheet 4	0	Fig. 3.6-37	14
Sheet 2	9	Tbl 3.6-18		Fig. 3.6-38	14
Sheet 3	9	Sheet 1	0	Fig. 3.6-39	14
Tbl 3.6-8		Sheet 2	0	Fig. 3.6-40	14
Sheet 1	11	Tbl 3.6-19		Fig. 3.6-41	14
Sheet 2	11	Sheet 1	0	Fig. 3.6-42	14
Sheet 3	11	Sheet 2	0	Fig. 3.6-43	14
Tbl 3.6-9		Tbl 3.6-20	0	Fig. 3.6-44	14
Sheet 1	11	Tbl 3.6-21	0	Fig. 3.6-45	0
Sheet 2	11	Tbl 3.6-22	11	Fig. 3.6-46	0
Sheet 3	11	3.6 Fig. Tab		Fig. 3.6-47	0
Tbl 3.6-10		Fig. 3.6-1	9	Fig. 3.6-48	17
Sheet 1	11	Fig. 3.6-2	9	Fig. 3.6-49	17
Sheet 2	11	Fig. 3.6-3	9	Fig. 3.6-50	17
Tbl 3.6-11		Fig. 3.6-4	9	Fig. 3.6-51	18
Sheet 1	11	Fig. 3.6-5	0	Fig. 3.6-52	17
Sheet 2	11	Fig. 3.6-6	9	Fig. 3.6-53	17
Sheet 3	11	Fig. 3.6-7	9	Fig. 3.6-54	17
Sheet 4	11	Fig. 3.6-8	16	Fig. 3.6-55	17
Tbl 3.6-12		Fig. 3.6-9	16	Fig. 3.6-56	17
Sheet 1	11	Fig. 3.6-10	16	Fig. 3.6-57	17
Sheet 2	11	Fig. 3.6-11	16	Fig. 3.6-58	18
Sheet 3	11	Fig. 3.6-12	16	Fig. 3.6-59	17
Sheet 4	11	Fig. 3.6-13	16	Fig. 3.6-60	17
Tbl 3.6-13		Fig. 3.6-14	11	Fig. 3.6-61	17
Sheet 1	14	Fig. 3.6-15	11	Fig. 3.6-62	0
Sheet 2	14	Fig. 3.6-16	16	Fig. 3.6-63	18
Sheet 3	11	Fig. 3.6-17	16	Fig. 3.6-64	18
Tbl 3.6-14		Fig. 3.6-18	16	Fig. 3.6-65	18
Sheet 1	13	Fig. 3.6-19	16	Fig. 3.6-66	18
Sheet 2	14	Fig. 3.6-20	16	Fig. 3.6-67	18
Sheet 3	13	Fig. 3.6-21	16	Fig. 3.6-68	18
Tbl 3.6-15		Fig. 3.6-22	16	Fig. 3.6-69	0
Sheet 1	14	Fig. 3.6-23	16	Fig. 3.6-70	0
Sheet 2	14	Fig. 3.6-24	16	Fig. 3.6-71	21
Sheet 3	14	Fig. 3.6-25	16	Fig. 3.6-72	21
Sheet 4	14	Fig. 3.6-26	16	Fig. 3.6-73	22
Sheet 5	14	Fig. 3.6-27	16	Fig. 3.6-74	21
Tbl 3.6-16		Fig. 3.6-28	16	Fig. 3.6-75	21
Sheet 1	17	Fig. 3.6-29	16	Fig. 3.6-76	22
Sheet 2	17	Fig. 3.6-30	16	Fig. 3.6-77	21
Sheet 3	17	Fig. 3.6-31	21	Fig. 3.6-78	21
Sheet 4	17	Fig. 3.6-32	21	Fig. 3.6-79	21
Tbl 3.6-17		Fig. 3.6-33	16	Fig. 3.6-80	22
Sheet 1	17	Fig. 3.6-34	14	Fig. 3.6-81	21
Sheet 2	17	Fig. 3.6-35	14	Fig. 3.6-82	8

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Fig. 3.6-83	8	xiii	15	Fig. 3.7-2	0
Fig. 3.6-84	22	xiv	21	Fig. 3.7-3	0
Fig. 3.6-85	22	xv	21	Fig. 3.7-4	0
Fig. 3.6-86	22	xvi	12	Fig. 3.7-5	0
Fig. 3.6-87	21	xvii	12	Fig. 3.7-6	0
Fig. 3.6-88	21	xviii	21	Fig. 3.7-7	0
Fig. 3.6-89	22	xix	26	Fig. 3.7-8	0
Fig. 3.6-90	22	xx	26	Fig. 3.7-9	0
Fig. 3.6-91	21	xxi	12	Fig. 3.7-10	0
Fig. 3.6-92	21	xxii	26	Fig. 3.7-11	0
Fig. 3.6-93	13	xxiii	26	Fig. 3.7-12	0
Fig. 3.6-94	13	xxiv	26	Fig. 3.7-13	0
Fig. 3.6-95	8	xxv	26	Fig. 3.7-14	0
Fig. 3.6-96	8	xxvi	26	Fig. 3.7-15	0
Fig. 3.6-97	8	xxvii	26	Fig. 3.7-16	0
Fig. 3.6-98	8	xxviii	26	Fig. 3.7-17	0
Fig. 3.6-99	8	xxix	26	Fig. 3.7-18	0
Fig. 3.6-100	13	xxx	26	Fig. 3.7-19	0
Fig. 3.6-101	23	xxxi	26	Fig. 3.7-20	0
Fig. 3.6-102	22	xxxii	26	Fig. 3.7-21	0
Fig. 3.6-103	21	3.7 Tab		Fig. 3.7-22	0
Fig. 3.6-103A	21	3.7-1	15	Fig. 3.7-23	0
Fig. 3.6-104	15	3.7-2	24	Fig. 3.7-24	0
Fig. 3.6-105	15	3.7-2a	24	Fig. 3.7-25	0
Fig. 3.6-106	15	3.7-2b	24	Fig. 3.7-26	0
Fig. 3.6-107	15	3.7-3	24	Fig. 3.7-27	19
Fig. 3.6-108	15	3.7-4	15	Fig. 3.7-28	19
Fig. 3.6-109	15	3.7-5	15	Fig. 3.7-29	19
Fig. 3.6-110	15	3.7-6	15	Fig. 3.7-30	19
Fig. 3.6-111	15	3.7-7	15	Fig. 3.7-31	19
Fig. 3.6-112	15	3.7-8	19	Fig. 3.7-32	19
Fig. 3.6-113	18	3.7-9	19	Fig. 3.7-33	0
		3.7-10	19	Fig. 3.7-34	0
VOLUME 7		3.7-11	19	Fig. 3.7-35	0
		3.7-12	19	Fig. 3.7-36	0
i	12	3.7-13	19	Fig. 3.7-37	0
ii	12	3.7-14	19	Fig. 3.7-38	0
iii	21	3.7-15	15	Fig. 3.7-39	0
iv	21	3.7-16	16	Fig. 3.7-40	0
v	21	3.7-17	15	Fig. 3.7-41	0
vi	21	3.7-18	10	Fig. 3.7-42	0
vii	21	3.7 Tbl Tab		Fig. 3.7-43	0
viii	21	Tbl 3.7-1	0	Fig. 3.7-44	0
ix	21	Tbl 3.7-2	0	Fig. 3.7-45	0
x	21	Tbl 3.7-3	0	Fig. 3.7-46	0
xi	21	3.7 Fig. Tab		Fig. 3.7-47	0
xii	21	Fig. 3.7-1	0	Fig. 3.7-48	19

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Fig. 3.7-49	19	3.8-25	18	3.8-62	14
Fig. 3.7-50	19	3.8-26	18	3.8-63	26
Fig. 3.7-51	19	3.8-26a	18	3.8-64	14
Fig. 3.7-52	19	3.8-26b	13	3.8-65	26
Fig. 3.7-53	19	3.8-27	18	3.8-66	26
Fig. 3.7-54	0	3.8-28	0	3.8-66a	26
Fig. 3.7-55	0	3.8-29	0	3.8-66b	26
Fig. 3.7-56	0	3.8-30	26	3.8-67	18
Fig. 3.7-57	0	3.8-31	0	3.8-68	14
Fig. 3.7-58	0	3.8-32	14	3.8-69	14
Fig. 3.7-59	0	3.8-33	23	3.8-70	14
Fig. 3.7-60	0	3.8-34	14	3.8-70a	19
Fig. 3.7-61	0	3.8-35	14	3.8-70b	19
Fig. 3.7-62	0	3.8-36	14	3.8-70c	19
Fig. 3.7-63	0	3.8-36a	14	3.8-70d	19
Fig. 3.7-64	15	3.8-36b	14	3.8-71	8
Fig. 3.7-65	15	3.8-37	0	3.8-72	0
Fig. 3.7-66	15	3.8-38	0	3.8-73	0
Fig. 3.7-67	15	3.8-39	0	3.8-74	1
Fig. 3.7-68	24	3.8-40	0	3.8-75	0
3.8 Tab		3.8-41	0	3.8-76	1
3.8-1	C	3.8-42	0	3.8-77	0
3.8-2	8	3.8-43	0	3.8-78	15
3.8-3	1	3.8-44	0	3.8 Tbl Tab	
3.8-4	0	3.8-45	7	Tbl 3.8-1	0
3.8-5	0	3.8-46	0	Tbl 3.8-2	0
3.8-6	0	3.8-47	0	Tbl 3.8-3	0
3.8-7	8	3.8-48	0	Tbl 3.8-4	0
3.8-8	8	3.8-49	25	Tbl 3.8-5	0
3.8-8a	8	3.8-50	17	Tbl 3.8-6	0
3.8-8b	8	3.8-50a	17	Tbl 3.8-7	0
3.8-9	0	3.8-50b	17	Tbl 3.8-8	0
3.8-10	0	3.8-50c	17	Tbl 3.8-9	0
3.8-11	0	3.8-50d	17	Tbl 3.8-10	0
3.8-12	0	3.8-51	14	Tbl 3.8-11	0
3.8-13	0	3.8-52	17	Tbl 3.8-12	0
3.8-14	0	3.8-52a	8	Tbl 3.8-13	0
3.8-15	0	3.8-52b	8	Tbl 3.8-14	0
3.8-16	0	3.8-53	14	Tbl 3.8-15	0
3.8-17	0	3.8-54	17	Tbl 3.8-16	0
3.8-18	0	3.8-55	1	Tbl 3.8-17	0
3.8-19	18	3.8-56	15	Tbl 3.8-18	
3.8-20	0	3.8-57	0	Sheet 1	19
3.8-21	0	3.8-58	0	Sheet 2	19
3.8-22	0	3.8-59	18	Sheet 3	19
3.8-23	13	3.8-60	18	Sheet 4	19
3.8-24	18	3.8-61	14	Sheet 5	19

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Tbl 3.8-19		Tbl 3.8-35	17	Fig. 3.8-45	21
Sheet 1	0	3.8 Fig. Tab		Fig. 3.8-45A	11
Sheet 2	0	Fig. 3.8-1	24	Fig. 3.8-46	21
Tbl 3.8-20	0	Fig. 3.8-2	26	Fig. 3.8-46A	14
Tbl 3.8-21	0	Fig. 3.8-3	0	Fig. 3.8-47	17
Tbl 3.8-22		Fig. 3.8-4	0	Fig. 3.8-48	10
Sheet 1	0	Fig. 3.8-5	0	Fig. 3.8-49	1
Sheet 2	0	Fig. 3.8-6	0	Fig. 3.8-50	0
Sheet 3	0	Fig. 3.8-7	9	Fig. 3.8-51	0
Tbl 3.8-23	0	Fig. 3.8-8	1	Fig. 3.8-52	5
Tbl 3.8-24	0	Fig. 3.8-9	1	Fig. 3.8-53	21
Tbl 3.8-25		Fig. 3.8-10	5	Fig. 3.8-54	26
Sheet 1	8	Fig. 3.8-11	11	Fig. 3.8-55	18
Sheet 2	8	Fig. 3.8-12	0	Fig. 3.8-56	14
Sheet 3	8	Fig. 3.8-13	9	Fig. 3.8-57	5
Sheet 4	8	Fig. 3.8-14	0	Fig. 3.8-58	16
Sheet 5	8	Fig. 3.8-15	0	Fig. 3.8-59	21
Sheet 6	8	Fig. 3.8-16	21	Fig. 3.8-60	13
Sheet 7	8	Fig. 3.8-17	0	Fig. 3.8-61	18
Sheet 8	8	Fig. 3.8-18	14	Fig. 3.8-62	21
Sheet 9	8	Fig. 3.8-19	26	Fig. 3.8-63	11
Sheet 10	8	Fig. 3.8-20	7	Fig. 3.8-64	26
Sheet 11	8	Fig. 3.8-21	7	Fig. 3.8-65	21
Tbl 3.8-26		Fig. 3.8-22	0	Fig. 3.8-66	16
Sheet 1	8	Fig. 3.8-23	0	Fig. 3.8-67	26
Sheet 2	8	Fig. 3.8-24	0	Fig. 3.8-68	21
Sheet 3	8	Fig. 3.8-25	12	Fig. 3.8-69	26
Tbl 3.8-27		Fig. 3.8-26	12	Fig. 3.8-70	16
Sheet 1	8	Fig. 3.8-27	0	Fig. 3.8-71	21
Sheet 2	8	Fig. 3.8-28	0	Fig. 3.8-72	21
Sheet 3	8	Fig. 3.8-29	0	Fig. 3.8-73	16
Sheet 4	8	Fig. 3.8-30	26	Fig. 3.8-74	16
Tbl 3.8-28		Fig. 3.8-31	26	Fig. 3.8-75	16
Sheet 1	8	Fig. 3.8-32	26	Fig. 3.8-76	16
Sheet 2	8	Fig. 3.8-33	26	Fig. 3.8-77	16
Tbl 3.8-29		Fig. 3.8-34	5	Fig. 3.8-78	16
Sheet 1	10	Fig. 3.8-35	5	Fig. 3.8-79	16
Sheet 2	10	Fig. 3.8-36	7	Fig. 3.8-80	16
Tbl 3.8-30		Fig. 3.8-37	11		
Sheet 1	10	Fig. 3.8-38	23	VOLUME 8	
Sheet 2	10	Fig. 3.8-39	14		
Sheet 3	10	Fig. 3.8-40	7	i	12
Sheet 4	10	Fig. 3.8-40A	26	ii	12
Tbl 3.8-31	17	Fig. 3.8-41	17	iii	21
Tbl 3.8-32	26	Fig. 3.8-42	18	iv	21
Tbl 3.8-33	17	Fig. 3.8-43	9	v	21
Tbl 3.8-34	17	Fig. 3.8-44	16	vi	21

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
vii	21	3.9-17	25	Sheet 18	27
viii	21	3.9-18	26	Sheet 19	16
ix	21	3.9-18a	20	Sheet 20	18
x	21	3.9-18b	20	Sheet 21	23
xi	21	3.9-18c	20	Sheet 22	16
xii	21	3.9-18d	20	Sheet 23	26
xiii	15	3.9-18e	20	Sheet 24	25
xiv	21	3.9-18f	20	Sheet 24a	25
xv	21	3.9-18g	26	Sheet 24b	25
xvi	12	3.9-18h	20	Sheet 25	25
xvii	12	3.9-19	26	Sheet 26	24
xviii	21	3.9-20	0	Sheet 27	26
xix	26	3.9-21	0	Sheet 28	24
xx	26	3.9-22	0	Sheet 29	25
xxi	12	3.9-23	3	Sheet 30	26
xxii	26	3.9-24	3	Sheet 31	25
xxiii	26	3.9-24a	26	Sheet 32	24
xxiv	26	3.9-24b	26	Sheet 33	21
xxv	26	3.9-25	5	Sheet 34	26
xxvi	26	3.9-26	16	Sheet 35	26
xxvii	26	3.9-27	18	Tbl 3.9-2	
xxviii	26	3.9-28	5	Sheet 1	0
xxix	26	3.9-29	24	Sheet 2	1
xxx	26	3.9-30	24	Tbl 3.9-3a	8
xxxi	26	3.9-31	27	Tbl 3.9-3b	
xxxii	26	3.9-32	27	Sheet 1	14
3.9 Tab		3.9 Tbl Tab		Sheet 2	14
3.9-1	0	Tbl 3.9-1		Tbl 3.9-4	8
3.9-2	0	Sheet 1	20	Tbl 3.9-5a	25
3.9-3	3	Sheet 2	27	Tbl 3.9-5b	
3.9-4	27	Sheet 3	25	Sheet 1	26
3.9-4a	3	Sheet 4	25	Sheet 2	8
3.9-4b	3	Sheet 5	26	Tbl 3.9-6	8
3.9-5	26	Sheet 6	16	Tbl 3.9-7	0
3.9-6	19	Sheet 7	25	Tbl 3.9-8	
3.9-7	19	Sheet 8	26	Sheet 1	19
3.9-8	19	Sheet 9	25	Sheet 2	26
3.9-8a	19	Sheet 10	26	Tbl 3.9-9	26
3.9-8b	14	Sheet 10a	27	Tbl 3.9-10	26
3.9-9	8	Sheet 10b	27	Tbl 3.9-10A	
3.9-10	26	Sheet 11	16	Sheet 1	26
3.9-11	26	Sheet 12	26	Sheet 2	27
3.9-12	26	Sheet 13	25	Sheet 3	26
3.9-13	26	Sheet 14	16	Sheet 4	14
3.9-14	8	Sheet 15	26	Sheet 5	14
3.9-15	12	Sheet 16	26	Tbl 3.9-11	
3.9-16	24	Sheet 17	27	Sheet 1	19

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Sheet 2	19	Sheet 14	24	Sheet 43	14
Tbl 3.9-12		Sheet 14a	20	Sheet 44	14
Sheet 1	0	Sheet 14b	20	Sheet 45	14
Sheet 2	0	Sheet 14c	20	Sheet 46	14
Tbl 3.9-13	0	Sheet 14d	26	Sheet 47	14
Tbl 3.9-14	0	Sheet 14e	26	Sheet 48	14
Tbl 3.9-15		Sheet 14f	20	Sheet 49	23
Sheet 1	19	Sheet 14g	20	Sheet 50	23
Sheet 2	19	Sheet 14h	20	Sheet 50a	23
Tbl 3.9-15a	19	Sheet 14i	20	Sheet 50b	23
Tbl 3.9-16	0	Sheet 14j	20	Sheet 51	14
Tbl 3.9-17		Sheet 14k	20	Sheet 52	16
Sheet 1	19	Sheet 14l	25	Sheet 53	16
Sheet 2	18	Sheet 14m	27	Sheet 54	16
Sheet 2a	21	Sheet 14n	25	Sheet 54a	16
Sheet 2b	21	Sheet 14o	27	Sheet 54b	16
Sheet 2c	21	Sheet 14p	25	Sheet 55	14
Sheet 2d	21	Sheet 15	26	Sheet 56	16
Sheet 2e	21	Sheet 16	23	Sheet 56a	25
Sheet 2f	26	Sheet 17	23	Sheet 56b	16
Sheet 2g	26	Sheet 18	14	Sheet 56c	16
Sheet 2h	21	Sheet 19	14	Sheet 56d	16
Sheet 3	8	Sheet 24	14	Sheet 57	16
Sheet 4	16	Sheet 21	14	Sheet 58	14
Sheet 5	24	Sheet 22	14	Sheet 59	20
Sheet 6	26	Sheet 23	14	Sheet 60	14
Sheet 6a	24	Sheet 24	14	Sheet 61	14
Sheet 6b	26	Sheet 25	14	Sheet 62	14
Sheet 6c	26	Sheet 26	14	Sheet 63	16
Sheet 6d	26	Sheet 27	14	Sheet 64	16
Sheet 7	14	Sheet 28	14	Sheet 65	16
Sheet 8	24	Sheet 29	14	Sheet 66	16
Sheet 9	8	Sheet 30	14	Sheet 67	14
Sheet 10	8	Sheet 31	14	Sheet 68	14
Sheet 10a	26	Sheet 32	14	Sheet 68a	26
Sheet 10b	16	Sheet 33	14	Sheet 68b	16
Sheet 11	8	Sheet 34	14	Sheet 69	21
Sheet 12	8	Sheet 35	14	Sheet 70	25
Sheet 12a	24	Sheet 36	14	Sheet 71	14
Sheet 12b	24	Sheet 37	14	Sheet 72	16
Sheet 12c	24	Sheet 38	23	Sheet 72a	27
Sheet 12d	24	Sheet 38a	23	Sheet 72b	16
Sheet 12e	24	Sheet 38b	23	Sheet 73	14
Sheet 12f	26	Sheet 39	23	Sheet 74	14
Sheet 12g	24	Sheet 40	14	Sheet 75	19
Sheet 12h	24	Sheet 41	14	Sheet 76	25
Sheet 13	24	Sheet 42	14	Sheet 76a	19

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Sheet 76b	20	Sheet 103	14	Sheet 13	4
Sheet 76c	20	Sheet 104	21	Sheet 14	4
Sheet 76d	20	Sheet 104a	21	Sheet 15	4
Sheet 77	23	Sheet 104b	17	Sheet 16	4
Sheet 78	23	Sheet 105	21	Sheet 17	4
Sheet 79	14	Sheet 106	21	Sheet 18	4
Sheet 80	14	Sheet 106a	21	Sheet 19	4
Sheet 81	14	Sheet 106b	26	Sheet 20	4
Sheet 82	14	Sheet 107	16	Tbl 3.9-19	0
Sheet 83	14	Sheet 108	21	Tbl 3.9-20	0
Sheet 84	14	Sheet 109	21	Tbl 3.9-21	
Sheet 85	26	Sheet 110	14	Sheet 1	5
Sheet 86	14	Sheet 111	26	Sheet 2	0
Sheet 87	14	Sheet 112	14	Tbl 3.9-22	3
Sheet 88	14	Sheet 112a	26	Tbl 3.9-23	
Sheet 89	27	Sheet 112b	26	Sheet 1	24
Sheet 90	27	Sheet 113	14	Sheet 2	24
Sheet 91	14	Sheet 114	26	Sheet 3	24
Sheet 92	14	Sheet 115	16	Sheet 4	24
Sheet 93	14	Sheet 116	14	Sheet 5	24
Sheet 94	20	Sheet 117	16	Sheet 6	24
Sheet 94a	20	Sheet 118	26	Sheet 7	24
Sheet 94b	26	Sheet 118a	26	Sheet 8	24
Sheet 95	14	Sheet 118b	25	Sheet 9	24
Sheet 96	26	Sheet 119	24	Sheet 10	24
Sheet 96a	16	Sheet 120	24	Sheet 11	24
Sheet 96b	26	Sheet 120a	24	Sheet 12	24
Sheet 96c	26	Sheet 120b	24	Tbl 3.9-24	
Sheet 96d	26	Sheet 121	20	Sheet 1	16
Sheet 96e	24	Sheet 122	20	Sheet 2	16
Sheet 96f	24	Sheet 123	20	Sheet 3	16
Sheet 96g	26	Sheet 124	27	Tbl 3.9-25	8
Sheet 96h	26	Tbl 3.9-18		Tbl 3.9-26	
Sheet 96i	25	Sheet 1	16	Sheet 1	8
Sheet 96j	25	Sheet 2	16	Sheet 2	8
Sheet 96k	25	Sheet 2a	22	Sheet 3	8
Sheet 96l	25	Sheet 3	21	Sheet 4	8
Sheet 96m	26	Sheet 4	4	Sheet 5	8
Sheet 96n	25	Sheet 5	4	Sheet 6	16
Sheet 96o	26	Sheet 6	19	Sheet 7	16
Sheet 90p	25	Sheet 6a	24	Sheet 8	16
Sheet 97	26	Sheet 7	4	Sheet 9	25
Sheet 98	14	Sheet 8	17	Sheet 10	25
Sheet 99	14	Sheet 9	26	Tbl 3.9-27	15
Sheet 100	14	Sheet 10	4	Tbl 3.9-28	
Sheet 101	21	Sheet 11	4	Sheet 1	18
Sheet 102	16	Sheet 12	4	Sheet 2	9

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Sheet 2a	23	Sheet 38	16	Sheet 3	16
Sheet 2b	23	Sheet 39	16	Sheet 4	16
Sheet 3	9	Sheet 40	16	Sheet 5	16
Sheet 4	16	Sheet 41	16	Tbl 3.9-37	16
Sheet 5	23	Sheet 42	16	Tbl 3.9-38	
Sheet 6	16	Sheet 43	16	Sheet 1	16
Sheet 7	9	Sheet 44	16	Sheet 2	25
Sheet 8	9	Sheet 45	16	Tbl 3.9-39	16
Sheet 9	16	Sheet 46	25	Tbl 3.9-40	16
Sheet 10	16	Sheet 46a	25	Tbl 3.9-41	16
Sheet 11	16	Sheet 46b	17	Tbl 3.9-42	
Sheet 12	16	Sheet 46c	17	Sheet 1	16
Sheet 13	16	Sheet 46d	27	Sheet 2	16
Sheet 14	26	Sheet 47	27	Tbl 3.9-43	
Sheet 15	16	Sheet 48	24	Sheet 1	25
Sheet 16	16	Sheet 49	19	Sheet 2	25
Sheet 17	16	Sheet 50	16	Tbl 3.9-44	
Sheet 18	27	Sheet 51	16	Sheet 1	16
Sheet 19	16	Sheet 52	16	Sheet 2	16
Sheet 20	16	Sheet 53	16	Tbl 3.9-45	17
Sheet 21	16	Tbl 3.9-29		Tbl 3.9-46	27
Sheet 22	16	Sheet 1	16	Tbl 3.9-47	16
Sheet 23	16	Sheet 2	16	Tbl 3.9-48	24
Sheet 24	16	Sheet 3	25	Tbl 3.9-48a	24
Sheet 25	16	Sheet 4	26	Tbl 3.9-48b	26
Sheet 26	16	Tbl 3.9-29A		Tbl 3.9-49	25
Sheet 27	16	Sheet 1	25	Tbl 3.9-50	16
Sheet 28	16	Sheet 2	26	Tbl 3.9-51	
Sheet 28a	20	Tbl 3.9-29B		Sheet 1	16
Sheet 28b	20	Sheet 1	26	Sheet 2	16
Sheet 29	16	Sheet 2	26	Sheet 3	16
Sheet 30	16	Tbl 3.9-30	14	Sheet 4	16
Sheet 31	16	Tbl 3.9-31	25	Sheet 5	16
Sheet 32	16	Tbl 3.9-32	16	Sheet 6	25
Sheet 33	16	Tbl 3.9-33		Sheet 7	16
Sheet 34	24	Sheet 1	21	Sheet 8	16
Sheet 34a	24	Sheet 2	21	Sheet 9	21
Sheet 34b	26	Tbl 3.9-34		Sheet 10	21
Sheet 34c	26	Sheet 1	20	Sheet 11	21
Sheet 34d	26	Sheet 2	20	Sheet 12	23
Sheet 34e	24	Sheet 3	20	Sheet 13	23
Sheet 34f	24	Sheet 4	20	Sheet 14	23
Sheet 34g	24	Sheet 5	20	Tbl 3.9-52	
Sheet 34h	24	Tbl 3.9-35	26	Sheet 1	26
Sheet 35	26	Tbl 3.9-36		Sheet 2	16
Sheet 36	16	Sheet 1	16	Tbl 3.9-53	
Sheet 37	26	Sheet 2	25	Sheet 1	16

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Sheet 2	16	Fig. 3.9-11	0	3.10-11	11
Tbl 3.9-54	16			3.10-12	13
Tbl 3.9-55	16	VOLUME 9		3.10-13	11
Tbl 3.9-56	16			3.10-14	14
Tbl 3.9-57	16	i	12	3.10-15	21
Tbl 3.9-58		ii	12	3.10-16	21
Sheet 1	18	iii	21	3.10-16a	21
Sheet 2	18	iv	21	3.10-16b	21
Sheet 3	18	v	21	3.10-16c	21
Sheet 4	18	vi	21	3.10-16d	21
Sheet 5	18	vii	21	3.10-17	14
Tbl 3.9-59	18	viii	21	3.10-18	17
Tbl 3.9-60	19	ix	21	3.10-18a	17
Tbl 3.9-61	19	x	21	3.10-18b	17
Tbl 3.9-62		xi	21	3.10-18c	17
Sheet 1	19	xii	21	3.10-18d	17
Sheet 2	19	xiii	15	3.10-19	14
Sheet 3	19	xiv	21	3.10-20	13
Sheet 4	19	xv	21	3.10-21	11
Sheet 5	19	xvi	12	3.10-22	11
Tbl 3.9-63		xvii	12	3.10-23	19
Sheet 1	25	xviii	21	3.10-24	19
Sheet 2	19	xix	26	3.10-24a	15
Sheet 3	19	xx	26	3.10-24b	15
Sheet 4	19	xxi	12	3.10-25	19
Tbl 3.9-64	26	xxii	26	3.10-26	19
Tbl 3.9-65	19	xxiii	26	3.10-27	27
Tbl 3.9-66	20	xxiv	26	3.10-28	27
Tbl 3.9-67	20	xxv	26	3.10-29	27
Tbl 3.9-68	20	xxvi	26	3.10-30	18
Tbl 3.9-68a	20	xxvii	26	3.10-30a	17
Tbl 3.9-69	20	xxviii	26	3.10-30b	18
Tbl 3.9-70	20	xxix	26	3.10-30c	18
Tbl 3.9-71		xxx	26	3.10-30d	18
Sheet 1	21	xxxi	26	3.10-31	25
Sheet 2	21	xxxii	26	3.10-32	26
3.9 Fig. Tab		3.10 Tab		3.10-33	26
Fig. 3.9-1	0	3.10-1	0	3.10-34	15
Fig. 3.9-2	0	3.10-2	11	3.10-35	15
Fig. 3.9-3	0	3.10-3	11	3.10-36	19
Fig. 3.9-4	26	3.10-4	11	3.10-36a	27
Fig. 3.9-5	0	3.10-5	11	3.10-36b	27
Fig. 3.9-6	0	3.10-6	11	3.10-36c	27
Fig. 3.9-7	0	3.10-7	11	3.10-36d	27
Fig. 3.9-8	0	3.10-8	11	3.10-37	27
Fig. 3.9-9	0	3.10-9	11	3.10-38	26
Fig. 3.9-10	0	3.10-10	18	3.10-38a	24

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
3.10-38b	26	Sheet 2	27	Sheet 47	25
3.10-38c	24	Sheet 3	20	Sheet 48	23
3.10-38d	27	Sheet 4	24	Sheet 49	23
3.10-38e	26	Sheet 5	20	Sheet 50	20
3.10-38f	24	Sheet 6	26	Sheet 51	21
3.10-39	17	Sheet 7	26	Sheet 52	21
3.10-40	11	Sheet 8	24	Sheet 53	24
3.10-41	11	Sheet 9	27	Tbl 3.11-2	
3.10-42	11	Sheet 10	27	Sheet 1	23
3.10-43	12	Sheet 11	20	Sheet 2	19
3.10-44	11	Sheet 12	19	Sheet 3	19
3.10-45	11	Sheet 13	19	Sheet 4	19
3.10-46	11	Sheet 14	26	Sheet 5	17
3.10-47	25	Sheet 15	20	Sheet 6	23
3.10-48	12	Sheet 16	26	Tbl 3.11-3	
3.10-49	12	Sheet 17	24	Sheet 1	23
3.10-50	13	Sheet 18	23	Sheet 2	23
3.10-51	11	Sheet 18a	24	Sheet 3	25
3.10-52	11	Sheet 18b	23	Sheet 4	17
3.10-53	13	Sheet 19	26	Sheet 5	16
3.10-54	13	Sheet 20	26	Sheet 6	25
3.10-55	27	Sheet 21	26	Tbl 3.11-4	
3.10 Tbl Tab		Sheet 22	25	Sheet 1	18
Tbl 3.10-1		Sheet 23	27	Sheet 2	18
Sheet 1	5	Sheet 24	26	Sheet 2a	18
Sheet 2	15	Sheet 25	18	Sheet 2b	18
3.10 Fig. Tab		Sheet 26	18	Sheet 3	12
Fig. 3.10-1	22	Sheet 27	25	Sheet 4	12
Fig. 3.10-2	26	Sheet 28	27	Sheet 5	12
Fig. 3.10-3	26	Sheet 29	26	Sheet 6	12
Fig. 3.10-4	26	Sheet 30	25	Sheet 7	12
Fig. 3.10-5	8	Sheet 31	26	Sheet 8	12
Fig. 3.10-6	8	Sheet 32	19	Sheet 9	12
3.11 Tab		Sheet 33	26	Sheet 10	12
3.11-1	27	Sheet 34	26	Sheet 11	12
3.11-2	27	Sheet 35	26	Sheet 12	12
3.11-3	0	Sheet 36	20	Sheet 13	12
3.11-4	0	Sheet 37	20	Sheet 14	26
3.11-5	0	Sheet 38	27	Sheet 15	12
3.11-6	0	Sheet 39	20	Sheet 16	12
3.11-7	26	Sheet 40	20	Sheet 17	12
3.11-8	19	Sheet 41	21	Sheet 18	26
3.11-9	0	Sheet 42	24	Sheet 19	12
3.11-10	0	Sheet 43	21	Sheet 20	12
3.11 Tbl Tab		Sheet 44	21	Sheet 21	12
Tbl 3.11-1		Sheet 45	23	Sheet 22	12
Sheet 1	27	Sheet 46	26	Sheet 23	12

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Sheet 24	12	Sheet 51	24	Sheet 84	18
Sheet 24a	14	Sheet 52	18	Sheet 85	18
Sheet 24b	14	Sheet 53	14	Sheet 86	18
Sheet 24c	12	Sheet 54	26	Sheet 87	18
Sheet 24d	12	Sheet 55	14	Sheet 88	18
Sheet 25	18	Sheet 56	14	Sheet 89	18
Sheet 26	14	Sheet 57	17	Sheet 90	26
Sheet 26a	14	Sheet 58	17	Sheet 91	25
Sheet 26b	14	Sheet 59	26	Sheet 92	25
Sheet 27	26	Sheet 60	26	Sheet 93	25
Sheet 28	19	Sheet 60a	21	Sheet 94	25
Sheet 29	19	Sheet 60b	21	Sheet 95	25
Sheet 30	19	Sheet 60c	21	Sheet 96	25
Sheet 30a	26	Sheet 60d	21	Sheet 97	25
Sheet 30b	19	Sheet 60e	21	Sheet 98	25
Sheet 30c	19	Sheet 60f	21	Sheet 99	25
Sheet 30d	19	Sheet 60g	21	Sheet 100	25
Sheet 30e	19	Sheet 60h	21	Sheet 101	25
Sheet 30f	19	Sheet 60i	21	Sheet 102	26
Sheet 30g	19	Sheet 60j	21	Sheet 103	25
Sheet 30h	19	Sheet 60k	21	Sheet 104	25
Sheet 30i	19	Sheet 60l	21	Sheet 105	25
Sheet 30j	19	Sheet 60m	26	Sheet 106	25
Sheet 31	21	Sheet 60n	21	Sheet 107	25
Sheet 32	12	Sheet 61	20	Sheet 108	25
Sheet 33	18	Sheet 62	16	Sheet 109	25
Sheet 34	18	Sheet 63	16	Sheet 110	25
Sheet 35	18	Sheet 64	16	Sheet 111	27
Sheet 36	14	Sheet 65	16	3.11 Fig. Tab	
Sheet 37	14	Sheet 66	16	Fig. 3.11-1	0
Sheet 38	14	Sheet 67	16	Fig. 3.11-2	0
Sheet 39	18	Sheet 68	16	Fig. 3.11-3	3
Sheet 40	16	Sheet 69	16	Fig. 3.11-4	3
Sheet 41	16	Sheet 70	16	App 3A Tab	
Sheet 42	16	Sheet 71	16	3A-1	10
Sheet 43	16	Sheet 72	26	3A-2	27
Sheet 44	16	Sheet 73	18	3A-3	0
Sheet 45	16	Sheet 74	18	3A-4	0
Sheet 46	16	Sheet 75	18	3A-5	0
Sheet 47	26	Sheet 76	18	3A-6	0
Sheet 48	18	Sheet 77	18	3A-7	0
Sheet 48a	18	Sheet 78	18	3A-8	0
Sheet 48b	18	Sheet 79	18	3A-9	0
Sheet 48c	26	Sheet 80	18	3A-10	17
Sheet 48d	18	Sheet 81	18	3A-11	0
Sheet 49	18	Sheet 82	18	3A-12	26
Sheet 50	18	Sheet 83	18	3A-12a	17

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
3A-12b	17	3A-54	0	Sheet 5	0
3A-13	0	3A-55	0	3A-83	0
3A-14	0	3A-56	0	3A-84	16
3A-15	16	3A-57	0	3A-85	16
3A-16	0	3A-58	0	3A-86	0
3A-17	4	3A-59	0	3A-87	0
3A-18	0	3A-60	0	3A-88	16
3A-19	4	3A-61	1	3A-89	0
3A-20	4	3A-62	0	3A-90	26
3A-21	26	3A-63	0	3A-91	25
3A-22	26	3A-64	0	3A-92	0
Fig. 3A/1.14-1	0	3A-65	8	3A-93	0
Fig. 3A/1.14-2	0	3A-66	8	3A-94	0
Fig. 3A/1.14-3	0	3A-66a	8	3A-95	17
3A-23	0	3A-66b	8	3A-96	27
3A-24	0	3A-67	0	3A-97	0
3A-25	27	3A-68	0	3A-98	0
3A-26	0	3A-69	0	3A-99	0
3A-27	14	3A-70	0	3A-100	15
3A-28	27	3A-71	0	3A-100a	18
3A-29	27	3A-72	26	3A-100b	18
3A-30	14	3A-73	26	3A-101	0
3A-31	0	3A-74	26	3A-102	0
3A-32	0	3A-75	0	3A-103	0
3A-33	0	3A-76	0	3A-104	0
3A-34	14	Tbl 3A.1.48-1	0	3A-105	0
3A-35	0	Tbl 3A.1.48-2	0	3A-106	16
3A-36	0	Tbl 3A.1.48-3	16	3A-107	18
3A-37	16	Tbl 3A.1.48-4	17	3A-108	0
3A-38	14	Tbl 3A.1.48-5	0	3A-109	15
3A-39	0	Tbl 3A.1.48-6		3A-110	0
3A-40	16	Sheet 1	0	3A-111	0
3A-41	25	Sheet 2	0	3A-112	14
3A-42	0	Tbl 3A.1.48-7		3A-113	14
3A-43	0	Sheet 1	17	3A-114	0
3A-44	0	Sheet 2	18	3A-115	27
3A-45	16	3A-77	25	3A-116	0
3A-46	0	3A-78	0	3A-117	0
3A-47	0	3A-79	8	3A-118	26
Fig. 3A/1.34-1	0	3A-80	8	3A-119	0
Fig. 3A/1.34-2	0	3A-81	0	3A-120	17
3A-48	0	3A-82	15	3A-121	19
3A-49	0	Tbl 3A.1.52-1		3A-122	20
3A-50	16	Sheet 1	15	3A-123	0
3A-51	16	Sheet 2	15	3A-124	0
3A-52	16	Sheet 3	0	3A-125	0
3A-53	0	Sheet 4	0	3A-126	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
3A-127	0	i	12	3C-15	0
3A-128	17	ii	12	3C-16	0
3A-129	25	iii	21	3C-17	0
3A-130	25	iv	21	3C-18	0
3A-130a	8	v	21	3C-19	0
3A-130b	8	vi	21	3C-20	0
3A-131	18	vii	21	3C-21	0
3A-132	18	viii	21	3C-22	0
3A-132a	18	ix	21	3C-23	0
3A-132b	18	x	21	3C-24	0
3A-133	18	xi	21	3C-25	0
3A-134	7	xii	21	3C-26	0
3A-135	9	xiii	21	3C-27	0
3A-136	0	xiv	21	3C-28	0
3A-137	0	xv	21	3C-29	0
3A-138	18	xvi	12	3C-30	0
3A-139	15	xvii	12	3C-31	0
3A-140	15	xviii	21	3C-32	0
3A-140a	15	xix	26	3C-33	0
3A-140b	15	xx	26	3C-34	0
3A-141	0	xxi	12	3C-35	0
3A-142	24	xxii	26	3C-36	0
3A-142a	24	xxiii	26	3C-37	0
3A-142b	24	xxiv	26	3C-38	0
3A-143	18	xxv	26	3C-39	0
3A-144	18	xxvi	26	3C-40	0
3A-145	14	xxvii	26	3C-41	0
3A-146	18	xxviii	26	3C-42	0
3A-147	18	xxix	26	3C-43	0
3A-148	9	xxx	26	3C-44	0
3A-149	14	xxxi	26	3C-45	0
3A-150	18	App 3B Tab		3C-46	0
3A-151	14	App 3C Tab		3C-47	0
3A-152	21	3C-1	0	3C-48	0
3A-153	24	3C-2	20	3C-49	0
3A-154	14	3C-3	0	3C-50	0
3A-155	16	3C-4	0	3C-51	0
3A-156	25	3C-5	0	3C-52	0
3A-157	14	3C-6	0	3C-53	0
3A-158	18	3C-7	0	3C-54	0
3A-159	18	3C-8	0	3C-55	0
3A-160	18	3C-9	0	3C-56	0
3A-161	18	3C-10	0	3C-57	0
3A-162	18	3C-11	0	3C-58	0
3A-163	18	3C-12	0	3C-59	0
		3C-13	0	3C-60	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
VOLUME 10		3C-14	0	3C-61	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
3C-62	0	3C-109	0	3C-156	0
3C-63	0	3C-110	0	3C-157	0
3C-64	0	3C-111	0	3C-158	0
3C-65	0	3C-112	0	3C-159	0
3C-66	0	3C-113	0	3C-160	0
3C-67	0	3C-114	0	3C-161	0
3C-68	0	3C-115	0	3C-162	0
3C-69	0	3C-116	0	3C-163	0
3C-70	0	3C-117	0	3C-164	0
3C-71	0	3C-118	0	3C-165	0
3C-72	0	3C-119	0	3C-166	0
3C-73	0	3C-120	0	3C-167	0
3C-74	0	3C-121	0	3C-168	0
3C-75	0	3C-122	0	3C-169	0
3C-76	0	3C-123	0	3C-170	0
3C-77	0	3C-124	0	3C-171	0
3C-78	0	3C-125	0	3C-172	0
3C-79	0	3C-126	0	3C-173	0
3C-80	0	3C-127	0	3C-174	0
3C-81	0	3C-128	0	3C-175	0
3C-82	0	3C-129	0	3C-176	0
3C-83	0	3C-130	0	3C-177	0
3C-84	0	3C-131	0	3C-178	0
3C-85	0	3C-132	0	3C-179	0
3C-86	0	3C-133	0	3C-180	0
3C-87	0	3C-134	0	3C-181	0
3C-88	0	3C-135	0	3C-182	0
3C-89	0	3C-136	0	3C-183	0
3C-90	0	3C-137	0	3C-184	0
3C-91	0	3C-138	0	3C-185	0
3C-92	0	3C-139	0	3C-186	0
3C-93	0	3C-140	0	3C-187	0
3C-94	0	3C-141	0	3C-188	0
3C-95	0	3C-142	0	3C-189	0
3C-96	0	3C-143	0	3C-190	0
3C-97	0	3C-144	0	3C-191	0
3C-98	0	3C-145	0	3C-192	0
3C-99	0	3C-146	0	3C-193	0
3C-100	0	3C-147	0	3C-194	0
3C-101	0	3C-148	0	3C-195	0
3C-102	0	3C-149	0	3C-196	0
3C-103	0	3C-150	0	3C-197	0
3C-104	0	3C-151	0	3C-198	0
3C-105	0	3C-152	0	3C-199	0
3C-106	0	3C-153	0	3C-200	0
3C-107	0	3C-154	0	3C-201	0
3C-108	0	3C-155	0	3C-202	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
3C-203	0	3C-250	0	3C-297	0
3C-204	0	3C-251	0	3C-298	0
3C-205	0	3C-252	0	3C-299	0
3C-206	0	3C-253	0	3C-300	0
3C-207	0	3C-254	0	3C-301	0
3C-208	0	3C-255	0	3C-302	0
3C-209	0	3C-256	0	3C-303	0
3C-210	0	3C-257	0	3C-304	20
3C-211	0	3C-258	0	3C-305	20
3C-212	0	3C-259	0	3C-306	20
3C-213	0	3C-260	0	3C-307	20
3C-214	0	3C-261	0	3C-308	20
3C-215	0	3C-262	0	3C-309	20
3C-216	0	3C-263	0	3C-310	20
3C-217	0	3C-264	0	3C-311	20
3C-218	0	3C-265	0	3C-312	20
3C-219	0	3C-266	0	3C-313	20
3C-220	0	3C-267	0	3C-314	20
3C-221	0	3C-268	0	3C-315	20
3C-222	0	3C-269	0	3C-316	20
3C-223	0	3C-270	0	3C-317	20
3C-224	0	3C-271	0	3C-318	20
3C-225	0	3C-272	0	3C-319	20
3C-226	0	3C-273	0	3C-320	20
3C-227	0	3C-274	0	App 3D Tab	
3C-228	0	3C-275	0	3D-i	19
3C-229	0	3C-276	0	3D-ii	19
3C-230	0	3C-277	0	3D-iii	19
3C-231	0	3C-278	0	3D-1	19
3C-232	0	3C-279	0	3D-2	19
3C-233	0	3C-280	0	3D-3	19
3C-234	0	3C-281	0	3D-4	19
3C-235	0	3C-282	0	3D-5	19
3C-236	0	3C-283	0	3D-6	19
3C-237	0	3C-284	0	3D-7	26
3C-238	0	3C-285	0	3D-8	19
3C-239	0	3C-286	0	3D-9	19
3C-240	0	3C-287	0	3D-10	19
3C-241	0	3C-288	0	3D-11	19
3C-242	0	3C-289	0	3D-12	19
3C-243	0	3C-290	0	3D-13	19
3C-244	0	3C-291	0	3D-14	19
3C-245	0	3C-292	0	3D-15	26
3C-246	0	3C-293	0	3D-16	19
3C-247	0	3C-294	0	3D-17	19
3C-248	0	3C-295	0	Fig. 3D-1	19
3C-249	0	3C-296	0	Fig. 3D-2	19

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Fig. 3D-3	19	4.2-13	9	Fig. 4.2-3	0
Fig. 3D-4	19	4.2-14	9	Fig. 4.2-4	0
Chapter 4 Tab		4.2-15	15	Fig. 4.2-5	0
4-i	26	4.2-16	15	Fig. 4.2-6	15
4-ii	26	4.2-17	15	Fig. 4.2-7	26
4-iii	0	4.2-18	9	Fig. 4.2-8	26
4-iv	18	4.2-18a	9	Fig. 4.2-9	26
4-v	26	4.2-18b	26	Fig. 4.2-10	26
4-vi	26	4.2-18c	26	Fig. 4.2-11	26
4-vii	16	4.2-18d	15	Fig. 4.2-12	26
4-viii	16	4.2-18e	15	Fig 4.2-13	26
4-ix	26	4.2-18f	15	Fig. 4.2-14	26
4-x	9	4.2-19	9	Fig. 4.2-15	26
4-xi	7	4.2-20	17	Fig. 4.2-16	26
4-xii	0	4.2-21	14	Fig. 4.2-17	0
4-xiii	7	4.2-22	26	Fig. 4.2-18	0
4-xiv	7	4.2-22a	26	Fig. 4.2-19	0
4-xv	7	4.2-22b	26	Fig. 4.2-20	9
4-xvi	0	4.2-23	26		
4-xvii	0	4.2-24	9	VOLUME 11	
4-xviii	0	4.2-25	9		
4-xix	0	4.2-26	9	i	12
4.1 Tab		4.2-27	9	ii	12
4.1-1	15	4.2-28	9	iii	21
4.1-2	15	4.2-29	9	iv	21
4.1 Tbl Tab		4.2-30	9	v	21
Tbl 4.1-1		4.2-31	9	vi	21
Sheet 1	15	4.2-32	9	vii	21
Sheet 2	15	4.2-33	9	viii	21
Tbl 4.1-2		4.2-34	15	ix	21
Sheet 1	0	4.2-35	26	x	21
Sheet 2	0	4.2-36	26	xi	21
4.2 Tab		4.2-37	26	xii	21
4.2-1	0	4.2 Tbl Tab		xiii	15
4.2-2	9	Tbl 4.2-1	26	xiv	21
4.2-3	10	Tbl 4.2-2	26	xv	21
4.2-4	9	Tbl 4.2-3	26	xvi	12
4.2-5	17	Tbl 4.2-4	0	xvii	12
4.2-6	26	Tbl 4.2-5	15	xviii	21
4.2-7	26	Tbl 4.2-6	26	xix	26
4.2-8	26	Tbl 4.2-7	9	xx	26
4.2-9	26	Tbl 4.2-8	9	xxi	12
4.2-10	26	Tbl 4.2-9	9	xxii	26
4.2-10a	18	Tbl 4.2-10	9	xxiii	26
4.2-10b	18	4.2 Fig. Tab		xxiv	26
4.2-11	9	Fig. 4.2-1	0	xxv	26
4.2-12	9	Fig. 4.2-2	0	xxvi	26

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
xxvii	26	4.3-41	26	Fig. 4.3-10	0
xxviii	26	4.3-42	3	Fig. 4.3-11	0
xxix	26	4.3-43	27	Fig. 4.3-12	0
xxx	26	4.3-44	5	Fig. 4.3-13	0
xxxi	26	4.3 Tbl Tab		Fig. 4.3-14	0
xxxii	26	Tbl 4.3-1	7	Fig. 4.3-15	0
4.3 Tab		Tbl 4.3-2	7	Fig. 4.3-16	0
4.3-1	0	Tbl 4.3-3	0	Fig. 4.3-17	0
4.3-2	0	Tbl 4.3-4	0	Fig. 4.3-18	0
4.3-3	0	Tbl 4.3-5	0	Fig. 4.3-19	7
4.3-4	0	Tbl 4.3-6	0	Fig. 4.3-20	7
4.3-5	7	Tbl 4.3-7	0	Fig. 4.3-21	0
4.3-6	0	Tbl 4.3-8	0	Fig. 4.3-22	0
4.3-7	1	Tbl 4.3-9	7	Fig. 4.3-23	0
4.3-8	0	Tbl 4.3-10	0	Fig. 4.3-24	0
4.3-9	26	Tbl 4.3-11	0	Fig. 4.3-25	0
4.3-10	0	Tbl 4.3-12	0	Fig. 4.3-26	0
4.3-11	8	Tbl 4.3-13	7	Fig. 4.3-27	0
4.3-12	12	Tbl 4.3-14	7	Fig. 4.3-28	0
4.3-13	0	Tbl 4.3-15	7	Fig. 4.3-29	0
4.3-14	7	Tbl 4.3-16	0	Fig. 4.3-30	0
4.3-15	7	Tbl 4.3-17	0	Fig. 4.3-31	0
4.3-16	7	Tbl 4.3-18	0	Fig. 4.3-32	0
4.3-17	7	Tbl 4.3-19	0	Fig. 4.3-33	0
4.3-18	7	Tbl 4.3-20	0	Fig. 4.3-34	0
4.3-19	7	Tbl 4.3-21	3	Fig. 4.3-35	0
4.3-20	7	Tbl 4.3-22	0	Fig. 4.3-36	7
4.3-21	7	Tbl 4.3-23	0	Fig. 4.3-37	0
4.3-22	7	Tbl 4.3-24	0	Fig. 4.3-38	0
4.3-23	7	Tbl 4.3-25	0	Fig. 4.3-39	0
4.3-24	0	Tbl 4.3-26	25	Fig. 4.3-40	0
4.3-25	0	Tbl 4.3-27	0	Fig. 4.3-41	0
4.3-26	0	Tbl 4.3-28	0	Fig. 4.3-42	0
4.3-27	0	Tbl 4.3-29	0	Fig. 4.3-43	7
4.3-28	25	Tbl 4.3-30	0	Fig. 4.3-44	0
4.3-29	0	Tbl 4.3-31	0	Fig. 4.3-45	0
4.3-30	27	Tbl 4.3-32	25	Fig. 4.3-46	0
4.3-31	0	4.3 Fig. Tab		Fig. 4.3-47	0
4.3-32	0	Fig. 4.3-1	0	Fig. 4.3-48	0
4.3-33	25	Fig. 4.3-2	0	Fig. 4.3-49	0
4.3-34	5	Fig. 4.3-3	0	Fig. 4.3-50	0
4.3-35	5	Fig. 4.3-4	0	Fig. 4.3-51	0
4.3-36	5	Fig. 4.3-5	0	Fig. 4.3-52	0
4.3-37	0	Fig. 4.3-6	0	Fig. 4.3-53	0
4.3-38	27	Fig. 4.3-7	0	Fig. 4.3-54	0
4.3-39	0	Fig. 4.3-8	0	Fig. 4.3-55	0
4.3-40	25	Fig. 4.3-9	0	Fig. 4.3-56	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Fig. 4.3-57	0	Fig. 4.3-104	0	4.4-37	8
Fig. 4.3-58	0	Fig. 4.3-105	0	4.4-38	15
Fig. 4.3-59	0	Fig. 4.3-106	0	4.4-39	15
Fig. 4.3-60	0	Fig. 4.3-107	0	4.4-40	17
Fig. 4.3-61	0	Fig. 4.3-108	0	4.4-41	17
Fig. 4.3-62	7	Fig. 4.3-109	0	4.4-42	17
Fig. 4.3-63	7	Fig. 4.3-110	0	4.4-43	17
Fig. 4.3-64	7	Fig. 4.3-111	0	4.4-44	18
Fig. 4.3-65	7	4.4 Tab		4.4-45	18
Fig. 4.3-66	7	4.4-1	0	4.4 Tbl Tab	
Fig. 4.3-67	0	4.4-2	18	Tbl 4.4-1	
Fig. 4.3-68	0	4.4-3	3	Sheet 1	26
Fig. 4.3-69	0	4.4-4	3	Sheet 2	18
Fig. 4.3-70	0	4.4-5	0	Tbl 4.4-2	0
Fig. 4.3-71	0	4.4-6	3	Tbl 4.4-3	0
Fig. 4.3-72	0	4.4-7	3	Tbl 4.4-4	0
Fig. 4.3-73	0	4.4-8	0	Tbl 4.4-5	0
Fig. 4.3-74	0	4.4-9	0	Tbl 4.4-6	0
Fig. 4.3-75	0	4.4-10	0	Tbl 4.4-7	0
Fig. 4.3-76	0	4.4-11	0	Tbl 4.4-8	0
Fig. 4.3-77	0	4.4-12	0	Tbl 4.4-9	0
Fig. 4.3-78	0	4.4-13	0	Tbl 4.4-10	0
Fig. 4.3-79	7	4.4-14	0	Tbl 4.4-11	
Fig. 4.3-80	7	4.4-15	3	Sheet 1	10
Fig. 4.3-81	0	4.4-16	0	Sheet 2	10
Fig. 4.3-82	7	4.4-17	3	4.4 Fig. Tab	
Fig. 4.3-83	7	4.4-18	0	Fig. 4.4-1	3
Fig. 4.3-84	0	4.4-19	0	Fig. 4.4-2	3
Fig. 4.3-85	0	4.4-20	0	Fig. 4.4-3	0
Fig. 4.3-86	0	4.4-21	0	Fig. 4.4-4	0
Fig. 4.3-87	0	4.4-22	0	Fig. 4.4-5	0
Fig. 4.3-88	0	4.4-23	26	Fig. 4.4-6	0
Fig. 4.3-89	7	4.4-24	0	Fig. 4.4-7	0
Fig. 4.3-90	0	4.4-25	26	Fig. 4.4-8	0
Fig. 4.3-91	0	4.4-26	0	Fig. 4.4-9	0
Fig. 4.3-92	0	4.4-27	0	Fig. 4.4-10	0
Fig. 4.3-93	0	4.4-28	10	Fig. 4.4-11	0
Fig. 4.3-94	0	4.4-28a	10	Fig. 4.4-12	0
Fig. 4.3-95	0	4.4-28b	10	Fig. 4.4-13	0
Fig. 4.3-96	0	4.4-29	0	Fig. 4.4-14	0
Fig. 4.3-97	0	4.4-30	0	Fig. 4.4-15	0
Fig. 4.3-98	0	4.4-31	3	Fig. 4.4-16	0
Fig. 4.3-99	0	4.4-32	0	Fig. 4.4-17	0
Fig. 4.3-100	3	4.4-33	0	Fig. 4.4-18	0
Fig. 4.3-101	0	4.4-34	8	Fig. 4.4-19	3
Fig. 4.3-102	0	4.4-35	8	Fig. 4.4-20	0
Fig. 4.3-103	0	4.4-36	8	Fig. 4.4-21	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Fig. 4.4-22	0	Tbl 5.1-4	26	5.2-17	26
Fig. 4.4-23	0	Tbl 5.1-5		5.2-18	26
Fig. 4.4-24	0	Sheet 1	27	5.2-19	26
Fig. 4.4-25	0	Sheet 2	27	5.2-20	26
Fig. 4.4-26	0	Tbl 5.1-6		5.2-21	26
4.5 Tab		Sheet 1	26	5.2-22	26
4.5-1	0	Sheet 2	26	5.2-23	26
4.5-2	8	Tbl 5.1-7		5.2-24	26
4.5-3	8	Sheet 1	27	5.2-25	26
4.5-4	8	Sheet 2	27	5.2-26	26
4.6 Tab		5.1 Fig. Tab		5.2-27	26
4.6-1	0	Fig. 5.1-1		5.2-28	26
4.6-2	0	Sheet 1	27	5.2-29	26
4.6-3	0	Sheet 2	27	5.2-30	26
4.6-4	27	Fig. 5.1-2		5.2-31	26
4.6-5	0	Sheet 1	27	5.2-32	26
4.6 Tbl Tab		Sheet 2	27	5.2-33	26
Tbl 4.6-1	0	Fig. 5.1-3	0	5.2-34	26
Tbl 4.6-2	0	Fig. 5.1-4	0	5.2 Tbl Tab	
Chapter 5 Tab		Fig. 5.1-5	3	Tbl 5.2-1	3
5-i	26	5.2 Tab		Tbl 5.2-2	
5-ii	26	5.2-1	0	Sheet 1	0
5-iii	26	5.2-2	0	Sheet 2	0
5-iv	26	5.2-3	10	Tbl 5.2-3	
5-v	26	5.2-4	15	Sheet 1	8
5-vi	25	5.2-4a	15	Sheet 2	0
5-via	27	5.2-4b	10	Sheet 3	0
5-vib	18	5.2-5	0	Tbl 5.2-3A	8
5-vii	19	5.2-6	18	Tbl 5.2-4	
5-viii	26	5.2-6a	19	Sheet 1	0
5-ix	18	5.2-6b	19	Sheet 2	0
5-ixa	18	5.2-6c	19	Tbl 5.2-5	0
5.1 Tab		5.2-6d	19	Tbl 5.2-6	0
5.1-1	0	5.2-6e	19	Tbl 5.2-7	19
5.1-2	0	5.2-6f	19	Tbl 5.2-8	
5.1-3	0	5.2-6g	25	Sheet 1	25
5.1-4	0	5.2-6h	18	Sheet 2	25
5.1 Tbl Tab		5.2-7	0	Sheet 3	25
Tbl 5.1-1		5.2-8	26	Sheet 4	25
Sheet 1	0	5.2-9	0	Sheet 5	25
Sheet 2	0	5.2-10	0	Sheet 6	25
Tbl 5.1-2		5.2-11	0	Sheet 7	25
Sheet 1	0	5.2-12	0	Sheet 8	25
Sheet 2	25	5.2-13	0	Sheet 9	25
Tbl 5.1-3		5.2-14	0	Sheet 10	25
Sheet 1	26	5.2-15	8	Sheet 11	25
Sheet 2	26	5.2-16	26	Sheet 12	25

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Sheet 13	25	Fig. 5.3-10	15	5.4-32	0
Sheet 14	25	5.4 Tab		5.4-33	0
5.2 Fig. Tab		5.4-1	27	5.4-34	26
Fig. 5.2-1	20	5.4-2	27	5.4-35	0
Fig. 5.2-2	20	5.4-3	27	5.4 Tbl Tab	
Fig. 5.2-3	20	5.4-4	27	Tbl 5.4-1	27
Fig. 5.2-4	18	5.4-5	27	Tbl 5.4-2	0
Fig. 5.2-5	18	5.4-6	18	Tbl 5.4-3	27
5.3 Tab		5.4-6a	8	Tbl 5.4-4	27
5.3-1	0	5.4-6b	27	Tbl 5.4-5	
5.3-2	3	5.4-6c	27	Sheet 1	27
5.3-3	24	5.4-6d	27	Sheet 2	0
5.3-4	26	5.4-7	0	Sheet 3	0
5.3-5	8	5.4-8	0	Sheet 4	0
5.3-6	18	5.4-9	0	Sheet 5	0
5.3-6a	22	5.4-10	0	Tbl 5.4-6	7
5.3-6b	22	5.4-11	0	Tbl 5.4-7	0
5.3-7	22	5.4-12	27	Tbl 5.4-8	0
5.3-8	8	5.4-13	8	Tbl 5.4-9	14
5.3-9	8	5.4-14	8	Tbl 5.4-10	
5.3-10	8	5.4-14a	8	Sheet 1	19
5.3-11	21	5.4-14b	8	Sheet 2	19
5.3-12	26	5.4-15	0	Sheet 3	19
5.3-13	26	5.4-16	0	Tbl 5.4-11	0
5.3-14	26	5.4-17	0	Tbl 5.4-12	
5.3-15	8	5.4-18	0	Sheet 1	9
5.3-16	8	5.4-18a	19	Sheet 2	9
5.3 Tbl Tab		5.4-18b	19	Tbl 5.4-13	0
Tbl 5.3-1	8	5.4-19	19	Tbl 5.4-14	
Tbl 5.3-2	26	5.4-20	15	Sheet 1	14
Tbl 5.3-3	22	5.4-20a	9	Sheet 2	14
Tbl 5.3-4	8	5.4-20b	3	Tbl 5.4-14A	15
Tbl 5.3-5	8	5.4-21	2	Tbl 5.4-15	19
Tbl 5.3-6	8	5.4-22	0	5.4 Fig. Tab	
Tbl 5.3-7		5.4-23	0	Fig. 5.4-1	0
Sheet 1	26	5.4-24	19	Fig. 5.4-2	27
Sheet 2	22	5.4-25	18	Fig. 5.4-3	0
5.3 Fig. Tab		5.4-26	14	Fig. 5.4-4	0
Fig. 5.3-1	0	5.4-26a	14	Fig. 5.4-5	0
Fig. 5.3-2	8	5.4-26b	14	Fig. 5.4-6	0
Fig. 5.3-3	8	5.4-26c	14	Fig. 5.4-7	0
Fig. 5.3-4	8	5.4-26d	14	Fig. 5.4-8	0
Fig. 5.3-5	8	5.4-27	26	Fig. 5.4-9	0
Fig. 5.3-6	8	5.4-28	26	Fig. 5.4-10	23
Fig. 5.3-7	15	5.4-29	3	Fig. 5.4-11	23
Fig. 5.3-8	15	5.4-30	0	Fig. 5.4-12	0
Fig. 5.3-9	15	5.4-31	0	Fig. 5.4-13	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Fig. 5.4-14	0	6-vib	8	6.2-6	0
Fig. 5.4-15	21	6-vii	8	6.2-7	0
Fig. 5.4-16	3	6-viii	17	6.2-8	4
Fig. 5.4-17	3	6-ix	8	6.2-9	24
		6-x	19	6.2-10	24
VOLUME 12		6-xi	19	6.2-11	15
		6-xii	22	6.2-12	24
i	12	6-xiia	26	6.2-12a	24
ii	12	6-xiib	22	6.2-12b	24
iii	21	6-xiii	26	6.2-13	12
iv	21	6-xiv	26	6.2-14	3
v	21	6-xv	11	6.2-15	0
vi	21	6-xvi	26	6.2-16	0
vii	21	6-xvii	8	6.2-17	0
viii	21	6-xviii	11	6.2-18	0
ix	21	6-xix	11	6.2-19	0
x	21	6-xx	11	6.2-20	19
xi	21	6-xxi	14	6.2-21	19
xii	21	6-xxii	27	6.2-22	19
xiii	15	6-xxiii	20	6.2-22a	19
xiv	21	6-xxiv	20	6.2-22b	19
xv	21	6-xxv	22	6.2-23	0
xvi	12	6-xxvi	22	6.2-24	0
xvii	12	6-xxvii	26	6.2-25	3
xviii	21	6-xxviii	26	6.2-26	0
xix	26	6-xxix	27	6.2-27	0
xx	26	6.1 Tab		6.2-28	0
xxi	12	6.1-1	0	6.2-29	0
xxii	26	6.1-2	18	6.2-30	0
xxiii	26	6.1-3	14	6.2-31	0
xxiv	26	6.1-4	14	6.2-32	0
xxv	26	6.1-5	14	6.2-33	0
xxvi	26	6.1 Tbl Tab		6.2-34	0
xxvii	26	Tbl 6.1-1	0	6.2-35	0
xxviii	26	Tbl 6.1-2	0	6.2-36	0
xxix	26	Tbl 6.1-3	0	6.2-37	0
xxx	26	Tbl 6.1-4	8	6.2-38	0
xxxi	26	Tbl 6.1-5		6.2-39	0
xxxii	26	Sheet 1	8	6.2-40	0
Chapter 6 Tab		Sheet 2	8	6.2-41	0
6-i	15	Sheet 3	8	6.2-42	0
6-ii	15	6.2 Tab		6.2-43	0
6-iii	15	6.2-1	0	6.2-44	0
6-iv	15	6.2-2	0	6.2-45	0
6-v	26	6.2-3	0	6.2-46	0
6-vi	17	6.2-4	2[illegible]	6.2-47	0
6-via	15	6.2-5	1	6.2-48	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
6.2-49	0	6.2-92	2	Tbl 6.2-3	1
6.2-50	0	6.2-92a	2	Tbl 6.2-4	
6.2-51	0	6.2-92b	2	Sheet 1	24
6.2-52	0	6.2-93	0	Sheet 2	24
6.2-53	0	6.2-94	27	Sheet 3	24
6.2-54	0	6.2-95	8	Sheet 4	24
6.2-55	0	6.2-96	8	Sheet 5	24
6.2-56	0	6.2-96a	9	Sheet 6	24
6.2-57	3	6.2-96b	8	Sheet 7	24
6.2-58	0	6.2-97	9	Sheet 8	24
6.2-59	0	6.2-98	0	Sheet 9	24
6.2-60	0	6.2-99	0	Sheet 10	24
6.2-61	3	6.2-100	0	Tbl 6.2-5	
6.2-62	12	6.2-101	0	Sheet 1	24
6.2-63	15	6.2-102	0	Sheet 2	24
6.2-64	8	6.2-102a	2	Sheet 3	24
6.2-65	8	6.2-102b	2	Sheet 4	24
6.2-66	13	6.2-103	1	Sheet 5	24
6.2-67	13	6.2-104	0	Sheet 6	24
6.2-68	0	6.2-105	17	Sheet 7	24
6.2-69	0	6.2-106	17	Sheet 8	24
6.2-70	15	6.2-107	8	Sheet 9	24
6.2-71	25	6.2-108	8	Sheet 10	24
6.2-72	25	6.2-109	26	Sheet 11	24
6.2-72a	25	6.2-110	26	Sheet 12	24
6.2-72b	17	6.2-110a	23	Sheet 13	24
6.2-73	26	6.2-110b	23	Sheet 14	24
6.2-74	15	6.2-111	17	Sheet 15	24
6.2-75	18	6.2-112	17	Tbl 6.2-6	
6.2-76	26	6.2-113	20	Sheet 1	0
6.2-77	18	6.2-114	26	Sheet 2	0
6.2-78	13	6.2-114a	26	Tbl 6.2-7	27
6.2-79	13	6.2-114b	15	Tbl 6.2-8	0
6.2-80	13	6.2-114c	17	Tbl 6.2-9	
6.2-81	13	6.2-114d	15	Sheet 1	0
6.2-82	13	6.2-115	0	Sheet 2	0
6.2-83	0	6.2-116	0	Tbl 6.2-10	
6.2-84	0	6.2-117	0	Sheet 1	12
6.2-85	2	6.2-118	0	Sheet 2	12
6.2-86	22	6.2-119	18	Sheet 3	12
6.2-86a	22	6.2-120	22	Sheet 4	12
6.2-86b	22	6.2-121	22	Tbl 6.2-11	
6.2-87	21	6.2 Tbl Tab		Sheet 1	12
6.2-88	0	Tbl 6.2-1		Sheet 2	12
6.2-89	15	Sheet 1	24	Sheet 3	12
6.2-90	0	Sheet 2	24	Tbl 6.2-12	0
6.2-91	0	Tbl 6.2-2	26	Tbl 6.2-13	

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Sheet 1	24	Tbl 6.2-24		Tbl 6.2-32	0
Sheet 2	24	Sheet 1	27	Tbl 6.2-33	0
Tbl 6.2-14		Sheet 2	0	Tbl 6.2-34	
Sheet 1	13	Tbl 6.2-25	0	Sheet 1	8
Sheet 2	12	Tbl 6.2-26	0	Sheet 2	8
Sheet 3	13	Tbl 6.2-27		Tbl 6.2-35	
Sheet 4	12	Sheet 1	23	Sheet 1	0
Sheet 5	14	Sheet 2	23	Sheet 2	0
Sheet 6	12	Sheet 3	26	Sheet 3	0
Sheet 7	24	Sheet 4	23	Tbl 6.2-36	
Sheet 8	24	Sheet 5	23	Sheet 1	0
Tbl 6.2-15		Sheet 6	26	Sheet 2	0
Sheet 1	15	Sheet 7	23	Sheet 3	0
Sheet 2	15	Sheet 8	23	Tbl 6.2-37	
Sheet 3	15	Tbl 6.2-28		Sheet 1	0
Sheet 4	24	Sheet 1	18	Sheet 2	0
Tbl 6.2-16		Sheet 2	21	Sheet 3	0
Sheet 1	11	Sheet 3	18	Tbl 6.2-38	
Sheet 2	11	Sheet 4	20	Sheet 1	0
Sheet 3	11	Sheet 5	20	Sheet 2	0
Tbl 6.2-17		Sheet 6	18	Sheet 3	0
Sheet 1	12	Sheet 7	18	Tbl 6.2-39	
Sheet 2	12	Sheet 8	18	Sheet 1	0
Sheet 3	12	Sheet 9	23	Sheet 2	0
Sheet 4	12	Sheet 10	23	Sheet 3	0
Sheet 5	12	Sheet 11	20	Tbl 6.2-40	
Tbl 6.2-18	0	Sheet 12	20	Sheet 1	0
Tbl 6.2-19	24	Sheet 13	19	Sheet 2	0
Sheet 1	24	Sheet 14	18	Sheet 3	0
Sheet 2	24	Sheet 15	21	Tbl 6.2-41	
Tbl 6.2-20	24	Tbl 6.2-28A		Sheet 1	0
Sheet 1	24	Sheet 1	21	Sheet 2	0
Sheet 2	24	Sheet 2	21	Sheet 3	0
Tbl 6.2-21		Sheet 3	20	Tbl 6.2-42	19
Sheet 1	0	Sheet 4	17	Tbl 6.2-43	
Sheet 2	0	Sheet 5	23	Sheet 1	12
Tbl 6.2-22		Sheet 6	22	Sheet 2	12
Sheet 1	26	Sheet 7	18	6.2 Fig. Tab	
Sheet 2	26	Sheet 8	18	Fig. 6.2-1	23
Sheet 3	25	Sheet 9	21	Fig. 6.2-1a	26
Tbl 6.2-23		Tbl 6.2-29		Fig. 6.2-2	0
Sheet 1	23	Sheet 1	0	Fig. 6.2-3	0
Sheet 2	15	Sheet 2	26	Fig. 6.2-4	0
Sheet 3	15	Tbl 6.2-30		Fig. 6.2-5	0
Sheet 4	15	Sheet 1	17	Fig. 6.2-6	0
Sheet 5	15	Sheet 2	8	Fig. 6.2-7	0
Sheet 6	15	Tbl 6.2-31	0	Fig. 6.2-8	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.
Fig. 6.2-9	0
Fig. 6.2-10	0
Fig. 6.2-11	0
Fig. 6.2-12	0
Fig. 6.2-13	0
Fig. 6.2-14	24
Fig. 6.2-15	24
Fig. 6.2-16	0
Fig. 6.2-17	0
Fig. 6.2-18	0
Fig. 6.2-19	24
Fig. 6.2-20	24
Fig. 6.2-21	12
Fig. 6.2-22	0
Fig. 6.2-23	11
Fig. 6.2-24	11
Fig. 6.2-25	11
Fig. 6.2-26	11
Fig. 6.2-27	11
Fig. 6.2-28	11
Fig. 6.2-29	11
Fig. 6.2-30	11
Fig. 6.2-31	11
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Fig. 6.2-37	0
Fig. 6.2-38	0
Fig. 6.2-39	0
Fig. 6.2-40	0
Fig. 6.2-41	0
Fig. 6.2-42	0
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Fig. 6.2-44	0
Fig. 6.2-45	0
Fig. 6.2-46	0
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Fig. 6.2-48	0
Fig. 6.2-49	0
Fig. 6.2-50	0
Fig. 6.2-51	
Sheet 1	27
Sheet 2	27
Fig. 6.2-52	
Sheet 1	27
Sheet 2	27
Fig. 6.2-53	0
Fig. 6.2-54	0
Fig. 6.2-55	17
Fig. 6.2-56	17
Fig. 6.2-57	17
Fig. 6.2-58	23
Fig. 6.2-58A	26
Fig. 6.2-59	17
Fig. 6.2-60	18
Fig. 6.2-61	0
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Fig. 6.2-64	0
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Fig. 6.2-67	0
Fig. 6.2-68	8
Fig. 6.2-69	0
Fig. 6.2-70	0
Fig. 6.2-71	17
Fig. 6.2-72	14
Fig. 6.2-73	4
Fig. 6.2-74	4
Fig. 6.2-75	0
Fig. 6.2-76	0
Fig. 6.2-77	0
Fig. 6.2-78	0
Fig. 6.2-79	0
Fig. 6.2-80	0
Fig. 6.2-81	0
Fig. 6.2-82	0
Fig. 6.2-83	21
Fig. 6.2-84	22
Fig. 6.2-85	26
Fig. 6.2-86	22
Fig. 6.2-87	21
Fig. 6.2-88	11
Fig. 6.2-89	11
Fig. 6.2-90	11
Fig. 6.2-91	11
Fig. 6.2-92	11
Fig. 6.2-93	11
Fig. 6.2-94	11
Fig. 6.2-95	11
Fig. 6.2-96	14
Fig. 6.2-97	24
Fig. 6.2-98	11
Fig. 6.2-99	11
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Fig. 6.2-101	11
Fig. 6.2-102	11
Fig. 6.2-103	11
Fig. 6.2-104	11
Fig. 6.2-105	11
Fig. 6.2-106	11
Fig. 6.2-107	11
Fig. 6.2-108	11
Fig. 6.2-109	11
Fig. 6.2-110	11
Fig. 6.2-111	11
Fig. 6.2-112	11
Fig. 6.2-113	11
Fig. 6.2-114	11
Fig. 6.2-115	11
Fig. 6.2-116	11
Fig. 6.2-117	11
Fig. 6.2-118	11
Fig. 6.2-119	14
Fig. 6.2-120	14
Fig. 6.2-121	14
Fig. 6.2-122	14
Fig. 6.2-123	14
Fig. 6.2-124	14
Fig. 6.2-125	14
Fig. 6.2-126	14
Fig. 6.2-127	14
Fig. 6.2-128	14
Fig. 6.2-129	14
Fig. 6.2-130	14
Fig. 6.2-131	14
Fig. 6.2-132	14
Fig. 6.2-133	14
Fig. 6.2-134	14
Fig. 6.2-135	20
Fig. 6.2-136	19
Fig. 6.2-137	24
Fig. 6.2-138	19

VOLUME 13

i	12
ii	12
iii	21

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
iv	21	6.3-12	27	Sheet 7	15
v	21	6.3-13	3	Sheet 8	15
vi	21	6.3-14	0	Sheet 9	26
vii	21	6.3-15	26	Tbl 6.3-7	17
viii	21	6.3-16	21	Tbl 6.3-8	1
ix	21	6.3-16a	18	Tbl 6.3-9	14
x	21	6.3-16b	18	Tbl 6.3-10	26
xi	21	6.3-17	15	Tbl 6.3-11	
xii	21	6.3-18	15	Sheet 1	9
xiii	15	6.3-19	17	Sheet 2	9
xiv	21	6.3-20	17	Sheet 3	9
xv	21	6.3-21	15	Tbl 6.3-12	
xvi	12	6.3-22	26	Sheet 1	9
xvii	12	6.3-23	26	Sheet 2	9
xviii	21	6.3-24	20	Sheet 3	9
xix	36	6.3-24a	17	Tbl 6.3-13	19
xx	26	6.3-24b	17	6.3 Fig. Tab	
xxi	12	6.3-25	15	Fig. 6.3-1	
xxii	26	6.3-26	15	Sheet 1	27
xxiii	26	6.3-27	23	Sheet 2	27
xxiv	26	6.3-28	15	Fig. 6.3-2	27
xxv	26	6.3-29	15	Fig. 6.3-3	0
xxvi	26	6.3-30	15	Fig. 6.3-4	0
xxvii	26	6.3-31	15	Fig. 6.3-5	26
xxviii	26	6.3-32	15	Fig. 6.3-6	15
xxix	26	6.3-33	15	6.4 Tab	
xxx	2	6.3-34	15	6.4-1	0
xxxi	26	6.3 Tbl Tab		6.4-2	22
xxxii	26	Tbl 6.3-1		6.4-3	0
6.3 Tab		Sheet 1	9	6.4-4	3
6.3-1	3	Sheet 2	26	6.4-4a	3
6.3-2	3	Sheet 3	26	6.4-4b	0
6.3-3	0	Sheet 4	9	6.4-5	0
6.3-4	0	Sheet 5	8	6.4-6	0
6.3-5	16	Tbl 6.3-2		6.4-7	15
6.3-6	15	Sheet 1	15	6.4-8	15
6.3-6a	15	Sheet 2	15	6.4-8a	15
6.3-6b	15	Tbl 6.3-3	0	6.4-8b	0
6.3-7	0	Tbl 6.3-4	9	6.4-9	0
6.3-8	3	Tbl 6.3-5	26	6.4-10	0
6.3-9	21	Tbl 6.3-6		6.4 Tbl Tab	
6.3-10	15	Sheet 1	17	Tbl 6.4-1	0
6.3-10a	15	Sheet 2	17	Tbl 6.4-2	0
6.3-10b	15	Sheet 3	17	Tbl 6.4-3	
6.3-10c	27	Sheet 4	26	Sheet 1	24
6.3-10d	27	Sheet 5	26	Sheet 2	24
6.3-11	27	Sheet 6	15	6.4 Fig. Tab	

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Fig. 6.4-1	26	Fig. 6.8-3	24	6B-39	3
Fig. 6.4-2	21	Fig. 6.8-4	24	6B-40	3
Fig. 6.4-3	26	Fig. 6.8-5	24	6B-41	3
Fig. 6.4-4	26	Fig. 6.8-6	24	Tbl 6B-1	3
6.5 Tab		Fig. 6.8-7	24	Tbl 6B-2	3
6.5-1	0	Fig. 6.8-8	24	Tbl 6B-3	3
6.5-2	0	App 6A Tab		Tbl 6B-4	3
6.5-3	14	Deleted	14	Tbl 6B-5	
6.5-4	14	App 6B Tab		Sheet 1	3
6.5-5	14	6B-1	3	Sheet 2	3
6.5-6	14	6B-2	3	Tbl 6B-6	
6.5-7	14	6B-3	3	Sheet 1	3
6.5-8	14	6B-4	3	Sheet 2	3
6.5-9	14	6B-5	3	Tbl 6B-7	3
6.5-10	14	6B-6	3	Tbl 6B-8	3
6.5-11	14	6B-7	3	Tbl 6B-9	3
6.5-12	14	6B-8	3	Tbl 6B-10	3
6.5 Tbl Tab		6B-9	3	Tbl 6B-11	3
Tbl 6.5-1	0	6B-10	3	Tbl 6B-12	3
Tbl 6.5-2		6B-11	3	Tbl 6B-13	3
Sheet 1	0	6B-12	3	Tbl 6B-14	3
Sheet 2	27	6B-13	3	Tbl 6B-15	3
Tbl 6.5-3	17	6B-14	3	Tbl 6B-16	3
Tbl 6.5-4	17	6B-15	3	Fig. 6B-1	3
Tbl 6.5-5	14	6B-16	3	Fig. 6B-2	3
6.5 Fig. Tab		6B-17	3	Fig. 6B-3	3
Fig. 6.5-1	21	6B-18	3	Fig. 6B-4	3
Fig. 6.5-2	20	6B-19	3	Fig. 6B-5	3
6.6 Tab		6B-20	3	Fig. 6B-6	3
6.6-1	0	6B-21	3	Fig. 6B-7	3
6.6-2	0	6B-22	3	Fig. 6B-8	3
6.7 Tab		6B-23	3	Fig. 6B-9	3
6.7-1	0	6B-24	3	Fig. 6B-10	3
6.8 Tab		6B-25	3	Fig. 6B-11	3
6.8-1	23	6B-26	3	Fig. 6B-12	3
6.8-2	23	6B-27	3	Fig. 6B-13	3
6.8-3	23	6B-28	3	Fig. 6B-14	3
6.8-4	21	6B-29	3	Fig. 6B-15	3
6.8-5	23	6B-30	3	Fig. 6B-16	3
6.8-6	23	6B-31	3	Fig. 6B-17	3
6.8-7	23	6B-32	3	Fig. 6B-18	3
6.8-8	23	6B-33	3	Fig. 6B-19	3
6.8 Tbl Tab		6B-34	3	Fig. 6B-20	3
Tbl 6.8-1	0	6B-35	3	Fig. 6B-21	3
6.8 Fig. Tab		6B-36	3	Fig. 6B-22	3
Fig. 6.8-1	20	6B-37	3	App 6C Tab	
Fig. 6.8-2	20	6B-38	3	6C-1	11

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
6C-2	11	Fig. 6D-8	19	Fig. 6E-16	26
6C-3	3	Fig. 6D-9	19	Fig. 6E-17	26
6C-4	3	Fig. 6D-9A	22	Fig. 6E-18	26
6C-5	3	Fig. 6D-10	22	Fig. 6E-19	26
App 6D Tab		Fig. 6D-11	22	Fig. 6E-20	26
6D-1	22	Fig. 6D-12	22	Fig. 6E-21	26
6D-2	22	Fig. 6D-13	22	Fig. 6E-22	26
Tbl 6D-1	8	Fig. 6D-14	22	Fig. 6E-23	26
Tbl 6D-2	8	Fig. 6D-15	22	Fig. 6E-24	26
Tbl 6D-3		Fig. 6D-16	22	Fig. 6E-25	26
Sheet 1	8	Fig. 6D-17	22	Fig. 6E-26	26
Sheet 2	8	Fig. 6D-18	22	Fig. 6E-27	26
Tbl 6D-4		Fig. 6D-19	22	Fig. 6E-28	26
Sheet 1	8	Fig. 6D-20	22	Fig. 6E-29	26
Sheet 2	8	App 6E Tab		FIg. 6E-30	26
Tbl 6D-5		6E-1	26	Fig. 6E-31	26
Sheet 1	8	6E-2	26	Fig. 6E-32	26
Sheet 2	8	6E-3	26	Fig. 6E-33	26
Tbl 6D-6		6E-4	26	Fig. 6E-34	26
Sheet 1	22	6E-5	26	Fig. 6E-35	26
Sheet 2	22	Tbl 6E-1	26	Fig. 6E-36	26
Tbl 6D-7		Tbl 6E-2		Fig. 6E-37	26
Sheet 1	22	Sheet 1	22	Fig. 6E-38	26
Sheet 2	22	Sheet 2	22	Fig. 6E-39	26
Tbl 6D-8		Tbl 6E-3	17	Fig. 6E-40	26
Sheet 1	22	Tbl 6E-4	26	Fig. 6E-41	26
Sheet 2	22	Tbl 6E-5	26	Fig. 6E-42	26
Tbl 6D-9		Tbl 6E-6	26	Fig. 6E-43	26
Sheet 1	22	Tbl 6E-7	26	FIg. 6E-44	26
Sheet 2	22	Tbl 6E-8	26	Fig. 6E-45	26
Sheet 3	22	Tbl 6E-9	26		
Tbl 6D-10		Tbl 6E-10	26	VOLUME 14	
Sheet 1	22	Fig. 6E-1	22		
Sheet 2	22	Fig. 6E-2	22	i	12
Sheet 3	22	Fig. 6E-3	22	ii	12
Tbl 6D-11		Fig. 6E-4	22	iii	21
Sheet 1	22	Fig. 6E-5	22	iv	21
Sheet 2	22	Fig. 6E-6	17	v	21
Sheet 3	22	Fig. 6E-7	22	vi	21
Tbl 6D-12	22	Fig. 6E-8	26	vii	21
Fig. 6D-1	8	Fig. 6E-9	26	viii	21
Fig. 6D-2	8	Fig. 6E-10	26	ix	21
Fig. 6D-3	8	Fig. 6E-11	26	x	21
Fig. 6D-4	8	Fig. 6E-12	26	xi	21
Fig. 6D-5	8	Fig. 6E-13	26	xii	21
Fig. 6D-6	19	Fig. 6E-14	26	xiii	15
Fig. 6D-7	19	Fig. 6E-15	26	xiv	21

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
xv	21	7.1 Tbl Tab		Fig. 7.2-4	16
xvi	12	Tbl 7.1-1		Fig. 7.2-5	18
xvii	12	Sheet 1	15	7.3 Tab	
xviii	21	Sheet 2	18	7.3-1	0
xix	26	Sheet 3	2	7.3-2	12
xx	26	Tbl 7.1-2	21	7.3-3	0
xxi	12	7.1 Fig Tab		7.3-4	0
xxii	26	Fig 7.1-1	15	7.3-5	3
xxiii	26	7.2 Tab		7.3-6	0
xxiv	26	7.2-1	0	7.3-7	0
xxv	26	7.2-2	0	7.3-8	0
xxvi	26	7.2-3	0	7.3-9	2
xxvii	26	7.2-4	0	7.3-10	0
xxviii	26	7.2-5	0	7.3-11	0
xxix	26	7.2-6	0	7.3-12	0
xxx	26	7.2-7	0	7.3-13	0
xxxi	27	7.2-8	0	7.3-14	14
xxxii	28	7.2-9	3	7.3-15	14
Chapter 7 Tab		7.2-10	2	7.3-16	0
7-i	15	7.2-10a	2	7.3-17	0
7-ii	20	7.2-10b	2	7.3-18	0
7-iii	20	7.2-11	0	7.3-19	0
7-iv	26	7.2-12	14	7.3-20	17
7-iva	26	7.2-13	14	7.3-20a	17
7-ivb	26	7.2-14	14	7.3-20b	17
7-v	13	7.2-15	14	7.3-21	4
7-vi	2	7.2-16	14	7.3-22	15
7-vii	13	7.2-17	26	7.3-23	15
7-viii	18	7.2-18	18	7.3-24	18
7-ix	18	7.2-19	18	7.3-25	18
7-x	18	7.2-20	18	7.3-26	15
7.1 Tab		7.2-21	18	7.3-27	15
7.1-1	2	7.2-22	18	7.3-28	15
7.1-2	2	7.2-23	18	7.3-29	15
7.1-3	2	7.2-24	18	7.3-30	21
7.1-4	2	7.2 Tbl Tab		7.3-30a	21
7.1-5	18	Tbl 7.2-1		7.3-30b	21
7.1-6	15	Sheet 1	0	7.3-31	15
7.1-7	15	Sheet 2	0	7.3-32	15
7.1-8	15	Tbl 7.2-2	13	7.3-33	15
7.1-9	15	Tbl 7.2-3	0	7.3-34	15
7.1-10	15	Tbl 7.2-4	13	7.3-34a	15
7.1-11	15	Tbl 7.2-5	13	7.3-34b	2
7.1-12	15	7.2 Fig. Tab		7.3-35	0
7.1-13	15	Fig. 7.2-1	0	7.3-36	4
7.1-14	15	Fig. 7.2-2	0	7.3-37	0
7.1-15	15	Fig. 7.2-3	0	7.3-38	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
7.3-39	0	Fig. 7.3-2	20	7.5-3	27
7.3-40	0	Fig. 7.3-3	25	7.5-4	27
7.3-41	0	Fig. 7.3-4	25	7.5-5	12
7.3-42	14	Fig. 7.3-5	25	7.5-6	12
7.3-43	26	Fig. 7.3-6	25	7.5-7	17
7.3-44	0	Fig. 7.3-7	19	7.5-8	12
7.3-45	4	Fig. 7.3-8	15	7.5-9	18
7.3-46	17	Fig. 7.3-9	25	7.5-10	18
7.3-47	4	Fig. 7.3-10	18	7.5 Tbl Tab	
7.3 Tbl Tab		7.4 Tab		Tbl 7.5-1	
Tbl 7.3-1	12	7.4-1	20	Sheet 1	27
Tbl 7.3-2		7.4-2	27	Sheet 2	27
Sheet 1	19	7.4-2a	27	Sheet 3	27
Sheet 2	26	7.4-2b	10	Sheet 4	27
Sheet 3	16	7.4-3	0	Sheet 5	27
Tbl 7.3-3		7.4-4	2	Sheet 6	27
Sheet 1	18	7.4-5	25	Tbl 7.5-2	
Sheet 2	13	7.4-6	17	Sheet 1	18
Sheet 3	14	7.4-7	27	Sheet 2	18
Sheet 4	12	7.4-8	20	Sheet 3	18
Sheet 5	13	7.4-8a	27	7.6 Tab	
Sheet 6	12	7.4-8b	27	7.6-1	21
Sheet 7	12	7.4-8c	27	7.6-2	19
Sheet 8	14	7.4-8d	27	7.6-3	8
Sheet 9	25	7.4-9	27	7.6-4	8
Sheet 10	13	7.4-10	17	7.6-5	26
Sheet 11	14	7.4-11	17	7.6-6	26
Sheet 12	15	7.4-12	26	7.6-7	21
Sheet 13	14	7.4-12a	18	7.6-8	21
Sheet 14	15	7.4-12b	27	7.6-9	21
Sheet 15	15	7.4-12c	20	7.6-10	27
Sheet 16	25	7.4-12d	20	7.6-11	26
Tbl 7.3-4	0	7.4-13	0	7.7 Tab	
Tbl 7.3-5		7.4-14	27	7.7-1	18
Sheet 1	12	7.4-15	27	7.7-2	26
Sheet 2	12	7.4-16	27	7.7-2a	2
Sheet 3	12	7.4 Tbl Tab		7.7-2b	2
Sheet 4	12	Tbl 7.4-1		7.7-3	0
Sheet 5	12	Sheet 1	18	7.7-4	0
Sheet 6	12	Sheet 2	27	7.7-5	0
Sheet 7	12	Tbl 7.4-2	27	7.7-6	0
Sheet 8	12	Tbl 7.4-3	^	7.7-7	0
Sheet 9	12	7.4 Fig. Tab		7.7-8	0
Sheet 10	12	Fig. 7.4-1	0	7.7-9	0
Sheet 11	12	7.5 Tab		7.7-10	0
7.3 Fig. Tab		7.5-1	5	7.7-11	26
Fig. 7.3-1	0	7.5-2	17	7.7-12	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
7.7-13	3	7.8-2b	2	8.1-1	27
7.7-14	3	7.8-3	0	8.1-2	0
7.7-14a	3	7.8-4	0	8.1-3	0
7.7-14b	3	7.8-5	0	8.1-4	25
7.7-15	0	7.8-6	0	8.1-5	2
7.7-16	0	7.8-7	0	8.1-6	0
7.7-17	0	7.8 Fig. Tab		8.1-7	0
7.7-18	0	Fig. 7.8-1	2	8.1-8	0
7.7-19	0	Fig. 7.8-2	0	8.1-9	2
7.7-20	0	Fig. 7.8-3	0	8.1-10	25
7.7-21	27	Fig. 7.8-4	0	8.1-10a	2
7.7-22	0	Fig. 7.8-5	2	8.1-10b	25
7.7-23	0	App 7A Tab		8.1-11	0
7.7-24	15	7A-1	14	8.1-12	0
7.7-25	15	7A-2	14	8.1-13	0
7.7-26	25	7A-3	14	8.1 Fig. Tab	
7.7-27	18	Tbl 7A-1		Fig. 8.1-1	0
7.7-28	0	Sheet 1	13	8.2 Tab	
7.7-29	3	Sheet 2	13	8.2-1	10
7.7-30	0	Sheet 3	13	8.2-2	10
7.7 Tbl Tab		Sheet 4	13	8.2-3	10
Tbl 7.7-1		Tbl 7A-2		8.2-4	24
Sheet 1	0	Sheet 1	13	8.2-5	19
Sheet 2	10	Sheet 2	13	8.2-6	19
Sheet 3	10	Sheet 3	13	8.2-7	19
Tbl 7.7-2		Sheet 4	13	8.2-8	27
Sheet 1	23	Sheet 5	21	8.2-9	27
Sheet 2	27	Sheet 6	13	8.2 Fig. Tab	
Sheet 3	27	Tbl 7A-3		Fig. 8.2-1	0
Tbl 7.7-3	13	Sheet 1	13	Fig. 8.2-2	0
7.7 Fig. Tab		Sheet 2	13	Fig. 8.2-3	0
Fig. 7.7-1	0	Sheet 3	13	Fig. 8.2-4	0
Fig. 7.7-2	0	Sheet 4	13	Fig. 8.2-5	3
Fig. 7.7-3	0	Sheet 5	13	Fig. 8.2-6	3
Fig. 7.7-4	0	Fig. 7A-1	14	Fig. 8.2-7	3
Fig. 7.7-5	3	Fig. 7A-2	14	Fig. 8.2-8	3
Fig. 7.7-6	0	Fig. 7A-3	14	Fig. 8.2-9	10
Fig. 7.7-7	0	Chapter 8 Tab		Fig. 8.2-10	10
Fig. 7.7-8	27	8-i	18	Fig. 8.2-11	16
Fig. 7.7-9	27	8-ii	26	Fig. 8.2-12	19
Fig. 7.7-10	27	8-iii	18	8 3 Tab	
Fig. 7.7-11	27	8-iv	19	8.3-1	0
Fig. 7.7-12	0	8-v	20	8.3-2	0
7.8 Tab		8-vi	20	8.3-3	18
7.8-1	2	8-vii	20	8.3-4	18
7.8-2	2	8-viia	20	8.3-5	18
7.8-2a	2	8.1 Tab		8.3-6	26

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
8.3-7	18	8.3-34	15	Sheet 6	20
8.3-8	26	8.3-35	21	Tbl 8.3-3	
8.3-9	18	8.3-36	21	Sheet 1	20
8.3-10	18	8.3-36a	26	Sheet 2	20
8.3-11	26	8.3-36b	26	Sheet 3	20
8.3-12	18	8.3-36c	21	Sheet 4	20
8.3-12a	24	8.3-36d	21	Sheet 5	20
8.3-12b	24	8.3-36e	27	Sheet 6	20
8.3-12c	24	8.3-36f	27	Tbl 8.3-4	14
8.3-12d	24	8.3-37	27	Tbl 8.3-5	
8.3-12e	24	8.3-38	27	Sheet 1	14
8.3-12f	24	8.3-38a	27	Sheet 2	14
8.3-12g	24	8.3-38b	27	Tbl 8.3-6	19
8.3-12h	24	8.3-39	0	Tbl 8.3-7	27
8.3-13	1	8.3-40	0	Tbl 8.3-8	0
8.3-14	18	8.3-41	0	Tbl 8.3-9	0
8.3-15	18	8.3-42	0	Tbl 8.3-10	0
8.3-16	18	8.3-43	0	Tbl 8.3-11	
8.3-16a	18	8.3-44	15	Sheet 1	18
8.3-16b	18	8.3-45	18	Sheet 2	18
8.3-16c	26	8.3-46	18	Tbl 8.3-12	
8.3-16d	8	8.3-47	18	Sheet 1	11
8.3-17	26	8.3-48	18	Sheet 2	11
8.3-18	0	8.3-49	18	Tbl 8.3-13	11
8.3-19	27	8.3-50	18	Tbl 8.3-14	18
8.3-20	3	8.3-51	18	Tbl 8.3-15	18
8.3-21	3	8.3 Tbl Tab		8.3 Fig. Tab	
8.3-22	26	Tbl 8.3-1		Fig. 8.3-1	24
8.3-22a	3	Sheet 1	19	Fig. 8.3-2a	27
8.3-22b	3	Sheet 2	15	Fig. 8.3-2b	27
8.3-23	0	Sheet 3	15	Fig. 8.3-3	27
8.3-24	10	Sheet 4	14	Fig. 8.3-4	
8.3-25	20	Sheet 5	19	Sheet 1	27
8.3-26	20	Sheet 6	15	Sheet 2	27
8.3-26a	20	Sheet 7	25	Fig. 8.3-5	25
8.3-26b	20	Sheet 8	16	Fig. 8.3-6	0
8 3-26c	20	Sheet 9	15	Fig. 8.3-7	20
8.3-26d	20	Sheet 10	16	Fig. 8.3-8	20
8.3-27	0	Sheet 11	25	Fig. 8.3-8a	20
8.3-28	15	Sheet 12	25	Fig. 8.3-8b	20
8.3-28a	15	Sheet 13	16	Fig. 8.3-8c	20
8.3-28b	13	Tbl 8.3-2		Fig. 8.3-8d	23
8.3-29	0	Sheet 1	20	Fig. 8.3-9	20
8.3-30	0	Sheet 2	20	Fig. 8.3-10	20
8.3-31	18	Sheet 3	20	Fig. 8.3-11	20
8.3-32	0	Sheet 4	20	Fig. 8.3-12	20
8.3-33	10	Sheet 5	20	Fig. 8.3-13	20

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Fig. 8.3-14	20	8A-4	0	9-x	15
Fig. 8.3-15	20	8A-5	0	9-xi	26
Fig. 8.3-15A	20			9-xii	18
Fig. 8.3-16	20	VOLUME 15		9-xiii	18
Fig. 8.3-17	20			9-xiv	18
Fig. 8.3-18	20	i	12	9-xv	18
Fig. 8.3-19	0	ii	12	9-xvi	23
Fig. 8.3-20	20	iii	21	9-xvii	27
Fig. 8.3-21	20	iv	21	9-xviii	27
Fig. 8.3-22	20	v	21	9-xix	27
Fig. 8.3-23	20	vi	21	9-xx	26
Fig. 8.3-24	20	vii	21	9-xxi	26
Fig. 8.3-25	20	viii	21	9-xxii	27
Fig. 8.3-26	20	ix	21	9-xxiii	27
Fig. 8.3-27	20	x	21	9-xxiv	26
Fig. 8.3-28	20	xi	21	9-xxv	25
Fig. 8.3-29	20	xii	21	9-xxvi	25
Fig. 8.3-30	20	xiii	15	9.1 Tab	
Fig. 8.3-31	20	xiv	21	9.1-1	23
Fig. 8.3-32	0	xv	21	9.1-2	23
Fig. 8.3-32A	20	xvi	12	9.1-3	27
Fig. 8.3-33	24	xvii	12	9.1-4	19
Fig. 8.3-34	24	xviii	21	9.1-5	15
Fig. 8.3-35	24	xix	26	9.1-6	15
Fig. 8.3-36	24	xx	26	9.1-7	17
Fig. 8.3-37	0	xxi	12	9.1-8	27
Fig. 8.3-38	0	xxii	26	9.1-8a	27
Fig. 8.3-39	18	xxiii	26	9.1-8b	27
Fig. 8.3-40	18	xxiv	26	9.1-9	27
Fig. 8.3-41	0	xxv	26	9.1-10	19
Fig. 8.3-4	0	xxvi	26	9.1-10a	19
Fig. 8.3-43	18	xxvii	26	9.1-10b	15
Fig. 8.3-44	18	xxviii	26	9.1-11	0
Fig. 8.3-45	18	xxix	26	9.1-12	3
Fig. 8.3-46	18	xxx	26	9.1-13	0
Fig. 8.3-47	18	xxxi	26	9.1-14	25
Fig. 8.3-48	18	xxxii	26	9.1-15	17
Fig. 8.3-49	18	Chapter 9 Tab		9.1-16	17
Fig. 8.3-50	18	9-i	16	9.1-16a	17
Fig. 8.3-51	18	9-ii	17	9.1-16b	2
Fig. 8.3-52	18	9-iii	17	9.1-17	17
Fig. 8.3-53	18	9-iv	9	9.1-18	0
Fig. 8.3-54	27	9-v	0	9.1-19	0
App 8A Tab		9-vi	18	9.1-20	0
8A-1	0	9-vii	7	9.1-21	0
8A-2	0	9-viii	2	9.1-22	0
8A-3	0	9-ix	26	9.1-23	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
9.1-24	0	Fig. 9.1-2	0	9.2-28	22
9.1-25	0	Fig. 9.1-3	0	9.2-29	20
9.1-26	0	Fig. 9.1-4	0	9.2-30	22
9.1-27	0	Fig. 9.1-5	0	9.2-31	0
9.1-28	0	Fig. 9.1-6	0	9.2-32	0
9.1-29	0	Fig. 9.1-7	0	9.2-33	0
9.1-30	0	Fig. 9.1-8	0	9.2-34	0
9.1-31	0	Fig. 9.1-9	0	9.2-35	0
9.1-32	0	Fig. 9.1-10	0	9.2-36	3
9.1-33	0	Fig. 9.1-11	17	9.2-37	3
9.1-34	0	Fig. 9.1-12	17	9.2-38	3
9.1-35	9	Fig. 9.1-13	17	9.2-39	3
9.1-36	9	Fig. 9.1-14	14	9.2-40	14
9.1-37	9	Fig. 9.1-15	19	9.2-41	14
9.1-38	9	Fig. 9.1-16	19	9.2-42	14
9.1-39	18	9.2 Tab		9.2-43	14
9.1-40	18	9.2-1	0	9.2-44	14
9.1-41	16	9.2-2	0	9.2-45	17
9.1-42	16	9.2-3	0	9.2-46	14
9.1-43	16	9.2-4	0	9.2-47	8
9.1-44	18	9.2-5	24	9.2-48	8
9.1 Tbl Tab		9.2-6	24	9.2-49	22
Tbl 9.1-1	17	9.2-7	8	9.2-50	17
Tbl 9.1-2		9.2-8	8	9.2-50a	17
Sheet 1	17	9.2-9	8	9.2-50b	8
Sheet 2	17	9.2-10	18	9.2-51	3
Tbl 9.1-3	0	9.2-10a	11	9.2-52	8
Tbl 9.1-4	0	9.2-10b	8	9.2-53	3
Tbl 9.1-5	3	9.2-11	0	9.2-54	27
Tbl 9.1-6	0	9.2-12	27	9.2-55	27
Tbl 9.1-7		9.2-13	0	9.2-56	3
Sheet 1	0	9.2-14	0	9.2-57	27
Sheet 2	0	9.2-15	0	9.2-58	0
Sheet 3	0	9.2-16	0	9.2 Tbl Tab	
Sheet 4	0	9.2-17	0	Tbl 9.2-1	0
Tbl 9.1-8	3	9.2-18	8	Tbl 9.2-2	0
Tbl 9.1-9		9.2-19	8	Tbl 9.2-3	
Sheet 1	18	9.2-20	8	Sheet 1	0
Sheet 2	18	9.2-20a	8	Sheet 2	0
Sheet 3	18	9.2-20b	8	Tbl 9.2-4	0
Tbl 9.1-10		9.2-21	9	Tbl 9.2-5	
Sheet 1	18	9.2-22	14	Sheet 1	0
Sheet 2	18	9.2-23	14	Sheet 2	0
9.1 Fig. Tab		9.2-24	14	Tbl 9.2-6	0
Fig. 9.1-1		9.2-25	14	Tbl 9.2-7	0
Sheet 1	27	9.2-26	14	Tbl 9.2-8	
Sheet 2	27	9.2-27	0	Sheet 1	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Sheet 2	0	Sheet 1	27	Sheet 1	26
Tbl 9.2-9		Sheet 2	27	Sheet 2	27
Sheet 1	0	Fig. 9.2-3		Fig. 9.2-23	27
Sheet 2	0	Sheet 1	27	Fig. 9.2-24	
Sheet 3	0	Sheet 2	27	Sheet 1	27
Tbl 9.2-10		Fig. 9.2-4		Sheet 2	27
Sheet 1	0	Sheet 1	27	Fig. 9.2-25	
Sheet 2	0	Sheet 2	27	Sheet 1	26
Tbl 9.2-11	23	Fig. 9.2-5	25	Sheet 2	26
Tbl 9.2-12		Fig. 9.2-6	0	Fig. 9.2-26	3
Sheet 1	0	Fig. 9.2-7		9.3 Tab	
Sheet 2	0	Sheet 1	27	9.3-1	3
Tbl 9.2-13	0	Sheet 2	27	9.3-2	9
Tbl 9.2-14	0	Fig. 9.2-8		9.3-3	0
Tbl 9.2-15	0	Sheet 1	27	9.3-4	0
Tbl 9.2-16	0	Sheet 2	27	9.3-5	0
Tbl 9.2-17		Fig. 9.2-9		9.3-6	0
Sheet 1	0	Sheet 1	27	9.3-7	19
Sheet 2	0	Sheet 2	27	9.3-8	26
Sheet 3	0	Fig. 9.2-10		9.3-8a	26
Sheet 4	0	Sheet 1	27	9.3-8b	22
Tbl 9.2-18		Sheet 2	27	9.3-9	19
Sheet 1	3	Fig. 9.2-11		9.3-10	0
Sheet 2	7	Sheet 1	27	9.3-11	0
Tbl 9.2-19	23	Sheet 2	27	9.3-12	17
Tbl 9.2-20	0	Sheet 3	27	9.3-13	17
Tbl 9.2-21	0	Fig. 9.2-12		9.3-14	17
Tbl 9.2-22	0	Sheet 1	26	9.3-15	0
Tbl 9.2-23	0	Sheet 2	26	9.3-16	0
Tbl 9.2-24	0	Sheet 3	26	9.3-17	0
Tbl 9.2-25		Sheet 4	26	9.3-18	14
Sheet 1	19	Fig. 9.2-13	12	9.3-19	0
Sheet 2	15	Fig. 9.2-14	3	9.3-20	0
Sheet 3	15	Fig. 9.2-15	3	9.3-21	0
Tbl 9.2-26		Fig. 9.2-16	12	9.3-22	0
Sheet 1	27	Fig. 9.2-17	12	9.3-23	0
Sheet 2	27	Fig. 9.2-18		9.3-24	3
Sheet 3	27	Sheet 1	27	9.3-25	3
Tbl 9.2-27	27	Sheet 2	27	9.3-26	4
Tbl 9.2-28	3	Fig. 9.2-19	25	9.3-27	3
Tbl 9.2-29		Fig. 9.2-20		9.3-28	0
Sheet 1	3	Sheet 1	26	9.3-29	0
Sheet 2	3	Sheet 2	26	9.3-30	0
Tbl 9.2-30	9	Fig. 9.2-21		9.3-31	0
9.2 Fig. Tab		Sheet 1	27	9.3-32	0
Fig. 9.2-1	0	Sheet 2	27	9.3-33	3
Fig. 9.2-2		Fig. 9.2-22		9.3-34	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
9.3-35	0	Tbl 9.3-4	0	Sheet 2	27
9.3-36	21	Tbl 9.3-5	0	Fig. 9.3-18	27
9.3-37	21	Tbl 9.3-6		Fig. 9.3-19	27
9.3-38	21	Sheet 1	0	Fig. 9.3-20	0
9.3-38a	21	Sheet 2	0	Fig. 9.3-21	0
9.3-38b	8	Tbl 9.3-7		Fig. 9.3-22	0
9.3-39	0	Sheet 1	3	Fig. 9.3-23	0
9.3-40	25	Sheet 2	0	Fig. 9.3-24	0
9.3-41	25	Sheet 3	0	Fig. 9.3-25	0
9.3-42	14	Sheet 4	3	Fig. 9.3-26	0
9.3-42a	26	Sheet 5	0	Fig. 9.3-27	0
9.3-42b	14	Sheet 6	0	Fig. 9.3-28	0
9.3-43	0	Sheet 7	0	Fig. 9.3-29	14
9.3-44	0	Sheet 8	4	Fig. 9.3-30	0
9.3-45	0	Sheet 9	0	Fig. 9.3-31	
9.3-46	26	Tbl 9.3-8	25	Sheet 1	26
9.3-47	0	Tbl 9.3-9	0	Sheet 2	27
9.3-48	0	Tbl 9.3-10		Fig. 9.3-32	
9.3-49	0	Sheet 1	0	Sheet 1	27
9.3-50	3	Sheet 2	0	Sheet 2	27
9.3-50a	3	Sheet 3	0	Fig. 9.3-33	
9.3-50b	3	Tbl 9.3-11		Sheet 1	26
9.3-51	0	Sheet 1	1	Sheet 2	27
9.3-52	25	Sheet 2	0	Fig. 9.3-34	
9.3-53	0	Tbl 9.3-12	0	Sheet 1	27
9.3-54	0	Tbl 9.3-13	0	Sheet 2	27
9.3-55	0	Tbl 9.3-14	9	Fig. 9.3-35	27
9.3-56	0	Tbl 9.3-15	14	Fig. 9.3-36	
9.3-57	0	9.3 Fig. Tab		Sheet 1	26
9.3-58	0	Fig. 9.3-1	26	Sheet 2	26
9.3-59	0	Fig. 9.3-2	26	Fig. 9.3-37	
9.3-60	7	Fig. 9.3-3	27	Sheet 1	26
9.3-61	25	Fig. 9.3-4	27	Sheet 2	27
9.3-62	10	Fig. 9.3-5	27	Fig. 9.3-38	
9.3-63	10	Fig. 9.3-6	27	Sheet 1	27
9.3-64	25	Fig. 9.3-7	23	Sheet 2	26
9.3 Tbl Tab		Fig. 9.3-8	26	Fig. 9.3-39	26
Tbl 9.3-1		Fig. 9.3-9	23	Fig. 9.3-40	
Sheet 1	9	Fig. 9.3-10	23	Sheet 1	27
Sheet 2	9	Fig. 9.3-11	23	Sheet 2	27
Sheet 3	9	Fig. 9.3-12	23	Fig. 9.3-41	
Sheet 4	9	Fig. 9.3-13	23	Sheet 1	26
Sheet 5	9	Fig. 9.3-14	23	Sheet 2	26
Tbl 9.3-2	19	Fig. 9.3-15	24	Fig. 9.3-42	25
Tbl 9.3-3		Fig. 9.3-16	24	Fig. 9.3-43	
Sheet 1	17	Fig. 9.3-17		Sheet 1	26
Sheet 2	17	Sheet 1	27	Sheet 2	26

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Fig. 9.3-44	0	9.4-6b	1	9.4-39	0
Fig. 9.3-45		9.4-7	1	9.4-40	0
Sheet 1	26	9.4-8	2	9.4-41	0
Sheet 2	26	9.4-8a	2	9.4-42	0
		9.4-8b	2	9.4-43	8
VOLUME 16		9.4-9	8	9.4-44	25
		9.4-10	1	9.4-45	0
i	12	9.4-10a	1	9.4-46	24
ii	12	9.4-10b	1	9.4-47	24
iii	21	9.4-11	0	9.4-48	24
iv	21	9.4-12	0	9.4-48a	24
v	21	9.4-13	18	9.4-48b	24
vi	21	9.4-14	26	9.4-49	24
vii	21	9.4-14a	18	9.4-50	23
viii	21	9.4-14b	2	9.4-51	23
ix	21	9.4-15	0	9.4-52	23
x	21	9.4-16	0	9.4-52a	23
xi	21	9.4-17	0	9.4-52b	23
xii	21	9.4-18	0	9.4-53	5
xiii	15	9.4-19	23	9.4-54	5
xiv	21	9.4-20	0	9.4-55	5
xv	21	9.4-21	27	9.4-56	8
xvi	12	9.4-22	0	9.4-57	27
xvii	12	9.4-23	0	9.4-58	8
xviii	21	9.4-24	0	9.4 Tbl Tab	
xix	26	9.4-25	2	Tbl 9.4-1	
xx	26	9.4-26	2	Sheet 1	26
xxi	12	9.4-26a	2	Sheet 2	26
xxii	26	9.4-26b	2	Sheet 3	26
xxiii	26	9.4-27	26	Sheet 4	26
xxiv	26	9.4-28	25	Sheet 5	26
xxv	26	9.4-28a	25	Tbl 9.4-2	
xxvi	26	9.4-28b	25	Sheet 1	0
xxvii	26	9.4-29	0	Sheet 2	8
xxviii	26	9.4-30	26	Tbl 9.4-3	
xxix	26	9.4-31	27	Sheet 1	26
xxx	26	9.4-32	2	Sheet 2	26
xxxi	26	9.4-32a	2	Sheet 3	26
xxxii	26	9.4-32b	2	Tbl 9.4-4	0
9.4 Tab		9.4-33	0	Tbl 9.4-5	
9.4-1	3	9.4-34	0	Sheet 1	0
9.4-2	1	9.4-35	2	Sheet 2	0
9.4-3	3	9.4-36	2	Sheet 3	0
9.4-4	8	9.4-36a	2	Tbl 9.4-6	
9.4-5	8	9.4-36b	2	Sheet 1	0
9.4-6	8	9.4-37	0	Sheet 2	0
9.4-6a	8	9.4-38	15	Sheet 3	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Sheet 4	0	Fig. 9.4-11	27	9.5-21	10
Tbl 9.4-7	0	Fig. 9.4-12	27	9.5-22	27
Tbl 9.4-8		Fig. 9.4-13		9.5-23	27
Sheet 1	27	Sheet 1	27	9.5-24	27
Sheet 2	27	Sheet 2	27	9.5-24a	27
Tbl 9.4-9	0	Sheet 3	27	9.5-24b	27
Tbl 9.4-10	0	Fig. 9.4-14		9.5-25	10
Tbl 9.4-11	0	Sheet 1	27	9.5-26	10
Tbl 9.4-12	0	Sheet 2	27	9.5-27	27
Tbl 9.4-13		Fig. 9.4-15		9.5-28	10
Sheet 1	0	Sheet 1	27	9.5-29	10
Sheet 2	0	Sheet 2	27	9.5-30	10
Sheet 3	0	Fig. 9.4-16	26	9.5-30a	15
Sheet 4	0	Fig. 9.4-17	22	9.5-30b	15
Tbl 9.4-14		Fig. 9.4-18		9.5-30c	15
Sheet 1	0	Sheet 1	27	9.5-30d	21
Sheet 2	0	Sheet 2	27	9.5-30e	21
Sheet 3	0	Fig. 9.4-19		9.5-30f	15
Sheet 4	0	sheet 1	27	9.5-31	27
Sheet 5	0	Sheet 2	27	9.5-32	15
Tbl 9.4-15		Fig. 9.4-20	26	9.5-33	17
Sheet 1	0	Fig. 9.4-21	24	9.5-34	21
Sheet 2	0	Fig. 9.4-22	26	9.5-35	17
Tbl 9.4-16		Fig. 9.4-23	18	9.5-36	21
Sheet 1	24	9.5 Tab		9.5-37	21
Sheet 2	24	9.5-1	0	9.5-38	21
Tbl 9.4-17		9.5-2	25	9.5-39	21
Sheet 1	23	9.5-3	0	9.5-40	21
Sheet 2	23	9.5-4	0	9.5-41	15
Sheet 3	23	9.5-5	25	9.5 Tbl Tab	
Sheet 4	23	9.5-6	19	Tbl 9.5-1	
Sheet 5	23	9.5-7	0	Sheet 1	10
Tbl 9.4-18		9.5-8	0	Sheet 2	10
Sheet 1	5	9.5-9	19	Tbl 9.5-2	1
Sheet 2	5	9.5-10	0	Tbl 9.5-3	0
9.4 Fig. Tab		9.5-11	15	Tbl 9.5-4	0
Fig. 9.4-1	26	9.5-12	20	Tbl 9.5-5	0
Fig. 9.4-2	26	9.5-12a	20	Tbl 9.5-6	0
Fig. 9.4-3	26	9.5-12b	15	Tbl 9.5-7	10
Fig. 9.4-4	13	9.5-13	10	Tbl 9.5-8	0
Fig. 9.4-5	22	9.5-14	20	Tbl 9.5-9	
Fig. 9.4-6	13	9.5-15	15	Sheet 1	21
Fig. 9.4-7	24	9.5-16	10	Sheet 2	21
Fig. 9.4-8	22	9.5-17	10	Sheet 3	21
Fig. 9.4-9	22	9.5-18	10	Tbl 9.5-10	10
Fig. 9.4-10	27	9.5-19	10	Tbl 9.5-11	15
Fig. 9.4-10A	27	9.5-20	10	9.5 Fig. Tab	

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Fig. 9.5-1	19	9A-3	23	9A-38	23
Fig. 9.5-2	24	9A-4	23	9A-39	23
Fig. 9.5-3	24	9A-5	23	9A-40	23
Fig. 9.5-4	19	9A-6	23	9A-41	23
Fig. 9.5-5	24	9A-7	23	9A-42	23
Fig. 9.5-6	25	9A-8	23	9A-43	23
Fig. 9.5-7	25	9A-9	23	9A-44	23
Fig. 9.5-8	25	9A-10	23	9A-45	23
Fig. 9.5-9	25	9A-11	23	9A-46	23
Fig. 9.5-10	25	9A-12	23	9A-47	23
Fig. 9.5-11	25	9A-13	23	9A-48	23
Fig. 9.5-12	25	9A-14	23	9A-49	23
Fig. 9.5-13	25	9A-15	23	9A-50	23
Fig. 9.5-14	25	9A-16	23	9A-51	23
Fig. 9.5-15	25	9A-17	23	9A-52	23
Fig. 9.5-16	25	9A-18	23	9A-53	23
Fig. 9.5-17	25	9A-19	23	9A-54	23
Fig. 9.5-18	25	9A-20	23	9A-55	23
Fig. 9.5-19	25	9A-21	24	9A-56	23
Fig. 9.5-20	25	9A-22	23	9A-57	23
Fig. 9.5-21	25	9A-23	24	9A-58	23
Fig. 9.5-22	25	9A-24	23	9A-59	23
Fig. 9.5-23	25	9A-25	23	9A-60	23
Fig. 9.5-24		9A-26	23	9A-61	23
Sheet 1	27	9A-27	24	9A-62	23
Sheet 2	27	Tbl 9A-1		9A-63	23
Fig. 9.5-25		Sheet 1	26	9A-64	23
Sheet 1	27	Sheet 2	26	9A-65	23
Sheet 2	27	Sheet 3	26	9A-66	23
Fig. 9.5-26	0	Sheet 4	26	9A-67	23
Fig. 9.5-27	15	Sheet 5	26	9A-68	23
Fig. 9.5-28	15	Sheet 6	26	9A-69	23
Fig. 9.5-29		Sheet 7	26	9A-70	23
Sheet 1	26	Sheet 8	26	9A-71	23
Sheet 2	26	Sheet 9	23	9A-72	23
Fig. 9.5-30		Sheet 10	23	9A-73	23
Sheet 1	27	Sheet 11	23	9A-74	23
Sheet 2	27	9A-28	23	9A-75	23
Fig. 9.5-31	15	9A-29	23	9A-76	23
Fig. 9.5-31	15	9A-29	23	9A-76	23
Fig. 9.5-32	15	9A-30	23	9A-77	23
App 9A Tab		9A-31	23	9A-78	23
9A-i	23	9A-32	23	9A-79	23
9A-ii	23	9A-33	23	9A-80	23
9A-iii	24	9A-34	23	9A-81	23
9A-iv	24	9A-35	23	9A-82	23
9A-1	23	9A-36	23	9A-83	23
9A-2	26	9A-37	23	9A-84	23

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
9A-85	23	Fig. 9A-7	26	xvii	12
9A-86	23	Fig. 9A-8	26	xviii	21
9A-87	23	Fig. 9A-9	26	xix	26
9A-88	23	Fig. 9A-10	26	xx	26
9A-89	23	Fig. 9A-11	26	xxi	12
9A-90	23	Fig. 9A-12	26	xxii	26
9A-91	23	Fig. 9A-13	23	xxiii	26
9A-92	23	Fig. 9A-14	23	xxiv	26
9A-93	23	Fig. 9A-15	23	xxv	26
9A-94	23	Fig. 9A-16	23	xxvi	26
9A-95	23	Fig. 9A-17	26	xxvii	26
9A-96	23	Fig. 9A-18	26	xxviii	26
9A-97	23	Fig. 9A-19	26	xxix	26
9A-98	23	Fig. 9A-20	26	xxx	26
9A-99	23	Fig. 9A-21	26	xxxi	26
9A-100	23	Fig. 9A-22	26	xxxii	26
9A-101	23	Fig. 9A-23	23	Chapter 10 Tab	
9A-102	23	Fig. 9A-24	23	10-i	16
9A-103	23	Fig. 9A-25	26	10-ii	26
9A-104	23	Fig. 9A-26	26	10-iii	16
9A-105	23	Fig. 9A-27	26	10-iv	16
9A-106	23	Fig. 9A-28	26	10-v	16
9A-107	23	Fig. 9A-29	23	10-vi	16
9A-108	23	Fig. 9A-30		10-vii	16
9A-109	23	Sheet 1	26	10-viii	25
9A-110	23	Sheet 2	26	10-ix	25
9A-111	23	Sheet 3	27	10-x	25
9A-112	23	Sheet 4	27	10-1	0
9A-113	23			10.1 Tab	
9A-114	23	VOLUME 17		10.1-1	0
9A-115	23			10.1-2	0
9A-116	23	i	12	10.1-3	0
9A-117	23	ii	12	10.1 Tbl Tab	
9A-118	23	iii	21	Tbl 10.1-1	
9A-119	23	iv	21	Sheet 1	0
9A-120	23	v	21	Sheet 2	0
9A-121	24	vi	21	Sheet 3	0
9A-122	23	vii	21	Sheet 4	0
9A-123	23	viii	21	Tbl 10.1-2	0
9A-124	23	ix	21	10.1 Fig. Tab	
9A-125	23	x	21	Fig. 10.1-1	14
Fig. 9A-1	23	xi	21	Fig. 10.1-2	25
Fig. 9A-2	26	xii	21	Fig. 10.1-3	0
Fig. 9A-3	23	xiii	15	Fig. 10.1-4	0
Fig. 9A-4	26	xiv	21	Fig. 10.1-5	0
Fig. 9A-5	26	xv	21	Fig. 10.1-6	0
Fig. 9A-6	26	xvi	12	10.2 Tab	

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
10.2-1	3	10.3 Tbl Tab		10.4-19	0
10.2-2	12	Tbl 10.3-1		10.4-20	0
10.2-2a	12	Sheet 1	0	10.4-21	0
10.2-2b	12	Sheet 2	0	10.4-22	0
10.2-3	0	Tbl 10.3-2	10	10.4-23	0
10.2-4	0	Tbl 10.3-3	0	10.4-24	0
10.2-5	10	Tbl 10.3-4	0	10.4-25	26
10.2-6	15	Tbl 10.3-5		10.4-26	0
10.2-6a	15	Sheet 1	20	10.4-27	[illegible]
10.2-6b	15	Sheet 2	20	10.4-28	18
10.2-7	15	Sheet 3	18	10.4-28a	18
10.2-8	0	10.3 Fig. Tab		10.4-28b	2
10.2-9	0	Fig. 10.3-1		10.4-29	0
10.2-10	0	Sheet 1	26	10.4-30	0
10.2-11	0	Sheet 2	26	10.4-31	0
10.2-12	3	Fig. 10.3-2		10.4-32	16
10.2-13	3	Sheet 1	27	10.4-33	20
10.2 Tbl Tab		Sheet 2	27	10.4-34	16
Tbl 10.2-1	0	Fig. 10.3-3	22	10.4-34a	16
10.2 Fig. Tab		Fig. 10.3-4		10.4-34b	14
Fig. 10.2-1		Sheet 1	27	10.4-35	3
Sheet 1	26	Sheet 2	27	10.4-36	27
Sheet 2	26	Fig. 10.3-5	17	10.4-36a	27
Fig. 10.2-2		Fig. 10.3-6	16	10.4-36b	3
Sheet 1	26	10.4 Tab		10.4-37	10
Sheet 2	26	10.4-1	0	10.4-38	10
Fig. 10.2-3		10.4-2	15	10.4-39	26
Sheet 1	26	10.4-3	15	10.4-40	10
Sheet 2	26	10.4-4	15	10.4-41	10
Fig. 10.2-4		10.4-4a	15	10.4-42	10
Sheet 1	26	10.4-4b	10	10.4-42a	10
Sheet 2	26	10.4-5	0	10.4-42b	10
Fig. 10.2-5	10	10.4-6	0	10.4-43	0
10.3 Tab		10.4-7	0	10.4-44	0
10.3-1	0	10.4-8	0	10.4-45	21
10.3-2	0	10.4-9	0	10.4-46	21
10.3-3	14	10.4-10	0	10.4-47	21
10.3-4	16	10.4-11	0	10.4-48	21
10.3-5	26	10.4-12	0	10.4-48a	21
10.3-6	26	10.4-13	0	10.4-48b	21
10.3-6a	26	10.4-14	2	10.4-49	0
10.3-6b	12	10.4-14a	2	10.4-50	0
10.3-7	26	10.4-14b	2	10.4-51	3
10.3-8	15	10.4-15	9	10.4-52	26
10.3-9	15	10.4-16	0	10.4-53	3
10.3-10	15	10.4-17	26	10.4-54	3
10.3-11	15	10.4-18	8	10.4 Tbl Tab	

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.
Tbl 10.4-1	
Sheet 1	10
Sheet 2	0
Tbl 10.4-2	0
Tbl 10.4-3	0
Tbl 10.4-4	0
Tbl 10.4-5	
Sheet 1	0
Sheet 2	0
Tbl 10.4-6	
Sheet 1	8
Sheet 2	8
Tbl 10.4-7	0
Tbl 10.4-8	0
Tbl 10.4-9	
Sheet 1	0
Sheet 2	0
Tbl 10.4-10	0
Tbl 10.4-11	
Sheet 1	0
Sheet 2	0
Tbl 10.4-12	18
10.4 Fig. Tab	
Fig. 10.4-1	
Sheet 1	26
Sheet 2	26
Fig. 10.4-2	
Sheet 1	26
Sheet 2	26
Fig. 10.4-3	
Sheet 1	27
Sheet 2	27
Fig. 10.4-4	
Sheet 1	26
Sheet 2	26
Fig. 10.4-5	
Sheet 1	26
Sheet 2	26
Fig. 10.4-6	
Sheet 1	26
Sheet 2	26
Fig. 10.4-7	
Sheet 1	26
Sheet 2	26
Fig. 10.4-8	
Sheet 1	26
Sheet 2	26
Fig. 10.4-9	
Sheet 1	26
Sheet 2	26
Fig. 10.4-10	
Sheet 1	27
Sheet 2	27
Sheet 3	26
Fig. 10.4-11	
Sheet 1	26
Sheet 2	26
Fig. 10.4-12	
Sheet 1	27
Sheet 2	27
Fig. 10.4-13	
Sheet 1	27
Sheet 2	27
Sheet 3	26
Fig. 10.4-14	
Sheet 1	27
Sheet 2	27
Fig. 10.4-15	
Sheet 1	27
Sheet 2	27
Fig. 10.4-16	24
Fig. 10.4-17	24
Fig. 10.4-18	24
Fig. 10.4-19	24
Fig. 10.4-19	
Sheet 1	26
Sheet 2	26
Fig. 10.4-20	26
Fig. 10.4-21	
Sheet 1	26
Sheet 2	26
Fig. 10.4-22	
Sheet 1	26
Sheet 2	26
Fig. 10.4-22A	27
Fig. 10.4-23	0
Fig. 10.4-24	27
Fig. 10.4-25	
Sheet 1	27
Sheet 2	27
Fig. 10.4-26	
Sheet 1	27
Sheet 2	27
Fig. 10.4-27	26
Fig. 10.4-28	
Sheet 1	26
Sheet 2	26
Chapter 11 Tab	
11-i	0
11-ii	13
11-iii	4
11-iv	6
11-v	0
11-vi	0
11-vii	0
11-viii	0
11-ix	19
11-x	19
11-xa	19
11-xb	19
11-xi	6
11-1	0
11.1 Tab	
11.1-1	0
11.1-2	0
11.1-3	0
11.1-4	0
11.1-5	0
11.1-6	0
11.1-7	0
11.1-8	0
11.1-9	0
11.1-10	0
11.1-11	0
11.1-12	0
11.1-13	0
11.1-14	0
11.1-15	0
11.1-16	0
11.1 Tbl Tab	
Tbl 11.1-1	0
Tbl 11.1-2	0
Tbl 11.1-3	0
Tbl 11.1-4	0
Tbl 11.1-5	0
Tbl 11.1-6	0
Tbl 11.1-7	
Sheet 1	0
Sheet 2	0
Tbl 11.1-8	0
Tbl 11.1-9	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Tbl 11.1-10	0	11.2 Fig. Tab		Tbl 11.3-14	27
Tbl 11.1-11	0	Fig. 11.2-1		Tbl 11.3-15	10
Tbl 11.1-12	0	Sheet 1	27	Tbl 11.3-16	10
Tbl 11.1-13	0	Sheet 2	26	Tbl 11.3-17	10
Tbl 11.1-14		Fig. 11.2-2		Tbl 11.3-18	27
Sheet 1	0	Sheet 1	27	Tbl 11.3-19	27
Sheet 2	0	Sheet 2	27	Tbl 11.3-20	10
Tbl 11.1-15		Fig. 11.2-3		Tbl 11.3-21	27
Sheet 1	5	Sheet 1	26	Tbl 11.3-22	10
Sheet 2	5	Sheet 2	26	Tbl 11.3-23	10
Tbl 11.1-16	5	Fig. 11.2-4	26	Tbl 11.3-24	10
Tbl 11.1-17	25	Fig. 11.2-5	0	Tbl 11.3-25	27
11.2 Tab		Fig. 11.2-6	27	11.3 Fig. Tab	
11.2-1	0	11.3 Tab		Fig. 11.3-1	0
11.2-2	0	11.3-1	0	Fig. 11.3-2	
11.2-3	0	11.3-2	27	Sheet 1	27
11.2-4	0	11.3-3	0	Sheet 2	27
11.2-5	0	11.3-4	27	Fig. 11.3-3	0
11.2-6	0	11.3-5	20	Fig. 11.3-4	24
11.2-7	0	11.3-6	20	Fig. 11.3-5	7
11.2-8	0	11.3-7	20	Fig. 11.3-6	7
11.2-9	27	11.3-8	20	Fig. 11.3-7	21
11.2-10	27	11.3-8a	27	Fig. 11.3-8	14
11.2-11	27	11.3-8b	13	Fig. 11.3-9	13
11.2 Tbl Tab		11.3-9	0	Fig. 11.3-10	3
Tbl 11.2-1		11.3-10	0	11.4 Tab	
Sheet 1	0	11.3-11	0	11.4-1	0
Sheet 2	0	11.3-12	0	11.4-2	0
Sheet 3	0	11.3-13	0	11.4-3	20
Sheet 4	27	11.3-14	0	11.4-4	20
Sheet 5	27	11.3-15	0	11.4-4a	20
Sheet 6	27	11.3 Tbl Tab		11.4-4b	17
Sheet 7	27	Tbl 11.3-1	27	11.4-5	4
Sheet 8	0	Tbl 11.3-2	0	11.4-6	4
Tbl 11.2-2	13	Tbl 11.3-3	0	11.4-7	4
Tbl 11.2-3		Tbl 11.3-4	0	11.4-8	4
Sheet 1	13	Tbl 11.3-5	0	11.4-9	4
Sheet 2	13	Tbl 11.3-6		11.4 Tbl Tab	
Tbl 11.2-4	0	Sheet 1	0	Tbl 11.4-1	1
Tbl 11.2-5	0	Sheet 2	0	Tbl 11.4-2	
Tbl 11.2-6		Tbl 11.3-7	11	Sheet 1	0
Sheet 1	0	Tbl 11.3-8	13	Sheet 2	0
Sheet 2	0	Tbl 11.3-9	10	Tbl 11.4-3	0
Tbl 11.2-7	0	Tbl 11.3-10	10	Tbl 11.4-4	0
Tbl 11.2-8	10	Tbl 11.3-11	27	Tbl 11.4-5	0
Tbl 11.2-9	27	Tbl 11.3-12	10	Tbl 11.4-6	
Tbl 11.2-10	10	Tbl 11.3-13	10	Sheet 1	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Sheet 2	0	Sheet 2	20	xxvii	26
Sheet 3	0	Tbl 11.5-6		xxviii	26
Sheet 4	0	Sheet 1	20	xxix	26
Sheet 5	0	Sheet 2	20	xxx	26
Tbl 11.4-7	0	11.6 Tab		xxxi	26
Tbl 11.4-8	4	11.6-1	6	xxxii	26
Tbl 11.4-9	17	11.6-2	6	Chapter 12 Tab	
11.4 Fig. Tab		11.6-3	6	12-i	26
Fig. 11.4-1	26	11.6-4	6	12-ii	0
Fig. 11.4-2		11.6-5	6	12-iii	0
Sheet 1	26	11.6-6	6	12-iv	8
Sheet 2	26	11.6-7	6	12-v	19
Sheet 3	26	11.6 Tbl Tab		12-vi	0
Sheet 4	26	Tbl 11.6-1	7	12-vii	0
Fig. 11.4-3	1	Tbl 11.6-2	6	12-viii	0
Fig. 11.4-4	18	Tbl 11.6-3	7	12.1 Tab	
Fig. 11.4-5	18	11.6 Fig. Tab		12.1-1	0
11.5 Tab		Fig. 11.6-1	6	12.1-2	0
11.5-1	19			12.1-3	0
11.5-2	19	VOLUME 18		12.1-4	
11.5-3	19			12.1-5	20
11.5-4	19	i	12	12.1-6	20
11.5-5	19	ii	12	12.2 Tab	
11.5-6	20	iii	21	12.2-1	20
11.5-7	26	iv	21	12.2-2	0
11.5-8	19	v	21	12.2-3	0
11.5-9	19	vi	21	12.2-4	0
11.5-10	20	vii	21	12.2-5	0
11.5-11	19	viii	21	12.2-6	0
11.5-12	20	ix	21	12.2-7	0
11.5-13	20	x	21	12.2-8	20
11.5-14	20	xi	21	12.2 Tbl Tab	
11.5 Tbl Tab		xii	21	Tbl 12.2-1	13
Tbl 11.5-1		xiii	15	Tbl 12.2-2	0
Sheet 1	20	xiv	21	Tbl 12.2-3	0
Sheet 2	20	xv	21	Tbl 12.2-4	0
Tbl 11.5-2		xvi	12	Tbl 12.2-5	0
Sheet 1	20	xvii	12	Tbl 12.2-6	0
Sheet 2	19	xviii	21	Tbl 12.2-7	0
Tbl 11.5-3	20	xix	26	Tbl 12.2-8	0
Tbl 11.5-4		xx	26	Tbl 12.2-9	0
Sheet 1	20	xxi	12	Tbl 12.2-10	0
Sheet 2	20	xxii	26	Tbl 12.2-11	0
Sheet 3	20	xxiii	26	Tbl 12.2-12	13
Sheet 4	20	xxiv	26	Tbl 12.2-13	0
Tbl 11.5-5		xxv	26	Tbl 12.2-14	0
Sheet 1	20	xxvi	26	Tbl 12.2-15	

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Sheet 1	0	12.3 Tbl Tab		Fig. 12.3-18	17
Sheet 2	0	Tbl 12.3-1	0	Fig. 12.3-19	21
Sheet 3	0	Tbl 12.3-2		Fig. 12.3-20	14
Tbl 12.2-16		Sheet 1	20	Fig. 12.3-21	17
Sheet 1	0	Sheet 2	19	Fig. 12.3-22	17
Sheet 2	0	Tbl 12.3-3	20	Fig. 12.3-23	14
Sheet 3	0	Tbl 12.3-4	0	Fig. 12.3-24	17
Sheet 4	0	Tbl 12.3-5		Fig. 12.3-25	14
Sheet 5	0	Sheet 1	27	Fig. 12.3-26	0
Sheet 6	0	Sheet 2	27	Fig. 12.3-27	0
12.3 Tab		Sheet 3	27	Fig. 12.3-28	14
12.3-1	0	Sheet 4	27	Fig. 12.3-29	0
12.3-2	27	Sheet 5	27	Fig. 12.3-30	0
12.3-3	27	Sheet 6	27	Fig. 12.3-31	1
12.3-4	8	Sheet 7	27	Fig. 12.3-32	1
12.3-4a	8	Sheet 8	27	Fig. 12.3-33	1
12.3-4b	8	Sheet 9	27	Fig. 12.3-34	1
12.3-5	0	Sheet 10	27	Fig. 12.3-35	1
12.3-6	0	Sheet 11	27	Fig. 12.3-36	1
12.3-7	9	Sheet 12	27	Fig. 12.3-37	0
12.3-8	4	Sheet 13	27	Fig. 12.3-38	0
12.3-9	27	Sheet 14	27	Fig. 12.3-39	23
12.3-10	0	Sheet 15	27	Fig. 12.3-40	15
12.3-11	27	Sheet 16	27	Fig. 12.3-41	21
12.3-12	0	Sheet 17	27	Fig. 12.3-42	26
12.3-13	0	Sheet 18	27	Fig. 12.3-43	27
12.3-14	0	Sheet 19	27	12.4 Tab	
12.3-15	0	Sheet 20	27	12.4-1	0
12.3-16	0	Sheet 21	27	12.4-2	0
12.3-17	0	12.3 Fig. Tab		12.4-3	19
12.3-18	0	Fig. 12.3-1	26	12.4-4	8
12.3-19	19	Fig. 12.3-2	27	12.4-5	0
12.3-20	19	Fig. 12.3-3	0	12.4 Tbl Tab	
12.3-21	19	Fig. 12.3-4	21	Tbl 12.4-1	
12.3-22	19	Fig. 12.3-5	0	Sheet 1	13
12.3-23	19	Fig. 12.3-6	5	Sheet 2	13
12.3-24	19	Fig. 12.3-7	0	Tbl 12.4-2	
12.3-25	19	Fig. 12.3-8	0	Sheet 1	13
12.3-26	19	Fig. 12.3-9	27	Sheet 2	13
12.3-27	19	Fig. 12.3-10	0	Tbl 12.4-3	0
19.3-28	19	Fig. 12.3-11	27	Tbl 12.4-4	0
12.3-29	19	Fig. 12.3-12	0	Tbl 12.4-5	0
12.3-30	19	Fig. 12.3-13	21	Tbl 12.4-6	0
12.3-31	19	Fig. 12.3-14	0	Tbl 12.4-7	0
12.3-32	19	Fig. 12.3-15	0	Tbl 12.4-8	8
12.3-33	20	Fig. 12.3-16	14	12.5 Tab	
12.3-34	20	Fig. 12.3-17	14	12.5-1	11

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
12.5-2	11	13.1-14	0	Tbl 13.2-2	20
12.5-3	11	13.1-15	8	13.2 Fig. Tab	
12.5-4	11	13.1-16	8	Fig. 13.2-1	20
12.5-5	11	13.1-17	20	Fig. 13.2-2	20
12.5-6	11	13.1-18	20	Fig. 13.2-3	0
12.5-7	11	13.1-19	23	Fig. 13.2-4	0
12.5-8	11	13.1-20	23	Fig. 13.2-5	0
12.5-9	11	13.1-21	23	13.3 Tab	
12.5-10	11	13.1-22	23	13.3-1	5
12.5-11	11	13.1-23	27	13.4 Tab	
12.5-12	11	13.1-24	23	13.4-1	18
12.5-13	11	13.1-25	10	13.4-2	18
12.5-14	11	13.1-26	8	13.4-3	0
12.5-15	11	13.1 Tbl Tab		13.4-4	0
12.5-16	11	Tbl 13.1-1	18	13.4-5	15
12.5-17	11	13.1 Fig. Tab		13.4-6	18
12.5-18	11	Fig. 13.1-1	0	13.4-7	18
12.5-19	11	Fig. 13.1-2	0	13.5 Tab	
12.5-20	11	Fig. 13.1-3	20	13.5-1	0
12.5-21	11	13.2 Tab		13.5-2	0
12.5-22	11	13.2-1	16	13.5-3	13
12.5-23	20	13.2-2	20	13.5-4	13
12.5-24	0	13.2-2a	20	13.5-5	13
12.5 Fig. Tab		13.2-2b	16	13.5-6	13
Fig. 12.5-1	26	13.2-3	14	13.5-7	13
Chapter 13 Tab		13.2-4	20	13.5-8	13
13-i	26	13.2-5	20	13.5 Fig. Tab	
13-ii	5	13.2-6	20	Fig. 13.5-1	8
13-iii	13	13.2-7	20	Fig. 13.5-2	3
13-iv	14	13.2-8	20	13.6 Tab	
13-v	5	13.2-9	20	13.6-1	7
13.1 Tab		13.2-10	20	App 13A Tab	
13.1-1	0	13.2-11	20	13A-i	1
13.1-2	0	13.2-12	20	13A.1-1	0
13.1-3	0	13.2-13	15	13A.1-2	0
13.1-4	0	13.2-14	15	13A.1-3	0
13.1-5	18	13.2-14a	15	13A.1-4	0
13.1-6	0	13.2-14b	15	13A.1-5	0
13.1-7	0	13.2-15	11	13A.1-6	0
13.1-8	0	13.2-16	8	13A.1-7	0
13.1-9	0	13.2-17	8	13A.1-8	0
13.1-10	3	13.2-18	8	13A.1-9	0
13.1-11	3	13.2-19	8	13A.1-10	0
13.1-12	3	13.2-20	8	13A.1-11	0
13.1-12a	3	13.2-21	8	13A.1-12	0
13.1-12b	3	13.2 Tbl Tab		13A.1-13	0
13.1-13	0	Tbl 13.2-1	25	13A.1-14	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
13A.1-15	0	13A.2-36	25	xiv	21
13A.1-16	0	13A.2-37	12	xv	21
13A.1-17	0	13A.2-38	12	xvi	12
13A.1-18	0	13A.2-39	12	xvii	12
13A.1-19	1	13A.2-40	20	xviii	21
13A.1-20	0	13A.2-41	20	xix	26
13A.1-21	3	13A.2-42	12	xx	26
13A.1-22	3	13A.2-43	12	xxi	12
13A.1-23	5	13A.2-44	12	xxii	26
13A.1-24	5	13A.2-45	12	xxiii	26
13A.1-25	16	13A.2-46	12	xxiv	26
13A.1-26	16	13A.2-47	12	xxv	26
13A.2-1	0	13A.2-48	12	xxvi	26
13A.2-2	0	13A.2-49	12	xxvii	26
13A.2-3	0	13A.2-50	12	xxviii	26
13A.2-4	12	13A.2-51	12	xxix	26
13A.2-5	12	13A.2-52	12	xxx	26
13A.2-6	12	13A.2-53	12	xxxi	26
13A.2-7	12	13A.2-54	12	xxxii	26
13A.2-8	12	13A.2-55	12	Chapter 14 Tab	
13A.2-9	12	13A.2-56	12	14-i	26
13A.2-10	18	13A.2-57	20	14-ii	26
13A.2-11	18	13A.2-58	12	14-iii	0
13A.2-12	20	13A.2-59	12	14-iv	0
13A.2-13	18	13A.2-60	12	14.1 Tab	
13A.2-14	12	13A.2-61	12	14.1-1	0
13A.2-15	12	13A.2-62	12	14.2 Tab	
13A.2-16	25	13A.2-63	12	14.2-1	0
13A.2-17	25	13A.2-64	12	14.2-2	0
13A.2-18	25	13A.2-65	12	14.2-3	0
13A.2-19	25	13A.2-66	20	14.2-4	0
13A.2-20	12			14.2-5	18
13A.2-21	25	VOLUME 19		14.2-6	18
13A.2-22	25			14.2-7	20
13A.2-23	12	i	12	14.2-8	20
13A.2-24	12	ii	12	14.2-9	20
13A.2-25	12	iii	21	14.2-10	20
13A.2-26	12	iv	21	14.2-11	20
13A.2-27	12	v	21	14.2-12	20
13A.2-28	12	vi	21	14.2-13	20
13A.2-29	12	vii	21	14.2-14	20
13A.2-30	12	viii	21	14.2-14a	20
13A.2-31	12	ix	21	14.2-14b	20
13A.2-32	12	x	21	14.2-15	20
13A.2-33	12	xi	21	14.2-16	18
13A.2-34	12	xii	21	14.2-16a	18
13A.2-35	12	xiii	15	14.2-16b	18

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
14.2-17	0	14A.1-11	21	14A.1-52	0
14.2-18	0	14A.1-12	21	14A.1-53	0
14.2-19	26	14A.1-12a	21	14A.1-54	0
14.2-20	0	14A.1-12b	21	14A.1-55	21
14.2-21	20	14A.1-13	21	14A.1-56	21
14.2-22	0	14A.1-14	0	14A.1-56a	21
14.2-23	0	14A.1-15	0	14A,1-56b	21
14.2-24	19	14A.1-16	21	14A.1-57	0
14.2-25	19	14A.1-17	20	14A.1-58	0
14.2-26	21	14A.1-18	20	14A.1-59	0
14.2-26a	21	14A.1-19	23	14A.1-60	0
14.2-26b	9	14A.1-20	20	14A.1-61	0
14.2-27	0	14A.1-21	20	14A.1-62	0
14.2-28	0	14A.1-22	20	14A.1-63	23
14.2-29	0	14A.1-23	21	14A.1-64	0
14.2-30	0	14A.1-24	20	14A.1-65	0
14.2-31	0	14A.1-24a	21	14A.1-66	0
14.2-32	0	14A.1-24b	20	14A.1-67	0
14.2-33	0	14A.1-25	27	14A.1-68	0
14.2 Tbl Tab		14A.1-26	27	14A.1-69	23
Tbl 14.2-1		14A.1-27	27	14A.1-70	0
Sheet 1	0	14A.1-28	20	14A.1-71	0
Sheet 2	0	14A.1-29	20	14A.1-72	0
Sheet 3	0	14A.1-30	21	14A.1-73	19
Sheet 4	21	14A.1-30a	21	14A.1-74	21
Tbl 14.2-2	19	14A.1-30b	21	14A.1-75	21
Tbl 14.2-3	19	14A.1-31	0	14A.1-76	27
Tbl 14.2-4		14A.1-32	0	14A.2-1	0
Sheet 1	19	14A.1-33	27	14A.2-2	0
Sheet 2	19	14A.1-34	20	14A.2-3	0
14.2 Fig. Tab		14A.1-35	0	14A.2-4	19
Fig. 14.2-1	18	14A.1-36	20	14A.2-5	0
Fig. 14.2-2	20	14A.1-37	0	14A.2-6	0
Fig. 14.2-3	20	14A.1-38	0	14A.2-7	0
App 14A Tab		14A.1-39	0	14A.2-8	0
14A.1-1	20	14A.1-40	0	14A.2-9	0
14A.1-2	20	14A.1-41	0	14A.3-1	0
14A.1-3	20	14A.1-42	0	14A.3-2	19
14A.1-4	20	14A.1-43	0	14A.3-2a	19
14A.1-5	20	14A.1-44	20	14A.3-2b	19
14A.1-6	20	14A.1-45	21	14A.3-3	0
14A.1-6a	20	14A.1-46	21	14A.3-4	0
14A.1-6b	20	14A.1-47	20	14A.3-5	0
14A.1-7	0	14A.1-48	20	14A.3-6	19
14A.1-8	20	14A.1-49	0	14A.4-1	0
14A.1-9	0	14A.1-50	10	14A.4-2	0
14A.1-10	0	14A.1-51	21	14A.4-3	0

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
14A.4-4	19	15-xxvii	13	15.1-4	12
14A.4-5	19	15-xxviii	13	15.1-5	9
14A.4-6	0	15.0 Tab		15.1-6	9
14A.4-7	0	15.0-1	0	15.1-7	9
14A.4-8	0	15.0-2	18	15.1-8	10
14A.4-9	19	15.0-3	26	15.1-8a	10
14A.4-10	0	15.0-4	0	15.1-8b	10
14A.4-11	0	15.0-5	18	15.1-9	19
14A.4-12	0	15.0-6	18	15.1-10	19
14A.4-13	21	15.0-7	18	15.1-11	26
14A.4-14	0	15.0-8	26	15.1-12	26
14A.4-15	0	15.0-9	9	15.1-13	9
14A.4-16	0	15.0 Tbl Tab		15.1-14	7
14A.4-17	0	Tbl 15.0-1		15.1 Tbl Tab	
14A.4-18	0	Sheet 1	3	Tbl 15.1-1	0
14A.4-19	19	Sheet 2	3	Tbl 15.1-2	0
14A.4-20	19	Sheet 3	2	Tbl 15.1-3	0
14A.4-21	19	Sheet 4	4	Tbl 15.1-4	0
Chapter 15 Tab		Sheet 5	2	Tbl 15.1-5	7
15-i	18	Sheet 6	2	Tbl 15.1-6	7
15-ii	9	Tbl 15.0-2		Tbl 15.1-7	7
15-iii	9	Sheet 1	9	Tbl 15.1-8	7
15-iv	7	Sheet 2	9	Tbl 15.1-9	19
15-v	3	Sheet 3	9	Tbl 15.1-10	24
15-vi	26	Tbl 15.0-3		Tbl 15.1-11	19
15-vii	26	Sheet 1	13	Tbl 15.1-12	7
15-viii	3	Sheet 2	13	Tbl 15.1-12A	10
15-ix	11	Tbl 15.0-4		Tbl 15.1-13	19
15-x	18	Sheet 1	2	Tbl 15.1-14	7
15-xi	18	Sheet 2	2	Tbl 15.1-15	
15-xii	18	Tbl 15.0-5		Sheet 1	7
15-xiia	18	Sheet 1	0	Sheet 2	7
15-xiib	18	Sheet 2	0	Tbl 15.1-16	
15-xiii	11	Tbl 15.0-6		Sheet 1	7
15-xiv	11	Sheet 1	13	Sheet 2	18
15-xv	11	Sheet 2	13	Tbl 15.1-17	7
15-xvi	19	Sheet 3	13	15.1 Fig. Tab	
15-xvii	13	Tbl 15.0-7	18	Fig. 15.1-1	0
15-xviii	15	15.0 Fig. Tab		Fig. 15.1-2	0
15-xix	14	Fig. 15.0-1	0	Fig. 15.1-2A	12
15-xx	13	Fig. 15.0-2	0	Fig. 15.1-3	7
15-xxi	13	Fig. 15.0-3	0	Fig. 15.1-4	7
15-xxii	13	Fig. 15.0-4	9	Fig. 15.1-5	3
15-xxiii	13	15.1 Tab		Fig. 15.1-6	3
15-xxiv	17	15.1-1	0	Fig. 15.1-7	7
15-xxv	13	15.1-2	0	Fig. 15.1-8	7
15-xxvi	13	15.1-3	0	Fig. 15.1-8A	10

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Fig. 15.1-9	19	Fig. 15.2-2	0	15.4-12	0
Fig. 15.1-10	19	Fig. 15.2-3	2	15.4-13	0
Fig. 15.1-11	19	Fig. 15.2-3A	12	15.4-14	0
15.2 Tab		Fig. 15.2-4	7	15.4-15	0
15.2-1	3	Fig. 15.2-5	2	15.4-16	0
15.2-2	9	Fig. 15.2-6	7	15.4-17	0
15.2-3	3	Fig. 15.2-7	7	15.4-18	0
15.2-4	10	Fig. 15.2-8	15	15.4-19	0
15.2-5	3	15.3 Tab		15.4-20	0
15.2-6	10	15.3-1	2	15.4-21	3
15.2-6a	10	15.3-2	2	15.4-22	12
15.2-6b	10	15.3-3	2	15.4-23	2
15.2-7	18	15.3-4	0	15.4-24	21
15.2-8	18	15.3-5	0	15.4-25	21
15.2-8a	15	15.3-6	16	15.4-26	26
15.2-8b	15	15.3-7	16	15.4-26a	21
15.2-9	9	15.3-8	0	15.4-26b	21
15.2-10	9	15.3 Tbl Tab		15.4-27	0
15.2-10a	9	Tbl 15.3-1	2	15.4-28	0
15.2-10b	9	Tbl 15.3-2	2	15.4-29	0
15.2-11	3	Tbl 15.3-3	0	15.4-30	0
15.2-12	12	Tbl 15.3-4	2	15.4-31	0
15.2-13	9	Tbl 15.3-5	16	15.4-32	2
15.2-14	7	15.3 Fig. Tab		15.4-33	8
15.2-15	7	Fig. 15.3-1	0	15.4-34	8
15.2-16	7	Fig. 15.3-2	0	15.4-35	18
15.2-17	7	Fig. 15.3-3	0	15.4 Tbl Tab	
15.2 Tbl Tab		Fig. 15.3-4	0	Tbl 15.4-1	0
Tbl 15.2-1	0	Fig. 15.3-5	0	Tbl 15.4-2	9
Tbl 15.2-2		Fig. 15.3-6	0	Tbl 15.4-2a	9
Sheet 1	18	Fig. 15.3-7	0	Tbl 15.4-3	0
Sheet 2	18	Fig. 15.3-8	2	Tbl 15.4-4	9
Tbl 15.2-3	0	Fig. 15.3-9	2	Tbl 15.4-4a	9
Tbl 15.2-4		Fig. 15.3-10	2	Tbl 15.4-5	13
Sheet 1	18	Fig. 15.3-11	2	Tbl 15.4-6	13
Sheet 2	18	15.4 Tab		Tbl 15.4-7	13
Tbl 15.2-5	2	15.4-1	0	Tbl 15.4-8	13
Tbl 15.2-6	0	15.4-2	9	Tbl 15.4-9	0
Tbl 15.2-7	7	15.4-3	12	Tbl 15.4-10	0
Tbl 15.2-8	7	15.4-4	9	Tbl 15.4-11	3
Tbl 15.2-9	7	15.4-5	0	Tbl 15.4-12	3
Tbl 15.2-10	7	15.4-6	0	Tbl 15.4-13	0
Tbl 15.2-11		15.4-7	0	Tbl 15.4-14	0
Sheet 1	7	15.4-8	0	Tbl 15.4-15	3
Sheet 2	7	15.4-9	0	Tbl 15.4-16	0
15.2 Fig. Tab		15.4-10	0	Tbl 15.4-17	
Fig. 15.2-1	0	15.4-11	0	Sheet 1	18

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.
Sheet 2	18
Sheet 3	18
Sheet 4	18
Tbl 15.4-18	18
15.4 Fig. Tab	
Fig. 15.4-1	3
Fig. 15.4-1A	12
Fig. 15.4-2	0
Fig. 15.4-2A	13
Fig. 15.4-3	0
Fig. 15.4-4	0
Fig. 15.4-5	3
Fig. 15.4-6	3
Fig. 15.4-7	0
Fig. 15.4-8	0
Fig. 15.4-9	0
Fig. 15.4-10	0
Fig. 15.4-11	0
Fig. 15.4-12	0
Fig. 15.4-13	0
Fig. 15.4-14	0
Fig. 15.4-15	0
Fig. 15.4-16	0
Fig. 15.4-17	0
Fig. 15.4-18	0
Fig. 15.4-19	0
Fig. 15.4-20	0
Fig. 15.4-21	0
Fig. 15.4-22	0
Fig. 15.4-23	0
Fig. 15.4-24	0
Fig. 15.4-25	0
Fig. 15.4-26	0
Fig. 15.4-27	0
Fig. 15.4-28	0
Fig. 15.4-29	0
Fig. 15.4-30	0
Fig. 15.4-31	0
Fig. 15.4-32	0
Fig. 15.4-33	0
Fig. 15.4-34	0
Fig. 15.4-35	0
Fig. 15.4-36	0
Fig. 15.4-37	0
Fig. 15.4-38	0
Fig. 15.4-39	0
Fig. 15.4-39A	12
Fig. 15.4-40	0
Fig. 15.4-41	0
Fig. 15.4-42	0
Fig. 15.4-43	0
Fig. 15.4-44	0
Fig. 15.4-45	0
Fig. 15.4-46	0
Fig. 15.4-47	0
Fig. 15.4-48	0
Fig. 15.4-49	2
Fig. 15.4-50	8
Fig. 15.4-51	8
Fig. 15.4-52	9
Fig. 15.4-52a	12
15.5 Tab	
15.5-1	9
15.5-2	9
15.5-3	9
15.6 Tab	
15.6-1	10
15.6-2	23
15.6-2a	12
15.6-2b	3
15.6-3	0
15.6-4	3
15.6-5	25
15.6-6	25
15.6-6a	25
15.6-6b	25
15.6-7	3
15.6-8	8
15.6-8a	8
15.6-8b	8
15.6-9	0
15.6-10	18
15.6-11	14
15.6-12	14
15.6-13	17
15.6-14	14
15.6-15	14
15.6-16	14
15.6-17	14
15.6 Tbl Tab	
Tbl 15.6-1	0
Tbl 15.6-2	3
Tbl 15.6-3	
Sheet 1	0
Sheet 2	18
Tbl 15.6-4	18
Tbl 15.6-5	0
Tbl 15.6-6	0
Tbl 15.6-7	
Sheet 1	18
Sheet 2	18
Sheet 3	18
Tbl 15.6-8	18
Tbl 15.6-9	18
Tbl 15.6-10	
Sheet 1	18
Sheet 2	18
Sheet 3	18
Sheet 4	18
Tbl 15.6-11	
Sheet 1	18
Sheet 2	18
Tbl 15.6-12	0
Tbl 15.6-13	0
Tbl 15.6-14	0
Tbl 15.6-15	3
15.6 Fig. Tab	
Fig. 15.6-1	0
Fig. 15.6-2	3
Fig. 15.6-3	3
Fig. 15.6-4	8
15.7 Tab	
15.7-1	0
15.7-2	0
15.7-3	0
15.7-4	20
15.7-5	20
15.7-6	0
15.7-7	0
15.7 Tbl Tab	
Tbl 15.7-1	
Sheet 1	18
Sheet 2	18
Tbl 15.7-2	18
Tbl 15.7-3	18
Tbl 15.7-4	18
Tbl 15.7-5	
Sheet 1	18
Sheet 2	18
Sheet 3	18
Tbl 15.7-6	18

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Tbl 15.7-7	18	Tbl 15A-3	19	Tbl 15C-13	
15.8 Tab		Tbl 15A-4	0	Sheet 1	9
15.8-1	0	Tbl 15A-5	0	Sheet 2	9
		App 15B Tab		Tbl 15C-14	
VOLUME 20		15B.1-1	0	Sheet 1	9
		15B.1-2	27	Sheet 2	9
i	12	15B.1-3	27	Tbl 15C-15	
ii	12	15B.1-4	27	Sheet 1	9
iii	21	15B.1-5	0	Sheet 2	9
iv	21	15B.1-6	27	Tbl 15C-16	17
v	21	15B.1-7	27	Fig. 15C-1	9
vi	21	15B.1-8	27	Fig. 15C-2	9
vii	21	15B.1-9	0	Fig. 15C-3	9
viii	21	15B.1-10	0	Fig. 15C-4	9
ix	21	15B.1-11	0	Fig. 15C-5	9
x	21	15B.1-12	0	Fig. 15C-6	9
xi	21	Tbl 15B-1	0	Fig. 15C-7a	9
xii	21	Tbl 15B-2	0	Fig. 15C-7b	9
xiii	15	Tbl 15B-3	0	Fig. 15C-8	9
xiv	21	Tbl 15B-4	0	Fig. 15C-9	9
xv	21	Fig. 15B-1	9	Fig. 15C-10	9
xvi	12	Fig. 15B-2	9	Fig. 15C-10A	17
xvii	12	App 15C Tab		Fig. 15C-11	17
xviii	21	15C-1	9	App 15D Tab	
xix	26	15C-2	9	15D-1	10
xx	26	15C-3	17	15D-2	10
xxi	12	15C-4	9	15D-3	10
xxii	26	15C-5	17	15D-4	10
xxiii	26	15C-6	17	15D-5	19
xxiv	26	Tbl 15C-1	9	15D-6	19
xxv	26	Tbl 15C-2	9	15D-7	19
xxvi	26	Tbl 15C-3		Tbl 15D-1	10
xxvii	26	Sheet 1	9	Tbl 15D-2	10
xxviii	26	Sheet 2	9	Tbl 15D-3	
xxix	26	Tbl 15C-4	9	Sheet 1	10
xxx	26	Tbl 15C-5	9	Sheet 2	10
xxxi	26	Tbl 15C-6	9	Tbl 15D-4	10
xxxii	26	Tbl 15C-7	9	Tbl 15D-5	10
App 15A Tab		Tbl 15C-8	9	Tbl 15D-6	10
15A-1	0	Tbl 15C-9	11	Tbl 15D-7	10
15A-2	0	Tbl 15C-10	9	Tbl 15D-8	10
15A-3	0	Tbl 15C-11		Tbl 15D-9	10
Tbl 15A-1		Sheet 1	9	Tbl 15D-10	10
Sheet 1	0	Sheet 2	9	Tbl 15D-11,12	10
Sheet 2	0	Tbl 15C-12		Tbl 15D-12A	19
Sheet 3	0	Sheet 1	9	Tbl 15D-13	10
Tbl 15A-2	0	Sheet 2	9	Tbl 15D-14	10

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
Tbl 15D-15	10	15E-21	11	15E-68	11
Tbl 15D-16	10	15E-22	11	15E-69	18
Tbl 15D-17	10	15E-23	11	15E-70	11
Tbl 15D-18	10	15E-24	11	15E-71	11
Tbl 15D-19	10	15E-25	11	15E-72	12
Tbl 15D-20	10	15E-26	11	15E-73	11
Fig. 15D-1	10	15E-27	11	15E-74	11
Fig. 15D-2	10	15E-28	11	15E-75	11
Fig. 15D-3	10	15E-29	11	15E-76	12
Fig. 15D-4	10	15E-30	11	15E-77	11
Fig. 15D-5	10	15E-31	11	15E-78	12
Fig. 15D-6	10	15E-32	11	15E-79	11
Fig. 15D-7	10	15E-33	11	15E-80	11
Fig. 15D-8	10	15E-34	11	15E-81	11
Fig. 15D-9	10	15E-35	18	15E-82	11
Fig. 15D-10	10	15E-36	11	15E-83	11
Fig. 15D-11	10	15E-37	11	15E-84	11
Fig. 15D-12	10	15E-38	12	15E-85	11
Fig. 15D-13	10	15E-39	11	15E-86	12
Fig. 15D-14	10	15E-40	11	15E-87	11
Fig. 15D-15	10	15E-41	11	15E-88	11
Fig. 15D-16	10	15E-42	11	Tbl 15E-1	11
Fig. 15D-17	10	15E-43	11	Tbl 15E-2	
Fig. 15D-18	10	15E-44	11	Sheet 1	11
Fig. 15D-19	10	15E-45	26	Sheet 2	11
Fig. 15D-20	10	15E-46	11	Sheet 3	11
App 15E Tab		15E-47	11	Sheet 4	11
15E-1	11	15E-48	11	Tbl 15E-3	11
15E-2	11	15E-49	11	Chapter 16 Tab	
15E-3	11	15E-50	11	16-i	5
15E-4	11	15E-51	11	16-ii	5
15E-5	11	15E-52	11	16-iii	26
15E-6	11	15E-53	11	16-iv	26
15E-7	11	15E-54	11	16-v	26
15E-8	11	15E-55	11	16-vi	26
15E-9	11	15E-56	11	16-vii	26
15E-10	11	15E-57	11	16-viii	5
15E-11	11	15E-58	11	16-ix	5
15E-12	11	15E-59	11	16-x	5
15E-13	11	15E-60	11	16-xi	5
15E-14	11	15E-61	11	16-xii	5
15E-15	11	15E-62	11	16-xiii	5
15E-16	12	15E-63	11	16.1 Tab	
15E-17	11	15E-64	11	16.1-1	5
15E-18	11	15E-65	11	16.1-2	5
15E-19	11	15E-66	12	16.1-3	5
15E-20	11	15E-67	11	16.1-4	5

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
16.1-5	5	16.3/4.1-21	5	16.3/4.3-16	20
16.1-6	5	16.3/4.1-22	5	16.3/4.3-17	10
16.1-7	5	16.3/4.1-23	5	16.3/4.3-18	20
16.1-8	5	16.3/4.1-24	5	16.3/4.3-19	5
16.2 Tab		16.3/4.1-25	5	16.3/4.3-20	18
16.2-1	5	16.3/4.1-26	5	16.3/4.3-21	18
16.2-2	5	16.3/4.1-27	5	16.3/4.3-22	20
16.2-3	5	16.3/4.1-28	5	16.3/4.3-23	5
16.2-4	5	16.3/4.1-29	5	16.3/4.3-24	5
16.2-5	5	16.3/4.1-30	5	16.3/4.3-25	18
16.2-6	5	16.3/4.1-31	5	16.3/4.3-26	20
16.2-7	5	16.3/4.1-32	5	16.3/4.3-27	5
16.2-8	5	16.3/4.1-33	5	16.3/4.3-28	20
16.2-9	5	16.3/4.1-34	5	16.3/4.3-29	20
16.2-10	5	16.3/4.1-35	5	16.3/4.3-30	20
16.2-11	5	16.3/4.1-36	5	16.3/4.3-31	20
16.2-12	5	16.3/4.1-37	5	16.3/4.3-32	20
16.2-13	5	16.3/4.1-38	5	16.3/4.3-33	20
16.2-14	5	16.3/4.2-1	5	16.3/4.3-34	5
16.2-15	5	16.3/4.2-2	5	16.3/4.3-35	18
16.2-16	5	16.3/4.2-3	5	16.3/4.3-36	5
16.2-17	5	16.3/4.2-4	5	16.3/4.3-37	18
16.2-18	5	16.3/4.2-5	12	16.3/4.3-38	18
16.3/4 Tab		16.3/4.2-6	5	16.3/4.3-39	5
16.3/4-1	5	16.3/4.2-7	5	16.3/4.3-40	5
16.3/4-2	5	16.3/4.2-8	5	16.3/4.3-41	20
16.3/4-3	5	16.3/4.2-9	5	16.3/4.3-42	18
16.3/4.1-1	21	16.3/4.2-10	5	16.3/4.3-43	5
16.3/4.1-2	21	16.3/4.2-11	5	16.3/4.3-44	5
16.3/4.1-3	5	16.3/4.2-12	5	16.3/4.3-45	5
16.3/4.1-4	5	16.3/4.2-13	5	16.3/4.3-46	20
16.3/4.1-5	5	16.3/4.2-14	5	16.3/4.3-47	5
16.3/4.1-6	5	16.3/4.3-1	5	16.3/4.3-48	5
16.3/4.1-7	5	16.3/4.3-2	5	16.3/4.3-49	5
16.3/4.1-8	5	16.3/4.3-3	10	16.3/4.3-50	5
16.3/4.1-9	5	16.3/4.3-4	5	16.3/4.3-51	5
16.3/4.1-10	5	16.3/4.3-5	26	16.3/4.3-52	5
16.3/4.1-11	5	16.3/4.3-6	5	16.3/4.3-53	5
16.3/4.1-12	5	16.3/4.3-7	5	16.3/4.3-54	5
16.3/4.1-13	10	16.3/4.3-8	5	16.3/4.3-55	5
16.3/4.1-14	5	16.3/4.3-9	25	16.3/4.3-56	20
16.3/4.1-15	5	16.3/4.3-10	25	16.3/4.3-57	5
16.3/4.1-16	5	16.3/4.3-11	20	16.3/4.3-58	5
16.3/4.1-17	5	16.3/4.3-12	20	16.3/4.3-59	5
16.3/4.1-18	5	16.3/4.3-13	18	16.3/4.3-60	5
16.3/4.1-19	5	16.3/4.3-14	5	16.3/4.4-1	5
16.3/4.1-20	5	16.3/4.3-15	20	16.3/4.4-2	25

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
16.3/4.4-3	5	16.3/4.6-3	5	16.3/4.7-12	5
16.3/4.4-4	5	16.3/4.6-4	5	16.3/4.7-13	5
16.3/4.4-5	5	16.3/4.6-5	21	16.3/4.7-14	5
16.3/4.4-6	24	16.3/4.6-6	5	16.3/4.7-15	5
16.3/4.4-7	24	16.3/4.6-7	5	16.3/4.7-16	5
16.3/4.4-8	24	16.3/4.6-8	5	16.3/4.7-17	21
16.3/4.4-9	24	16.3/4.6-9	26	16.3/4.7-18	20
16.3/4.4-10	24	16.3/4.6-10	26	16.3/4.7-19	5
16.3/4.4-11	24	16.3/4.6-11	5	16.3/4.7-20	5
16.3/4.4-12	24	16.3/4.6-12	17	16.3/4.7-21	5
16.3/4.4-12a	24	16.3/4.6-12a	17	16.3/4.7-22	5
16.2/4.4-12b	25	16.3/4.6-12b	26	16.3/4.7-23	5
16.3/4.4-13	25	16.3/4.6-12c	26	16.3/4.7-24	5
16.3/4.4-14	5	16.3/4.6-12d	21	16.3/4.7-25	5
16.3/4.4-15	5	16.3/4.6-13	17	16.3/4.7-26	5
16.3/4.4-16	19	16.3/4.6-14	5	16.3/4.7-27	20
16.3/4.4-17	19	16.3/4.6-15	20	16.3/4.7-28	5
16.3/4.4-18	22	16.3/4.6-16	20	16.3/4.7-29	20
16.3/4.4-19	5	16.3/4.6-17	21	16.3/4.7-30	5
16.3/4.4-20	5	16.3/4.6-18	21	16.3/4.7-31	20
16.3/4.4-21	26	16.3/4.6-19	20	16.3/4.7-32	5
16.3/4.4-22	18	16.3/4.6-20	20	16.3/4.7-33	20
16.3/4.4-23	5	16.3/4.6-21	20	16.3/4.7-34	11
16.3/4.4-24	5	16.3/4.6-22	23	16.3/4.7-35	20
16.3/4.4-25	26	16.3/4.6-23	21	16.3/4.7-36	20
16.3/4.4-26	5	16.3/4.6-24	20	16.3/4.8-1	5
16.3/4.4-27	17	16.3/4.6-25	20	16.3/4.8-2	5
16.3/4.4-28	5	16.3/4.6-26	20	16.3/4.8-3	20
16.3/4.4-29	17	16.3/4.6.26a	18	16.3/4.8-4	20
16.3/4.4-30	5	16.3/4.6-26b	18	16.3/4.8-4a	20
16.3/4.4-31	26	16.3/4.6-27	26	16.3/4.8-4b	20
16.3/4.4-32	22	16.3/4.6-28	26	16.3/4.8-5	5
16.3/4.4-33	22	16.3/4.6-29	5	16.3/4.8-6	26
16.3/4.4-34	22	16.3/4.6-30	5	16.3/4.8-7	5
16.3/4.4-35	22	16.3/4.6-31	5	16.3/4.8-8	26
16.3/4.5-1	5	16.3/4.6-32	5	16.3/4.8-9	5
16.3/4.5-2	25	16.3/4.7-1	5	16.3/4.8-10	5
16.3/4.5-3	5	16.3/4.7-2	5	16.3/4.8-11	5
16.3/4.5-4	11	16.3/4.7-3	10	16.3/4.8-12	5
16.3/4.5-5	5	16.3/4.7-4	5	16.3/4.9-1	5
16.3/4.5-6	5	16.3/4.7-5	20	16.3/4.9-2	5
16.3/4.5-7	21	16.3/4.7-6	14	16.3/4.9-3	5
16.3/4.5-8	21	16.3/4.7-7	11	16.3/4.9-4	5
16.3/4.5-9	21	16.3/4.7-8	5	16.3/4.9-5	14
16.3/4.5-10	21	16.3/4.7-9	5	16.3/4.9-6	14
16.3/4.6-1	5	16.3/4.7-10	5	16.3/4.9-7	5
16.3/4.6-2	8	16.3/4.7-11	5	16.3/4.9-8	18

LIST OF EFFECTIVE PAGES (continued)

Sheet ID	Latest Rev.	Sheet ID	Latest Rev.	Sheet ID	Latest Rev.
16.3/4.9-9	5	16.3/A-32	5	17-i	16
16.3/4.9-10	5	16.3/A-33	5	17-ii	19
16.3/4.9-11	5	16.3/A-34	5	17-iii	18
16.3/4.9-12	5	16.3/A-35	5	17.1 Tab	
16.3/4.9-13	5	16.3/A-36	5	17.1-1	16
16.3/4.9-14	21	16.3/A-37	12	17.1-2	16
16.3/4.9-15	21	16.3/A-38	12	17.1-3	16
16.3/4.9-16	21	16.3/A-39	12	17.1-4	16
16.3/4.9-17	25	16.3/A-40	12	17.1-5	16
16.3/4.9-18	21	16.3/A-41	12	17.1-6	19
16.3/4.10-1	5	16.3/A-42	12	17.1-7	19
16.3/4.10-2	5	16.3/A-43	12	17.1-8	27
16.3/4.10-3	5	16.5 Tab		17.1-9	19
16.3/4.10-4	5	16.5-1	5	17.1-10	19
16.3/4.10-5	5	16.5-2	5	17.1-11	19
App 16.3/4A Tab		16.5-3	5	17.1-12	26
16.3/A-1	5	16.5-4	5	17.1.12a	26
16.3/A-2	5	16.5-5	5	17.1.12b	26
16.3/A-3	5	16.5-6	5	17.1-13	19
16.3/A-4	5	16.5-7	5	17.1-14	19
16.3/A-5	5	16.5-8	5	17.1-15	19
16.3/A-6	5	16.6 Tab		17.1-16	19
16.3/A-7	5	16.6-1	18	17.1-17	19
16.3/A-8	5	16.6-2	5	17.1-18	26
16.3/A-9	5	16.6-3	8	17.1-19	19
16.3/A-10	5	16.6-4	18	17.1-20	19
16.3/A-11	5	16.6-5	5	17.1-21	19
16.3/A-12	5	16.6-6	18	17.1-22	19
16.3/A-13	5	16.6-7	5	17.1-23	19
16.3/A-14	12	16.6-8	5	17.2 Tab	
16.3/A-15	12	16.6-9	5	17.2-1	18
16.3/A-16	5	16.6-10	18	17.2-2	18
16.3/A-17	5	16.6-11	18	17.2-3	20
16.3/A-18	5	16.6-12	15	17.2-4	20
16.3/A-19	5	16.6-13	5	17.2-5	18
16.3/A-20	5	16.6-14	18	17.2-6	18
16.3/A-21	5	16.6-15	5	17.2-7	18
16.3/A-22	22	16.6-16	5	17.2-8	18
16.3/A-23	22	16.6-17	5		
16.3/A-24	22	16.6-18	5		
16.3/A-25	22	16.6-19	5		
16.3/A-26	5	16.6-20	5		
16.3/A-27	5	16.6-21	20		
16.3/A-28	5	16.6-22	20		
16.3/A-29	5	16.6-23	20		
16.3/A-30	5	16.7 Tab			
16.3/A-31	5	Chapter 17 Tab			

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.
3.6-87	Piping Drawing Area 3 Auxiliary Building Plan of El. 634'-6"	M-64 Sh 1
3.6-88	Piping Drawing Area 3 Auxiliary Building Plan of El. 634'-6"	M-64 Sh 2
3.6-89	Area 1 Auxiliary Building Plan of El. 645'-0"	M-36 Sh 1
3.6-90	Area 1 Auxiliary Building Plan of El. 645'-0"	M-36 Sh 2
3.6-91	Piping Drawing Area 3 Auxiliary Building Plan of El. 646'-0"	M-65 Sh 1
3.6-92	Piping Drawing Area 3 Auxiliary Building Plan of El. 646'-0"	M-65 Sh 2
3.6-93	Area 1 Auxiliary Building Plan of El. 659'-0"	M-37 Sh 1
3.6-94	Area 1 Auxiliary Building Plan of El. 659'-0"	M-37 Sh 2
3.6-95	Piping Drawing Area 3 Auxiliary Building Plan of El. 659'-0"	M-66 Sh 1
3.6-96	Piping Drawing Area 3 Auxiliary Building Plan of El. 659'-0"	M-66 Sh 2
3.6-97	Area Composite Auxiliary Building Plan of El. 704'-0"	M-38 Sh 1
3.6-98	Piping Drawing Area 3 Auxiliary Building Plan of El. 673'-6"	M-67 Sh 1
3.6-99	Piping Drawing Area 3 Auxiliary Building Plan at El. 673'-6"	M-67 Sh 2
3.6-100	Area 3 Auxiliary Building Plan of El. 685'-0"	M-68
3.6-101	Piping Drawing Area 3 Auxiliary Building Plan of El. 704'-0"	M-69

8

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
3.6-102	RCS Pipe Break Related Analyses Flow Chart	N/A	
3.6-103	Area vs Time for Hot Leg/Reactor Vessel Nozzle Guillotine	N/A	15
3.6-103A	Break Opening area at Hot Leg/Reactor Vessel Nozzle	N/A	27
3.6-104	Area vs Time for Cold Leg/Reactor Vessel Guillotine	N/A	15
3.6-105	RC Pump Seal Water Supply Line Isometric	FSK-M-1CCB-7	
3.6-106	RC Pump Seal Water Supply Line Isometric	FSK-M-1CCC-9	21
3.6-107	RC Pump Seal Water Supply Line Isometric	FSK-M-1CCC-13	
3.6-108	RC Pump Seal Water Supply Line Isometric	FSK-M-1CCC-14	
3.6-109	RC Pump Seal Water Supply Line Isometric	FSK-M-2CCB-7	
3.6-110	RC Pump Seal Water Supply Line Isometric	FSK-M-2CCC-9	15
3.6-111	RC Pump Seal Water Supply Line Isometric	FSK-M-2CCC-13	
3.6-112	RC Pump Seal Water Supply Line Isometric	FSK-M-2CCC-14	
3.6-113	Pressure Transient for a 36 Inch Process Steam Line Break in the Tunnel	N/A	18
3.7-1	Horizontal Design Response Spectra-Operating Basis Earthquake	N/A	
3.7-2	Horizontal Design Response Spectra-Safe Shutdown Earthquake	N/A	
3.7-3	Comparison Horizontal Time History and Design Spectrum	N/A	
3.7-4	Comparison Horizontal Time History and Design Spectrum	N/A	13
3.7-5	Comparison Horizontal Time History and Design Spectrum	N/A	
3.7-6	Comparison Horizontal Time History and Design Spectrum	N/A	
3.7-7	Comparison Horizontal Time History and Design Spectrum	N/A	

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
4.4-6	Total Core Pressure Drop Versus Axial Length Midland Units - 2452Mwt 177 Assemblies	N/A	
4.4-7	Hydraulic Force Versus Percent System Flow at 112% Power	N/A	13
4.4-8	Minimum DNBR Versus Time for Ramp Load Changes, Most Probable Design Conditions	N/A	
4.4-9	Minimum DNBR Versus Time for Step Load Changes, Most Probable Design Conditions	N/A	
4.4-10	Comparison BAW-2 Calculated to Experimental Critical Heat Fluxes	N/A	
4.4-11	DNB Ratio (BAW-2) versus Population for Various Confidence Levels	N/A	13
4.4-12	Reactor Coolant System Isometric	N/A	
4.4-13	Temperature Versus Power With Four Reactor Coolant Pumps Operating	N/A	
4.4-14	Temperature Versus Power with Three Reactor Coolant Pumps Operating	N/A	13
4.4-15	Temperature versus Power with two Reactor Coolant Pumps - one in each loop	N/A	
4.4-16	Partial RC Pump Operation	N/A	
4.4-17	Reactor Fuel Assembly Design Radial Power Distribution for 1/4 Core	N/A	
4.4-18	Maximum Allowable Axial Power Distributions for Maximum Design Radial Local Peaking Factor (1.78)	N/A	13
4.4-19	Equivalent Allowable Axial Power Distribution for a Radial Local Peaking Factor of 1.65	N/A	
4.4-20	Hot Channel Factors Versus Percent Population Protected	N/A	13
4.4-21	Transient Mass Flowrates due to Power Perturbation	N/A	

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
4.4-22	Transient Mass Flowrates due to Power Perturbation During 3 pump Operation	N/A	
4.4-23	Transient Mass Flowrates due to Power Perturbation During 2 pump Operation	N/A	
4.4-24	MDNBR Versus Core Power for the Maximum Design Condition, Densified Fuel	N/A	13
4.4-25	MDNBR Versus System Flow for Maximum Design Condition, Densified Fuel	N/A	
4.4-26	MDNBR Versus Inlet Temperature for Maximum Design Condition at 112% Overpower, Densified Fuel	N/A	
5.1-1	Deleted	M-401	24
5.1-1 Sh 1	Reactor Coolant and Pressure Control-Unit 1	M-401A	27
5.1-1 Sh 2	Reactor Coolant and Pressure Control-Unit 1	M-401B	
5.1-2	Deleted	M-402	24
5.1-2 Sh 1	Reactor Coolant and Pressure Control-Unit 2	M-402A	27
5.1-2 Sh 2	Reactor Coolant and Pressure Control-Unit 2	M-402B	
5.1-3	Reactor Coolant System Flow Diagram at Full Power Steady State Condition	N/A	
5.1-4	Reactor Coolant System Arrangement-Plan	N/A	
5.1-5	Reactor Coolant System Arrangement - Elevation	N/A	
5.2-1	This figure has been deleted.		
5.2-2	This figure has been deleted.		20
5.2-3	This figure has been deleted.		
5.2-4	Overpressurization Protection During Normal and Upset Conditions	N/A	18
5.2-5	Overpressurization Protection During Emergency Conditions	N/A	

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.
6.2-38	ECC Spillage Pump Suction Break	N/A
6.2-39	ECC Spillage Pump Discharge Break	N/A
6.2-40	Test Section and Pressure Vessel Schematic and Cross-Sectional View	N/A
6.2-41	Required Heating Distance for Feedwater in 350 and 550F Steam	N/A
6.2-42	Steam-Water Concurrent Flow	N/A
6.2-43	Craft Noding Diagram - Loop Noding	N/A
6.2-44	Craft Noding Diagram - Reactor Vessel Noding	N/A
6.2-45	Nodal Representation of Core Reflood Model	N/A 13
6.2-46	Core Sections	N/A
6.2-47	Fuel Pin Heat Transfer Model	N/A
6.2-48	Thermal Circuit	N/A
6.2-49	Steam Generator Heat Transfer Model	N/A

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
6.2-50	Steam Generator Reflood Model	N/A	
6.2-51 Sh 1	Reactor Building Spray Unit 1	M-412A	
6.2-51 Sh 2	Reactor Building Spray Unit 1	M-412B	27
6.2-52 Sh 1	Reactor Building Spray Unit 2	M-413A	
6.2-52 Sh 2	Reactor Building Spray Unit 2	M-413B	
6.2-53	Hanger Drawing Reactor Building Spray System Unit 2 (Reactor Building Headers Plan & Sections)	H-613 Sh 1	13
6.2-54	Modified Tagami Condensing Heat Transfer Coefficient for Minimum Containment Pressure Analysis	N/A	
6.2-55	Reactor Bldg Spray System Unit 2 Section "A"-"A"	N/A	
6.2-56	Reactor Bldg Spray System Unit 2 "A" System Spray Nozzle Coverage	N/A	17
6.2-57	Reactor Bldg Spray System Unit 2 "B" System Spray Nozzle Coverage	N/A	
6.2-58	Reactor Building Units 1&2 Reactor Sump Plans and Sections	C-495	7
6.2-58A	Reactor Building Units 1&2 Reactor Sump Sections and Details	C-496	
6.2-59	Containment Isolation Valve Schemes	N/A	
6.2-60	Containment Isolation Valve Schemes	N/A	
6.2-61	H_2 Concentration in Containment vs Time with one Recombiner and two Recombiners in Operation	N/A	
6.2-62	Total Hydrogen Generation Rate vs Time	N/A	13
6.2-63	Hydrogen Accumulation versus Time	N/A	
6.2-64	Hydrogen Concentration in Containment vs Time with no Removal	N/A	
6.2-65	Decay Power vs Time	N/A	

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
6.2-131	Reactor Vessel Pressure Differential Response for a 4.27 ft^2 Cold Leg Break	N/A	
6.2-132	Reactor Vessel Pressure Differential Response for a 4.27 ft^2 Cold Leg Break	N/A	14
6.2-133	Reactor Vessel Pressure Differential Response for a 4.27 ft^2 Cold Leg Break	N/A	
6.2-134	Reactor Vessel Pressure Differential Response for a 4.27 ft^2 Cold Leg Break	N/A	
6.2-135	Primary Shield Plug Detail	C-370	
6.2-136	Reactor Building Spray Solution Flow Path to Containment Sump During Recirculation	N/A	15
6.2-137	Temperature History - Containment Liner & Wall for Maximum Containment Atmospheric Temperature	N/A	
6.2-138	Illustration of Jet Area Directed into Reactor Vessel Cavity for Subcompartment Pressurization	N/A	19
6.3-1 Sh 1	Makeup and Purification Units 1 & 2	M-703 Sh 1	27
6.3-1 Sh 2	Makeup and Purification Units 1 & 2	M-703 Sh 2	
6.3-2	Decay Heat Removal and Core Flooding System Units 1 & 2	M-710	
6.3-3	HPI Flow vs RCS Pressure	N/A	
6.3-4	LPI Flow vs RCS Pressure	N/A	
6.3-5	HPI Pump Performance Curves	N/A	3
6.3-6	HPI Flow Splits for HPI Line Break Affected Train	N/A	
6.4-1	Definition of Control Room Envelope	M-525 Sh 3	
6.4-2	Definition of Control Room Envelope	M-525 Sh 4	
6.4-3	Control Room Equipment Arrangement	J-725	
6.4-4	Location of Outside Air Intakes	M-527 Sh 3	

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
6.5-1	Hydrogen Vent Exhaust System Inside Containment	M-531 Sh 3	
6.5-2	Hydrogen Vent Exhaust Piping Outside the Containment	M-527 Sh 2	
6.8-1	This figure has been deleted.		
6.8-2	This figure has been deleted.		
6.8-3	Reactor Building Penetration Pressurization Unit 1	M-421 Sh 1	
6.8-4	Reactor Building Penetration Pressurization Unit 1	M-421 Sh 2	20
6.8-5	Reactor Building Penetration Pressurization Unit 1	M-421 Sh 3	
6.8-6	Reactor Building Penetration Pressurization Unit 2	M-422 Sh 1	
6.8-7	Reactor Building Penetration Pressurization Unit 2	M-422 Sh 2	
6.8-8	Reactor Building Penetration Pressurization Unit 2	M-422 Sh 3	
6D-1	Maximum Steam Generator Cavity Differential Pressure as a Function of Number of Nodes for Worst Case Hot Leg Break	N/A	
6D-2	17 Node Model of Steam Generator Compartment for Nodal Sensitivity Study	N/A	8
6D-3	21 Node Model of Steam Generator Compartment for Nodal Sensitivity Study	N/A	
6D-4	25 Node Model of Steam Generator Compartment for Nodal Sensitivity Study	N/A	
6D-5	34 Node Model of Steam Generator Compartment for Nodal Sensitivity Study	N/A	
6D-6	22 Node Model of Reactor Vessel Cavity for Node Sensitivity Study	N/A	19

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
8.2-2	Area Station Layout	N/A	3
8.2-3	Consumers Power Co. 138kV Transmission System	N/A	13
8.2-4	Consumers Power Co and Detroit Edison Co 345 Transmission System	N/A	
8.2-5	Preferred Power Supply Tittabawassee Terminal	N/A	3
8.2-6	Area Transmission Plant Terminal Details	N/A	
8.2-7	Preferred Power Supply Plant Terminal	N/A	
8.2-8	Control Circuit Power Supply	N/A	
8.2-9	Power Supply Bus Conditions Following Sudden Loss of Tittabawassee 345kV Station and Midland Units	N/A	16
8.2-10	Power Supply Bus Conditions Following Sudden Loss of Ludington Pumped Storage Load	N/A	
8.2-11	Predicted Unsnubbered RC Flow Coastdown for Selected Pump Trip	N/A	16
8.2-12	Generator and Power Supply Bus Conditions Following a Three Phase Bus Fault with Stuck breaker	N/A	19
8.3-1	Plant Single Line	E-1	
8.3-2A	Single Line Diagram 120VAC Control, Instrument and Preferred Power System Unit 1 and Common	E-23	27
8.3-2B	Single Line Diagram 120VAC Control Instrument and Preferred Power System Unit 1 and Common	E-23	27
8.3-3	Single Line Diagram 120VAC Control, Instrument and Preferred Power System Unit 2 and Common	E-24	13
8.3-4 Sh 1	Logic Diagram 4.16 kV Bus Undervoltage Relays	J-878 Sh 1	27

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
8.3-4 Sh 2	Logic Diagram 4.16 kV Bus Undervoltage Relays	J-878 Sh 2	27
8.3-5	Diesel Generator Local Control Panel Alarms	N/A	
8.3-6	Time-Current Characteristics Protection System and Penetration Assembly - Medium Voltage Power	N/A	18
8.3-7	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A	
8.3-8	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A	
8.3-8A	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A	
8.3-8B	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A	20
8.3-8C	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A	
8.3-8D	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A	
8.3-9	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A	
8.3-10	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A	
8.3-11	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A	
8.3-12	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A	

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.
8.3-13	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A
8.3-14	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A
8.3-15	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A
8.3-15A	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A
8.3-16	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A
8.3-17	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A
8.3-18	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A
8.3-19	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A
8.3-20	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A
8.3-21	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A
8.3-22	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A
8.3-23	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A

20

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
8.3-24	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A	
8.3-25	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A	
8.3-26	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A	
8.3-27	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Power	N/A	
8.3-28	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Control	N/A	
8.3-29	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Control	N/A	
8.3-30	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Control	N/A	
8.3-31	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Control	N/A	
8.3-32	Time-Current Characteristics Protection System and Penetration Assembly - Low Voltage Control	N/A	1
8.3-32A	Time-Current Characteristics Protection System and Penetration Assembly - CRD Stator	N/A	13
8.3-37	Typical Synchronizer Input Circuit from a Diesel Generator and its Associated Class 1E 4160V Bus	N/A	12 13
8.3-38	Typical Synchronizer Output Circuit for Class 1E Breaker Control	N/A	
8.3-39	Single Line Diagram 250 and 125VDC Systems Unit 1	E-21	13

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
8.3-40	Single Line Diagram 250 and 125VDC Systems Unit 2	E-22	13
8.3-41	Typical Separation for Raceway Systems in Cable Spreading Areas	N/A	
8.3-42	Typical Separation for Raceway Systems in General Plant Areas	N/A	
8.3-43	Diesel Generator Local Control Panel Alarms	J-877 Sh 1	
8.3-44	Logic Diagram Diesel Generator Breakers	J-877 Sh 2	
8.3-45	Logic Diagram Diesel Generator Breakers	J-879 Sh 1	
8.3-46	Logic Diagram Emergency Diesel Generators	J-879 Sh 2	
8.3-47	Logic Diagram Emergency Diesel Generators	J-879 Sh 3	18
8.3-48	Logic Diagram Emergency Diesel Generators	J-879 Sh 4	
8.3-49	Logic Diagram Emergency Diesel Generators	J-879 Sh 5	
8.3-50	Logic Diagram Emergency Diesel Generators	J-879 Sh 6	
8.3-51	Logic Diagram Emergency Diesel Generators	J-879 Sh 7	
8.3-52	Logic Diagram Emergency Diesel Generators	J-879 Sh 8	
8.3-53	Logic Diagram Emergency Diesel Generators	J-880	
8.3-54	Single Line Diagram - Separation Group E	N/A	20
9.1-1 Sh 1	Fuel Pool Cooling and Purification	M-414A	27
9.1-1 Sh 2	Fuel Pool Cooling and Purification	M-414B	
9.1-2	New Fuel Handling Tool	N/A	
9.1-3	R.V. Closure Head Handling	N/A	13
9.1-4	Reactor Internals (Plenum) Handling	N/A	
9.1-5	Fuel Handling Bridge	N/A	
9.1-6	Fuel Transfer System	N/A	
9.1-7	New Fuel Elevator	N/A	

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
9.1-8	Rod Handling Container Assembly	N/A	
9.1-9	Rod Assembly Handling Tool	N/A	
9.1-10	Typical Double Yoke Concept Cask Lifting Rig	N/A	
9.1-11	Cask Drop into Railroad Bay	N/A	
9.1-12	Cask Drop into Cask Washdown Area	N/A	
9.1-13	Cask Drop into Cask Loading Pit	N/A	
9.1-14	Fuel Pool Liner Plate Attachments	N/A	14
9.1-15	Spent Fuel Pool Storage Racks Plan Arrangement	N/A	19
9.1-16	Spent Fuel Pool Storage Rack Assembly	N/A	
9.2-1	Schematic Diagram Service Water System	N/A	
9.2-2 Sh 1	Service Water Cooling Tower and Pump Structure Units 1 & 2	M-418A	
9.2-2 Sh 2	Service Water Cooling Tower and Pump Structure Units 1 & 2	M-418B	
9.2-3 Sh 1	Service Water Reactor and Auxiliary Building Units 1 & 2	M-419A	
9.2-3 Sh 1	Service Water Reactor and Auxiliary Buildings Units 1 & 2	M-419A	27
9.2-4 Sh 1	Service Water Turbine Building Unit 1	M-420 Sh 1A	
9.2-4 Sh 2	Service Water Turbine Building Unit 2	M-420 Sh 1B	
9.2-5	Service Water Turbine Building Units 1&2	M-420 Sh 2	
9.2-6	Service Water Pump Impeller Elevation	N/A	
9.2-7 Sh 1	Component Cooling Water Unit 1	M-416 Sh 1A	
9.2-7 Sh 2	Component Cooling Water Unit 1	M-417 Sh 1B	27
9.2-8 Sh 1	Component Cooling Water Unit 1	M-416 Sh 2A	
9.2-8 Sh 2	Component Cooling Water Unit 1	M-416 Sh 2B	

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
9.2-9 Sh 1	Component Cooling Water Unit 2	M-417 Sh 1A	
9.2-9 Sh 2	Componente Cooling Water Unit 2	M-417 Sh 1B	
9.2-10 Sh 1	Component Cooling Water Unit 2	M-417 Sh 2A	
9.2-10 Sh 2	Component Cooling Water Unit 2	M-417 Sh 2B	27
9.2-11 Sh 1	Makeup Demineralizer	M-428A	
9.2-11 Sh 2	Makeup Demineralizer	M-428B	
9.2-11 Sh 3	Makeup Demineralizer	M-428C	
9.2-12 Sh 1	Domestic Water	M-459 Sh 1A	
9.2-12 Sh 2	Domestic Water	M-459 Sh 1B	26
9.2-12 Sh 3	Domestic Water	M-459 Sh 2	
9.2-12 Sh 4	Domestic Water	M-459 Sh 3	
9.2-13	Analytical Model of the Emergency Cooling Pond	SK-G-177	
9.2-14	Decay Heat (Rate and Integrated)	N/A	13
9.2-15	Heat Rate versus Time for Ultimate Heat Sink Analysis	N/A	
9.2-16	UHS Outlet Temperature After Accident and Safe Shutdown	SK-G-175	
9.2-17	Pond Volume and Elevation After Accident and Safe Shutdown	SK-G-176	
9.2-18 Sh 1	Plant Water Storage and Transfer	M-449 Sh 1A	27
9.2-18 Sh 2	Plant Water Storage and Transfer	M-449 Sh 1B	
9.2-19	Plant Water Storage and Transfer	M-449 Sh 2	
9.2-20 Sh 1	Chilled Water Auxiliary Building	M-457 Sh 1A	26
9.2-20 Sh 2	Chilled Water Auxiliary Building	M-457 Sh 1B	
9.2-21 Sh 1	Chilled Water Turbine Building Unit 1	M-457 Sh 4A	27
9.2-21 Sh 2	Chilled Water Turbine Building Unit 1	M-457 Sh 4B	
9.2-22 Sh 1	Chilled Water Turbine Building Unit 2	M-457 Sh 5A	26

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
9.2-22 Sh 2	Chilled Water Turbine Building Unit 2	M-457 Sh 5B	27
9.2-23	Chilled Water Office and Service Building	M-457 Sh 6	12
9.2-24 Sh 1	Chilled Water Safeguard Equipment Unit 1	M-457 Sh 2A	26
9.2-24 Sh 2	Chilled Water Safeguard Equipment Unit 1	M-457 Sh 2B	
9.2-25 Sh 1	Chilled Water Safeguard Equipment Unit 2	M-457 Sh 3A	
9.2-25 Sh 2	Chilled Water Safeguard Equipment Unit 2	M-457 Sh 3B	
9.2-26	Integrated versus Time for Ultimate Heat Sink Analysis	N/A	13
9.3-1	Instrument and Service Air	M-448 Sh 1	
9.3-2	Instrument and Service Air	M-448 Sh 2	
9.3-3	Reactor Plant Sample System	M-406 Sh 1	
9.3-4	Reactor Plant Sample System	M-406 Sh 2	
9.3-5	Reactor Plant Sample System	M-406 Sh 3	
9.3-6	Reactor Plant Sample System	M-406 Sh 4	
9.3-7	Steam Plant Sample System - Unit 1	M-445 Sh 1	14
9.3-8	Steam Plant Sample System - Unit 1	M-445 Sh 2	
9.3-9	Steam Plant Sample System - Unit 1	M-445 Sh 3	
9.3-10	Steam Plant Sample System - Unit 1	M-445 Sh 4	
9.3-11	Steam Plant Sample System - Unit 2	M-445 Sh 5	
9.3-12	Steam Plant Sample System - Unit 2	M-445 Sh 6	
9.3-13	Steam Plant Sample System - Unit 2	M-445 Sh 7	
9.3-14	Steam Plant Sample System - Unit 2	M-445 Sh 8	
9.3-15	Evaporator Plant Sample System	M-429 Sh 1	
9.3-16	Evaporator Plant Sample System	M-429 Sh 2	
9.3-17 Sh 1	Evaporator Plant Sample System	M-429 Sh 3	27

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
9.3-17 Sh 2	Evaporator Plant Sample System	M-429 Sh 4	27
9.3-18	Boron Recovery Unit 1 & 2 Riser Diagram	M-408 Sh 5	
9.3-19	Boron Recovery Unit 1 & 2 Riser Diagram	M-408 Sh 6	
9.3-20	Auxiliary Building DRW	M-259	
9.3-21	Auxiliary Building DRW Process Drainage	M-260	
9.3-22	Auxiliary Building DRW Process Drainage	M-261	
9.3-23	Auxiliary Building DRW Process Drainage	M-262	
9.3-24	Auxiliary Building DRW Process Drainage	M-263	
9.3-25	Auxiliary Building DRW Process Drainage	M-264	
9.3-26	Auxiliary Building DRW Process Drainage	M-265	
9.3-27	Auxiliary Building DTRW Process Drainage	M-266	
9.3-28	Auxiliary Building CHW Process Drainage	M-267	
9.3-29	Auxiliary and Turbine Building Plumbing	M-268	
9.3-30	Turbine Building Plumbing	M-269	
9.3-31 Sh 1	Makeup and Purification Unit 1	M-403 Sh 1A	26
9.3-31 Sh 2	Makeup and Purification Unit 1	M-403 Sh 1B	
9.3-32 Sh 1	Makeup and Purification Unit 1	M-403 Sh 2A	27
9.3-32 Sh 2	Makeup and Purification Unit 1	M-403 Sh 2B	
9.3-33 Sh 1	Makeup and Purification Unit 2	M-404 Sh 1A	
9.3-33 Sh 2	Makeup and Purification Unit 2	M-404 Sh 1B	
9.3-34 Sh 1	Makeup and Purification Unit 2	M-404 Sh 2A	27
9.3-34 Sh 2	Makeup and Purification Unit 2	M-404 Sh 2B	
9.3-35	Boron Recovery Units 1 & 2	M-408 Sh 1	
9.3-36 Sh 1	Boron Recovery Units 1 & 2	M-408 Sh 2A	26

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
9.3-36 Sh 2	Boron Recovery Units 1 & 2	M-408 Sh 2B	
9.3-37 Sh 1	Boron Recovery Units 1 & 2	M-408 Sh 3A	
9.3-37 Sh 2	Boron Recovery Units 1 & 2	M-408 Sh 3B	26
9.3-38 Sh 1	Boron Recovery Units 1 & 2	M-408 Sh 4A	
9.3-38 Sh 2	Boron Recovery Units 1 & 2	M-408 Sh 4B	
9.3-39	Boric Acid Evaporator	M-426	
9.3-40 Sh 1	Chemical Addition System	M-405A	27
9.3-40 Sh 2	Chemical Addition System	M-405B	
9.3-41 Sh 1	Miscellaneous Gas System Hydrogen Supply	M-463 Sh 1A	26
9.3-41 Sh 2	Miscellaneous Gas System Hydrogen Supply	M-463 Sh 1B	
9.3-42	Miscellaneous Gas System Nitrogen Supply	M-463 Sh 3	
9.3-43 Sh 1	Miscellaneous Gas System Carbon Dioxide Supply	M-463 Sh 2A	26
9.3-43 Sh 2	Miscellaneous Gas System Carbon Dioxide Supply	M-463 Sh 2B	
9.3-44	Makeup Pump Characteristics	N/A	
9.3-45 Sh 1	Boron Recovery Degasifier	M-469A	26
9.3-45 Sh 2	Boron Recovery Degasifier	M-469B	
9.4-1	HVAC Control Room, Battery Room, Switchgear and Cable Spreading Room	M-465 Sh 1	13
9.4-2	HVAC Control Room, Battery Room, and Switchgear Cable Spreading Room	M-465 Sh 2	
9.4-3	HVAC Auxiliary Building Units 1 & 2	M-454 Sh 1	
9.4-4	HVAC Auxiliary Building Units 1 & 2	M-454 Sh 2	
9.4-5	HVAC Auxiliary Building Units 1 & 2	M-454 Sh 3	

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
9.4-6	HVAC Auxiliary Building Units 1 & 2	M-454 Sh 4	
9.4-7	HVAC Auxiliary Building Units 1 & 2	M-454 Sh 5	
9.4-8	HVAC Turbine Building Unit 1	M-455 Sh 1	
9.4-9	HVAC Turbine Building Unit 2	M-455 Sh 2	
9.4-10	HVAC Reactor Building Unit 1	M-453	
9.4-10A	HVAC Reactor Building Unit 2	M-462	12
9.4-11	HVAC Diesel Generator Building and Service Water Pump Structure	M-468 Sh 1	
9.4-12	HVAC Access Control and Computer Area	M-466	
9.4-13 Sh 1	Plant Heating Turbine Building	M-456 Sh 1A	
9.4-13 Sh 2	Plant Heating Turbine Building	M-456 Sh 1B	2
9.4-13 Sh 3	Plant Heating Turbine Building	M-456 Sh 1C	
9.4-14 Sh 1	Plant Heating Auxiliary and Reactor Buildings	M-456 Sh 2A	
9.4-14 Sh 2	Plant Heating Auxiliary and Reactor Buildings	M-456 Sh 2B	26
9.4-15 Sh 1	Plant Heating Office and Service Building	M-456 Sh 3A	
9.4-15 Sh 2	Plant Heating Office and Service Building	M-456 Sh 3B	2
9.4-16	Plant Heating Miscellaneous Structures	M-456 Sh 4	24
9.4-17	HVAC Office and Service Buildings	M-467 Sh 1	
9.4-18 Sh 1	HVAC Office and Service Buildings	M-467 Sh 2	
9.4-18 Sh 2	HVAC Office and Service Buildings	M-467 Sh 3	
9.4-19 Sh 1	Miscellaneous Building HVAC System (Evaporator and Auxiliary Boiler Building)	M-468 Sh 3A	27
9.4-19 Sh 2	Miscellaneous Building HVAC System (Evaporator and Auxiliary Boiler Building)	M-468 Sh 3B	
9.4-20	Miscellaneous Structures HVAC	M-468 Sh 2	

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
9.4-21	Miscellaneous Structure HVAC (Guard House)	M-468 Sh 4	15
9.4-22	Miscellaneous Structures HVAC	M-468 Sh 5	16
9.5-1	Single Line Diagram Public Address System	E-554 Sh 1	
9.5-2	Single Line Diagram Public Address System	E-554 Sh 2	
9.5-3	Single Line Diagram Public Telephone System	E-555	
9.5-4	Single Line Diagram Intercommunication and Sound Powered Telephone System	E-556 Sh 1	
9.5-5	Single Line Diagram Intercommunication and Sound Powered Telephone System	E-556 Sh 2	
9.5-6	Deleted		
9.5-7	Deleted		
9.5-8	Deleted		
9.5-9	Deleted		
9.5-10	Deleted		
9.5-11	Deleted		
9.5-12	Deleted		
9.5-13	Deleted		25
9.5-14	Deleted		
9.5-15	Deleted		
9.5-16	Deleted		
9.5-17	Deleted		
9.5-18	Deleted		
9.5-19	Deleted		
9.5-20	Deleted		
9.5-21	Deleted		

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
9.5-22	Deleted		25
9.5-23	Deleted		
9.5-24 Sh 1	Single Line Diagram Lighting Distribution	E-551 Sh 1	27
9.5-24 Sh 2	Single Line Diagram-Lighting Distribution	E-551 Sh 2	
9.5-25 Sh 1	Emergency Diesel Generator Fuel Oil Storage and Transfer System Units 1 & 2	M-452A	26
9.5-25 Sh 2	Emergency Diesel Generator Fuel Oil Storage and Transfer System Units 1 & 2	M-452B	
9.5-26	Emergency Diesel Generator Cooling Water System	N/A	
9.5-27	Emergency Diesel Generator Starting System	N/A	
9.5-28	Emergency Diesel Generator Lubrication System	N/A	
9.5-29 Sh 1	Chemical and Oily Waste System	M-470 Sh 2A	26
9.5-29 Sh 2	Chemical and Oily Waste System	M-470 Sh 2B	
9.5-30 Sh 1	Chemical and Oily Waste System	M-470 Sh 1A	
9.5-30 Sh 2	Chemical and Oily Waste System	M-470 Sh 1B	
9.5-31	Emergency Diesel Engine Fuel Oil Piping Schematic	N/A	13
9.5-32	Emergency Diesel Fuel Oil Piping from Storage Tanks to and from Day Tanks	N/A	15
9.5-33	Single Line Diagram Evacuation System	E-557 Sh 1	25
9.5-34	Single Line Diagram Evacuation System	E-557 Sh 2	
9A-1	Fire Protection - Circulating Water Intake Structure and Chlorination Building Floor Plans at El 600'-0" and 634'-8"	A-114	24
9A-2	Fire Protection - Service Water Pump Structure Plans and Section	A-115	

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.
9A-3	Fire Protection - Diesel Generator Building Plan and Sections	A-118
9A-4	Fire Protection - Reactor and Auxiliary Buildings Plan at El 568'-0"	A-120
9A-5	Fire Protection - Reactor and Auxiliary Building Plan at El 584'-0"	A-121
9A-6	Fire Protection - Reactor and Auxiliary Buildings Plan at El 599'-0"	A-122
9A-7	Fire Protection - Reactor and Auxiliary Buildings Plan at El 614'-0"	A-123
9A-8	Fire Protection - Reactor and Auxiliary Buildings Plan at El 614'-0"	A-124
9A-9	Fire Protection - Reactor and Auxiliary Buildings Plan at El 646'-0"	A-125
9A-10	Fire Protection - Reactor and Auxiliary Buildings Plan at El 659'-0"	A-126
9A-11	Fire Protection - Reactor and Auxiliary Buildings Plan at El 673'-6" and 685'-0"	A-127
9A-12	Fire Protection - Auxiliary Building Solid Radwaste and Railroad Bay	A-128 Sh 1
9A-13	Fire Protection - Equipment Location - Solid Radwaste Building	A-128 Sh 2
9A-14	Fire Protection - Auxiliary Building Section A-A	A-129
9A-15	Fire Protection - Auxiliary Building Section E-E	A-130
9A-16	Fire Protection - Auxiliary Building Section F-F	A-131
9A-17	Fire Protection - turbine Building Unit 1 Plan at El 614'-0"	A-132
9A-18	Fire Protection - Turbine Building Unit 1 Plan at El 634'-6"	A-133

24

25

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
9A-19	Fire Protection - Turbine Building Unit 1 Plan at El 659'-0" and 695'-0 5/16"	A-134	
9A-20	Fire Protection - Turbine Building Unit 2 Plan at El 614'-0"	A-135	
9A-21	Fire Protection - Turbine Building Unit 2 Plan at El 634'-6"	A-136	
9A-22	Fire Protection - Turbine Building Unit 2 Plan at El 659'-0" and 695'-0 5/16"	A-137	
9A-23	Fire Protection - Turbine Building Unit 2 Sections	A-138	24
9A-24	Fire Protection - Miscellaneous Plans and Details	A-141	
9A-25	Fire Protection - Evaporator Building Floor Plan at El 634'-6" and 645'-6"	A-142	
9A-26	Fire Protection - Evaporator Building Floor Plan at El 653'-6" and 661'-0"	A-143	
9A-27	Fire Protection - Evaporator Building Miscellaneous Floor Plans and Section E-E	A-144	
9A-28	Fire Protection - Evaporator Building Sections	A-145	
9A-29	Yardwork - Plant Area - Fire Protection System	C-43	
9A-30 Sh 1	Piping and Instrument Diagram - Fire Protection	M-458 Sh 1A	
9A-30 Sh 2	Piping and Instrument Diagram - Fire Protection	M-458 Sh 1B	27
9A-30 Sh 3	Piping and Instrument Diagram - Fire Protection	M-458 Sh 1C	
9A-30 Sh 4	Piping and Instrument Diagram - Fire Protection	M-458 Sh 2	
10.1-1	Unit 1 Process Flow Diagram - Steam and Power Conversion System	N/A	

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
10.1-2	Unit 2 Process Flow Diagram - Steam and Power Conversion System	N/A	
10.1-3	Unit 1 MGL Heat Balances	N/A	
10.1-4	Unit 2 MGL Heat Balances	N/A	
10.1-5	Unit 1 VWO Heat Balances	N/A	
10.1-6	Unit 2 VWO Heat Balances	N/A	
10.2-1 Sh 1	Turbine Extraction, Heater Vents and Drains Unit 1	M-436	Sh 1A
10.2-1 Sh 2	Turbine Extraction, Heater Vents and Drains Unit 1	M-436	Sh 1B
10.2-2 Sh 1	Turbine Extraction, Heater Vents and Drains Unit 1	M-436	Sh 2A
10.2-2 Sh 2	Turbine Extraction, Heater Vents and Drains Unit 1	M-436	Sh 2B 26
10.2-3 Sh 1	Turbine Extraction, Heater Vents and Drains Unit 2	M-437	Sh 1A
10.2-3 Sh 2	Turbine Extraction, Heater Vents and Drains Unit 2	M-437	Sh 1B
10.2-4 Sh 1	Turbine Extraction, Heater Vents and Drains Unit 2	M-437	Sh 2A
10.2-4 Sh 2	Turbine Extraction, Heater Vents and Drains Unit 2	M-437	Sh 2B
10.2-5	EHC Mark II Turbine Overspeed Protection System	N/A	
10.3-1 Sh 1	Main Steam & Turbine Steam System - Unit 1	M-431	Sh 1A
10.3-1 Sh 2	Main Steam & Turbine Steam System - Unit 1	M-431	Sh 1B 26
10.3-2 Sh 1	Main Steam & Turbine Steam - Unit 1	M-431	Sh 2A
10.3-2 Sh 2	Main Steam & Turbine Steam - Unit 1	M-431	Sh 2B
10.3-3	Main Steam Supply System - Unit 2	M-432	Sh 1 25

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
10.3-4	Main Steam & Turbine Steam - Unit 2	M-432 Sh 2	
10.3-5	Main Steam Line Isolation Valves - Actuator - Hydraulic Circuit	N/A	1
10.3-6	Main Steam Line Isolation Valves - Logic Diagram	N/A	
10.4-1 Sh 1	Auxiliary Steam System - Unit 1	M-433A	
10.4-1 Sh 2	Auxiliary Steam System - Unit 1	M-433B	26
10.4-2 Sh 1	Auxiliary Steam System - Unit 2	M-434A	
10.4-2 Sh 2	Auxiliary Steam System - Unit 2	M-434B	
10.4-3 Sh 1	Circulating Water - Units 1 & 2	M-446A	27
10.4-3 Sh 2	Circulating Water - Units 1 & 2	M-446B	
10.4-4 Sh 1	Condensate Demineralizer System - Unit 1	M-440A	
10.4-4 Sh 2	Condensate Demineralizer System - Unit 1	M-440B	
10.4-5 Sh 1	Condensate Demineralizer Regeneration - Unit 1	M-441A	
10.4-5 Sh 2	Condensate Demineralizer Regeneration - Unit 1	M-441B	
10.4-6 Sh 1	Condensate Demineralizer System - Unit 2	M-442A	
10.4-6 Sh 2	Condensate Demineralizer System - Unit 2	M-442B	26
10.4-7 Sh 1	Condensate Demineralizer Regeneration - Unit 2	M-443A	
10.4-7 Sh 2	Condensate Demineralizer Regeneration - Unit 2	M-443B	
10.4-8 Sh 1	Condensate and Feedwater System - Unit 1	M-438 Sh 1A	
10.4-8 Sh 2	Condensate and Feedwater System - Unit 1	M-438 Sh 1B	
10.4-9 Sh 1	Condensate and Feedwater System - Unit 1	M-438 Sh 2A	
10.4-9 Sh 2	Condensate and Feedwater System - Unit 1	M-438 Sh 2B	

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.		
10.4-10 Sh 1	Condensate and Feedwater System - Unit 1	M-438	Sh 3A	
10.4-10 Sh 2	Condensate and Feedwater System - Unit 1	M-438	Sh 3B	
10.4-10 Sh 3	Condensate and Feedwater System - Unit 1	M-438	Sh 4	
10.4-11 Sh 1	Condensate and Feedwater System - Unit 2	M-439	Sh 1A	
10.4-11 Sh 2	Condensate and Feedwater System - Unit 2	M-439	Sh 1B	26
10.4-12 Sh 1	Condensate and Feedwater System - Unit 2	M-439	Sh 2A	
10.4-12 Sh 2	Condensate and Feedwater System - Unit 2	M-439	Sh 2B	
10.4-13 Sh 1	Condensate and Feedwater System - Unit 2	M-439	Sh 3A	
10.4-13 Sh 2	Condensate and Feedwater System - Unit 2	M-439	Sh 3B	
10.4-13 Sh 3	Condensate and Feedwater System - Unit 2	M-439	Sh 4	
10.4-14 Sh 1	Process Steam Evaporator System	M-461	Sh 1A	
10.4-14 Sh 2	Process Steam Evaporator System	M-462	Sh 1B	27
10.4-15 Sh 1	Process Steam Evaporator System	M-461	Sh 2A	
10.4-15 Sh 2	Process Steam Evaporator System	M-461	Sh 2B	
10.4-16	Process Steam Evaporator System	M-461	Sh 3	
10.4-17	Process Steam Evaporator System	M-461	Sh 4	
10.4-18	Process Steam Evaporator System	M-461	Sh 5	
10.4-19	Process Steam Evaporator System	M-461	Sh 6	14
10.4-19 Sh 1	Process Steam Evaporator System	M-461	Sh 7	26
10.4-19 Sh 2	Process Steam Evaporator System	M-461	Sh 8	
10.4-20	Process Steam, Supply and Return System	M-460	Sh 1	
10.4-21 Sh 1	Process Steam, Supply and Return System	M-460	Sh 2A	
10.4-21 Sh 2	Process Steam, Supply and Return System	M-460	Sh 2B	26
10.4-22 Sh 1	Process Steam, Supply and Return System	M-460	Sh 3A	

TABLE 1.1-1 PART 1 (continued)

FSAR Fig. No.	FSAR Figure Title	Bechtel Dwg. No.	
10.4-22 Sh 2	Process Steam, Supply and Return System	M-460 Sh 3B	26
10.4-22A	Process Steam, Supply and Return System	M-460 Sh 4	
10.4-23	Process Steam Heat Balance	N/A	
10.4-24	Cooling Pond Blowdown and Makeup System	M-464	
10.4-25 Sh 1	Feedwater Chemical Addition System	M-444A	
10.4-25 Sh 2	Feedwater Chemical Addition System	M-444B	27
10.4-26 Sh 1	Auxiliary Steam Boiler System	M-430 Sh 1A	
10.4-26 Sh 2	Auxiliary Steam Boiler System	M-430 Sh 1B	
10.4-27	Auxiliary Steam Boiler System	M-430 Sh 2	
10.4-28 Sh 1	Auxiliary Steam Boiler System	M-430 Sh 3A	
10.4-28 Sh 2	Auxiliary Steam Boiler System	M-430 Sh 3B	
11.2-1 Sh 1	Liquid Waste Units 1 & 2	M-407 Sh 1A	
11.2-1 Sh 2	Liquid Waste Units 1 & 2	M-407 Sh 1B	26
11.2-2 Sh 1	Liquid Waste Units 1 & 2	M-407 Sh 2A	
11.2-2 Sh 2	Liquid Waste Units 1 & 2	M-407 Sh 2B	
11.2-3 Sh 1	Liquid Waste Units 1 & 2	M-407 Sh 3A	
11.2-3 Sh 2	Liquid Waste Units 1 & 2	M-407 Sh 3B	
11.2-4	Liquid Waste Evaporator	M-427	
11.2-5	Boron Recovery System Block Diagram	N/A	
11.2-6	Liquid Waste System Block Diagram	N/A	
11.3-1	Potential Sources of Gaseous Releases	N/A	
11.3-2 Sh 1	Radwaste Gas - Unit 1 & 2	M-409A	
11.3-2 Sh 2	Radwaste Gas - Unit 1 & 2	M-409B	26
11.3-3	Radwaste Gas System - Unit 1 & 2	M-709	

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TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
C-654	Reactor Building Unit 2 - Steel Framing Plan at El. 685'-0"	3.8-45A	12
C-663	Missile Shield	3.8-47	13
C-666	Refueling Canal & Liner Plat Plan and Sections	3.8-43	9
C-676	Reactor Coolant System Pipe Restraints	3.8-34	
C-830	Auxiliary Building Tornado Missile Protection Plan Near Roof	3.5-6	15
C-831	Auxiliary Building Tornado Missile Protection - Typical Section	3.5-7	
C-836	Linear Component Support Attachments (Sheet 1)	3.8-64	21
C-836	Linear Component Support Attachments (Sheet 2)	3.8-65	
C-997	Benchmark Locations for Subsidence Monitoring Program	2.5-88	
C70-94	Linear Component Support Attachments (Sheet 1)	3.8-64	15
C70-261	Linear Component Support Attachments (Sheet 1)	3.8-64	
E-1	Plant Single Line	8.3-1	
E-21	Single Line Diagram 250 and 125VDC Systems Unit 1	8.3-39	3
E-22	Single Line Diagram 250 and 125VDC Systems Unit 2	8.3-40	13
E-23 Sh 1	Single Line Diagram 120VAC Control, Instrument and Preferred Power System Unit 1 and Common	8.3-2 Sh 1	
E-23 Sh 2	Single Line Diagram 120VAC Control, Instrument and Preferred Power System Unit 1 and Common	8.3-2 Sh 2	27

TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
E-24 Sh 1	Single Line Diagram 120VAC Control, Instrument and Preferred Power System Unit 2 and Common	8.3-3	13
E-551 Sh 1	Single Line Diagram Lighting Distribution	9.5-24 Sh 1	19

TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
E-551 Sh 2	Single Line Diagram-Lighting Distribution	9.5-24 Sh 2	27
E-554 Sh 1	Single Line Diagram Public Address System	9.5-1	
E-554 Sh 2	Single Line Diagram Public Address System	9.5-2	
E-555	Single Line Diagram Public Telephone System	9.5-3	
E-556 Sh 1	Single Line Diagram Intercommunication and Sound Powered Telephone System	9.5-4	
E-556 Sh 2	Single Lire Diagram Intercommunication and Sound Powered Telephone System	9.5-5	25

TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
			25
FSK-M-1CCB9	RC Pump Seal Water Supply Line Isometric	3.6-105	21
FSK-M-1CCC9	RC Pump Seal Water Supply Line Isometric	3.6-106	
FSK-M-1CCC13	RC Pump Seal Water Supply Line Isometric	3.6-107	
FSK-M-1CCC14	RC Pump Seal Water Supply Line Isometric	3.6-108	15
FSK-M-2CCB7	RC Pump Seal Water Supply Line Isometric	3.6-109	
FSK-M-2CCC9	RC Pump Seal Water Supply Line Isometric	3.6-110	
FSK-M-2CCC13	RC Pump Seal Water Supply Line Isometric	3.6-111	
FSK-M-2CCC14	RC Pump Seal Water Supply Line Isometric	3.6-112	
H-613 Sh 1	Hanger Drawing, Reactor Building Spray System Unit 2	6.2-53	17
J-001 Sh 1	Logic Diagram Legend and Notes	1.1-4	17
J-001 Sh 2	Logic Diagram Legend and Notes	1.1-5	
J-001 Sh 3	Logic Diagram Legend and Notes	1.1-6	
J-001 Sh 4	Logic Diagram Legend and Notes	1.1-7	
J-299 Sh 1	Engineered Safety Features Actuation System - RBIS-II, RBSAS, RBCAS, and RBIS-I	7.3-2	
J-299 Sh 2	Engineered Safety Features Actuation System - MSLIS	7.3-3	
J-299 Sh 3	Engineered Safety Features Actuation System - AFWAS, RAS, Loss of R.C. Pump	7.3-4	13
J-299 Sh 4	Engineered Safety Features Actuation System - CRIS	7.3-5	
J-299 Sh 5	Engineered Safety Features Actuation System - D.G. Start, LOP/ECCAS Seq.	7.3-6	13
J-299 Sh 6	Engineered Safety Features Actuation System - F.P.V.A.S.	7.3-7	13
J-299 Sh 8	Engineered Safety Features Actuation System - ECCAS, Sig Cond Cabinets	7.3-8	

TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.		FSAR Figure Title	FSAR Fig. No.	
J-299	Sh 9	Engineered Safety Features Actuation System - Reverse Feedwater From Steam Generators A & B	7.3-9	18 15
J-590		Process Steam Transfer System - Mode 1	7.7-8	
J-591		Process Steam Transfer System - Mode 2	7.7-9	
J-592		Process Steam Transfer System - Mode 3	7.7-10	1
J-593		Process Steam Transfer System - Mode 4	7.7-11	
J-725		Control Room Equipment Arrangement	6.4-3	
J-877	Sh 1	Diesel Generator Local Control Panel Alarms	8.3-43	18
J-877	Sh 2	Logic Diagram Diesel Generator Breakers	8.3-44	19
J-878	Sh 1	Logic Diagram 4.16kV Bus Undervoltage Relays	8.3-4 Sh 1	
J-878	Sh 2	Logic Diagram 4.16kV Bus Undervoltage Relays	8.3-4 Sh 2	
J-879	Sh 1	Logic Diagram Diesel Generator Breakers	8.3-45	
J-879	Sh 2	Logic Diagram Emergency Diesel Generators	8.3-46	
J-879	Sh 3	Logic Diagram Emergency Diesel Generators	8.3-47	
J-879	Sh 4	Logic Diagram Emergency Diesel Generators	8.3-48	18
J-879	Sh 5	Logic Diagram Emergency Diesel Generators	8.3-49	
J-879	Sh 6	Logic Diagram Emergency Diesel Generators	8.3-50	
J-879	Sh 7	Logic Diagram Emergency Diesel Generators	8.3-51	
J-879	Sh 8	Logic Diagram Emergency Diesel Generators	8.3-52	
J-880		Logic Diagram Emergency Diesel Generators	8.3-53	
M-1		Equipment Location - Reactor & Auxiliary Bldgs Plan at El. 568'-0"	1.2-2	15

TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
M-2	Equipment Location - Reactor & Auxiliary Bldgs Plan at El. 584'-0"	1.2-3	
M-3	Equipment Location - Reactor & Auxiliary Bldgs Plan at El. 599'-0"	1.2-4	
M-4	Equipment Location - Reactor & Auxiliary Bldgs Plan at El. 614'-0"	1.2-5	
M-5	Equipment Location - Reactor & Auxiliary Bldgs Plan at El. 634'-6"	1.2-6	15
M-6	Equipment Location - Reactor & Auxiliary Bldgs Plan at El. 645'-0"	1.2-7	
M-7 Sh 1	Equipment Location - Reactor & Auxiliary Bldgs Plan at El. 659'-0"	1.2-8	
M-7 Sh 2	Equipment Location - Reactor & Auxiliary Bldgs Plan at El. 674'-0" and 685'-0"	1.2-9	
M-8	Equipment Location - Auxiliary Building Section A-A	1.2-10	
M-9	Equipment Location - Reactor and Auxiliary Bldgs - Section B-B	1.2-11	
M-10	Equipment Location - Reactor Building Section C-C and D-D	1.2-12	
M-11 Sh 1	Equipment Location - Auxiliary Building Section E-E	1.2-13	
M-11 Sh 2	Equipment Location - Auxiliary Building Section F-F	1.2-14	
M-12 Sh 1	Equipment Location - Auxiliary Building Solid Radwaste and Railroad Bay	1.2-15	13
	Equipment Location - Auxiliary Building, Solid Radwaste and Railroad Bay	11.4-4	
M-12 Sh 2	Equipment Location - Solid Radwaste Building	1.2-16	
	Equipment Location - Solid Radwaste Bldg	11.4-5	
M-14	Equipment Location - Turbine Bldg - Unit 1 Plan at El. 614'-0"	1.2-17	15

TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
M-268	Auxiliary and Turbine Building Plumbing	9.3-29	
M-269	Turbine Building Plumbing	9.3-30	
M-400 Sh 1	Piping and Instrumentation Diagram Legend	1.1-1	
M-400 Sh 2	Piping and Instrumentation Diagram Legend	1.1-2	
M-400 Sh 3	Piping and Instrumentation Diagram Legend	1.1-3	
M-401	Deleted	5.1-1	
M-401A	Reactor Coolant and Pressure Control-Unit 1	5.1-1 Sh 1	27
M-401B	Reactor Coolant and Pressure Control-Unit 1	5.1-1 Sh 2	27
M-402	Deleted	5.1-2	24
M-402A	Reactor Coolant and Pressure Control-Unit 2	5.1-2 Sh 1	27
M-402B	Reactor Coolant and Pressure Control-Unit 2	5.1-2 Sh 2	27
M-403 Sh 1A	Makeup and Purification Unit 1	9.3-31 Sh 1	26
M-403 Sh 1B	Makeup and Purification Unit 1	9.3-31 Sh 2	27
M-403 Sh 2A	Makeup and Purification Unit 1	9.3-32 Sh 1	27
M-403 Sh 2B	Makeup and Purification Unit 1	9.3-32 Sh 2	
M-404 Sh 1A	Makeup and Purification Unit 2	9.3-33 Sh 1	26
M-404 Sh 1B	Makeup and Purification Unit 2	9.3-33 Sh 2	
M-404 Sh 2A	Makeup and Purification Unit 2	9.3-34 Sh 1	
M-404 Sh 2B	Makeup and Purification Unit 2	9.3-34 Sh 2	27
M-405A	Chemical Addition System	9.3-40 Sh 1	
M-405B	Chemical addition System	9.3-40 Sh 2	
M-406 Sh 1	Reactor Plant Sample System	9.3-3	
M-406 Sh 2	Reactor Plant Sample System	9.3-4	
M-406 Sh 3	Reactor Plant Sample System	9.3-5	

TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
M-406 Sh 4	Reactor Plant Sample System	9.3-6	
M-407 Sh 1A	Liquid Waste Units 1 & 2	11.2-1 Sh 1	
M-407 Sh 1B	Liquid Waste Units 1 & 2	11.2-1 Sh 2	
M-407 Sh 2A	Liquid Waste Units 1 & 2	11.2-2 Sh 1	
M-407 Sh 2B	Liquid Waste Units 1 & 2	11.2-2 Sh 2	26
M-407 Sh 3A	Liquid Waste Units 1 & 2	11.2-3 Sh 1	
M-407 Sh 3B	Liquid Waste Units 1 & 2	11.2-3 Sh 2	
M-407 Sh 4	Liquid Waste Units 1 & 2	11.2-3A	
M-408 Sh 1	Boron Recovery Units 1 & 2	9.3-35	
M-408 Sh 2A	Boron Recovery Units 1 & 2	9.3-36 Sh 1	
M-408 Sh 2B	Boron Recovery Units 1 & 2	9.3-36 Sh 2	
M-408 Sh 3A	Boron Recovery Units 1 & 2	9.3-37 Sh 1	26
M-408 Sh 3B	Boron Recovery Units 1 & 2	9.3-37 Sh 2	
M-408 Sh 4A	Boron Recovery Units 1 & 2	9.3-38 Sh 1	
M-408 Sh 4B	Boron Recovery Units 1 & 2	9.3-38 Sh 2	
M-408 Sh 5	Boron Recovery Unit 1 & 2 Riser Diagram	9.3-18	
M-408 Sh 6	Boron Recovery Unit 1 & 2 Riser Diagram	9.3-19	
M-409A	Radwaste Gas - Unit 1 & 2	11.3-2 Sh 1	26
M-409B	Radwaste Gas - Unit 1 & 2	11.3-2 Sh 2	
M-410	Decay Heat Removal and Core Flooding-Unit 1	5.4-10	18
M-411	Decay Heat Removal and Core Flooding-Unit 2	5.4-11	
M-412A	Reactor Building Spray Unit 1	6.2-51 Sh 1	
M-412B	Reactor Building Spray Unit 1	6.2-51 Sh 2	27
M-413A	Reactor Building Spray Unit 2	6.2-52 Sh 1	

TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
M-413B	Reactor Building Spray Unit 2	6.2-52 Sh 2	
M-414A	Fuel Pool Cooling and Purification	9.1-1 Sh 1	
M-414B	Fuel Pool Cooling and Purification	9.1-1 Sh 2	
M-416 Sh 1A	Component Cooling Water Unit 1	9.2-7 Sh 1	
M-416 Sh 1B	Component Cooling Water Unit 1	9.2-7 Sh 2	
M-416 Sh 2A	Component Cooling Water Unit 1	9.2-8 Sh 1	
M-416 Sh 2B	Component Cooling Water Unit 1	9.2-8 Sh 2	
M-417 Sh 1A	Component Cooling Water Unit 2	9.2-9 Sh 1	
M-417 Sh 1B	Component Cooling Water Unit 2	9.2-9 Sh 2	27
M-417 Sh 2A	Component Cooling Water Unit 2	9.2-10 Sh 1	
M-417 Sh 2B	Component Cooling Water Unit 2	9.2-10 Sh 2	
M-418A	Service Water Cooling Tower and Pump Structure Units 1 & 2	9.2-2 Sh 1	
M-418B	Service Water Cooling Tower and Pump Structure Units 1 & 2	9.2-2 Sh 2	
M-419A	Service Water Reactor and Auxiliary Building Units 1 & 2	9.2-3 Sh 1	
M-419B	Service Water Reactor and Auxiliary Buildings Units 1 & 2	9.2-3 Sh 2	
M-420 Sh 1A	Service Water Turbine Building Unit 1	9.2-4 Sh 1	
M-420 Sh 1B	Service Water Turbine Building Unit 2	9.2-4 Sh 2	
M-420 Sh 2	Service Water Turbine Building Units 1 & 2	9.2-5	12
M-421 Sh 1	Reactor Building Penetration Pressurization Unit 1	6.8-3	
M-421 Sh 2	Reactor Building Penetration Pressurization Unit 1	6.8-4	20
M-421 Sh 3	Reactor Building Penetration Pressurization Unit 1	6.8-5	

TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
M-422 Sh 1	Reactor Building Penetration Pressurization Unit 2	6.8-6	20
M-422 Sh 2	Reactor Building Penetration Pressurization Unit 2	6.8-7	24
M-422 Sh 3	Reactor Building Penetration Pressurization Unit 2	6.8-8	20
M-423	CCW and CRDM Interface - Unit 1	3.9-4	13
M-425 Sh 1	Solid Waste	11.4-1	
M-425 Sh 2	Solid Waste System	11.4-2 Sh 1	26
M-425 Sh 3	Solid Waste System	11.4-2 Sh 2	
M-425 Sh 4	Solid Waste System	11.4-2 Sh 3	
M-425 Sh 5	Solid Waste System	11.4-2 Sh 4	
M-426	Boric Acid Evaporator	9.3-39	
M-427	Liquid Waste Evaporator	11.2-4	
M-428A	Makeup Demineralizer	9.2-11 Sh 1	27
M-428B	Makeup Demineralizer	9.2-11 Sh 2	
M-428C	Makeup Demineralizer	9.2-11 Sh 3	
M-429 Sh 1	Evaporator Plant Sample System	9.3-15	
M-429 Sh 2	Evaporator Plant Sample System	9.3-16	
M-429 Sh 3	Evaporator Plant Sample System	9.3-17 Sh 1	27
M-429 Sh 4	Evaporator Plant Sample System	9.3-17 Sh 2	
M-430 Sh 1A	Auxiliary Steam Boiler System	10.4-26 Sh 1	
M-430 Sh 1B	Auxiliary Steam Boiler System	10.4-26 Sh 2	
M-430 Sh 2	Auxiliary Steam Boiler System	10.4-27	
M-430 Sh 3A	Auxiliary Steam Boiler System	10.4-28 Sh 1	26
M-430 Sh 3B	Auxiliary Steam Boiler System	10.4-28 Sh 2	

TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
M-431 Sh 1A	Main Steam & Turbine Steam Supply System - Unit 1	10.3-1 Sh 1	
M-431 Sh 1B	Main Steam & Turbine Steam Supply System - Unit 1	10.3-1 Sh 2	26
M-431 Sh 2A	Main Steam & Turbine Steam - Unit 1	10.3-2 Sh 1	
M-431 Sh 2B	Main Steam & Turbine Steam - Unit 1	10.3-2 Sh 2	
M-432 Sh 1	Main Steam Supply System - Unit 2	10.3-3	
M-432 Sh 2	Main Steam & Turbine Steam - Unit 2	10.3-4	25
M-433A	Auxiliary Steam System - Unit 1	10.4-1 Sh 1	
M-433B	Auxiliary Steam System - Unit 1	10.4-1 Sh 2	
M-434A	Auxiliary Steam System - Unit 2	10.4-2 Sh 1	
M-434B	Auxiliary Steam System - Unit 2	10.4-2 Sh 2	
M-436 Sh 1A	Turbine Extraction, Heater Vents and Drains Unit 1	10.2-1 Sh 1	
M-436 Sh 1B	Turbine Extraction, Heater Vents and Drains Unit 1	10.2-1 Sh 2	
M-436 Sh 2A	Turbine Extraction, Heater Vents and Drains Unit 1	10.2-2 Sh 1	26
M-436 Sh 2B	Turbine Extraction, Heater Vents and Drains Unit 1	10.2-2 Sh 2	
M-437 Sh 1A	Turbine Extraction, Heater Vents and Drains Unit 2	10.2-3 Sh 1	
M-437 Sh 1B	Turbine Extraction, Heater Vents and Drains Unit 2	10.2-3 Sh 2	
M-437 Sh 2A	Turbine Extraction, Heater Vents and Drains Unit 2	10.2-4 Sh 1	
M-437 Sh 2B	Turbine Extraction, Heater Vents and Drains Unit 2	10.2-4 Sh 2	
M-438 Sh 1A	Condensate and Feedwater System - Unit 1	10.4-8 Sh 1	

TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
M-438 Sh 1B	Condensate and Feedwater System - Unit 1	10.4-8 Sh 2	
M-438 Sh 2A	Condensate and Feedwater System - Unit 1	10.4-9 Sh 1	
M-438 Sh 2B	Condensate and Feedwater System - Unit 1	10.4-9 Sh 2	
M-438 Sh 3A	Condensate and Feedwater System - Unit 1	10.4-10 Sh 1	
M-438 Sh 3B	Condensate and Feedwater System - Unit 1	10.4-10 Sh 2	
M-438 Sh 4	Condensate and Feedwater System - Unit 1	10.4-10 Sh 3	
M-439 Sh 1A	Condensate and Feedwater System - Unit 2	10.4-11 Sh 1	
M-439 Sh 1B	Condensate and Feedwater System - Unit 2	10.4-11 Sh 2	
M-439 Sh 2A	Condensate and Feedwater System - Unit 2	10.4-12 Sh 1	
M-439 Sh 2B	Condensate and Feedwater System - Unit 2	10.4-12 Sh 2	
M-439 Sh 3A	Condensate and Feedwater System - Unit 2	10.4-13 Sh 1	
M-439 Sh 3B	Condensate and Feedwater System - Unit 2	10.4-13 Sh 2	
M-439 Sh 4	Condensate and Feedwater System - Unit 2	10.4-13 Sh 3	26
M-440A	Condensate Demineralizer System - Unit 1	10.4-4 Sh 1	
M-440B	Condensate Demineralizer System - Unit 1	10.4-4 Sh 2	
M-441A	Condensate Demineralizer Regeneration - Unit 1	10.4-5 Sh 1	
M-441B	Condensate Demineralizer Regeneration - Unit 1	10.4-5 Sh 2	
M-442A	Condensate Demineralizer System - Unit 2	10.4-6 Sh 1	
M-442B	Condensate Demineralizer System - Unit 2	10.4-6 Sh 2	
M-443A	Condensate Demineralizer Regeneration - Unit 2	10.4-7 Sh 1	
M-443B	Condensate Demineralizer Regeneration - Unit 2	10.4-7 Sh 2	
M-444A	Feedwater Chemical Addition System	10.4-25 Sh 1	27

TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
M-444B	Feedwater Chemical Addition System	10.4-25 Sh 2	27
M-445 Sh 1	Steam Plant Sample System - Unit 1	9.3-7	
M-445 Sh 2	Steam Plant Sample System - Unit 1	9.3-8	
M-445 Sh 3	Steam Plant Sample System - Unit 1	9.3-9	
M-445 Sh 4	Steam Plant Sample System - Unit 1	9.3-10	
M-445 Sh 5	Steam Plant Sample System - Unit 2	9.3-11	14
M-445 Sh 6	Steam Plant Sample System - Unit 2	9.3-12	
M-445 Sh 7	Steam Plant Sample System - Unit 2	9.3-13	
M-445 Sh 8	Steam Plant Sample System - Unit 2	9.3-14	
M-446A	Circulating Water - Units 1 & 2	10.4-3 Sh 1	27
M-446B	Circulating Water - Units 1 & 2	10.4-3 Sh 2	
M-448 Sh 1	Instrument and Service Air	9.3-1	
M-448 Sh 2	Instrument and Service Air	9.3-2	
M-449 Sh 1A	Plant Water Storage and Transfer	9.2-18 Sh 1	27
M-449 Sh 1B	Plant Water Storage and Transfer	9.2-18 Sh 2	
M-449 Sh 2	Plant Water Storage and Transfer	9.2-19	
M-452A	Emergency Diesel Generator Fuel Oil Storage and Transfer System Units 1 & 2	9.5-25 Sh 1	26
M-452B	Emergency Diesel Generator Fuel Oil Storage and Transfer System Units 1 & 2	9.5-25 Sh 2	
M-453	HVAC Reactor Building Unit 1	9.4-10	
M-454 Sh 1	HVAC Auxiliary Building Units 1 & 2	9.4-3	
M-454 Sh 2	HVAC Auxiliary Building Units 1 & 2	9.4-4	
M-454 Sh 3	HVAC Auxiliary Building Units 1 & 2	9.4-5	
M-454 Sh 4	HVAC Auxiliary Building Units 1 & 2	9.4-6	

TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
M-454 Sh 5	HVAC Auxiliary Building Units 1 & 2	9.4-7	
M-455 Sh 1	HVAC Turbine Building Unit 1	9.4-8	
M-455 Sh 2	HVAC Turbine Building Unit 2	9.4-9	
M-456 Sh 1A	Plant Heating Turbine Building	9.4-13 Sh 1	27
M-456 Sh 1B	Plant Heating turbine Building	9.4-13 Sh 2	
M-456 Sh 1C	Plant Heating Turbine Building	9.4-13 Sh 3	
M-456 Sh 2A	Plant Heating Auxiliary and Reactor Buildings	9.4-14 Sh 1	26
M-456 Sh 2B	Plant Heating Auxiliary and Reactor Buildings	9.4-14 Sh 2	
M-456 Sh 3A	Plant Heating Office and Service Buildings	9.4-15 Sh 1	27
M-456 Sh 3B	Plant Heating Office and Service Buildings	9.4-15 Sh 2	
M-456 Sh 4	Plant Heating Miscellaneous Structures	9.4-16	25
M-457 Sh 1A	Chilled Water Auxiliary Building	9.2-20 Sh 1	
M-457 Sh 1B	Chilled Water Auxiliary Building	9.2-20 Sh 2	
M-457 Sh 2A	Chilled Water Safeguards Equipment Unit 1	9.2-24 Sh 1	26
M-457 Sh 2B	Chilled Water Safeguards Equipment Unit 2	9.2-24 Sh 2	
M-457 Sh 3A	Chilled Water Safeguard Equipment Unit 2	9.2-25 Sh 1	
M-457 Sh 3B	Chilled Water Safeguard Equipment Unit 2	9.2-25 Sh 2	
M-457 Sh 4A	Chilled Water Turbine Building Unit 1	9.2-21 Sh 1	27
M-457 Sh 4B	Chilled Water Turbine Building Unit 1	9.2-21 Sh 2	
M-457 Sh 5A	Chilled Water Turbine Building Unit 2	9.2-22 Sh 1	
M-457 Sh 5B	Chilled Water Turbine Building Unit 2	9.2-22 Sh 2	27
M-457 Sh 6	Chilled Water Office and Service Building	9.2-23	13
M-458 Sh 1A	Fire Protection	9A-30 Sh 1	27
M-458 Sh 1B	Fire Protection	9A-30 Sh 2	

TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
M-458 Sh 1C	Fire Protection	9A-30 Sh 3	27
M-458 Sh 2	Fire Protection	9A-30 Sh 4	
M-459 Sh 1A	Domestic Water	9.2-12 Sh 1	
M-459 Sh 1B	Domestic Water	9.2-12 Sh 2	26
M-459 Sh 2	Domestic Water	9.2-12 Sh 3	
M-459 Sh 3	Domestic Water	9.2-12 Sh 4	
M-460 Sh 1	Process Steam, Supply and Return System	10.4-20	
M-460 Sh 2A	Process Steam, Supply and Return System	10.4-21 Sh 1	
M-460 Sh 2B	Process Steam, Supply and Return System	10.4-21 Sh 2	26
M-460 Sh 3A	Process Steam, Supply and Return System	10.4-22 Sh 1	
M-460 Sh 3B	Process Steam, Supply and Return System	10.4-22 Sh 2	
M-460 Sh 4	Process Steam, Supply and Return System	10.4-22A	14
M-461 Sh 1A	Process Steam Evaporator System	10.4-14 Sh 1	
M-461 Sh 1B	Process Steam Evaporator System	10.4-14 Sh 2	27
M-461 Sh 2A	Process Steam Evaporator System	10.4-15 Sh 1	
M-461 Sh 2B	Process Steam Evaporator System	10.4-15 Sh 2	
M-461 Sh 3	Process Steam Evaporator System	10.4-16	
M-461 Sh 4	Process Steam Evaporator System	10.4-17	
M-461 Sh 5	Process Steam Evaporator System	10.4-18	
M-461 Sh 6	Process Steam Evaporator System	10.4-19	14
M-461 Sh 7	Process Steam Evaporator System	10.4-19 Sh 1	26
M-461 Sh 8	Process Steam Evaporator System	10.4-19 Sh 2	
M-462	HVAC Reactor Building Unit 2	9.4-10A	12

TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
M-463 Sh 1A	Miscellaneous Gas System Hydrogen Supply	9.3-41 Sh 1	
M-463 Sh 1B	Miscellaneous Gas System Hydrogen Supply	9.3-41 Sh 2	
M-463 Sh 2A	Miscellaneous Gas System Carbon Dioxide Supply	9.3-43 Sh 1	
M-463 Sh 2B	Miscellaneous Gas System Carbon Dioxide Supply	9.3-43 Sh 2	
M-463 Sh 3	Miscellaneous Gas System Nitrogen Supply	9.3-42	
M-464	Cooling Pond Blowdown and Makeup System	10.4-24	
M-465 Sh 1	HVAC-Control Room-Battery Room-Switchgear and Cable Spreading Room	9.4-1	
M-465 Sh 2	HVAC-Control Room-Battery Room-Switchgear and Cable Spreading Room	9.4-2	
M-466	HVAC Access Control and Computer Area	9.4-12	
M-467 Sh 1	HVAC Office and Service Buildings	9.4-17	
M-467 Sh 2	HVAC Office and Service Buildings	9.4-18 Sh 1	27
M-467 Sh 3	HVAC Office and Service Buildings	9.4-18 Sh 2	
M-468 Sh 1	HVAC Diesel Generator Building and Service Water Pump Structure	9.4-11	
M-468 Sh 2	Miscellaneous Structures HVAC	9.4-20	
M-468 Sh 3A	Miscellaneous Building HVAC System (Evaporator and Auxiliary Boiler Building)	9.4-19 Sh 1	27
M-468 Sh 3B	Miscellaneous Building HVAC System (Evaporator and Auxiliary Boiler Building)	9.4-19 Sh 2	
M-468 Sh 4	Miscellaneous Structure HVAC (Guard House)	9.4-21	15
M-468 Sh 5	Miscellaneous Structures HVAC	9.4-22	16
M-469A	Boron Recovery Regasifier	9.3-45 Sh 1	26
M-469B	Boron Recovery Regasifier	9.3-45 Sh 2	

TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
M-470 Sh 1A	Chemical and Oily Waste System	9.5-3[illegible] Sh 1	22
M-470 Sh 1B	Chemical and Oily Waste System	9.5-30 Sh 2	
M-470 Sh 2A	Chemical and Oily Waste System	9.5-29 Sh 1	26
M-470 Sh 2B	Chemical and Oily Waste System	9.5-29 Sh 2	

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TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
M-472 Sh 1	Miscellaneous Instrumentation Reactor Building Unit 1	6.2-119	12
M-472 Sh 2	Miscellaneous Instrumentation Reactor Building Unit 2	6.2-120	
M-507 Sh 3	Typical Layout of Safety Related Filter Units	12.3-41	
M-509 Sh 2	Typical Layout of Non-Safety Related Filter Units (Elevation)	12.3-39	
M-511 Sh 2	Typical Layout of Non-Safety Related Filter Units (Plan View)	12.3-40	
M-525 Sh 3	Definition of Control Room Envelope	6.4-1	
M-525 Sh 4	Definition of Control Room Envelope	6.4-2	
M-527 Sh 2	Hydrogen Vent Exhaust System Outside the Containment	6.5-2	13 1
M-527 Sh 3	Location of Outside Air Intakes	6.4-4	
M-531 Sh 3	Hydrogen Vent Exhaust System Inside Containment	6.5-1	
M-601 Sh 3	Reactor Coolant and Pressure Control System Unit 1	5.4-15	
M-703 Sh 1	Makeup and Purification Units 1 & 2	6.3-1 Sh 1	27
M-703 Sh 2	Makeup and Purification Units 1 & 2	6.3-1 Sh 2	
M-709	Radwaste Gas System - Unit 1 & 2	11.3-3	
M-710	Decay Heat Removal and Core Flooding System Units 1 & 2	6.3-2	
M-725	Solid Waste Flow Diagram	11.4-3	
M-754 Sh 1	Flow Diagram - Heating, Ventilation and Air Conditioning Auxiliary Building - Unit 1 & 2	11.3-4	13
M-754 Sh 2	Flow Diagram - Heating, Ventilation and Air Conditioning Auxiliary Building - Unit 1 & 2	11.3-5	

TABLE 1.1-1 PART 2 (continued)

Bechtel Dwg. No.	FSAR Figure Title	FSAR Fig. No.	
M-754 Sh 3	Flow Diagram - Heating, Ventilation and Air Conditioning Auxiliary Building - Unit 1 & 2	11.3-6	
M-754 Sh 4	Flow Diagram - Heating, Ventilation and Air Conditioning Auxiliary Building - Unit 1 & 2	11.3-7	
M-754 Sh 5	Flow Diagram - Heating, Ventilation and Air Conditioning Auxiliary Building - Unit 1 & 2	11.3-8	
M-754 Sh 6	Flow Diagram - Heating, Ventilation and Air Conditioning Auxiliary Building - Unit 1 & 2	11.3-9	13
SK -195	Personnel Traffic Patterns Plan of El. 568'-0", 584'-0", and 599'-0"	12.3-31	
SK-A-196	Personnel Traffic Patterns Plan El 614'-0"	12.3-32	
SK-A-197	Personnel Traffic Patterns Plan El 634'-6"	12.3-33	
SK-A-198	Personnel Traffic Patterns Plan El 646'-0"	12.3-34	
SK-A-199	Personnel Traffic Patterns Plan El 659'-0"	12.3-35	
SK-A-200	Personnel Traffic Patterns Plan El 674'-0" and 685'-0"	12.3-36	1
SK-C-351	SAP Finite Element Mesh for Equipment Hatch	3.8-29	
SK-C-416	Finel Model 1	3.8-25	
SK-C-417	Finel Model 2	3.8-26	13
SK-C-468	PMF Protection	3.4-1	
SD-C-557	Plant Site Drainage System	2.4-37	25
SK-G-3	Atterberg Limits and Mean Grain Size (D_{50}) for Plant Area	2.5-30	27

HVAC LINES

DUCTED AIR FLOW

AIR MOVEMENT (NON DUCTED)

FLOW (CFM) DUCTED AIR FLOW TO SPACE

FLOW (CFM) DUCTED AIR FLOW FROM SPACE

EXHAUST HOOD

RD RUPTURE DISK

FANS

CENTRIFUGAL BLOWER OR COMPRESSER

CENTRIFUGAL FAN

CENTRIFUGAL FAN WITH INLET VANES

VANE AXIAL FAN

PROPELLER FAN

H E UNIT HEATER ELECTRIC COIL SHOWN. (SEE UNDER COILS FOR DEFINITION S OF OTHER LETTER SYMBOLS)

ROOF EXHAUSTER

DAMPERS

M MOTOR OPERATED

NORMAL LEAKAGE

BACKDRAFT OR GRAVITY RELIEF

SINGLE BLADE OR BUTTERFLY

MANUAL BALANCE

TORNADO DAMPER

FUSIBLE LINK FIRE DAMPER OR FIRE DOOR

BUBBLE TIGHT

FACE AND BYPASS

CONSTANT VOLUME

NOTE: REFER TO SHEET 3, M-400 FOR ACTUATOR SYMBOLS

COILS

H HW

(H) HEATING COIL

(HW) HOT WATER (SHOWN)
(S) STEAM
(E) ELECTRIC
(G) GAS

C CH

(C) COOLING COIL

(CH) REFRIG. CHILLED WATER (SHOWN)
(CW) COOLING WATER
(DX) REFRIGERANT DIRECT EXPANSION

HUMIDIFIERS

(HG) LOW PRESSURE STEAM GRID (SHOWN)
(S) STEAM FAN
(H) HOT WATER FAN
(E) ELECTRIC FAN

DUST COLLECTORS

CDC

(CDC) CYCLONE DUST COLLECTOR (SHOWN)
(BDC) BAG TYPE DUST COLLECTOR

DYNAMIC TYPE DUST COLLECTOR

AIR CLEANING DEVICES

LOW EFFICIENCY ROLL TYPE FILTER

CHARCOAL FILTER

ROUGHING FILTER

HIGH EFFICIENCY PARTICULATE ABSORBER

MIST ELIMINATOR

START UP (CONSTRUCTION) FILTER

LOUVERS

FIXED

ADJUSTABLE

FIRE PROTECTION EQUIPMENT

FIRE HYDRANT

FIRE HYDRANT WITH HOSE HOUSE

HOSE REEL STATION

HOSE RACK STATION

DELUGE VALVE

ALARM CHECK VALVE

DRY PIPE VALVE

POST INDICATOR VALVE

BALL DRIP VALVE

WMA FIRE SYSTEM WATER MOTOR ALARM

GENERAL NOTES:

DUCTWORK AND DAMPER C
THE FIRST CHARACTER IN
CHARACTER DESCRIBES T

FIRST CHA
2. LESS TH
3. -12-3/4
4. -8-3/4
5. -3-3/4
6. +4"
7. +7
8. GREATER

SECOND C
B- CARBON
C- AUSTENI
E- ALUMINU
N- CARBON

THIRD CH
DUCTWORK
K- STANDAR
L- GAS TIGH
M- SEISMIC
SUPPORT
N- SEISMIC
ONLY
P- SEISMIC
SUPPORT
R- SEISMIC
ONLY FO
S- DUST OR

RB-REACTOR BUILDI
RBVH-REACTOR BUIL
RBCH-REACTOR BUIL
ABVH-AUXILIARY BUI
ABCH-AUXILIARY BUI
AB-AUXILIARY BUILDI
TB-TURBINE BUILDIN
DGB-DIESEL GENERATO
EB-EVAPORATOR BUIL
CHLB-CHLORINATION B
AFWAS-AUXILIARY FEE
OSS-OUTSIDE STRUCT
BWST-BORATED WATER
CST-CONDENSATE ST
RMT-REACTOR MAKE-U
RCS-REACTOR COOLAN
RGS-RADWASTE GAS S
PWST-PRIMARY WATE
CCW-COMPONENT C
AC-ACCESS CONTRO
CS-COMBINATION SH
CT-COOLING TOWER
IS-INTAKE STRUCTU
SW-SERVICE WATER
CRS-CONTROL ROOM
HP-HIGH PRESSURE
LP-LOW PRESSURE
FW-FEEDWATER
MUP-MAKE UP AND
AMSS-AUTOMATIC
SYSTEM (CO

DUCTWORK IDENTIFICATION

5W 90°

UCT CLASS — SIZE ROUND EQUIVALENT DUCT DIAMETER IN INCHES

ASSES ARE DESIGNATED BY A THREE CHARACTER ALPHANUMERIC CODE. DICATES THE DUCT PRIMARY PRESSURE RATING, THE SECOND E MATERIAL AND THE THIRD INDICATES APPLICABLE STANDARDS.

ARACTER PRIMARY PRESSURE RATING

IN (3" W.G. TOTAL PRESSURE
W.G. TO -1" TOTAL PRESSURE
W.G. TO -4" TOTAL PRESSURE
W.G. TO -9 3/4" TOTAL PRESSURE
W.G. TO -18 3/4" TOTAL PRESSURE
W.G. TO -28 3/4" TOTAL PRESSURE
THAN -10" W.G. TOTAL PRESSURE

ARACTER MATERIAL

TEEL
E STAINLESS STEEL

TEEL GALVANIZED

ARACTER APPLICABLE BECHTEL POWER CORPORATION H V A C STANDARDS

CONSTRUCTION
WELDED CONSTRUCTION
CATEGORY I CONSTRUCTION INCLUDING HANGER AND
CATEGORY I CONSTRUCTION HANGERS AND SUPPORTS
CATEGORY I CONSTRUCTION INCLUDING HANGERS AND
OF GAS TIGHT WELDED DUCTWORK
CATEGORY I CONSTRUCTION HANGERS AND SUPPORTS
GAS TIGHT WELDED DUCTWORK
MATERIAL HANDLING DUCTWORK

FLOW DIAGRAM	PIPING AND INSTRUMENT DIAGRAMS	
	M-400	LEGEND
M-701	M-401	REACTOR COOLANT AND PRESSURE CONTROL UNIT 1
	M-402	REACTOR COOLANT AND PRESSURE CONTROL UNIT 2
M-703	M-403	MAKE-UP AND PURIFICATION UNIT 1
	M-404	MAKE-UP AND PURIFICATION UNIT 2
M-705	M-405	REACTOR CHEMICAL ADDITION
	M-406	REACTOR PLANT SAMPLE
M-707	M-407	LIQUID WASTE
M-708	M-408	BORON RECOVERY
M-709	M-409	RADWASTE GAS
M-710	M-410	DECAY HEAT REMOVAL AND CORE FLOODING UNIT 1
	M-411	DECAY HEAT REMOVAL AND CORE FLOODING UNIT 2
M-712	M-412	REACTOR BUILDING SPRAY UNIT 1
	M-413	REACTOR BUILDING SPRAY UNIT 2
M-714	M-414	FUEL POOL COOLING AND PURIFICATION
M-715	M-415	REACTOR CAVITY FLOODING (PLOCAP) UNIT 1
	M-416	COMPONENT COOLING WATER UNIT 1
M-717	M-417	COMPONENT COOLING WATER UNIT 2
M-718	M-418	SERVICE WATER - COOLING TOWER AND PUMP STRUCTURE
M-719	M-419	SERVICE WATER - AUXILIARY AND REACTOR BUILDINGS
M-720	M-420	SERVICE WATER - TURBINE BUILDING
	M-421	REACTOR BUILDING PENETRATION PRESSURIZATION UNIT 1
	M-422	REACTOR BUILDING PENETRATION PRESSURIZATION UNIT 2
	M-423	CONTROL ROD DRIVES AND MISCELLANEOUS REACTOR COOLANT PUMP CONNECTIONS UNIT 1
	M-424	CONTROL ROD DRIVES AND MISCELLANEOUS REACTOR COOLANT PUMP CONNECTIONS UNIT 2
M-725	M-425	SOLID WASTE
	M-426	BORIC ACID EVAPORATOR
	M-427	LIQUID WASTE EVAPORATOR
	M-428	MAKE-UP DEMINERALIZER
	M-429	EVAPORATOR SAMPLE SYSTEM
M-730	M-430	AUXILIARY STEAM BOILERS
M-731	M-431	MAIN STEAM AND TURBINE STEAM UNIT 1
M-732	M-432	MAIN STEAM AND TURBINE STEAM UNIT 2
M-733	M-433	AUXILIARY STEAM UNIT 1
M-734	M-434	AUXILIARY STEAM UNIT 2
	M-435	REACTOR CAVITY FLOODING (PLOCAP) UNIT 2
M-736	M-436	TURBINE EXTRACTION-HEATER VENTS AND DRAINS UNIT 1
M-737	M-437	TURBINE EXTRACTION - HEATER VENTS AND DRAINS UNIT 2
M-738	M-438	FEEDWATER AND CONDENSATE UNIT 1
M-739	M-439	FEEDWATER AND CONDENSATE UNIT 2
	M-440	CONDENSATE DEMINERALIZER UNIT 1
	M-441	CONDENSATE DEMINERALIZER REGENERATION UNIT 1
	M-442	CONDENSATE DEMINERALIZER UNIT 2
	M-443	CONDENSATE DEMINERALIZER REGENERATION UNIT 2
	M-444	FEEDWATER CHEMICAL ADDITION
	M-445	STEAM PLANT SAMPLING
M-746	M-446	CIRCULATING WATER
M-747	M-447	SERVICE WATER AND CIRCULATING WATER CHEMICAL ADDITION
	M-448	INSTRUMENT AND SERVICE AIR
M-749	M-449	PLANT WATER STORAGE AND TRANSFER
M-750	M-450	LUBE OIL UNIT 1
M-751	M-451	LUBE OIL UNIT 2
M-752	M-452	EMERGENCY DIESEL FUEL OIL STORAGE AND TRANSFER
M-753	M-453	HVAC - REACTOR BUILDING UNIT 1
M-754	M-454	HVAC - AUXILIARY BUILDING
M-755	M-455	HVAC - TURBINE BUILDING
M-756	M-456	PLANT HEATING
M-757	M-457	CHILLED WATER
M-758	M-458	FIRE PROTECTION
M-759	M-459	DOMESTIC WATER
M-760	M-460	TURBINE EXTRACTION STEAM TO EVAPORATOR
M-761	M-461	EVAPORATOR PROCESS STEAM TO DOW
	M-462	HVAC - REACTOR BUILDING UNIT 2
M-763	M-463	MISCELLANEOUS GAS SUPPLY
M-764	M-464	COOLING POND BLOWDOWN AND MAKE-UP
M-765	M-465	HVAC - CONTROL ROOM - BATTERY ROOM - SWITCH GEAR AND CABLE SPREADING ROOM
M-766	M-466	HVAC - ACCESS CONTROL AND COMPUTER AREA
M-767	M-467	HVAC - OFFICE AND SERVICE BUILDINGS
M-768	M-468	HVAC - MISCELLANEOUS STRUCTURES
	M-469	RADWASTE DEGASIFIER
	M-470	CHEMICAL AND OILY WASTE
	M-472	MISCELLANEOUS INSTRUMENTATION REACTOR BLDG UNIT 1 & 2
	M-418	PROCESS STEAM RADIATION MONITOR
	M-479	PLANT RADIATION MONITORING SYSTEM

NOTES:
1. THE ABOVE IS A LIST OF P&ID TITLES AND NUMBERS ONLY. REFER TO DRAWING CONTROL LOG FOR COMPLETE LIST OF P&ID SHTS, LATEST REV ETC.
2. REFER TO 7220-M-1(2) FOR EQUIPMENT NUMBER CODES.

ABBREVIATIONS

NG VENT HEADER
NG COLLECTION HEADER
ING VENT HEADER
ING COLLECTION HEADER
R BUILDING
ING
ILDING
WATER ACTUATION SIGNAL
URES
STORAGE TANK
RAGE TANK
TANK
SYSTEM
STEM
STORAGE TANK
OLING WATER
AREA
P
RE
STRUCTURE
SOLATION SIGNAL

BRS - BORON RECOVERY SYSTEM
LWS - LIQUID WASTE SYSTEM
ESFAS - ENGINEERED SAFETY FEATURES ACTUATION SYSTEM
ECCAS - EMERGENCY CORE COOLING ACTUATION SIGNAL
MSLIS - MAIN STEAM LINE ISOLATION SIGNAL
RBSAS - REACTOR BUILDING SPRAY ACTUATION SIGNAL
RBCAS - REACTOR BUILDING COOLING ACTUATION SIGNAL
FPVAS - FUEL POOL VENTILATION ACTUATION SIGNAL
RAS - RECIRCULATION ACTIVATION SIGNAL
RPS - REACTOR PROTECTION SYSTEM
ICS - INTEGRATED CONTROL SYSTEM
RCFAS - REACTOR CAVITY FLOOD ACTUATION SIGNAL
PSTS - PROCESS STEAM TRANSFER SYSTEM
A/S - AIR SUPPLY (COMPRESSED)
RA - RETURN AIR
EA - EXHAUST AIR
OA - OUTSIDE AIR
PAS - PURGE AIR SUPPLY
PAE - PURGE AIR EXHAUST
SA - SUPPLY AIR
TA - TRANSFER AIR (NON DUCTED)
GH - GUARD HOUSE
MCR - MAIN CONTROL ROOM
WT - WATER TREATMENT BUILDING
RBIS 1, RBIS 2 → REACTOR BUILDING ISOLATION SIGNAL I & II
CRIS 1, CRIS 2 → CONTROL ROOM ISOLATION SIGNAL I & II
LOP - LOSS OF OFFSITE POWER SEQUENCER

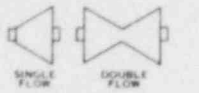
IFICATION SYSTEM
KES UP AND BLOWDOWN
LING POND)

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Legend Piping & Instrument Diagram
(M-400 Sh 1 Rev 3)

FSAR Figure 1.1-1

EQUIPMENT



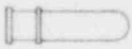
TURBINE

HORIZONTAL CENTRIFUGAL PUMP

VERTICAL PUMPS

POSITIVE DISPLACEMENT PUMP

ROTARY GEAR PUMP


U TUBE HEAT EXCHANGER

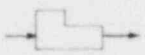
STRAIGHT TUBE HEAT EXCHANGER

PRESSURE VESSELS VERTICAL (SHOWN)OR HORIZONTAL (TANKS, RECEIVERS, DRYERS, SEPARATORS, ETC)

CONE ROOF TANK

FLOATING TOP TANK

AFTERCOOLER


RECIPROCATING AIR COMPRESSOR (INSTR AND SERVICE)

MIXER

PRESSURIZED GAS BOTTLE

HAND PUMP

VACUUM PUMP

EVAPORATOR

ELECTRICAL IMMERSION HEATER

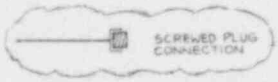
HEAT EXCHANGE SURFACE

PROCESS PIPING

MAIN PROCESS FLOW

SECONDARY PROCESS FLOW

INCREASER REDUCER



WELDED CAP

SCREWED CAP

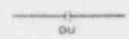
HOSE CONNECTION

QUICK DISCONNECT

REMOVABLE SPOOL

FLEXIBLE CONNECTION

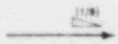
BLIND FLANGE



INSULATING FLANGES (IF) OR DIELECTRIC UNION (DU) (SHOWN)

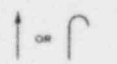
BREATHER CAP

LOOP SEAL

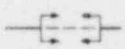


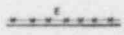
DOWNWARD SLOPE (1" PER 8')

UPWARD SLOPE (1" PER 8')

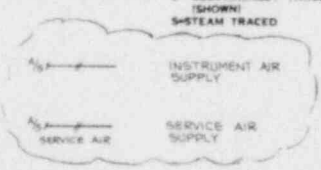


ATMOSPHERIC VENT (STRAIGHT VENT IS REQ'D IN DRAINAGE SYSTEMS)

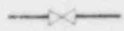

BURIED OR EMBEDDED PIPE



HEAT TRACING E= ELECTRICALLY TRACED (SHOWN) S=STEAM TRACED



LINE VALVES


GATE

GLOBE

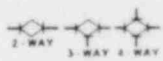
Y-PATTERN GLOBE

ANGLE

THREE WAY (NOTE 19, M-400 SH.3)

FOUR WAY (NOTE 19, M-400 SH.3)

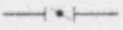
NEEDLE



PLUG

DIAPHRAGM

BALL

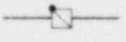

BUTTERFLY

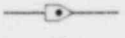
HOSE

PINCH

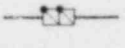
TANDEM BLOWDOWN

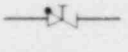
CHECK


FOOT


FLOW LIMITING (OR EXCESS FLOW) CHECK

BLEEDER TRIP

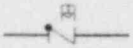

BACKFLOW PREVENTER


STOP CHECK

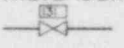
ANGLE STOP CHECK

G = GEAR-OPERATED (SHOWN)
A = AIR WRENCH
CH = CHAIN
X = EXTENSION STEM
S = SPECIAL TYPE

BALANCING VALVE


AUTOMATIC RECIRCULATION CONTROL VALVE

VALVE IDENTIFICATION



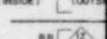
NOTE:
VALVE SIZE AND MATERIAL ARE IDENTIFIED WITH THE PIPING

VALVE STA

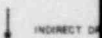
(USED WHEN LOCKE
THROTTLING POSI

MISCELL

(INSIDE) (OUTS



EQUIPMENT VENT


INDIRECT DR

TUS SYMBOLS

STEM LEAKOFF

OPEN DURING NORMAL OPERATION (ALL VALVES EXCEPT BUTTERFLY)

LOCKED OPEN (ALL VALVES EXCEPT BUTTERFLY)

CLOSED DURING NORMAL OPERATION (ALL VALVES EXCEPT BUTTERFLY)

LOCKED CLOSED (ALL VALVES EXCEPT BUTTERFLY)

THROTTLE

OPEN DURING NORMAL OPERATION (BUTTERFLY ONLY)

CLOSED DURING NORMAL OPERATION (BUTTERFLY ONLY)

ANEOUS

SPECTACLE BLIND (SB)

CIRCULAR OR HAMER BLIND (HB)

SINGLE BASKET STRAINER (SBS)

TWIN BASKET STRAINER (TBS)

Y-TYPE STRAINER (SHOWN WITHOUT BLOWOFF VALVE) (YS)

TEMPORARY STARTUP STRAINER (SUS)

SCREEN TYPE STRAINER (STS)

FILTER

EXPANSION JOINT (EJ)

FLAME ARRESTER (FA)

TRAP
ST = STEAM (SHOWN)
D = DRAIN
AT = AIR

CLASS CHANGE (FOR EXACT PHYSICAL DESCRIPTION OF CLASS CHANGES REFER TO APPROPRIATE ISOMETRIC)

REACTOR BUILDING PENETRATION

ENETRATION NUMBER)

BUILDING OUTER WALL PENETRATION

SEISMIC CATEGORY I REQUIREMENTS APPLY BETWEEN FLAGS (FOR EXACT PHYSICAL DESCRIPTION OF SEISMIC BOUNDARIES REFER TO APPROPRIATE ISOMETRIC)

EQUIPMENT DRAIN

(D)

MISCELLANEOUS (CONT.)

EJECTOR OR EDUCTOR

EXHAUST HEAD

MANUAL HYDRO DRAIN

MANUAL HYDRO VENT

AUTOMATIC VENT

SPARGER (SHOWN WITH UPWARD FLOW)

WATER HAMMER ARRESTER

DRWG NO.
2M 403
SHT (D-1)
SHEET ZONE

LINE BREAK OR RESUMPTION

FURNISHED WITH EQUIPMENT

TRAP WITH INTEGRAL STRAINER

12
78

CONTAINMENT PENETRATION IDENTIFICATION NUMBER

A

IDENTIFICATION OF PIPING CONNECTION AT CONDENSERS, EXPANSION JOINT, STRAINER ETC.

1

IDENTIFICATION OF PIPING CONNECTION AT TURBINE GENERATOR

S SBW

BECHTEL - VENDOR INTERFACE
S = BECHTEL, GE = GENERAL ELECTRIC
BSW = BABCOCK & WILCOX
* = OTHER VENDORS

DESIGNATION FOR EQUIPMENT AND PIPING WHICH APPEAR ON OTHER P&ID'S

SPRAY NOZZLES

DESUPERHEATER

MIXING TEE

SC

SAMPLE COOLER

AIR SILENCER

SEISMIC ANCHOR

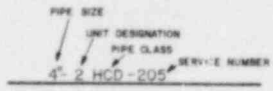
II

MILLEPORE SAMPLE

RUBBER AIR SEAL

SAMPLE CYLINDER

PIPING IDENTIFICATION



1- PIPE AND VALVE CLASSES ARE DESIGNATED BY THE (3) LETTER CODE THE FIRST LETTER INDICATES THE PRIMARY VALVE & FLANGE RATING, THE SECOND LETTER THE TYPE OF MATERIAL AND THE THIRD LETTER THE CODE TO WHICH THE PIPING IS DESIGNED (AS FOLLOWS).

FIRST LETTER - PRIMARY PRESSURE RATING
(UNLESS OTHERWISE NOTED) ALL RATINGS ARE IN ACCORDANCE WITH ANSI B16.5)

A - SPECIFIC PRESSURE & SPECIFIC TEMPERATURE
B - 2500 #
C - 1500 #
D - 900 #
E - 600 #
F - 400 #
G - 300 #
H - 150 #
J - 125 # ANSI B16.1
K - 175 # WOG UNDERWRITERS LAB. INC.
L - 250 # ANSI B16.1
M - 200 # WOG
N - 150 # ANSI B16.24
P - 100 # AWWA (OR MANUFACTURER'S RATING)
R - 75 # AWWA (OR MANUFACTURER'S RATING)
S - 50 # AWWA (OR MANUFACTURER'S RATING)
T - 25 # AWWA (OR MANUFACTURER'S RATING)
X - GRAVITY RATING
Y-Z - GENERAL USE AS DESIGNATED ON PIPING CLASS SHEETS.

SECOND LETTER - MATERIAL

A - ALLOY STEEL
B - CARBON STEEL
C - AUSTENITIC STAINLESS STEEL
D - COPPER, BRASS, OR BRONZE
E - ALUMINUM
F - CARBON STEEL-COPPER BEARING
G - CARBON STEEL-LINED
H - CAST IRON
J - CONCRETE
K - VITRIFIED CLAY
L - CARBON STEEL-IMPACT TESTED
M - CAST IRON-HIGH SILICON
N - CARBON STEEL-GALVANIZED
P - CAST IRON-CEMENT LINED
Q - ASBESTOS-CEMENT
R - DUCTILE IRON
S - DUCTILE IRON-CEMENT LINED
X - SPECIAL MATERIAL SEE CLASS SHEET

THIRD LETTER - APPLICABLE CODES

A - NUCLEAR POWER PLANT COMPONENTS, ASME B & PV CODE, SEC III, CLASS 1
B - NUCLEAR POWER PLANT COMPONENTS, ASME B & PV CODE, SEC III, CLASS 2
C - NUCLEAR POWER PLANT COMPONENTS, ASME B & PV CODE, SEC III, CLASS 3
D - POWER PIPING CODE, ANSI B 31.1.0 (1967) ANSI B 31.1 (1973)
F - NATIONAL FIRE PROTECTION ASSOCIATION CODE
G - NATIONAL OR APPLICABLE PLUMBING CODE
H - POWER BOILERS, ASME B & PV CODE SEC. I
J - AMERICAN WATER WORKS STANDARDS

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Legend Piping & Instrument Diagram
(M-400 Sh 2 Rev 3)

FSAR Figure 1.1-2

FIRST LETTER (NOTE 1)										SUCCEEDING LETTER (NOTES
MEASURED OR INITIATING VARIABLE (NOTE 11)	SYMBOL	SENSING DEVICE (NOTE 3)		DISPLAY DEVICE						CONTROL DEVICE
		PRIMARY ELEMENT	TRANSMITTER	INDICATOR	RECORDER	INTEGRATING INDICATOR	ALARM (NOTE 6) LOW	ALARM (NOTE 6) HIGH	ALARM (NOTE 6) HIGH & LOW	CONTROL STATION MAN/AUTO	CONTROLLER (NOTE 3)	CONTROL VALVE OR DAMPER (NOTE 4)
TYPICAL SYMBOL	[ ]	[ ] E	[ ] T	[ ] I	[ ] R	[ ] QI	[ ] AL	[ ] AH	[ ] AHL	[ ] K	[ ] C	[ ] V
ANALYSIS (NOTE 2)	A	AE	AT	AI	AR		AAL	AAH	AAHL	AK	AC	AV
BURNER FLAME	B	BE	BT	BI	BR		BAL				BC	BV
CONDUCTIVITY	C	CE	CT	CI	CR		CAL	CAH	CAHL	CK		CV
DENSITY (MASS) OR WEIGHT	D	DE	DT	DI	DR		DAL	DAH	DAHL	DK	DC	DV
VOLTAGE (EMF)	E	EE	ET	EI	ER		EAL	EAH	EAHL	EK	EC	
FLOW (NOTE 5)	F	FE	FT	FI	FR	FQI	FAL	FAH	FAHL	FK	FC	FV
GAGING (DIMENSIONAL)	G	GE	GT	GI	GR		GAL	GAH	GAHL	GK	GC	
HAND (MANUAL)	H										HC	HV
CURRENT	I	IE	IT	II	IR	IQI	IAL	IAH	IAHL	IK	IC	
POWER	J	JE	JT	JI	JR	JQI	JAL	JAH	JAHL	JK	JC	
TIME	K		KT	KI		KQI	KAL	KAH	KAHL		KC	KV
LEVEL	L	LE	LT	LI	LR		LAL	LAH	LAHL	LK	LC	LV
MOISTURE	M	ME	MT	MI	MR		MAL	MAH	MAHL	MK	MC	MV
NEUTRON FLUX	N	NE	NT	NI	NR	NQI	NAL	NAH	NAHL	NK	NC	
USER'S CHOICE (NOTE 7)	O											
PRESSURE (NOTE 12)	P	PE	PT	PI	PR		PAL	PAH	PAHL	PK	PC	PV
PRESSURE DIFFERENTIAL	PD		PDT	PDI	PDR		PDAL	PDAH	PDAHL	PDK	PDC	PDV
QUANTITY OR EVENT	Q		QT	QI	QR	QQI	QAL	QAH	QAHL	QK	QC	QV
RADIOACTIVITY (NOTE 14)	R	RE	RT	RI	RR	RQI	RAL	RAH	RAHL	RK	RC	RV
SPEED OR FREQUENCY	S		ST	SI	SR	SQI	SAL	SAH	SAHL	SK	SC	
TEMPERATURE	T	TE	TT	TI	TR		TAL	TAH	TAHL	TK	TC	TV
MULTIVARIABLE	U			UI	UR		UAL	UAH	UAHL		UC	UV
VISCOSITY	V		VT	VI	VR		VAL	VAH	VAHL	VK	VC	VV
WEIGHT	W	WE	WT	WI	WR	WQI	WAL	WAH	WAHL	WK	WC	WV
UNCLASSIFIED (NOTE 8)	X											
VIBRATION	Y	YE	YT	YI	YR			YAH				
POSITION	Z	ZE	ZT	ZI	ZR		ZAL	ZAH	ZAHL		ZC	

GENERAL INSTRUMENTS (NOTE 15)

- INSTRUMENT FOR SINGLE MEASURED VARIABLE AND ANY NUMBER OF FUNCTIONS. INSTRUMENT IS LOCALLY MOUNTED.
- DIA. TYP.
- FOR ASME TEST ONLY
- FOR ASME TEST PLUS NORMAL USE
- INSTRUMENT FOR TWO MEASURED VARIABLES OR MORE THAN ONE FUNCTION. INSTRUMENT IS LOCALLY MOUNTED.
- INSTRUMENT IS MOUNTED BEHIND A PANEL (TYPICAL)
- 2C25 — INSTRUMENT IS MOUNTED ON THE FRONT OF A PANEL (TYPICAL) WITH PANEL NUMBER

COMPUTER OR DATA LOGGER

- T 345 — COMPUTER OR DATA LOGGER INPUT OR OUTPUT. I/O POINT ADDRESS WILL BE INSCRIBED.

SIGNALS AND LINES

- CONNECTION TO PROCESS OR MECHANICAL LINK, OR INSTRUMENT SUPPLY
- PNEUMATIC SIGNAL, OR UNDEFINED SIGNAL FOR PROCESS FLOW DIAGRAMS
- ELECTRIC SIGNAL
- CAPILLARY TUBING (FILLED SYSTEM)
- HYDRAULIC SIGNAL
- ELECTROMAGNETIC OR SONIC SIGNAL (WITHOUT WIRING OR TUBING)

SENSORS-ANALYSIS

- AI — THROUGH-FLOW TYPE
- AE — NON-THROUGH FLOW TYPE

SENSORS-FLOW

- FE — ULTRASONIC FLOW ELEMENT
- FE — ANNUBAR FLOW ELEMENT
- FE — ELBOW TAP

SENSORS-FLOW (CONT.)

- ORIFICE PLATE (FE) OR RESTRICTION ORIFICE (FO)
- ORIFICE PLATE (FE) & QUICK-CHANGE FITTING
- VENTURI TUBE OR FLOW NOZZLE (FE)
- PITOT OR PITOT-VENTURI TUBE (FE)
- FORWARD-REVERSE PITOT TUBE (FE)
- FLUME (FE)
- WEIR (FE)
- TURBINE OR PROPELLER TYPE (FE)
- FI — ROTAMETER
- (NOTE 25) FT — IN-LINE INSTR SUCH AS MAGNETIC FLOWMETER, DISPLACEMENT METER, MASS FLOWMETER
- FLOW SIGHT GLASS
- FLOW STRAIGHTENING VANES (FX)
- TARGET FLOW METER

SENSORS-LEVEL

- LI — GAGE GLASS (LG) OR FLOAT OR DISPLACEMENT TYPE LEVEL INSTRUMENT
- (NOTE 17) LT — DIFFERENTIAL-PRESSURE TYPE
- (NOTE 17) LT — TANK MOUNTED DIFFERENTIAL-PRESSURE TYPE
- LI — INTERNAL BALL-FLOAT TYPE
- LI — GAGE BOARD TYPE
- LE — SONIC (ULTRASONIC)
- SONIC (ULTRASONIC) TYPE LEVEL INSTRUMENT
- DSE, BSE — NUCLEAR — NUCLEAR TYPE LEVEL INSTRUMENT

SENSORS-PRESSURE

- PI — DIRECT CONNECTED
- PI — WITH DIAPHRAGM SEAL, PIPED
- PI — WITH DIAPHRAGM SEAL, LINE OR EQPT. MOUNTED
- PE — STRAIN-GAGE TYPE

SENSORS-TEMPERATURE

- TI — BIMETALLIC THERMOMETER (TI) OR TEST WELL (TW) OR SINGLE SENSOR (TE)
- TE TE — DUAL SENSOR
- TI — FILLED THERMAL SYSTEM DIRECT CONNECTED

VALVES-BODIES (NOTES 18 & 19)

- FO — GLOBE, GATE OR OTHER IN-LINE TYPE NOT OTHERWISE IDENTIFIED (GLOBE SHOWN)
  - FO= FAIL OPEN
  - FC= FAIL CLOSE
  - FL= FAIL LOCKED (POSITION DOES NOT CHANGE)
  - FI= FAIL INDETERMINATE
- FO — THREE-WAY
- FO — FOUR-WAY

FOR OTHER TYPES OF VALVE BODIES SEE M-400 SH.2

PILOT SOLENOID VALVES

- ① PORT OPEN WHEN ENERGIZED (AIR SUPPLY OR VENT)
- ② PORT OPEN AT ALL TIMES (VALVE CONNECTIONS)
- ③ PORT OPEN WHEN DE-ENERGIZED (AIR SUPPLY OR VENT)

REFERENCE: NOTE 24

VALVES-ACTUATORS

- AO — PNEUMATIC DIAPHRAG… AO= AIR TO OPEN (SHOWN… AO= AIR TO CLOSE
- DIAPHRAGM, PRESSURE…
- M — ROTARY MOTOR (SHOWN TYPICALLY W… ELECTRIC SIGNAL)
- PNEUMATIC CYLINDER… SINGLE-ACTING
- HYDRAULIC OR PNEU… CYLINDER, DOUBLE-A…
- S — PNEUMATIC CYLINDER… DOUBLE-ACTING, WITH… PILOT VALVE
- S, R — SINGLE SOLENOID (NO… RESET AFTER LATCH… (OPTIONAL)
- ELECTRO-OR PNEUMA… HYDRAULIC
- HAND ACTUATOR (MOUNTED AT TOP, S… OR BOTTOM OF ACTU… DEVICE AS APPLICABL…
- X — UNCLASSIFIED (TYPE … ACTUATOR TO BE WI… ADJACENT TO THE SY…

SELF-ACTUATED DEVICES-F…

- FCV — FLOW REGULATOR (N…

SELF-ACTUATED DEVICES-LE…

- LEVEL REGULATOR WITH MECHANICAL …

(NOTE 3) ACTUATED VALVE	(OTHER FINAL CONTROL ELEMENT (NOTE 4)	SWITCH (NOTE 13)	MISCELLANEOUS DEVICE: LOCAL INDICATOR (GLASS)	TEST POINT CONNECTION (NOTE 9)	RELAY OR COMPUTER (NOTE 5)	USER'S CHOICE (NOTE 7)	TWO POSITION ON-OFF VALVE (NOTE 23)	THERMOSTAT	
CV	[ ]Z	[ ]S	[ ]G	[ ]P	[ ]Y	[ ]R	[ ]V		
	AZ	AS		AP(NOTE 9)	AY	AR			
		BS	BG	BP	BY	BR	BTV		
	CZ	CS		CP	CY	CR			
	DZ	DS		DP	DY	DR			
	EZ	ES			EY	ER			
FCV	FZ	FS	FG	FP	FY	FR			
		GS			GY	GR			
HCV	HZ	HS			HY				
	IZ	IS			IY	IR			
	JZ	JS			JY	JR			
	KZ	KS			KY	KR			
LCV	LZ	LS	LG	LP	LY	LR			
	MZ	MS		MP	MY	MR	MO		
	NZ	NS			NY	NR			
PCV	PZ	PS		PP	PY	PR			
PDCV	PDZ	PDS							
	QZ	QS			QY	QR			
	RZ	RS			RY	RR			
	SZ	SS			SY	SR	SV		
TCV	TZ	TS		TR(NOTE 9)	TY	TR		TX	
	UZ	US			UY	UR			
	VZ	VS		VP	VY	VR			
	WZ	WS			WY	WR			
							XV		
		YS		YP	YY	YR			
	ZZ	ZS			ZY	ZR			

SELF ACTUATED DEVICES-PRESSURE

- PRESSURE REDUCING REGULATOR (PCV) SELF CONTAINED
- PRESSURE REDUCING REGULATOR (PCV) WITH EXTERNAL PRESSURE TAP
- DIFFERENTIAL PRESSURE REDUCING REGULATOR (PDCV) WITH INTERNAL AND EXTERNAL PRESSURE TAPS
- BACKPRESSURE REGULATOR (PCV) SELF-CONTAINED
- BACKPRESSURE REGULATOR (PCV), WITH EXTERNAL PRESSURE TAP
- PRESSURE RELIEF OR SAFETY VALVE (PSV), ANGLE PATTERN SPRING- OR WEIGHT-LOADED, OR WITH INTEGRAL PILOT
- VACUUM RELIEF VALVE (PSV), ANGLE PATTERN, SPRING OR WEIGHT LOADED, OR WITH INTEGRAL PILOT
- PRESSURE RELIEF OR SAFETY VALVE ANGLE PATTERN, TRIPPED BY INTEGRAL SOLENOID
- RUPTURE DISK OR SAFETY HEAD (PSE) FOR PRESSURE RELIEF
- RUPTURE DISK OR SAFETY HEAD (PSE) FOR VACUUM RELIEF

SELF ACTUATED DEVICES-TEMP

- TEMPERATURE REGULATOR (TCV), FILLED-SYSTEM TYPE

HAND ACTUATED DEVICES

- TWO-WAY HAND CONTROL VALVE (HCV) IN PROCESS LINE (NOTE 20)
- MANUALLY ADJUSTABLE RESTRICTION ORIFICE (HO) IN SIGNAL LINE
- TWO-WAY HAND-ACTUATED SWITCHING VALVE (HS) IN PNEUMATIC SIGNAL LINE

FOR OTHER STYLES OF VALVE BODIES, SEE "VALVES-BODIES" ON THIS SHEET

MISCELLANEOUS DEVICES (NOTE 21)

- SIGNAL RELAY (NOTE 10)
- VOLUME BOOSTER
- SQUARE ROOT EXTRACTOR
- HIGH SELECTOR
- LOW SELECTOR
- I/P — CURRENT TO PNEUMATIC CONVERTER
- E/P — VOLTAGE TO PNEUMATIC CONVERTER

FOR ADDITIONAL RELAY SYMBOLS SEE ISA S5.1 TABLE 2

- INTERLOCK (USE IS OPTIONAL)
- PANEL MOUNTED PATCH-BOARD OR MATRIX CONNECTION
- PURGE DEVICE (MEANS OF REGULATING PURGE STAY BE SHOWN IN PLACE OF THE SYMBOL). PURGE FLUID AND POWER SUPPLIES ARE:
  - AS AIR SUPPLY
  - ES ELECTRIC SUPPLY
  - GS GAS SUPPLY
  - HS HYDRAULIC SUPPLY
  - NS NITROGEN SUPPLY
  - SS STEAM SUPPLY
  - WA WATER SUPPLY
- PILOT LIGHT
  - O = OPEN
  - C = CLOSED

NOTES:

1. THE INSTRUMENT LEGEND IS BASED ON ISA STANDARD S5.1 1958. FOR FURTHER DETAILS AND CLARIFICATION, REFER TO ISA STANDARD.
2. A IS USED FOR ALL ANALYSIS VARIABLES, THE FOLLOWING TERMS MAY BE PLACED OUTSIDE INSTRUMENT CIRCLE OF A LOOP TO DENOTE THE SPECIFIC VARIABLES: CO, CARBON MONOXIDE; COMB, COMBUSTIBLES; H, DISSOLVED HYDROGEN; H_2, GASEOUS HYDROGEN; Na, SODIUM; N_2H_4, HYDRAZINE; NO_x, NITROGEN OXIDES; O, DISSOLVED OXYGEN; O_2, GASEOUS OXYGEN; pH, pH; SIL, SILICA; SMOKE, SMOKE DENSITY; SO_2, SULFUR DIOXIDE; TRB, TURBIDITY.
3. A CONTROL OR SENSING DEVICE OR RELAY HAVING A DISPLAY FUNCTION SHOULD HAVE THE APPROPRIATE DISPLAY LETTER(S) ADDED AFTER THE MEASURED VARIABLE DESIGNATION. EXAMPLE: AIR IS AN ANALYSIS INDICATING CONTROL STATION.
4. SUCCEEDING LETTER Z REPRESENTS FINAL DEVICES OTHER THAN CONTROL VALVES AND DAMPERS, SUCH AS HYDRAULIC COUPLING, VARIABLE SPEED DRIVE, ACTUATORS, ETC.
5. FQ DESIGNATES A FLOW RESTRICTION ORIFICE FF DESIGNATES THE MEASURED VARIABLE FLOW RATIO E.G. FFC IS FLOW RATIO CONTROLLER.
6. HIGH-HIGH ALARMS HAVE [ ] AHH AND LOW-LOW ALARMS [ ] ALL IN CIRCLE IN P&ID. INSTRUMENT BALLOON FOR EXAMPLE, LAHH DENOTES HIGH-HIGH LEVEL ALARM.
7. A USER'S CHOICE LETTER IS FOR UNLISTED MEANINGS THAT WILL BE USED REPETITIVELY ON A PARTICULAR PROJECT. THE MEANINGS NEED BE DEFINED ONLY ONCE FOR THAT PROJECT, IF USED. THE LETTER MAY HAVE ONE AND ONLY ONE MEANING AS A FIRST LETTER AND ANOTHER SINGLE MEANING AS A SUCCEEDING LETTER.
8. THE UNCLASSIFIED LETTER X IS FOR UNLISTED MEANINGS THAT WILL BE USED ONLY ONCE OR TO A LIMITED EXTENT, IF USED, THE LETTER MAY HAVE ANY NUMBER OF MEANINGS AS A FIRST LETTER AND ANY NUMBER OF MEANINGS AS A SUCCEEDING LETTER. EXCEPT FOR ITS USE WITH DISTINCTIVE SYMBOLS, THE MEANINGS SHOULD BE DEFINED OUTSIDE ONE OF THE TAGGING CIRCLES OF THE LOOP ON A P&ID.
9. A TEST POINT IS A PROCESS CONNECTION TO WHICH NO INSTRUMENT IS PERMANENTLY CONNECTED, BUT WHICH IS INTENDED FOR TEMPORARY, INTERMITTENT, OR FUTURE CONNECTION OF AN INSTRUMENT. A PROCESS CONNECTION FOR MEASURING TEMPERATURE OR ANALYSIS IS DESIGNATED TP OR AP. AN EMPTY THERMOWELL IS TW. A SAMPLE NOZZLE IS AN.
10. EXCEPT FOR USE WITH DISTINCTIVE SYMBOLS SUCH AS A SOLENOID VALVE, THE EQUATION OR DESCRIPTION DENOTING THE RELAY FUNCTION SHOULD BE SHOWN ON THE P&ID.
11. ANY FIRST LETTER MAY BE MODIFIED BY THE FOLLOWING LETTERS:
    - D DIFFERENTIAL
    - J SCAN
    - Q INTEGRATE OR TOTALIZE

    USE OF D AND Q IS EXEMPLIFIED BY THE MEASURED VARIABLE PRESSURE DIFFERENTIAL AND THE DISPLAY DEVICE INTEGRATING INDICATOR. THE TERM SCAN APPLIES TO A DEVICE THAT IS INTERMITTENTLY CONNECTED TO EACH OF A NUMBER OF INPUTS.
12. PSV AND PSE DENOTE PRESSURE SAFETY VALVE AND RUPTURE DISC, RESPECTIVELY.
13. ADD H OR L SUFFIX FOR HIGH OR LOW, RESPECTIVELY, AS FOR ALARMS.
14. MEASURED VARIABLE RADIOACTIVITY DOES NOT INCLUDE NEUTRON FLUX, WHICH IS COVERED BY FIRST LETTER N.
15. THE SPECIFIC BOARD OR OTHER LOCATION AT WHICH AN INSTRUMENT IS MOUNTED MAY BE REFERRED TO BY A DESIGNATION OUTSIDE THE INSTRUMENT CIRCLE.
16. THE TYPE OF FLOW INSTRUMENT MAY BE NAMED OUTSIDE THE CIRCLE.
17. THE UPPER INSTRUMENT LEAD LINE IS OMITTED IF LEVEL IS MEASURED BY PRESSURE INSTEAD OF DIFFERENTIAL PRESSURE.
18. A DOUBLE SOLENOID VALVE IS DRAWN WITH TWO SINGLE SOLENOIDS.
19. VALVE BODY PORTS THAT ARE CLOSED IN NORMAL OPERATION ARE BLACKENED. THE OPERATING CONDITION SHOWN FOR ALL VALVE BODIES CORRESPONDS TO FULL LOAD OR NORMAL OPERATION REGARDLESS OF THE TYPE OF ACTUATOR OR WHETHER THE ACTUATOR IS ENERGIZED OR DE-ENERGIZED DURING THIS MODE OF OPERATION.
20. A HAND CONTROL VALVE IS A HAND-ACTUATED VALVE THAT EITHER MODULATES A PROCESS STREAM OR IS POSITIONED BY CONTROL SYSTEMS SECTION.
21. FOR INDOT AND OTHER INSTRUMENT VALVES SEE INSTRUMENT INSTALLATION DETAILS.
22. INSTRUMENT TAGS MAY BE BROKEN INTO SMALLER GROUPS, IF NECESSARY, E.G. PDAHL MAY BE BROKEN INTO THE DUAL INSTRUMENT PDAH,PDAL.
23. ON-OFF VALVES (NON-THROTTLING) ARE IDENTIFIED AS:
    - BTV — BLEEDER TRIP VALVE
    - MO - MOTOR OPERATED VALVE
    - SV — SOLENOID VALVE
    - XV - ON-OFF AIR OPERATED VALVE
24. ALL PILOT SOLENOID VALVES ARE SHOWN IN DE-ENERGIZED CONDITION. NE OR ND INDICATES NORMALLY ENERGIZED OR NORMALLY DE-ENERGIZED DURING NORMAL OPERATION.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Legend Piping & Instrument Diagram
(M-400 Sh 3 Rev 4)

FSAR Figure 1.1-3

substations, which form a part of the CPCo 345kV grid. This grid is in turn connected with utilities in Illinois, Indiana, Ohio, and Canada.

1.2.8.2 Electric Power Distribution Systems Summary Description

Electric power is supplied from the switchyard to the onsite power system for the electrical auxiliaries of each unit through two independent circuits. Each circuit supplies power through a separate startup transformer. Each startup transformer feeds one 6.9kV and one 4.16kV bus of each unit. Power is supplied to auxiliaries at 6.9kV, 4.16kV, and 480V levels.

The power distribution system includes Class 1E and non-Class 1E ac and dc power systems. The Class 1E power system supplies equipment used to shut down the reactor and limit the release of radioactive material following a design basis accident.

The Class 1E ac system for each unit consists of two independent and redundant load groups and four independent 120Vac preferred power supply systems. The load groups include 4.16kV switchgear, 480V load centers, and motor control centers. The 120Vac preferred power supply systems include static inverters supplied from battery systems and distribution panels. Voltages listed are nominal values.

One independent diesel generator is provided as a standby source for each Class 1E ac load group of each unit. Each generator has sufficient capacity to operate all the equipment of one unit which is necessary to prevent undue risk to public health and safety in the event of a design basis accident.

The non-Class 1E ac system includes 6.9kV switchgear, 4.16kV switchgear, 480V load centers, and motor control centers.

Direct current power for the Class 1E dc loads of each unit is supplied by two independent Class 1E 125Vdc batteries and associated battery chargers. One 250V center-tapped non-Class 1E battery and associated battery chargers supply 250 and 125Vdc power for the non-Class 1E dc system loads.

These systems are discussed individually in Chapter 8.

1.2.9 AUXILIARY SYSTEMS SUMMARY DESCRIPTION

1.2.9.1 Fuel Handling and Storage Summary Description

New fuel is stored in vertical racks within the fuel storage area in the auxiliary building. Space is provided for storage of 132 new fuel assemblies to service both units. Subsection 9.1.1 discusses and evaluates the criteria for the design of new fuel storage. |23

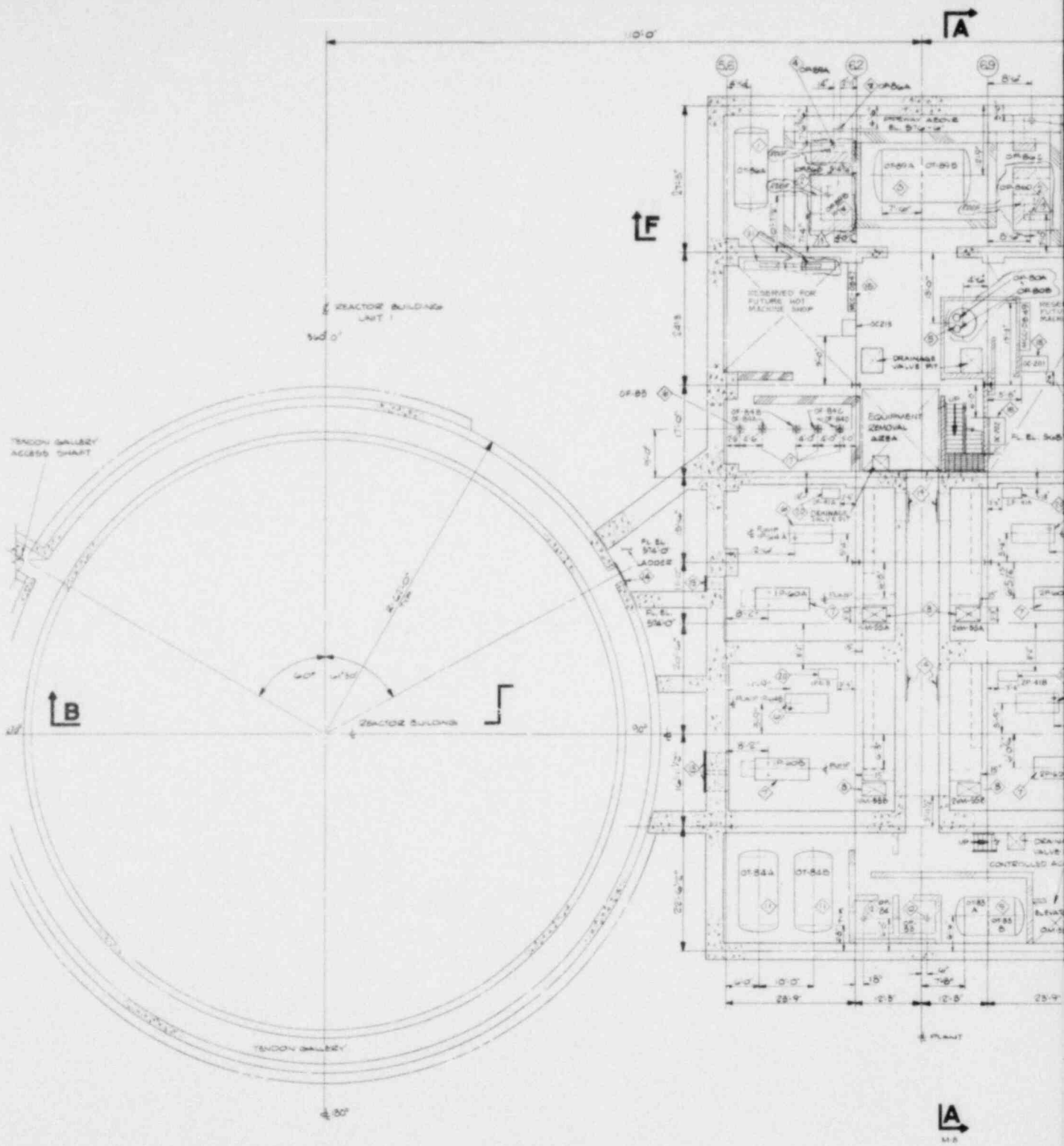
The stainless steel lined, reinforced concrete spent fuel pool provides for a maximum normal average of 4-2/3 cores. (Note that this leaves sufficient storage space for a full core if core offload is necessary.) Spent fuel assemblies are stored in vertical racks so spaced as to preclude criticality in a nonborated cooling water environment. The design criteria and evaluation of the spent fuel storage facility are discussed in Subsection 9.1.2. Control of the spent fuel pool water temperature during normal operation is accomplished by circulating the spent fuel pool water through heat exchangers cooled by the component cooling water system. Emergency makeup is provided by supplying essential service water to the pool to maintain its water level. Purification and clarification of the spent fuel pool water is by the use of a filter, strainers, and an ion exchanger. A description and evaluation of the spent fuel pool cooling and purification system is presented in Subsection 9.1.3. 27

The fuel handling system, as further discussed in Subsection 9.1.4, provides for the safe handling of fuel and control rod assemblies and for the required assembly, disassembly, and storage of reactor internals. These systems include a main fuel handling bridge located inside the containment above the refueling cavity, the fuel transfer carriage, the upending machines, the fuel transfer tube, a fuel handling bridge in the spent fuel storage area, and various devices used for handling and storing the reactor vessel head and internals.

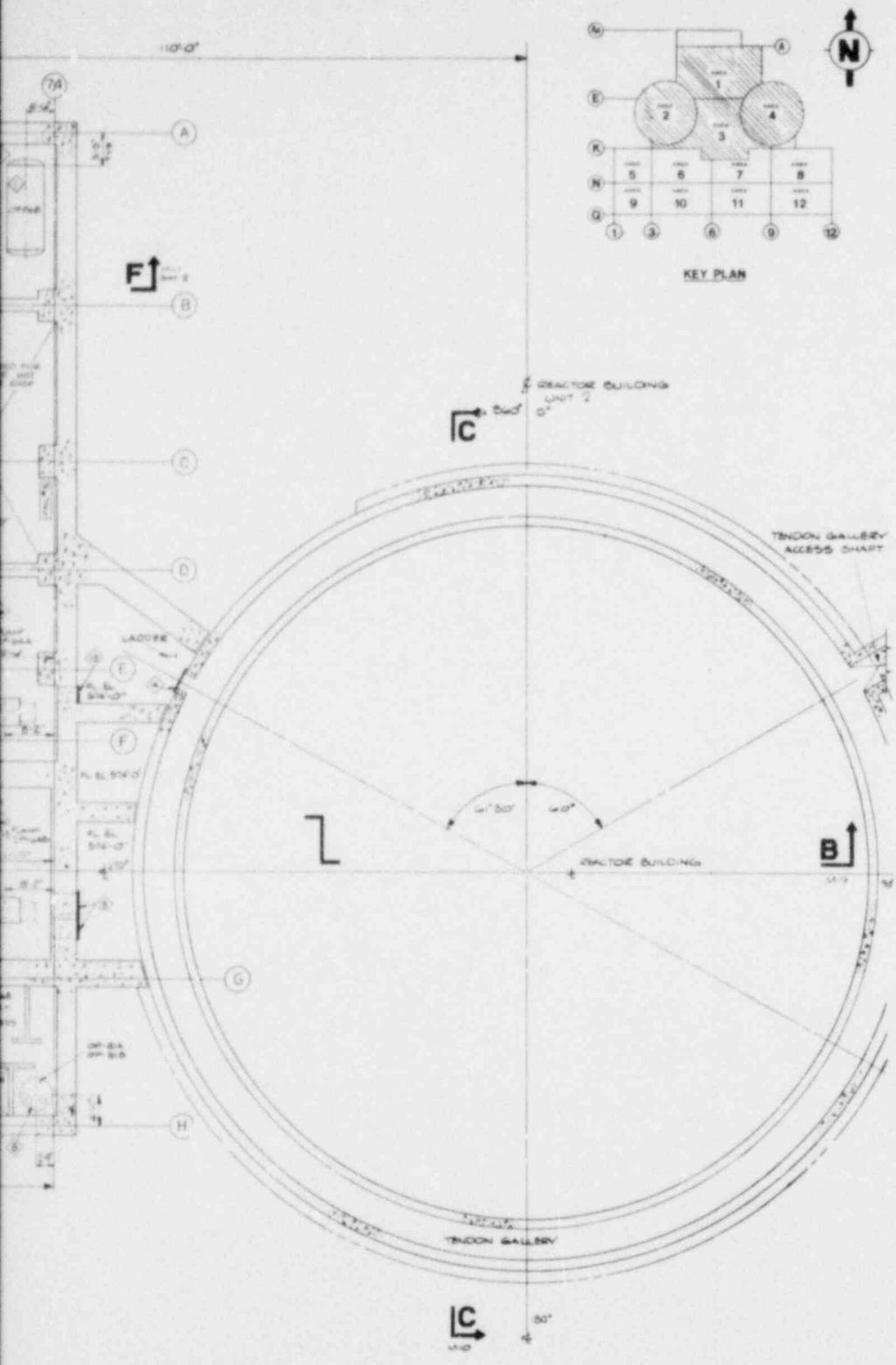
The fuel handling system is designed to provide a safe, effective means of transporting and handling fuel from the time it reaches the site in an unirradiated condition until it leaves the site after postirradiation cooling. The reactor is refueled with equipment capable of handling spent fuel under water from the time it is removed from the core until it is placed in a cask for shipment from the site. The system is designed and constructed to minimize the possibility of mishandling or maloperation that could cause fuel assembly damage and/or significant fission product release. Underwater transfer of spent fuel provides an optically transparent radiation shield, as well as a reliable source of coolant for removal of decay heat. The use of borated water ensures that the water in the reactor vessel is not diluted during fuel transfer operations.

1.2.9.2 Water Systems Summary Description

Water systems in operation at the facility include the service water system, decay heat removal system, component cooling water system, demineralized water system, domestic water system, ultimate heat sink, condensate storage facility, primary makeup water storage, borated water storage, circulating water system, plant heating system, safeguards chilled water system, and auxiliary chilled water system. Except for the circulating water system, which is discussed in Subsection 10.4.5, all the water systems are covered individually in Section 9.2.



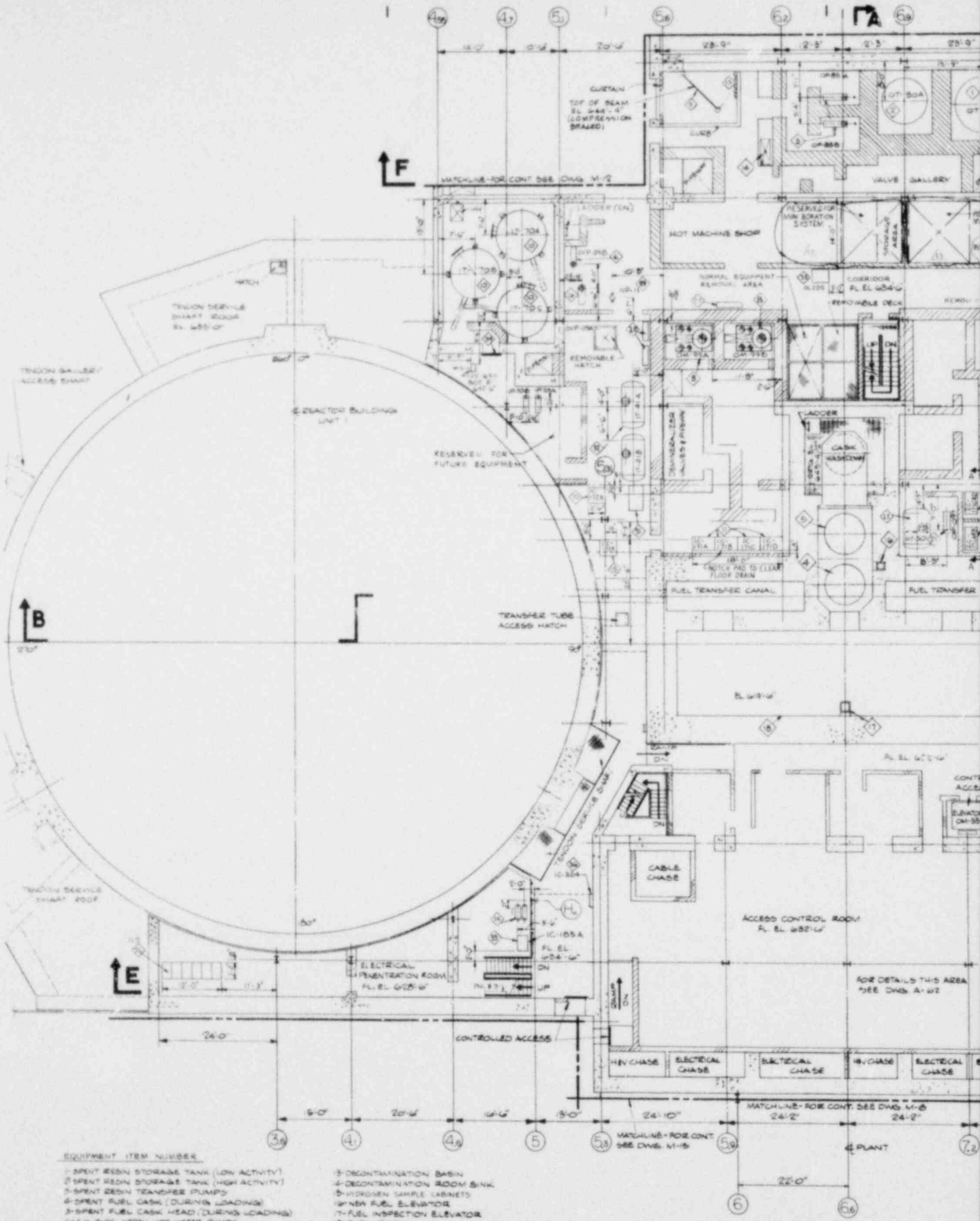
1- EQUIPMENT DRAIN TANK
2- EQUIPMENT DRAIN TANK PUMP
3- L.W.S. DRAIN TANK
4- L.W.S. DRAIN TANK PUMP
5- SUMP & SUMP PUMPS
6- REACTOR BUILDING SPRAY PUMP
7- DECAY HEAT REMOVAL PUMP
8- SAFE GUARD PUMP ROOM UNIT COOLER
9- CHEMICAL WASTE RECEIVER TANK
10- CHEMICAL WASTE RECEIVER TANK PUMP
11- LAUNDRY DRAIN TANK
12- LAUNDRY DRAIN TANK PUMP
13- PRESSURE RELIEF PANEL
14- WATERTIGHT DOOR
15- MOTOR CONTROL CENTER
16- CHEMICAL WASTE FILTER
17- LAUNDRY DRAIN FILTER
18- TERMINATION PANEL
19- LIQUID & AIRBORNE PROCESS RADIATION MONITORS
20- HYDRAZINE PUMP
21- RADWASTE PUMP SEAL WATER PRESSURIZATION UNIT

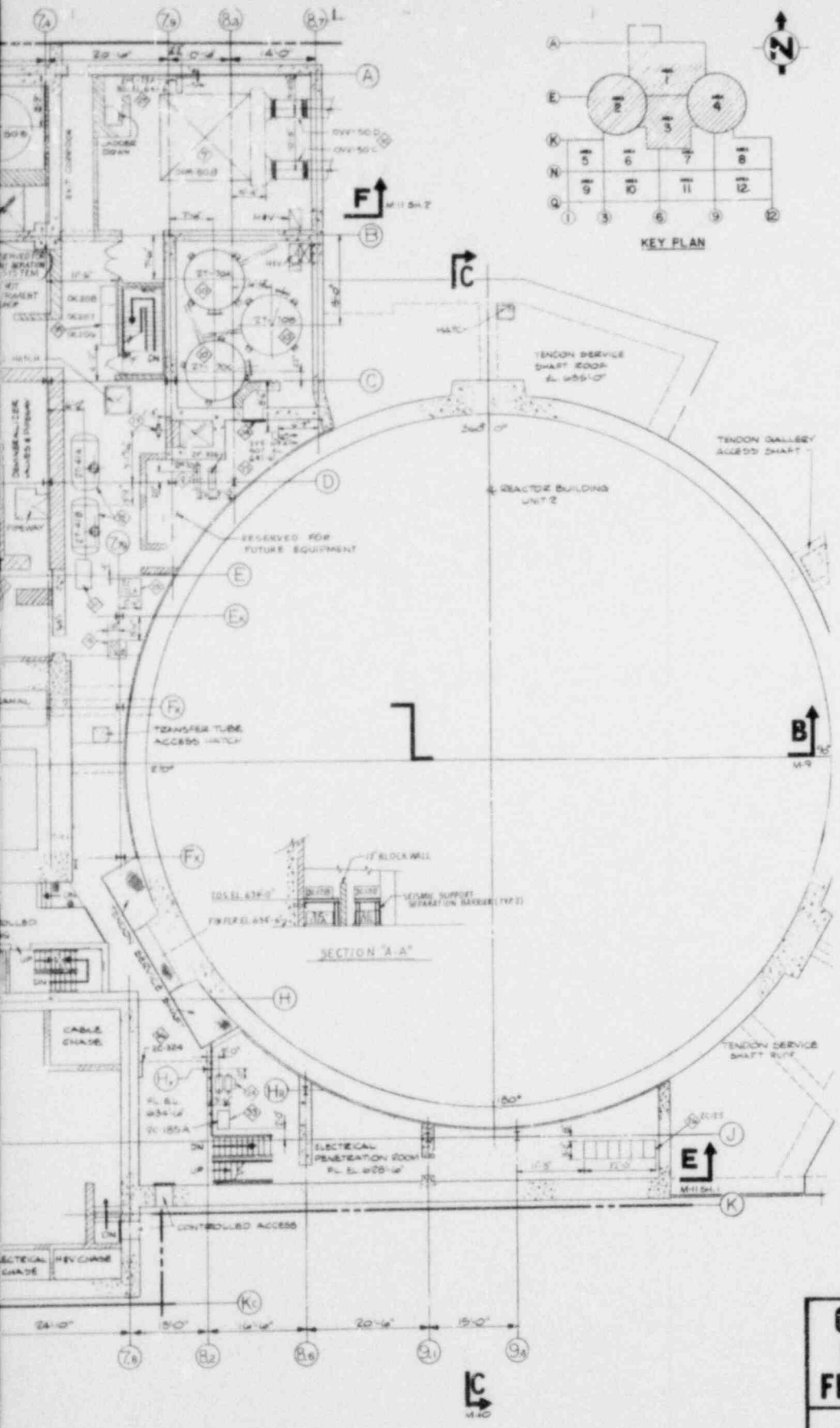


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

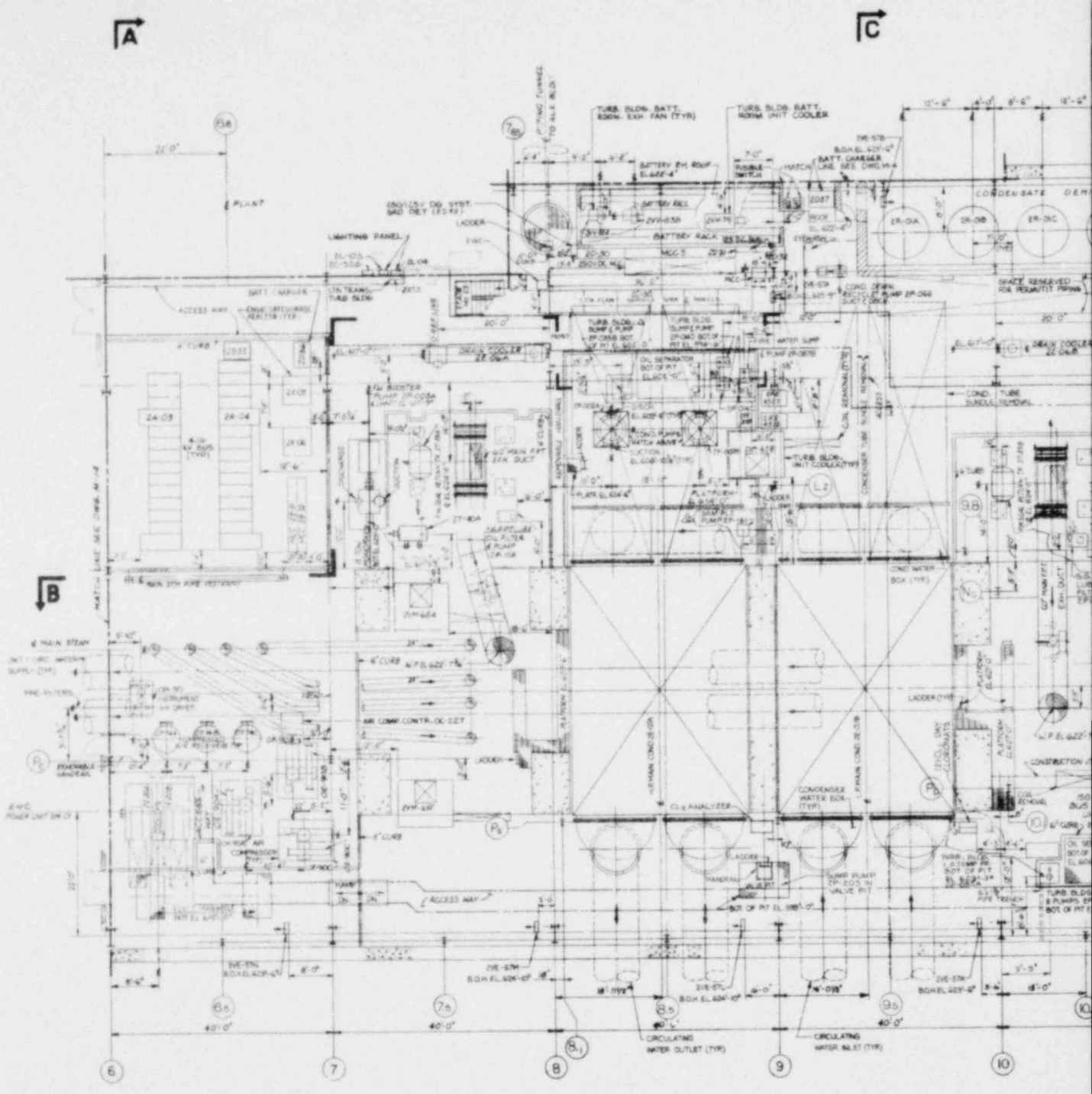
Equipment Location
Reactor & Auxiliary Buildings
Plan at El. 568'-0"
(M-1 Rev 13)

FSAR Figure 1.2-2


CURTAIN
TOP OF BEAM EL. 648'-4" (COMPRESSION BRACED)
MATCHLINE-FOR CONT. SEE DWG. M-12
HOT MACHINE SHOP
VALVE GALLERY
RESERVED FOR MAIN BORATION SYSTEM
NORMAL EQUIPMENT REMOVAL AREA
CORRIDOR EL. 654'-6"
REMOVABLE DECK
REMOVABLE HATCH
LADDER
CASK WASHDOWN
TENDON SERVICE SHAFT ROOM EL. 655'-0"
TENDON GALLERY ACCESS SHAFT
REACTOR BUILDING UNIT 1
RESERVED FOR FUTURE EQUIPMENT
NOTCH PAD TO CLEAR FLOOR DRAIN
FUEL TRANSFER CANAL
TRANSFER TUBE ACCESS HATCH
TENDON SERVICE SHAFT
CABLE CHASE
ACCESS CONTROL ROOM EL. 682'-6"
ELECTRICAL PENETRATION ROOM EL. 605'-6"
FOR DETAILS THIS AREA SEE DWG. A-102
CONTROLLED ACCESS
H&V CHASE
ELECTRICAL CHASE
MATCHLINE-FOR CONT. SEE DWG. M-13
MATCHLINE-FOR CONT. SEE DWG. M-15
MATCHLINE-FOR CONT. SEE DWG. M-8
℄ PLANT
EQUIPMENT ITEM NUMBER
1-SPENT RESIN STORAGE TANK (LOW ACTIVITY)
2-SPENT RESIN STORAGE TANK (HIGH ACTIVITY)
3-SPENT RESIN TRANSFER PUMPS
4-SPENT FUEL CASK (DURING LOADING)
5-SPENT FUEL CASK HEAD (DURING LOADING)
6-AUX. BLDG. NORTH HOT WATER PUMPS
7-AUXILIARY BUILDING EXHAUST FILTER UNIT
8-DEGASIFIER
9-DECONTAMINATION ROOM J.I.B. CRANE
10-BORIC ACID ADDITION TANKS
11-REACTOR BLDG. SAFEGUARDS RADIATION SAMPLE CABINET
12-L.P. BORIC ACID TRANSFER PUMPS
13-DECONTAMINATION BASIN
14-DECONTAMINATION ROOM SINK
15-HYDROGEN SAMPLE CABINETS
16-NEW FUEL ELEVATOR
17-FUEL INSPECTION ELEVATOR
18-FUEL POOL
19-NORMAL FUEL STORAGE AREA (144 SPACES MIN.)
20-NORMALLY EMPTY FUEL STORAGE AREA
21-FUEL POOL SKIMMER PUMP
22-FUEL POOL SKIMMER SUMP & OVERFLOW
23-FAILED FUEL CONTAINER (4 SPACES)
24-PERSONNEL LOCK AIR SUPPLY SYSTEM
25-UNIT HEATERS
26-LOCKS (1 SHUT / 1 OPEN)
27-DEGASIFIER TRANSMITTER RACK
28-DEGASIFIER CONDENSATE RACK
29-REACTOR BLDG. HOT WATER PUMP
30-EXHAUST FAN
31-PENETRATION PRESSURIZATION VALVE RACK
32-PENETRATION PRESSURIZATION WATER TANKS
33-HYDROGEN RECOMBINER POWER PANEL
34-WATERTIGHT DOOR
35-RADWASTE SYS. REMOTE CABINET
36-AUX. BLDG. FIRE AND SMOKE DETECTION PANEL

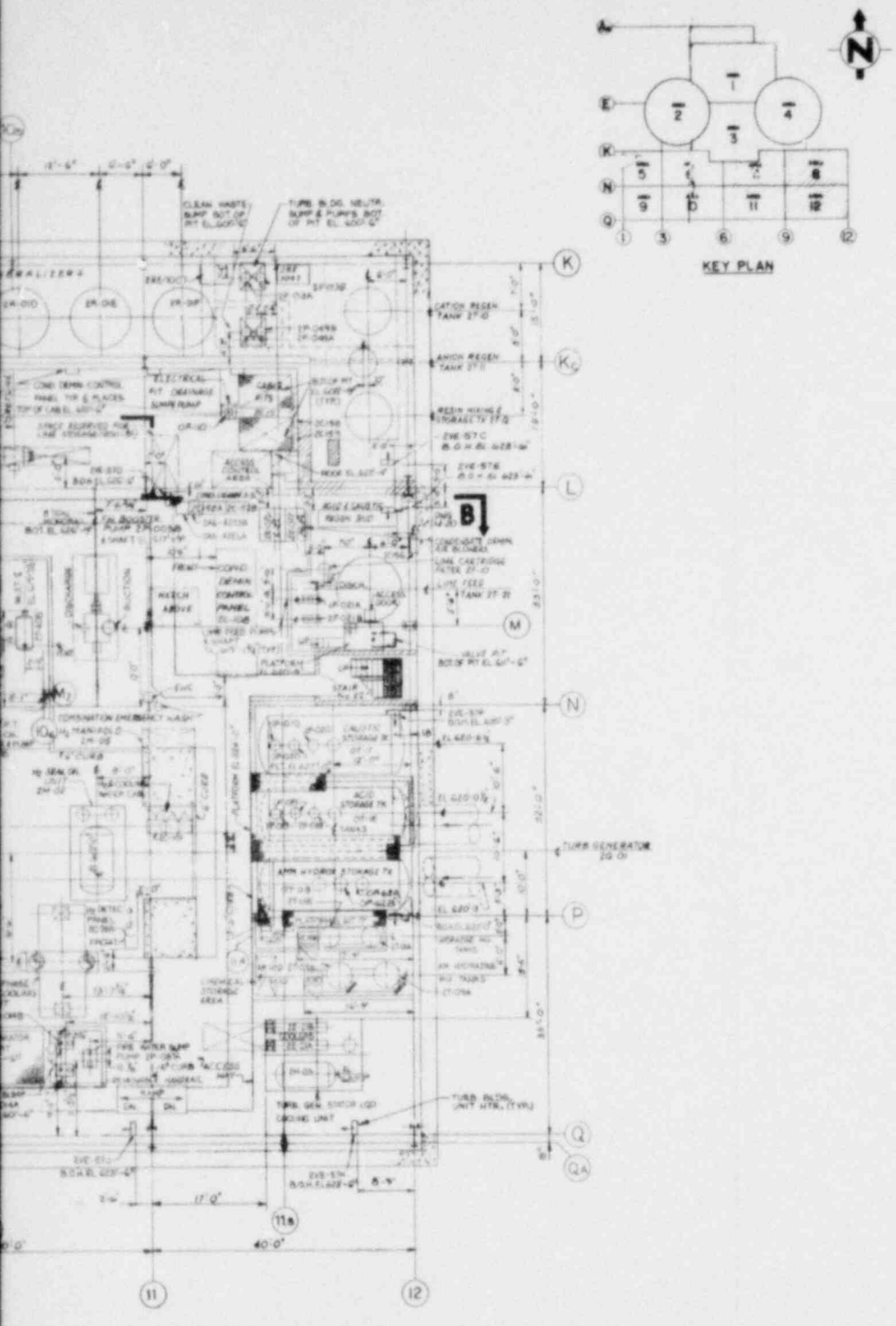


CONSUMERS POWER COMPANY MIDLAND PLANT UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Equipment Location Reactor & Auxiliary Buildings Plan of El. 634'-6" (M-5 Rev 13)
FSAR Figure 1.2-6



A
DWG. M-20

C
DWG. M-20



CONSUMERS POWER COMPANY MIDLAND PLANT UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Equipment Location Turbine Building Unit 2 Plan of El. 614'-0" (M-17 Rev 12)
FSAR Figure 1.2-20

TABLE 1.6-2 (continued)

B&W Topical Report	Title	Revision	FSAR Reference	Report Approval Status	
BAW-10100A	R.V. Material Surveillance Program Compliance with 10 CRF 50, Appendix H for Oconee Class Reactor	0	5.3	Accepted by NRC 2-19-75	24
					26
BAW-10103A	ECCS Analysis of B&W's 177 F.A. Lowered Loop NSSS	3	6.2	Accepted by NRC 2-18-77	24 26
BAW-10104	B&W's ECCS Evaluation Model	3	6.3	Accepted by NRC 2-18-77	
BAW-10106	QUENCH - Digital Program for Analysis of Core Thermal Transients	0	4	Accepted by NRC 12-24-76	
BAW-10110	CHATA - Core Hydraulics and Thermal Analysis	1	15.4.3	Under review Submitted 5-77	
					24
BAW-10111A	Summary Description of the B&W Integrated Nuclear Design System	0	1	Accepted by NRC 12-13-76	
BAW-10112A	ETOGM - Epithermal Cross Section Generation Code Using ENDF/B Data	0	4	Accepted by NRC 10-76	
BAW-10113A	THOR - Thermal Cross Section Generation Code Using ENDF/B Data	0	4	Accepted by NRC 10-76	
BAW-10114A	PROLIB - Code to Create Production Library of Nuclear Data for Design Calculations	0	4	Accepted by NRC 11-18-76	

TABLE 1.6-2 (continued)

B&W Topical Report	Title	Revision	FSAR Reference	Report Approval Status	
BAW-10115A	NULIF - Neutron Spectrum Generator, Few Group Constant Calculator and Fuel Depletion Code	0	4	Accepted by NRC 1-77	24
BAW-10116A	Assembly Calculations and Fitted Nuclear Data	0	4	Accepted by NRC 5-77	
BAW-10117PA	Babcock & Wilcox Version of PDQ07 User's Manual	0	4	Accepted by NRC 10-76	
BAW-10118A	Core Calculations Techniques and Procedures	0	4.3	Accepted by NRC 9-79	27
BAW-10119PA	Power Peaking Nuclear Reliability Factors	0	4	Accepted by NRC 11-78	24
BAW-10120P	Comparison of Core Physics Calculations with Measurements	0	4.3	Accepted by NRC 6-14-79	26
BAW-10124A	FLAME3-A - Three Dimensional Nodal Code for Calculating Core Reactivity and Power Distribution	0	15.4.3	Accepted by NRC 5-28-76	
BAW-10125PA	Verification of the Three-Dimensional FLAME Code	0	4.3	Accepted by NRC 5-28-76	24
BAW-10128	TRAP-2 - Fortran Program for Digital Simulation of the Transient Behavior of the OTSG and Associated Reactor Coolant System	0	15	Under review Submitted 8-26-76	26

TABLE 1.7-1

BOP NOTES, SYMBOLS, AND DETAILS

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-028	3	08-17-79	Symbols and General Notes for Single Lines and Schematics	Ref FSAR Tables 1.7-3, -4, -5, and -6	21
1	0				
2	0				
3	0				
4	1				
5	1				
6	2				
7	2				
9	0				18
10	0				
11	0				
12	0				
13	0				
14	0				
15	0				
16	0				
17	1				
18	1				
19	0				
E-039	8	12-03-79	Seismic Wire Supports Notes Symbols and Details		27
1	3				
2	1				18
3	1				
4	1				
5	1				21
7	1				
8	1				
9	1				18
11	2				
11A	0				
12	2				21
13	1				18
14	2				
15	4				25
16	3				
17	3				
17A	1				18
17B	0				

TABLE 1.7-1 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
18	0				
19	0				
19A	0				
19B	0				
20	3				
21	0				18
22	1				
23	1				
24	1				
26	2				
27	3				
28	5				25
28A	1				
29	0				18
30	3				
30A	1				21
30B	0				
31	1				18
32	2				
33	2				27
34	1				
34A	0				18
35	1				
35A	0				
36	2				27
37	0				
38	0				18
39	0				
40	1				27
41	0				21
E-042	44	02-20-80	Conduit and Tray Notes, Symbols and Details	Ref FSAR Table 1.7-7	
8	14				
10	11				27
10A	8				
11B	8				
18A	7				
33	4				
41	7				
46	2				18
51	3				
56	3				

TABLE 1.7-1 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
58	0				19
61	0				18
62	0				
63	2				27
64	4				15
65	2				
66	2				
67	0				18
68	6				
69	0				
69A	0				
69B	1				
69C	2				
69D	2				25
100	9				27
100A	2				
101	7				
102	3				18
103	2				
104	2				
105	6				19
106	8				
106A	1				27
107	7				
108	6				
108A	0				
109	3				
110	1				
111	2				
112	3				18
113	0				
114	2				
115	2				
116	0				
117	1				
118	1				
119	2				
120	1				
121	2				
122	2				19
123	1				
123A	0				
124	0				18

TABLE 1.7-1 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
125	0				
126	2				
127	0				
128	0				
129	0				
130	1				
131	2				
132	1				
133	0				
134	1				18
135	1				
136	0				
137	0				
138	2				
139	0				
140	0				
141	1				
142	2				
144	1				
145	3				27
146	2				25
147	2				
148	3				27
149	1				
300	0				19
301	0				18
302	1				27
303	1				21
304	0				18
305	0				
306	3				27
307	0				
308	0				18
309	0				
310	0				
311	1				27
312	0				18
313	0				
314	3				
314A	2				27
315	1				
316	1				
317	0				18

TABLE 1.7-1 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
318	2				21
318A	0				18
318B	1				27
319	1				
320	0				25
321	1				
322	0				19
323	0				18
324	3				27
325	1				25
326	0				
327	1				18
328	0				
329	4				21
330	1				18
331	1				25
332	3				
333	3				
334	2				
335	7				
336	6				27
337	3				
338	0				
339	2				25
340	0				
341	1				
342	2				
343	5				27
343A	2				
344	0				2
345	1				
346	1				
347	0				
348	0				
349	0				
350	0				18
351	0				
352	0				
353	0				
354	1				25
355	0				18
356	1				27
357	1				

TABLE 1.7-1 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
338	0				18
359	3				27
360	0				
361	1				25
362	2				
363	3				
364	2				
364A	2				
365	1				27
366	1				
367	0				
368	1				
500	0				
501	1				18
502	0				
503	1				27
504	0				
505	1				
506	0				
507	0				
507A	0				19
508	0				
509	0				
510	0				
511	0				
512	0				
513	3				27
514	0				25
515	1				
516	0				
517	0				19
518	0				
600	3				27
601	3				
602	1				25
603	2				
604	4				27
605	3				
606	0				18
607	0				
608	1				27
609	1				21
610	0				18

TABLE 1.7-1 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
611	0				
612	0				18
613	0				
614	0				19
615	0				
616	2				27
1000	2				
1001	2				21
1002	2				27
1003	0				19
1004	1				21
1005	0				19
E-047	2	12-28-79	Notes and Details for Separation of Class 1E Equipment and Circuits		27
					19
6	1				
7	0				21
8	0				
9	0				
10	1				27
11	0				
12	0				21
13	0				
13A	0				27

TABLE 1.7-2

BOP LOGIC DIAGRAMS, ELECTRICAL AUXILIARY DISTRIBUTION SYSTEM

Drawing No.	Rev.	Date	Title	Remarks	
J-870	1	10-04-78	480V MCC Feeder Breaker to Battery Chargers	Ref FSAR 8.3.1.1.9	18
J-873-1	2	08-29-78	Class 1E 4.16kV Bus Incoming Breakers	Ref FSAR 8.3.1.1.9	14
J-873-2	2	08-29-78	Class 1E 4.16kV Bus Incoming Breakers	Ref FSAR 8.3.1.1.9	14
J-874	1	09-22-78	Class 1E 480V Bus Incoming Breakers	Ref FSAR 8.3.1.1.9	18
J-877-1	1	02-09-79	Diesel Generator Breakers	Ref FSAR 8.3.1.1.9 and Figure 8.3-43	19
J-877-2	0	02-09-79	Diesel Generator Breakers	Ref FSAR 8.3.1.1.9 and Figure 8.3-44	
J-878-1	2	11-19-79	6.9 and 4.16kV Bus Undervoltage Relays	Ref FSAR 8.3.1.1.9	27
J-878-2	2	11-19-79	6.9 and 4.16kV Bus Undervoltage Relays	Ref FSAR 8.3.1.1.9	27
J-879-1	0	02-09-79	Diesel Generator	Ref FSAR 8.3 and Figure 8.3-45	
J-879-2	0	02-09-79	Diesel Generator	Ref FSAR 8.3 and Figure 8.3-46	
J-879-3	0	02-09-79	Diesel Generator	Ref FSAR 8.3 and Figure 8.3-47	19
J-879-4	0	02-09-79	Diesel Generator	Ref FSAR 8.3 and Figure 8.3-48	
J-879-5	0	02-09-79	Diesel Generator	Ref FSAR 8.3.1.1.9 and Figure 8.3-45	

TABLE 1.7-2 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-879-6	0	02 9-79	Diesel Generator	Ref FSAR 8.3.1.1.9 and Figure 8.3-46	19
J-879-7	1	11-19-79	Diesel Generator	Ref FSAR 8.3.1.1.9 and Figure 8.3-47	27 19
J-879-8	1	11-19-79	Diesel Generator	Ref FSAR 8.3.1.1.9 and Figure 8.3-48	27 19
J-880	1	02-09-79	Diesel Generator Protection	Ref FSAR 8.3.1.1.9	
J-885-1	A	08-10-78	Safety-Related MCC and LC Relays	Ref FSAR 8.3.1.1.9	
J-885-2	A	08-10-78	Safety-Related MCC and LC Relays	Ref FSAR 8.3.1.1.9	
J-888-1	3	09-27-78	Class 1E 480V Load Center Feeder to 480V MCCs	Ref FSAR 8.3.1.1.9	
J-888-2	3	09-27-78	Class 1E 480V Load Center Feeder to 480V MCCs	Ref FSAR 8.3.1.1.9	18
J-890-1	4	09-20-78	Class 1E 4,160-480V Station Power Transformer Feeder Breaker	Ref FSAR 8.3.1.1.9	
J-890-2	4	09-20-78	Class 1E 4,160-480V Station Power Transformer Feeder Breaker	Ref FSAR 8.3.1.1.9	
J-891-1	1	09-27-78	Diesel Generator 480V MCC Incoming Breaker	Ref FSAR 8.3.1.1.9	
J-891-2	1	09-27-78	Diesel Generator 480V MCC Incoming Breaker	Ref FSAR 8.3.1.1.9	
J-891-3	1	09-27-78	Diesel Generator 480V MCC Incoming Breaker	Ref FSAR 8.3.1.1.9	

TABLE 1.7-3

BOP SINGLE LINE DIAGRAMS

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-001	5	08-14-79	Plant Single Line Diagram	Ref FSAR 8.3.1	
E-005	8	09-04-79	6,900 and 4,160V Systems, Unit 1	Ref FSAR 8.3.1	25
E-006	8	09-04-79	6,900 and 4,160V Systems, Unit 2	Ref FSAR 8.3.1	18
E-011	5	09-27-79	Class 1E 480V Load Centers, Unit 1	Ref FSAR 8.3.1	27 18
E-015	5	09-27-79	Class 1E 480V Load Centers, Unit 2	Ref FSAR 8.3.1	27 18
E-017	10	12-03-79	Class 1E 460V MCC Schedule, Unit 1	Ref FSAR 8.3.1	
1	7				27
2	6				
3	7				
4	6				
5	2				18
6	6				21
7	5				
8	7				
9	7				
9A	3				
10	6				
11	7				27
11A	3				
12	5				
13	4				
14	4				
15	4				
					21
E-018	10	12-03-79	Class 1E 460V MCC Schedule, Unit 2	Ref FSAR 8.3.1	
1	7				
2	6				27
3	7				
4	7				
5	2				18

TABLE 1.7-3 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
6	5				21
7	6				
8	6				
9	7				
10	7				
11	7				
11A	3				
12	4				
13	4				
14	5				
15	4				27
16	6				
17	4				
18	4				
19	4				
20	4				
21	4				
22	4				
23	4				
E-021	5	02-06-79	250 and 125Vdc Systems, Unit 1	Ref FSAR 8.3.2	19
E-022	5	02-06-79	250 and 125Vdc Systems, Unit 2	Ref FSAR 8.3.2	
E-023-1	4	09-26-79	120Vac Instrument and Preferred Systems, Unit 1	Ref FSAR 8.3.1	27 18
E-023-2	0	09-26-79	120Vac Instrument and Preferred Systems, Unit 1	Ref FSAR 8.3.1	27
E-024	4	09-26-79	120Vac Instrument and Preferred Systems, Unit 2	Ref FSAR 8.3.1	
E-025-1	3	06-11-79	Synchronizing Diagram	Ref FSAR 8.3.1.2	25
E-025-2	3	06-11-79	Synchronizing Diagram	Ref FSAR 8.3.1.2	

TABLE 1.7-3 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-031	8	02-07-80	120Vac Distribution Panels, Unit 1	Ref FSAR 8.3.1	
3	7				27
4	7				
5	7				
6	6				
7	7				25
8	7				
E-032	10	01-15-80	120Vac Distribution Panels, Unit 2 and Common	Ref FSAR 8.3.1	24
3	7				
4	6				
5	6				
6	7				
7	7				
8	7				
13	7				
14	7				
36	3				
37	2				
38	2				27
E-033	7	01-18-80	DC Distribution Panel Schedule	Ref FSAR 8.3.2	
6	5				
7	5				
12	5				
13	5				
17	2				
18	2				
19	2				
20	2				
E-034	2	02-02-79	Electrical Penetration Schedule	Ref FSAR 8.3.1	19

TABLE 1.7-3 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-035	9	02-21-80	480V Distribution Panel Schedule	Ref FSAR 8.3.1	
5	5				
6	5				
28	5				
29	5				
56	7				
57	7				27
58	6				
61	5				
62	5				
63	4				
69	1				
70	1				

TABLE 1.7-4

BOP SCHEMATIC THREE LINE METER AND RELAY DIAGRAMS

Drawing No.	Rev	Date	Title	Remarks	
E-053	6	09-10-79	4,160V Class 1E System	Ref FSAR 8.3.1.1.9	25

TABLE 1.7-5

SCHEMATIC TWO LINE METER AND RELAY DIAGRAMS

Drawing No.	Rev	Date	Title	Remarks	
E-058	5	02-06-80	Class 1E 125Vdc System	Ref FSAR 8.3.1.2 and 8.3.2	27

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TABLE 1.7-6

BOP SCHEMATIC DIAGRAMS, ELECTRICAL AUXILIARY DISTRIBUTION SYSTEM

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-071	2	08-03-79	Typical 6.9 and 4.16kV Circuit Breaker Internal Schematic	Ref FSAR 8.3.1.1.9	25
E-072	2	07-05-77	Typical 480V Circuit Breaker Internal Schematic	Ref FSAR 8.3.1.1.9	
1	2				18
2	2				
E-073	3	08-03-79	6.9 and 4.16kV Bus Incoming Breaker From Station Power Transformer	Ref FSAR 8.3.1.1.9	25
1	1				18
2	2				
3	3				25
4	2				
5	1				18
6	2				
7	3				25
8	1				18
9	2				
E-074	3	08-13-79	6.9 and 4.16kV Bus Incoming Breaker From Startup Transformer	Ref FSAR 8.3.1.1.9	25
1	2				18
2	2				
3	3				25
4	3				
5	1				18
6	2				
7	3				25
8	0				
8A	1				
9	0				18
10	1				

TABLE 1.7-6 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-075	4	05-16-79	6.9 and 4.16kV Bus Under-Voltage Relays	Ref FSAR 8.3.1.1.9, 8.3.1.2.4	25 18 19
4	3				
5	4				25
5A	0				
6	3				
7	2				
E-076	4	06-19-79	4,160-480V Station Power and CRD Transformer Feeder Breakers	Ref FSAR 8.3.1.1.9, 8.3.1.2.4	25 18
1	4				
4	3				
5	3				
6	3				25
7	3				
8	3				
9	3				
10	0				18
E-077	3	05-11-79	4.16kV Bus Incoming Breakers	Ref FSAR 8.3.1.1.9, 8.3.1.2.4	27 18
1	3				
2	2				25
2A	1				
3	1				
E-078	5	05-11-79	Diesel Generator Breakers	Ref FSAR 8.3.1.1.9, 8.3.1.2.4	25 18
1	3				
2	4				25
3	4				
4	4				

TABLE 1.7-6 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-080	6	08-03-79	460V MCC Feeder Breakers	Ref FSAR 8.3.1.1.9	
1	4				
2	3				
3	5				25
3A	3				
4	1				
5	2				
7	5				
E-081	3	12-21-78	Diesel Generator Protection	Ref FSAR 8.3.1.1.9, 8.3.1.2.4	
1	2				18
2	1				
3	3				
4	2				
E-082	4	05-22-79	480V Load Center Incoming Breakers	Ref FSAR 8.3.1.1.9	25
4	2				
5	3				21
6	4				
E-083	5	05-16-79	480V Load Center Feeder Breakers to 460V MCCs	Ref FSAR 8.3.1.1.9	25
4	5				
5	4				
6	4				21
7	3				
8	2				
E-091	2	08-13-79	6.9 and 4.16kV Bus Auto Transfer	Ref FSAR 8.3.1.1.9	25
E-097	4	07-13-79	Low Voltage AC Distribution Panels	Ref FSAR 8.3.1.1.9	25
1	2				21
2	3				25
3	2				21

TABLE 1.7-6 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-098	3	12-18-78	480 ' Feeder Breakers to B ttery Chargers	Ref FSAR 8.3.1.1.9	18
1	2				
3	2				
4	3				

TABLE 1.7-9

BOP CONTROL BOARD AND PANEL ARRANGEMENT DRAWINGS

Drawing No.	Rev.	Date	Title	Remarks	2
J-721	2	05-17-79	Control Board 0C10 ESFAS Status Display Arrangement	Ref FSAR 7.3.3.2, 7.5, Table 7.5-1, 9.4.1.2, 9.4.2.2, 9.4.8.2	27 2
J-722-1 & J-722-2	2	02-23-79	Control Board 1C14 ESFAS Status Display Arrangement	Ref FSAR 5.4.7.2, 6.2.2.1, 6.2.2.2, 6.2.4.2, 6.8.2.3, 7.3.3.2, 7.5, Table 7.5-1, 9.1.3.2, 9.2.1.2, 9.2.2.2, 9.2.6.2, 9.2.10.2, 9.3.4.2, 10.3.2.3, 10.4.7.2, 10.4.9.2	19 2
J-723-1 & J-723-2	3	02-08-79	Control Board 2C14 ESFAS Status Display Arrangement	Ref FSAR 5.4.7.2, 6.2.2.1, 6.2.2.2, 6.2.4.2, 6.8.2.3, 7.3.3.2, 7.5, Table 7.5-1, 9.1.3.2, 9.2.1.2, 9.2.2.2, 9.2.6.2, 9.2.10.2, 9.3.4.2, 10.3.2.3, 10.4.7.2, 10.4.9.2	19 2
J-725	6	04-09-79	Main Control Room Arrangement	Ref FSAR 7.5. While this drawing is not specifically referenced in the FSAR, it is submitted as an aid in understanding the arrangement of control panels in the control room area (FSAR Figure 6.4-3).	21 12 14
J-726	4	05-17-79	Control Board 0C10 Arrangement	Ref FSAR 7.3.3.2, Table 7.5-1, 9.1.3.2, 9.2.1.2, 9.4.1.2, 9.4.2.2, 10.4.9.2	22 2
J-727	6	02-27-79	Control Board 1C11 Arrangement	Ref FSAR 6.2.4.2, 7.4.1.1, 7.5, Table 7.5-1 & 7.5-2, 9.2.6.2, 10.4.4.2, 10.4.7.2, 10.4.9.2	21 2
J-729	5	10-23-78	Control Board 1C12 Arrangement	Ref FSAR 5.2.5.4, 6.2.4.2, 7.5, Tables 7.5-1 and 7.5-2, 7.6.1.4, 9.2.2.2 9.3.4.2	19
J-730	7	02-07-79	Control Board 1C14 Arrangement	Ref FSAR 5.2.5.4, 5.4.7.2, 6.2.2.1, 6.2.4.2, 6.8.2.3, 7.3.2.2, 7.3.3 7.5, Table 7.5-1 & 7.5-2, 7.6.1.2, 7.6.1.3, 9.2.1.2, 9.2.2.2, 9.2.6.2, 9.2.10.2, 9.3.4.2, 10.3.2.3, 10.4.7.2, 10.4.9.2	18 2
J-731	6	02-27-79	Control Board 2C11 Arrangement	Ref FSAR 6.2.4.2, 7.4.1.1, Table 7.5-1 & 7.5-2, 9.2.6.2, 10.4.4.2, 10.4.7.2, 10.4.9.2	21 2
J-732	5	10-04-78	Control Board 2C13/2C23 Arrangement	Ref FSAR 7.2.1.2, Table 7.5-2	
J-733	5	10-02-78	Control Board 2C12 Arrangement	Ref FSAR 5.2.5.4, 6.2.4.2, Tables 7.5-1 and 7.5-2, 7.6.1.4, 9.2.2.2 9.3.4.2	19

TABLE 1.7-9 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-734	7	02-07-79	Control Board 2C14 Arrangement	Ref FSAR 5.2.5.4, 5.4.7.2, 6.2.2.1, 6.2.4.2, 6.8.2.3, 7.3.2.2, 7.3.3.2, Table 7.5-1 & 7.5-2, 7.6.1.2, 7.6.1.3, 9.2.1.2, 9.2.2.2, 9.2.6.2, 9.2.10.2, 9.3.4.2, 10.3.2.3, 10.4.7.2, 10.4.9.2	18 2
J-735	4	05-17-79	Control Board 0C20 Arrangement	Ref FSAR 6.2.4.2, Table 7.5-1 & 7.5-2, 9.1.2.2, 9.1.3.2, 9.2.6.2, 9.4.1.2, 9.4.2.2	25 2
J-736	5	02-27-79	Control Board 1C21 Arrangement	Ref FSAR 7.5, Table 7.5-2	21
J-737	1	04-05-76	Control Board 1C23 Arrangement	Ref FSAR 7.5	2
J-738	5	10-02-78	Control Board 1C22 Arrangement	Ref FSAR 5.2.5.4, 5.4.7.2, 6.2.4.2, 7.5, Table 7.5-1, 9.2.2.2, 9.2.6.2, 9.3.4.2	25 2
J-739	5	02-23-79	Control Board 1C24 Arrangement	Ref FSAR 6.2.2.2, 6.8.2.3, 7.5, Table 7.5-1, 9.2.1.2, 9.2.2.2, 9.2.10.2, 9.3.4.2, 9.4.5.2, 9.5.4.2	21
J-740	5	02-27-79	Control Board 2C21 Arrangement	Ref Table 7.5-2	2
J-741	1	04-05-76	Control Board 2C23 Arrangement	Ref FSAR 7.5	
J-742	5	10-02-78	Control Board 2C22 Arrangement	Ref FSAR 5.2.5.4, 5.4.7.2, 6.2.4.2, Table 7.5-1, 9.2.2.2, 9.2.6.2, 9.3.4.2	19
J-743	5	02-08-79	Control Board 2C24 Arrangement	Ref FSAR 6.2.2.2, 6.8.2.3, Table 7.5-1 & 7.5-2, 9.2.1.2, 9.2.2.2, 9.2.10.2, 9.3.4.2, 9.4.5.2, 9.5.4.2	21 2
J-744	4	09-15-78	Control Board 1C15 Arrangement	Ref FSAR 7.5	18 11
J-746	4	08-17-78	Control Board 2C15 Arrangement	Ref Table 7.5-2	18 2
J-749	4	04-09-79	Main Control Room Floor Penetration at Elevation 659'-0" and Control Panel Layout		21 2

TABLE 1.7-9 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-750	4	04-09-79	Main Control Room Floor Penetration at Elevation 674'-6" and Control Panel Layout		21 2
J-908	6	03-22-79	Local Control Panel 1C114 Auxiliary Shutdown Panel Arrangement (Unit 1)	Ref FSAR 6.2.4.2, 7.3.3.2, 7.4.1.1, 7.4.3, 7.4.3.1, Table 7.5-1 & 7.5-2, 9.2.1.2, 9.2.2.2, 9.2.6.2, 9.3.4.2, 10.4.9.2	21 2
J-909	6	03-22-79	Local Control Panel 2C114 Auxiliary Shutdown Panel Arrangement (Unit 2)	Ref FSAR 6.2.4.2, 7.3.3.2, 7.4.1.1, 7.4.3, 7.4.3.1, Table 7.5-1 & 7.5-2, 9.2.1.2, 9.2.2.2, 9.2.6.2, 9.3.4.2, 10.4.9.2	21 2
J-922	3	04-25-79	Local Control Panel 1C150 Reactor Building Heating and Ventilation Panel Arrangement	Ref FSAR 6.2.2.2, 6.2.4.2, 6.2.5.2, 9.4.6.2	27 2
J-923	3	04-25-79	Local Control Panel 2C150 Reactor Building Heating and Ventilation Panel Arrangement	Ref FSAR 6.2.2.2, 6.2.4.2, 6.2.5.2, 9.4.6.2	27 2
J-924	5	09-28-79	Local Control Panel 0C151 Auxiliary Building Heating and Ventilation Panel Arrangement	Ref FSAR 9.4.1.2, 9.4.2.2	21 27 2
J-933	4	08-14-79	Local Control Panel 0C180	Ref FSAR 9.4.8.2	27
J-939	2	01-30-79	Local Control Panel 1C175A	Ref FSAR 9.4.7.2	
J-940	2	01-30-79	Local Control Panel 1C175B	Ref FSAR 9.4.7.2	21
J-941	2	01-30-79	Local Control Panel 2C175A	Ref FSAR 9.4.7.2	
J-942	2	01-30-79	Local Control Panel 2C175B	Ref FSAR 9.4.7.2	
J-946	2	01-15-80	Vertical Control Panel 0C29		27
2717-1002 Sh 1	4	09-08-78	ESFAS General Arrangement (1C43, 2C43)	Ref FSAR Tables 7.5-1 and 7.5-2	19 18

TABLE 1.7-9 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
2717-1002 Sh 2	4	09-08-78	ESFAS General Arrangement (1C44, 2C44)	REF FSAR Tables 7.5-1 and 7.5-2	
2717-1002 Sh 3	4	09-08-78	ESFAS General Arrangement (1C35, 2C35)	Ref FSAR Tables 7.5-1 and 7.5-2	19
2717-1002 Sh 4	4	09-08-78	ESFAS General Arrangement (Alarm Panels)	Ref FSAR Tables 7.5-1 and 7.5-2	
2717-1002 Sh 5	4	09-08-78	ESFAS General Arrangement (Test Panel, Auto/Manual Switch Panel)	Ref FSAR Tables 7.5-1 and 7.5-2	18
2717-1002 Sh 6	4	09-08-78	ESFAS General Arrangement (nameplate Arrangement)	Ref FSAR Tables 7.5-1 and 7.5-2	19 18

TABLE 1.7-11

BOP EQUIPMENT LOGIC DIAGRAMS

Drawing No.	Rev.	Date	Title	Remarks	
J-001-1	2	05-21-76	Logic Diagram Legend and Notes	While this drawing is not specifically referenced in the FSAR, it is submitted as an aid in understanding the logic diagrams.	2
J-001-2, J-001-3, & J-001-4	1	01-26-76	Logic Diagram Legend and Notes	While this drawing is not specifically referenced in the FSAR, it is submitted as an aid in understanding the logic diagrams.	
J-007-1,	5	06-11-79	Makeup Pump	Ref FSAR 9.3.4.2	25
J-007-2, &	5	06-11-79			
J-007-3	3	01-08-79			18
J-008	2	12-27-77	Reactor Coolant Letdown Cooler Inlet Valve	Ref FSAR 7.6.1, 7.6.1.4, 9.2.2.2, 9.3.4.2	
J-009	1	12-12-77	Reactor Coolant Letdown Shutoff Valve	Ref FSAR 6.2.4.2, 9.3.4.2	5
J-011	2	12-12-77	Reactor Coolant Pump Seal Injection Valve	Ref FSAR 6.2.4.2, 9.3.4.2	
J-012	2	08-29-78	Reactor Coolant Pump Seal Return Valve	Ref FSAR 6.2.4.2, 9.2.2.2, 9.3.4.2	14
J-014	3	11-23-78	High-Pressure Injection Valve	Ref FSAR 6.2.4.2, 9.3.4.2	
J-015-1	3	01-08-79	Makeup and Purification System Isolation Valve	Ref FSAR 6.2.4.2, 9.3.4.2	18
J-016	3	12-05-78	Makeup Tank Isolation Valve	Ref FSAR 9.3.4.2	
J-017-1 &	5	03-26-79	Decay Heat Removal Pump	Ref FSAR 5.4.7.2	21
J-017-2	4	11-07-77			
J-018-1 &	3	11-27-78	Decay Heat Removal Heat	Ref FSAR 5.4.7.2	18
J-018-2	2	11-28-78	Exchanger Discharge Valve		
J-019-1	4	05-16-78	Decay Heat Removal Heat Exchanger Bypass Valve	Ref FSAR 5.4.7.2, 7.1.2.5	11

TABLE 1.7-11 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-019-2	4	05-16-78	Decay Heat Removal Heat Exchanger Bypass Valve	Ref FSAR 5.4.7.2, 7.1.2.5	2 11
J-020-1 & J-020-2	5	11-27-78	Low-Pressure Injection Valve	Ref FSAR 5.4.7.2, 6.2.4.2, 7.1.2.5	
J-021-1 & J-021-2	3 2	11-27-78 09-14-76	Decay Heat Cooldown Isolation Valve	Ref FSAR 5.4.7.2, 6.2.4.2	
J-022-1 & J-022-2	4	11-27-78	Core Flood Tank Outlet Block Valve	Ref FSAR 5.4.7.2, 7.1.2.5, 7.6.1, 7.6.1.3	
J-026-1 & J-026-2	3	11-27-78	Reactor Building Spray Pump	Ref FSAR 6.2.2.1	18
J-027	3	11-27-78	Reactor Building Spray Valve	Ref FSAR 6.2.2.1, 6.2.4.2	
J-028-1 & J-028-2	2	11-27-78	Borated Water Storage Tank Outlet Valve	Ref FSAR 5.4.7.2, 6.2.2.1	
J-029-1 & J-029-2	3	11-27-78	Reactor Building Emergency Sump Outlet Valve	Ref FSAR 5.4.7.2, 6.2.2.1, 6.2.4.2	
J-031	2	08-16-77	Fuel Pool Cooling Pump	Ref FSAR 9.1.3.2	
J-035-1 & J-035-2	2	07-05-77	Component Cooling Water Pump	Ref FSAR 9.2.2.2	
J-036-1 & J-036-2	2	07-05-77	Component Cooling Water Spare Pump	Ref FSAR 9.2.2.2	
J-040	1	07-05-77	Component Cooling Water Decay Heat Cooler Block Valve	Ref FSAR 9.2.2.2	2
J-041	1	07-05-77	Component Cooling Water Heat Exchanger Bypass Isolation Valve	Ref FSAR 9.2.2.2	

TABLE 1.7-11 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-043-1 & J-043-2	1	07-05-77	Component Cooling Water Loop Isolation Valve	Ref FSAR 9.2.2.2	2
J-044	1	07-05-77	Component Cooling Water System Reactor Building Isolation Valve	Ref FSAR 6.2.4.2, 9.2.2.2	
J-045-1, J-045-2, & J-045-3	2	12-01-78	Service Water Pump	Ref FSAR 9.2.1.2	18 2
J-046-1,	2	03-29-79	Spare Service Water Pump	Ref FSAR 9.2.1.2	21
J-046-2, &	2	03-29-79			21
J-046-3	1	01-18-77			25
J-050-1& J-050-2	2	08-21-78	Service Water Pump Pit Sluice Gate Motor	Ref FSAR 9.2.1.2	14
J-051-1& J-051-2	3	08-10-78	Service Water System Loop Isolation Valve	Ref FSAR 9.2.1.2	
J-052	2	12-17-79	Service Water System Turbine Plant and Cooling Tower Isolation Valve	Ref FSAR 9.2.1.2	27 2
J-053	2	08-21-78	Diesel Generator Cooler Isolation Valve	Ref FSAR 9.2.1.2	14 18
J-054	2	04-17-79	Service Water System Emergency Cooling Pond Return Valve	Ref FSAR 9.2.1.2	21 2
J-055	2	11-16-78	Service Water System CCW Heat Exchanger Block Valve	Ref FSAR 9.2.1.2	18
J-056	1	01-18-77	Service Water to Circulating Water Pumps and Chemical Injection System Isolation Valve	Ref FSAR 9.2.1.2	2
J-058	2	11-16-78	Reactor Building Air Cooler Isolation Valve	Ref FSAR 6.2.2.2, 6.2.4.2, 9.2.1.2	18

TABLE 1.7-11 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-085	0	12-21-78	Service Water System Strainers	Ref FSAR 9.2.1.2	18
J-102	1	12-27-77	Reactor Coolant Letdown Block Valve	Ref FSAR 7.6.1, 7.6.1.4, 9.2.2.2, 9.3.4.2	5
J-132-1, J-132-2, J-132-3, & J-132-4	5	01-08-79	Auxiliary Feedwater Pump-Turbine	Ref FSAR 7.4.1, 7.4.1.1, 9.2.1.2, 10.4.9.2	18 2
J-133-1 & J-133-2	5 4	01-08-79 01-08-79	Auxiliary Feedwater Pump-Electric	Ref FSAR 7.4.1, 7.4.1.1, 9.2.1.2, 10.4.9.2	18
J-136	2	04-03-78	Auxiliary Feedwater Pump Recirculating Valve	Ref FSAR 10.4.9.2	2
J-138-1 J-138-2 J-138-3 J-138-4	3	09-29-78	Steam Generator Main Feedwater Isolation Valve	Ref FSAR 6.2.4.2, 10.4.7.2	18 14
J-139	2	01-08-78	Main-Auxiliary Feedwater Crosstie Isolation Valve	Ref FSAR 10.4.9.2	18
J-141-1, & J-141-2	4	01-10-79	Auxiliary Feedwater System Valves	Ref FSAR 7.4.1.1, 10.4.9.2	2
J-167	2	08-16-78	Reactor Building Collection Header Isolation Valve	Ref FSAR 6.2.4.2	14 2
J-173-1 & J-173-2	3	11-27-78	Reactor Building Isolation Valve - Motor Operated	Ref FSAR 6.2.2.1, 6.2.4.2, 9.1.3.2	18 2
J-174	1	08-10-78	Reactor Building Isolation Valve - Air Operated	Ref FSAR 6.2.2.1, 6.2.4.2	14 2
J-175	1	08-29-78	Reactor Coolant Letdown Cooler Isolation Valve	Ref FSAR 6.2.4.2, 9.3.4.2	14 2

TABLE 1.7-11 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-176	1	12-12-77	Reactor Coolant Pump Seal Return Shutoff Valve	Ref FSAR 6.2.4.2, 9.3.4.2	2
J-177-1 & J-177-2	3	03-06-79	Reactor Building Isolation Valve Solenoid Valve	Ref FSAR 5.4.7.2, 6.2.4.2, 6.8.2.3, 9.2.6.2	2
J-178	4	05-30-79	Typical Safety-Related Motor Operated Valve	Ref FSAR 5.4.7.2	2
J-179	1	11-27-78	BWST Recirculation and Purification Outlet and Return Valves	Ref FSAR 6.2.2.1	2
J-184	5	01-12-79	Typical Solenoid Valve, Energize to Open	Ref FSAR 5.4.7.2, 6.8.2.3	2
J-185	1	07-05-77	Typical Solenoid Valve, Energize to Close	Ref FSAR 9.2.2.2	2
J-188	1	11-16-78	Emergency Diesel Oil Transfer Pump	Ref FSAR 9.5.4.2	18
J-189	0	02-07-79	Reactor Building Spray System Hydrazine Pumps	Ref FSAR 6.2.2.1	14
J-198	1	05-05-76	Penetration Pressurization System Valve	Ref FSAR 6.2.4.2, 6.8.2.3	2
J-203	3	12-12-78	Auxiliary Feedwater Pump Turbine Main Steam Supply Block Valve	Ref FSAR 6.2.4.2, 10.4.9.2	2
J-215	1	09-12-78	Reactor Building Vent Header Isolation Valve	Ref FSAR 6.2.4.2	2
J-221	4	01-12-79	High-Pressure Penetration Pressurization Valve	Ref FSAR 6.2.4.2, 6.8.2.3	18
J-226-1 & J-226-2	2	01-18-79	Condensate Storage Tank Auxiliary Feedwater Supply Valve	Ref FSAR 10.4.9.2	2

TABLE 1.7-11 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-227-1, J-227-2, & J-227-3	3 3 0	01-18-79 01-18-79 01-12-79	Service Water System Auxiliary Feedwater Supply Valve	Ref FSAR 10.4.9.2	2 19
J-230	1	11-29-78	Feedwater Startup Drain Valve	Ref FSAR 6.2.4.2, 10.4.7.2	18
J-231	2	01-16-79	Motor Driven Auxiliary Feedwater Pump Condensate Storage Tank Block Valve	Ref FSAR 10.4.9.2	2
J-232-1 & J-232-2	4	06-11-79	Standby Makeup Pump	Ref FSAR 9.3.4.2	25 18
J-234-1, J-234-2, & J-234-3	3 3 4	02-21-79 02-20-79 02-20-79	Steam Generator Auxiliary Feedwater Isolation Valve Motor Operated	Ref FSAR 6.2.4.2, 10.4.9.2	19
J-235	2	11-27-78	High-Pressure Injection Supply Valve	Ref FSAR 9.3.4.2	2
J-237-1 & J-237-2	3	06-11-79	Makeup Pump Auxiliary Lube Oil Pump	Ref FSAR 9.3.4.2	25 2
J-238-1 & J-238-2	3	06-11-79	Standby Makeup Pump Auxiliary Lube Oil Pump	Ref FSAR 9.3.4.2	25 2
J-251	2	11-16-78	Reactor Building Air Cooler Throttling Valve	Ref FSAR 6.2.2.2, 6.2.4.2, 9.2.1.2	18 2
J-252	2	02-01-79	Auxiliary Feedwater Isolation Valve	Ref FSAR 10.4.9.2	21 2
J-253-1 & J-253-2	2	11-27-78	Decay Heat Return Isolation Valve	Ref FSAR 5.4.7.2, 6.2.4.2, 7.6.1, 7.6.1.2	18 2
J-258	2	02-21-79	Main Steam Line Isolation Valve Alarms and Status Light	Ref FSAR 6.2.4.2, 10.3.2.3	21 2
J-261-1 & J-261-2	2	12-12-78	Auxiliary Feedwater Flow Control Valve Indication	Ref FSAR 7.4.1.1, 10.4.9.2	18 2

TABLE 1.7-11 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-262	1	07-18-77	ESFAS Subsystem Manual Bypass Status Lamp		2
J-263	0	02-24-78	Decay Heat Removal System Dump to Sump Valves	Ref FSAR 5.4.7.2	18 2
J-264	2	05-30-79	Low Pressure Injection Crosstie Valves	Ref FSAR 5.4.7.2	27 2
J-298	1	05-16-78	Core Flood Tank Vent Valve	Ref FSAR 5.4.7.2, 7.1.2.5	5
J-420-1 & J-420-2	1 2	08-03-78 12-12-78	Service Water Pump Cooling Fans	Ref FSAR 9.4.8.2	14 18
J-421-1 & J-421-2	1	08-03-78	Service Water Standby Pump Cooling Fan	Ref FSAR 9.4.8.2	14 2
J-423-1 & J-423-2	1	01-05-78	Diesel Generator Supply	Ref FSAR 9.4.7.2	27
J-806-1 & J-806-2	1	04-28-77	Component Cooling Water Pump Room Unit Cooler	Ref FSAR 9.4.5.2	
J-807	1	03-24-78	Spare CCW Pump Room Unit Cooler	Ref FSAR 9.4.5.2	2
J-808-1 & J-808-2	1	04-28-77	Makeup Pump Room Unit Cooler	Ref FSAR 9.4.5.2	
J-809	0	01-13-76	Spare Makeup Pump Unit Cooler	Ref FSAR 9.4.5.2	
J-810	1	04-28-77	Auxiliary Feedwater Electric Pump Room Unit Cooler	Ref FSAR 9.4.5.2	
J-811	2	01-08-79	Auxiliary Feedwater Steam Driven Pump Room Unit Cooler	Ref FSAR 9.4.5.2	18 2
J-812	1	04-28-77	Decay Heat Removal Heat Exchanger Room Unit Cooler	Ref FSAR 9.4.5.2	

TABLE 1.7-11 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-813	1	04-28-77	Engineered Safeguards Pump Room Unit Cooler	Ref FSAR 9.4.5.2	2
J-824	1	01-08-79	Safeguards Chilled Water Pump	Ref FSAR 9.2.10.2	18 2
J-825	1	03-27-79	Switchgear and Battery Room Unit Coolers	Ref FSAR 9.4.1.2	21 5
J-829-1, J-829-2, J-829-3, J-829-4, & J-829-5	3	10-13-78	Auxiliary Building Safety-Related Chiller Indication and Alarms	Ref FSAR 9.2.10.2	18 5
J-831	1	08-08-77	Fuel Area Safety Isolation Dampers	Ref FSAR 9.4.2.2	2
J-832-1 & J-832-2	2	12-28-78	Fuel Area Emergency Exhaust Fan	Ref FSAR 9.4.2.2	18 2
J-834-1 & J-834-2	2 2	03-02-79 01-10-79	Reactor Building Recirculating Air Cooling Unit Fan	Ref FSAR 6.2.2.2	21 18 2
J-841-1 & J-841-2	2 1	09-12-78 02-09-77	Reactor Building Isolation Dampers Motor Operated	Ref FSAR 6.2.4.2	14 18
J-854	2	07-18-77	Control Room A/H Unit	Ref FSAR 9.4.1.2	
J-855	2	07-18-77	Control Room A/H Unit Discharge and Return Dampers	Ref FSAR 9.4.1.2	2
J-856	3	02-01-79	Control Room Recirculating Air Fan	Ref FSAR 9.4.1.2	21
J-857	4	04-02-79	Control Room Recirculating Air Filter Fan Discharge and Suction Dampers	Ref FSAR 9.4.1.2	2

TABLE 1.7-11 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-858	2	07-18-77	Control Room Recirculating Air Filter Fan Bypass Damper	Ref FSAR 9.4.1.2	2
J-859	3	02-01-79	Control Room Makeup Air Supply Fan	Ref FSAR 9.4.1.2	21
J-860	2	07-18-77	Control Room Makeup Air Supply Fan Discharge and Suction Dampers	Ref FSAR 9.4.1.2	
J-861	2	07-28-77	Control Room Makeup Air Supply Fan Bypass Damper	Ref FSAR 9.4.1.2	2
J-862	2	07-18-77	Control Room Outside Air Intake and Switchgear Room Air Supply Isolation Dampers	Ref FSAR 9.4.1.2	
J-863-1 & J-863-2	3	02-01-79	Cable Spreading Room Supply and Control Room Exhaust Dampers	Ref FSAR 9.4.1.2	21 2
J-864	4	02-01-79	Control Room Emergency Makeup Air Supply Valve	Ref FSAR 9.4.1.2	21
J-865	2	07-18-77	Control Room A/H Humidifier Steam Supply Isolation Valve	Ref FSAR 9.4.1.2	2
J-867	2	02-01-79	Battery Room Exhaust Fan and Discharge Damper	Ref FSAR 9.4.1.2	21 2
J-869	B	06-20-79	Control Room Pressurizing System Flow Control Valve	Ref FSAR 9.4.1.2	27 2

TABLE 1.7-12

BOP SYSTEM AND EQUIPMENT LOOP DIAGRAMS

Drawing No.	Rev.	Date	Title	Remarks	
J-300-1	3	05-22-79	Loop Diagram Legend and Notes	While loop diagrams are not specifically referenced in the FSAR test, they are supplied to provide representative loop details to clarify instrument installation	27 5
J-300-2	0	05-22-79	Loop Diagram Legend and Notes		25
J-300-3	0	06-06-79	Loop Diagram Legend and Notes		
J-303-06	1	01-19-79	Makeup and Purification, Units 1 & 2		5
J-303-07	1	01-19-79	Makeup and Purification, Units 1 & 2		14 5
J-303-08	1	07-13-79	Makeup and Purification, Units 1 & 2		25
J-303-09	2	07-13-79	Makeup and Purification, Units 1 & 2		
J-316-02	3	06-11-79	Component Cooling Water, Units 1 & 2		27 5
J-316-04	2	06-11-79	Component Cooling Water, Units 1 & 2		27 5
J-316-05	1	06-11-79	Component Cooling Water, Units 1 & 2		27
J-316-06	0	10-06-77	Component Cooling Water, Units 1 & 2		5
J-316-08	1	10-06-77	Component Cooling Water, Units 1 & 2		
J-316-09	1	10-05-77	Component Cooling Water, Units 1 & 2		18 5
J-316-11	1	08-10-78	Component Cooling Water, Units 1 & 2		14

TABLE 1.7-12 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-318-07	2	12-03-79	Service Water Cooling Tower and Pump Service Structure		27 5
J-319-05	3	09-10-79	Service Water, Reactor, and Auxiliary Building		27 5
J-321-07	1	07-18-79	Reactor Building Penetration Pressurization, Units 1 & 2		25 5
J-337-07	2	06-05-79	Feedwater and Condensate, Unit 2		
J-337-17	2	07-23-79	Feedwater and Condensate, Unit 2		25
J-337-25	1	06-05-79	Feedwater and Condensate, Unit 2		
J-337-26	1	06-05-79	Feedwater and Condensate, Unit 2		5
J-337-29	1	01-30-79	Feedwater and Condensate, Unit 2		21 5
J-337-30	1	10-02-79	Feedwater and Condensate, Unit 2		27 19
J-337-31	1	10-02-79	Feedwater and Condensate, Unit 2		27
J-337-32	0	02-02-79	Feedwater and Condensate, Unit 2		19
J-338-19	2	06-05-79	Feedwater and Condensate, Unit 1		
J-338-20	2	06-05-79	Feedwater and Condensate, Unit 1		25
J-338-22	2	07-23-79	Feedwater and Condensate, Unit 1		

TABLE 1.7-12 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-338-27	1	01-30-79	Feedwater and Condensate, Unit 1		21 5
J-338-28	2	06-05-79	Feedwater and Condensate, Unit 1		25 5
J-338-29	1	02-06-79	Feedwater and Condensate, Unit 1		21 19
J-338-30	1	10-02-79	Feedwater and Condensate, Unit 1		27 19
J-338-31	1	10-02-79	Feedwater and Condensate, Unit 1		27
J-338-32	0	02-02-79	Feedwater and Condensate, Unit 1		19
J-352-05	3	07-31-79	Emergency Diesel Fuel Oil Storage and Transfer		27
J-357-05	0	12-16-77	Chilled Water System		5
J-357-06	0	09-27-77	Chilled Water System		
J-365-01	2	09-13-79	Control Room HVAC		
J-365-06	2	08-24-79	Control Room HVAC		27
J-365-07	2	09-13-79	Control Room HVAC		
J-368-01	2	12-21-78	Miscellaneous Structure HVAC		
J-368-02	1	02-13-79	Miscellaneous Structure HVAC		18
J-368-03	1	11-21-78	Miscellaneous Structure HVAC		
J-368-04	1	11-21-78	Miscellaneous Structure HVAC		14
J-392-1	2	10-30-79	Instrument Rack UN 1C166		

TABLE 1.7-12 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-392-2	2	10-30-79	Instrument Rack UN 1C166		5
J-392-3	1	10-30-79	Instrument Rack UN 1C166		
J-392-4	1	10-30-79	Instrument Rack UN 1C166		
J-393-1	2	10-30-79	Instrument Rack UN 2C166		27
J-393-2	2	10-30-79	Instrument Rack UN 2C166		
J-393-3	1	10-30-79	Instrument Rack UN 2C166		
J-393-4	1	10-30-79	Instrument Rack UN 2C166		
J-397	0	09-23-77	Instrument Rack Power Diagram		5

TABLE 1.7-13

BOP INSTRUMENT LOCATION DRAWINGS

Drawing No.	Rev.	Date	Title	Remarks	
J-31 1	6	05-29-79	Area 1, Elevation 568'-0"	While instrument location drawings are not specifically referenced in the FSAR text, they are supplied to aid in determining seismic and environmental criteria and to illustrate instrument location and separation where applicable	27
J-3102	5	06-08-79	Area 1, Elevation 584'-0"		
J-3103	6	09-11-79	Area 1, Elevation 584'-0"		
J-3104	4	06-20-79	Area 1, Elevation 599'-0"		
J-3105	4	06-26-79	Area 1, Elevation 599'-0"		
J-3106	4	06-12-79	Area 1, Elevation 614'-0"		
J-3107	3	06-12-79	Area 1, Elevation 614'-0"		
J-3108	1	06-20-79	Area 1, Elevation 624'-0"		
J-3109	5	09-11-79	Area 1, Elevation 634'-6"		
J-3110	4	09-11-79	Area 1, Elevation 634'-6"		
J-3111	3	03-08-79	Area 1, Elevation 634'-6"		21
J-3112	3	05-29-79	Area 1, Elevation 645'-0"		27
J-3113	2	10-10-78	Area 1, Elevation 645'-0"		18
J-3115	2	05-23-79	Area 1, Elevation 659'-0"		27
J-3116	2	05-29-79	Area 1, Elevation 659'-0"		
J-3124	2	07-23-79	Area 2, Elevation 593'-6"		
J-3125	0	09-07-78	Area 2, Elevation 626'-0"		18
J-3126	1	01-10-79	Area 2, Elevation 640'-0"	Ref Fig. 7.2-5	19
J-3127	0	09-07-78	Area 2, Elevation 659'-0"		18
J-3128	0	09-07-78	Area 2, Elevation 685'-0"		
J-3130	0	01-10-79	Solid Radwaste Building		
J-3132	1	11-08-79	Safety-Related Yard Piping		27

TABLE 1.7-13 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-3133	1	11-08-79	Safety-Related Yard Piping		
J-3134	5	06-08-79	Area 3, Elevation 568'-0"		27
J-3135	4	05-29-79	Area 3, Elevation 584'-0"		
J-3136	4	03-09-79	Area 3, Elevation 599'-0"		21
J-3137	1	06-08-79	Area 3, Elevation 614'-0"		
J-3138	1	06-14-79	Area 3, Elevation 614'-0"		27
J-3139	1	06-20-79	Area 3, Elevation 634'-6"		
J-3140	1	06-20-79	Area 3, Elevation 634'-6"		
J-3141	0	09-23-77	Area 3, Elevation 634'		18
J-3143	0	09-15-76	Area 3, Elevation 659'-0"		
J-3147	1	07-17-79	Area 3, Elevation 685'-0"		27
J-3148	0	12-16-77	Area 3, Elevation 704'-0"		18
J-3150	2	06-14-79	Area 4, Elevation 593'-6"		27
J-3151	0	09-07-78	Area 4, Elevation 626'-0"		
J-3152	1	12-01-78	Area 4, Elevation 640'-0"	Ref Fig. 7.2-5	
J-3153	0	09-07-78	Area 4, Elevation 659'-0"		18
J-3154	0	09-07-78	Area 4, Elevation 685'-0"		
J-3198	0	09-15-78	Diesel Generator Building Section		
J-3199	1	01-11-80	Diesel Generator Building Section		27
J-3204	5	11-08-79	Service Water Pump Structure, Elevation 634'-6"		21
J-3205	3	04-06-78	Service Water Pump Structure Below Elevation 634'-6"		18

TABLE 1.7-15

BOP EQUIPMENT SCHEMATIC DIAGRAMS

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-139	2	04-05-79	Steam Generator Recirculation Pumps	Ref FSAR 8.3.1.2	18 21 19
E-153	3	12-18-79	Auxiliary Feedwater Turbines	Ref FSAR 7.4.1.1, 8.3.1.2, 9.2.1.2, 10.4.9.2	27 19
1	3				27
2	3				19
3	1				
4	3				
5	3				27
6	3				
7	3				
8	3				
9	2				21
10	3				
11	3				
12	3				
13	2				27
E-154	2	12-28-79	Motor Driven Auxiliary Feedwater Pump	Ref FSAR 7.4.1.1, 8.3.1.2, 9.2.1.2, 10.4.9.2	
1	2				
2	1				
3	1				21
4	1				
5	2				27
6	1				
7	1				21
8	1				
9	1				27
10	0				
11	0				
12	0				
E-155	2	03-09-79	Main Feedwater Isolation and Startup Drain Valves	Ref FSAR 6.2.4.2, 10.4.7.2	21
1	1				
1A	1				
2	2				
3	2				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-158	3	08-03-79	Auxiliary Feedwater System Valves	Ref FSAR 6.2.4.2, 7.4.1.1, 10.4.9.2	18 27 18
1	1				
2	1				
3	1				
4	1				
5	1				
6	1				
7	1				
8	1				
9	1				
10	1				
11	1				
12	1				
13	1				
14	1				
15	1				
16	1				
17	1				
18	1				
19	1				22
20	1				
21	2				
22	2				
23	2				
24	1				
25	1				
26	1				
27	1				
28	1				
29	1				
30	1				
30A	1				
31	1				
32	1				
33	1				
34	1				
35	1				
36	0				
37	0				
38	A				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-185	2	05-16-79	Service Water Pumps Vent Valves	Ref FSAR 9.2.1.2	18
1	2				27
2	1				
3	1				
4	1				18
5	1				
6	1				
E-186	4	06-11-79	Service Water Pumps	Ref FSAR 8.3.1.2, 9.2.1.2	
1	2				
2	2				27
3	2				
4	3				
5	2				
E-187	4	06-11-79	Spare Service Water Pump	Ref FSAR 8.3.1.2, 9.2.1.2	
1	3				
2	2				
3	2				
4	3				21
5	3				
6	2				
E-191	3	04-16-79	Service Water Purp Pit Sluice Gates	Ref FSAR 9.2.1.2	
1	3				
2	3				
E-192	2	06-11-79	Service Water System Loop Isolation Valves	Ref FSAR 9.2.1.2	
1	1				27
2	1				
3	1				
E-193	2	08-03-79	Service Water System Plant Isolation Valves	Ref FSAR 9.2.1.2	
1	2				
2	2				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-194	3	04-16-79	Diesel Gen rator Cooler Isolation Valves	Ref FSAR 9.2.1.2	18
1	3				27
2	2				
E-195	2	04-16-79	Service Water System Emergency Cooling Pond Return Valves	Ref FSAR 9.2.1.2	18
					27
1	2				27
2	1				18
E-196	2	04-05-79	Service Water System Component Cooling Water Heat Exchanger Block Valve	Ref FSAR 9.2.1.2	21
					18
1	2				21
2	1				18
E-198	2	04-16-79	Reactor Building Air Cooler Throttling Valves	Ref FSAR 6.2.2.2, 6.2.4.2, 8.3.1.2, 9.2.1.2	
1	2				
2	2				
E-199	2	04-16-79	Reactor Building Air Cooler Isolation Valves	Ref FSAR 6.2.2.2, 6.2.4.2, 8.3.1.2, 9.2.1.2	
1	2				
2	2				
3	2				27
4	2				
E-200	2	04-16-79	Service Water to Circulating Water Pumps and Chemical Injection System Isolation Valves	Ref FSAR 9.2.1.2	
1	2				
2	2				
E-203	4	10-29-79	Component Cooling Water to RCP Solenoid Valve	Ref FSAR 8.3.1.2, 9.2.2.2	

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-205	4	05-16-79	Component Cooling Water Pumps	Ref FSAR 8.3.1.2, 9.2.2.2	18
1	3				
2	3				27
3	4				
4	4				
5	4				
6	4				
7	3				18
E-206	2	05-16-79	Spare Component Cooling Water Pump	Ref FSAR 8.3.1.2, 9.2.2.2	
1	2				
2	2				27
3	2				
4	2				
5	2				
6	1				
E-209	2	04-05-79	Component Cooling Water Decay Heat Cooler Block Valve	Ref FSAR 9.2.2.2	21
1	1				18
2	1				
E-210	2	04-05-79	Component Cooling Water Heat Exchanger Bypass Isolation Valve	Ref FSAR 9.2.2.2	27
					18
1	2				
2	1				21
E-211	1	03-21-79	Component Cooling Water Letdown Cooler Block Valves	Ref FSAR 8.3.1.2	18
1	1				21
2	1				
E-212	2	04-05-79	Component Cooling Water Loop Isolation Valves	Ref FSAR 9.2.2.2	27
1	2				21
2	1				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-213	2	03-29-79	Component Cooling Water Reactor Building Isolation Valves	Ref FSAR 6.2.4.2, 8.3.1.2, 9.2.2.2	18
2	2				
2	2				21
3	2				
4	2				
5	2				
6	2				
E-214	3	03-23-79	Reactor Coolant Pumps	Ref FSAR 8.3.1.2	
1	1				
2	1				18
3	2				
4	1				
5	2				
6	3				
7	0				
E-215	3	03-29-79	Reactor Coolant Pump Auxiliary Control	Ref FSAR 8.3.1.2	
1	3				21
3	3				
3	3				
4	3				
5	3				
E-216	3	03-21-79	Reactor Coolant Pumps ac Lube Oil Pumps	Ref FSAR 8.3.1.2	
1	3				
2	2				18
E-217	3	04-16-79	Reactor Coolant Pumps dc Lube Oil Pumps	Ref FSAR 8.3.1.2	27
1	3				
2	2				18
E-218	4	12-27-79	Reactor Coolant Pressurizer Heaters	Ref FSAR 8.3.1.2	
1	2				21
2	2				
3	2				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
4	1				
5	1				
6	2				21
7	1				
8	2				
9	1				18
10	0				
E-220	3	03-21-79	Reactor Coolant Pump Power Monitoring System	Ref FSAR 7.2.1.2	21
1	0				18
2	2				
3	2				
4	1				
5	1				21
E-222	2	03-21-79	Reactor Coolant Pressurizer Spray Valve	Ref FSAR 8.3.1.2	
1	1				18
2	2				
3	0				21
E-223	2	03-21-79	Reactor Coolant Pressurizer Electrically Operated Relief Valve	Ref FSAR 8.3.1.2	18
E-224	3	12-28-79	Reactor Coolant Pump Space Heaters	Ref FSAR 8.3.1.2	27
					18
E-225	2	03-21-79	Air Operated Valves	Ref FSAR 6.2.2.1, 6.2.4.2	
2	2				21
2	2				
3	1				
4	1				18
5	0				
E-226	2	10-02-79	Reactor Coolant System Motor Operated Valves	Ref FSAR 8.3.1.2	
1	1				27
2	2				
3	2				
4	1				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-227	2	04-16-79	Reactor Coolant and Pressurizer System Solenoid Valves	Ref FSAR 6.2.4.2, 8.3.1.2	18 27 18
1	1				
2	0				
3	2				27
E-231	3	08-13-79	Makeup Pumps	Ref FSAR 8.3.1.2, 9.3.4.2	
1	3				
2	2				
3	1				20
4	3				
5	3				
6	3				27
7	2				
8	2				
9	2				
10	0				
11	0				20
12	0				
E-232	5	08-13-79	Spare Makeup Pump	Ref FSAR 8.3.1.2	27
1	4				
2	3				20
3	1				
4	4				27
5	4				
6	3				20
7	2				
8	0				27
9	2				
10	0				20
11	0				
12	0				27
E-233	3	07-03-79	Makeup Pump Auxiliary Lube Oil Pump	Ref FSAR 8.3.1.2, 9.3.4.2	
1	3				
2	3				
3	2				20
4	1				
5	0				27

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-234	3	07-03-79	Spare Makeup Pump Auxiliary Lube Oil Pump	Ref FSAR 8.3.1.2, 9.3.4.2	18
1	3				27
2	3				
3	3				
4	1				
5	0				
E-235	2	03-23-79	Reactor Coolant Letdown Cooler Isolation Valves	Ref FSAR 6.2.4.2, 8.3.1.2, 9.3.4.2	21
1	2				
2	1				
E-236	1	11-09-78	Reactor Coolant Pump Seal Return Shutoff Valve	Ref FSAR 6.2.4.2, 9.3.4.2	18
E-237	2	03-23-79	Reactor Coolant Letdown Cooler Inlet Valves	Ref FSAR 7.6.1.4, 8.3.1.2, 9.2.2.2, 9.3.4.3	
1	2				
2	2				21
E-238	2	03-21-79	Reactor Coolant Letdown Shutoff Valves	Ref FSAR 6.2.4.2, 9.3.4.2	
1	2				
2	1				
E-240	0	08-03-78	Reactor Coolant Pump Seal Injection Valves	Ref FSAR 6.2.4.2, 9.3.4.2	18
E-241	2	04-05-79	Reactor Coolant Pump Seal Return Valves	Ref FSAR 6.2.4.2, 8.3.1.2, 9.2.2.2, 9.3.4.2	21
1	1				
2	2				
E-242	2	01-21-80	High-Pressure Injection Valves	Ref FSAR 6.2.4.2, 9.3.4.2	27
1	2				
2	2				
3	2				
4	2				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-243	5	01-21-80	Makeup Pump Recirculation Isolation Valves	Ref FSAR 6.2.4.2, 9.3.4.2	18
1	4				27
2	5				21
E-244	3	07-03-79	Makeup and Purification System Isolation Valve	Ref FSAR 9.3.4.2	27
1	2				21
2	2				27
3	0				
E-246	2	03-21-79	Reactor Coolant Letdown Block Valve	Ref FSAR 7.6.1.4, 8.3.1.2, 9.2.2.2, 9.3.4.2	21
E-248	1	11-14-78	High-Pressure Injection Supply Valve	Ref FSAR 9.3.4.2	18
1	1				
2	1				
E-249	2	02-27-79	Decay Heat Removal Pumps	Ref FSAR 5.4.7.2, 8.3.1.2	
1	2				
2	2				21
3	2				
4	2				
5	2				
6	2				
7	0				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-250	3	12-28-79	Decay Heat Removal System Motor Operated Valves	Ref FSAR 5.4.7.2, 7.1.2.5	18
1	3				
2	1				27
3	1				
4	0				
5	2				
6	2				
7	1				18
E-251	2	03-09-79	Core Flooding Tank Sample Line Isolation Valves	Ref FSAR 5.4.7.2, 6.2.4.2, 8.3.1.2	21
E-252	3	12-28-79	Decay Heat Removal Low-Pressure Injection Valves	Ref FSAR 5.4.7.2, 6.2.4.2, 7.1.2.5	27 21
1	2				18
2	1				
3	2				
4	2				
5	1				
6	2				
7	2				
E-253	3	12-28-79	Decay Heat Cooldown and Return Isolation Valves	Ref FSAR 5.4.7.2, 6.2.4.2, 7.6.1.2, 8.3.1.2	
1	3				
2	1				
3	3				27
4	1				
5	2				
6	3				
7	3				
8	3				
9	3				
10	2				
11	3				
E-254	3	12-28-79	Core Flooding Tank Outlet and Gas Sample Valves	Ref FSAR 5.4.7.2, 7.6.1.3, 8.3.1.2, 7.1.2.5	
1	3				
2	3				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-255	3	12-28-79	Reactor Building Spray Pump	Ref FSAR 6.2.2.1, 8.3.1.2	18
1	2				
2	2				
3	2				
3A	1				
4	2				27
5	2				
E-256	2	12-28-79	Reactor Building Spray Valves	Ref FSAR 6.2.2.1, 6.2.4.2	
1	2				
2	2				
E-257	3	12-28-79	Borated Water Storage Tank Recirculation and Outlet Valves	Ref FSAR 5.4.7.2, 6.2.2.1, 8.3.1.2	21
1	3				27
2	1				21
3	1				27
4	3				18
5	1				
6	1				
E-258	3	12-28-79	Reactor Building Emergency Sump Outlet Valves	Ref FSAR 5.4.7.2, 6.2.2.1, 6.2.4.2	27
1	3				
2	1				
E-260	1	11-14-78	Reactor Building Motor Operated Isolation Valve	Ref FSAR 6.2.2.1, 6.2.4.2, 8.3.1.2	18
1	1				
2	1				
E-313	1	02-04-80	Radwaste Gas Vent Header Isolation Valves	Ref FSAR 6.2.4.2, 8.3.1.2	27
1	1				
2	1				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-318	1	03-21-79	Spent Fuel Pool Cooling Pump	Ref FSAR 9.1.3.2	18
1	1				21
2	1				
E-322	3	02-05-80	Fuel Pool Cooling Purification System Valves	Ref FSAR 6.2.4.2, 9.1.3.2	
1	1				
2	2				
3	2				
E-325	1	05-16-79	Penetration Pressurization System	Ref FSAR 6.2.4.2, 6.8.2.3, 8.3.1.2	27
1	1				
2	0				
3	1				
4	1				
5	1				
E-347	4	02-12-8[illegible]	Boron Recovery System Reactor Building Collection Header Isolation Valve	Ref FSAR 6.2.4.2, 8.3.1.2	18
1	0				27
2	1				
3	0				
4	0				
E-352	0	07-31-78	Main Steam Line Valves	Ref FSAR 6.2.4.2, 10.3.2.3	
1	0				
2	0				
3	0				18
4	0				
5	0				
6	0				
7	0				
8	0				
9	0				
10	0				
11	0				
12	0				21
13	0				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
14	0				27
E-370	3	02-06-80	Reactor Nuclear Instrumentation Protection		18
1	0				
2	2				27
3	2				
4	3				
5	2				
6	0				18
7	0				
8	1				
9	1				
10	1				
11	3				27
12	1				
13	1				
14	3				
15	1				
16	2				
17	1				
18	3				
19	1				
20	C				21
21	0				
22	1				27
23	0				
24	0				21
25	0				
26	1				27
27	0				
28	0				
29	0				21
30	0				
31	0				
32	1				27
33	0				
34	0				
35	0				21
36	0				
37	0				
38	0				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
39	0				18
40	0				
41	0				
42	0				
43	0				
44	0				
45	0				21
46	0				
47	0				
48	0				
49	0				
50	0				
51	0				
52	0				
53	0				
54	0				
55	?				
56	3				
57	3				
58	3				
59	3				
60	3				
61	3				
62	3				
63	3				
64	3				
E-374	3	06-19-79	Emergency Core Cooling Actuation System (Bailey 881)	Ref FSAR 7.5.1.2	27
1	2				
2	1				
3	2				
4	1				
5	2				
6	1				
7	2				
8	1				
9	1				
10	0				21
11	0				
12	0				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
13	0				
14	0				
15	0				
16	1				
17	1				
18	1				21
19	1				
20	1				
21	1				
22	0				
23	0				
24	0				
25	0				
26	0				
27	1				
28	1				
29	3				27
30	2				
31	1				21
32	1				
33	1				
E-375	2	01-23-80	BOP - Engineered Safety Features Actuation System	Ref FSAR 5.4.7.2, 6.2.2.1, 6.2.4.2, 6.8.2.3, 7.3.3.2, 7.5.1.2.1, 9.2.1.2, 9.2.2.2, 9.2.10.2, 9.3.4.2, 9.4.1.2, 9.4.2.2, 9.4.5.2, 10.3.2.3, 10.4.7.2, 10.4.9.2	27 18
1	0				
2	1				
8	1				
9	0				
10	1				
20	1				
21	1				
22	1				21
27	0				
28	0				
29	0				
30	0				
31	0				
32	1				
33	0				
34	0				
35	0				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
36	0				18
37	0				
59	1				21
60	1				
61	1				
62	1				
63	1				
64	1				
65	1				
66	1				
67	1				
68	1				
69	1				27
70	1				
71	1				
72	0				
73	1				
74	1				
75	1				
76	1				
77	1				
78	1				
79	1				
E-376	F	08-14-78	Control Rod Power Supply Control	Ref FSAR 7.2.1.2	
8	D				18
9	D				
E-395	1	02-29-79	Diesel Fuel Oil Transfer Pumps	Ref FSAR 9.5.4.2	
1	1				21
2	1				
E-402	1	01-23-80	Diesel Generator Controls	Ref FSAR 8.3.1.2, 8.3.1.2, 9.5.5.2, 9.5.6.2, 9.5.7.2	
1	1				
2	1				
3	1				27
4	1				
5	1				
6	1				
7	1				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
8	1				18
9	1				
10	1				
11	1				
12	1				
13	1				
14	1				
15	1				
16	1				
17	1				27
18	1				
19	1				
20	1				
21	1				
22	1				
23	1				
24	1				
25	1				
26	1				
27	1				
28	1				
29	1				
E-438	2	09-17-79	Reactor Building Recirculating Air Cooling Unit Fans	Ref FSAR 6.2.2.2, 8.3.1.2	
					21
1	1				
2	2				27
3	2				
E-439	0	07-12-78	Reactor Building Isolation Dampers	Ref FSAR 6.2.4.2, 8.3.1.2	
1	0				
2	0				
3	0				18
4	0				
5	0				
6	0				
7	0				
8	0				
9	0				
10	0				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
11	0				21
12	0				
E-440	2	09-21-79	Reactor Building H&V	Ref FSAR 6.2.5.2, 8.3.1.2	18
1	2				
2	2				
3	2				
4	2				
5	2				
6	1				
7	2				
8	2				
9	2				
10	2				
11	2				
12	2				
13	2				
14	2				
15	2				
16	2				
17	2				27
18	2				
19	2				
20	2				
21	2				
22	2				
23	2				
24	2				
25	2				
26	2				
27	2				
28	2				
28A	1				
29	2				
30	2				
31	2				
32	2				
33	2				
33A	1				
34	2				
35	1				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-452	3	02-06-80	Auxiliary Building H&V	Ref FSAR 8.3.1.2, 9.4.2.2	18
1	1				
2	3				
3	3				
4	2				
5	2				
6	1				
7	2				
8	1				
9	2				
10	2				
11	2				
12	2				
13	2				
14	2				
15	1				27
15A	1				
16	2				
17	2				
18	2				
19	1				
21	1				
22	1				
23	2				
24	2				
25	2				
26	1				
27	2				
28	0				
29	2				
30	2				
31	3				
32	2				
33	0				
34	0				
E-456	1	07-03-79	Control Room Outside Makeup and Emergency Make-up Air	Ref FSAR 9.4.1.2	18
1	1				27
2	1				
3	1				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
4	1				18
6	1				
7	1				27
8	1				
9	1				
10	1				
E-457	0	11-13-78	Control Room Air Handling	Ref FSAR 8.3.1.2, 9.4.1.2	
1	0				
2	0				
4	0				
5	0				
6	0				
7	0				
E-458	0	11-10-78	Control Room Area Recirculation and Exhaust Air	Ref FSAR 9.4.1.2	18
1	0				
2	0				
4	0				
5	0				
6	0				
7	0				
9	0				
10	0				
11	0				
12	0				
14	0				21
15	0				
17	0				
18	0				
24	0				
E-468	5	02-19-80	Office Service and Miscellaneous Building H&V	Ref FSAR 8.3.1.2, 9.4.7.2, 9.4.8.2	27
					18
42	0				
43	1				21
47	0				
48	1				
49	1				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
51	0				18
52	0				21
53	1				
54	2				
55	2				
56	2				
57	2				
58	0				
E-478	2	05-22-79	Auxiliary Building Safeguard Chillers	Ref FSAR 8.3.1.2, 9.2.10.2	27
1	1				
2	2				
3	2				
3A	1				
4	2				
5	2				
6	1				
7	1				
E-480	1	02-27-79	Auxiliary Building Safeguards Chilled Water Pumps	Ref FSAR 9.2.10.2	21
1	1				
2	1				
3	1				
E-485	2	07-27-79	Engineered Safeguards Unit Coolers	Ref FSAR 9.4.1.2, 9.4.5	
1	2				
2	2				
3	2				
4	2				27
5	2				
6	2				
7	1				
8	2				
9	2				
10	2				
11	1				
12	2				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks
E-487	2	01-21-80	Plant Water Storage and Transfer System	Ref FSAR 6.2.4.2, 9.2.6.2
1	2			
2	2			
3	2			
4	1			
5	2			
6	2			
7	2			
8	1			
8A	1			
9	2			
10	1			
11	2			
12	2			
13	2			
14	2			
15	2			
15A	0			
16	2			
17	0			

18

27

exclusion or removal of personnel and property from the subject land.

2.1.1.2 Site Area Map

The plant property line, which is also the site boundary, the location of principal Dow facilities within the exclusion area boundary, and the location of principal plant structures are shown in Figures 2.1-1, 2.1-1A, and 2.1-2, respectively. The site encompasses 1,235 acres. There are no industrial, commercial, institutional, recreational, or residential structures, except for Dow brine well 28 (see Subsection 2.1.1.1), within the site boundary. 27

The plant exclusion area is discussed in Subsection 2.1.2.

The site is bordered to the north and east by the Tittabawassee River. A railroad spur for plant use, which connects to the Chesapeake and Ohio main lines, crosses the Titttabawassee River east of the site and runs westerly to the plant (see Figures 2.1-1 and 2.1-2).

Gordonville Road, which is the only road immediately adjacent to the site, runs along the southern property line next to the cooling pond. The only access to the site is from Poseyville Road and Miller Road west of the property line as shown in Figure 2.1-1. An access road off of Poseyville Road is provided with a bridge built solely for plant use located in the southern half of Section 28.

2.1.1.3 Boundaries for Establishing Effluent Release Limits

The boundary used to establish technical specification limits for the release of gaseous effluents from the Midland plant is the exclusion area boundary and the perimeter fence where the exclusion area boundary is within the perimeter fence. The perimeter fence is located outboard of the patrol road on top of the outer dikes. See Figure 2.1-1 for layout of the exclusion area and the top of the dike.

Virtually the entire plant site, with the exception of the access corridor in Section 28, is enclosed by the perimeter fence to control casual access to the site. In addition, there is a fenced-in area surrounding the immediate plant area within the Midland site. Access to the plant area will be continuously and actively controlled by CPCo. Only specifically authorized personnel will be permitted access to the plant area.

The area between the perimeter fence and the water's edge in the case of the Tittabawassee River and the top of the northwesterly bank in the case of Bullock Creek is owned in fee by CPCo. There

is no commercial river traffic and little pleasure boat traffic on the adjoining water areas.

Two parcels of property owned by Dow are included within this area: the waste water treatment pond west of the containments across Bullock Creek and the clarifier area north of the containments across the Tittabawassee River. See Figure 2.1-1 for location of the Dow property. Normally, there will be no persons working in the Dow owned portion of this area. Access to these portions will be controlled by gates and Dow personnel or contractors entering the area will be controlled by, and in contact with, Dow security personnel. The Dow Security Communication Center is continuously manned by a minimum of two persons and will have direct communication with CPCo's Midland plant.

The nearest gaseous release point to the described boundary is the auxiliary building stack which is located approximately at the northernmost edge of the Unit 2 containment. The minimum distance of this release point to the boundary is 500 meters (see Figure 2.1-1). For location of all potential release points for radioactive gaseous effluents see Figure 11.3-10.

2.1.2 EXCLUSION AREA AUTHORITY AND CONTROL

2.1.2.1 Authority

The exclusion area as defined in 10 CFR 100.3(a) is described as a "race track" shaped area formed by two semicircles each with a radius of 519 meters centered on each of the two containment buildings and joined by tangents parallel to the line joining the centers of the containments. The minimum distance from the outside face of either of the containment buildings to the nearest edge of the exclusion area is 500 meters. (See Figure 2.1-1 for layout of the exclusion area on the property.)

The majority of the area is owned by Consumers. Portions of the area as shown in Figure 2.1-1 include two segments of land owned by Dow and portions of the Tittabawassee River and Bullock Creek.

With respect to ownership of property within the exclusion area owned by Dow, Dow has made the following statement:

> All Dow Chemical Company property which is situated within the 500 meter radius is owned, in fee simple, by the Dow Chemical Company. This determination was made after a thorough examination of pertinent property records by qualified personnel.

By terms of Section 2 of the General Agreement between Dow Chemical Company and Consumers Power Company dated June 21, 978, Dow will revise its emergency plan covering evacuation of the | 27

personnel in Dow's Midland plant and other necessary action in connection with a radiological emergency at the Midland nuclear plant, and will be in a position to promptly carry out any applicable provisions of its emergency plan whenever required to do so by the terms of the Midland plan - Units 1 and 2 site emergency plan. 27

Dow has also agreed to cooperate fully with Consumers to ensure that all conditions of license for operation of the generating plant are met insofar as Dow property, facilities, personnel, and activities may be affected.

As noted in Subsection 2.1.1.1, all Consumers property within the exclusion area is owned in fee including mineral rights, and only a portion of easement 76-193 to Dow is within the exclusion area.

Arrangements have been made with local and state law enforcement agencies for removal and exclusion of the public from those portions of the Tittabawassee River and Bullock Creek within the exclusion area in the event of an emergency.

2.1.2.2 Control of Activities Unrelated to Plant Operation

Activities taking place within the exclusion area and unrelated to plant operation will be restricted to the construction, operation, and maintenance of communication, electric, and pipelines on easement 76-193, operation and maintenance of the tanks for storage of condensate and demineralized water, and associated piping, valves, and equipment, and the wastewater treatment pond west of the reactor building across Bullock Creek, and operation and maintenance of the clarifiers on the Dow property north of the reactor building across the river. 27

Normally there are no Dow Chemical personnel working in the Dow Chemical controlled portion of the exclusion area. Access to those areas (i.e., the area including the wastewater treatment pond and tanks for storage of condensate and demineralized water, and associated piping, valves, and equipment, west of the reactor building across Bullock Creek, and the clarifier area north of the reactor building across the river) will be controlled by gates on the access routes on the east and west side of the river, and Dow personnel or contractors' entry into the area will be controlled by Dow security personnel, in the continuously manned Dow Emergency Communications and Control Center. A minimum of two persons are on duty in this center 24 hours per day. 3 27 3 27

Those employees or contractor personnel who do enter the exclusion area for periodic equipment surveillance or maintenance will maintain radio contact with the Dow Emergency Communication and Control Center dispatcher. If the need arises, the Midland plant will, via a direct hot line, request the Dow dispatcher to evacuate the exclusion area in accordance with the agreements as 3 27

discussed in Subsection 2.1.2.1. Evacuation notification will be via direct radio contact with those employees within the exclusion area. | 3

Dow personnel or contractors working in that portion of easement 76-193 within the exclusion area will likewise be in radio communication with the Dow Emergency Communications and Control Center and will evacuate the area at the direction of Dow's dispatcher. However, access to this property will be across Consumers property providing the Midland plant with direct knowledge of their presence in the exclusion area. | 27

Control and evacuation of those portions of the Tittabawassee River and Bullock Creek within the exclusion area will be by state and local law enforcement agencies as noted in Subsection 2.1.2.1.

2.1.2.3 Arrangements For Traffic Control

There are no public highways or railways within the exclusion area.

All roads within the exclusion area are private roads owned and controlled by either Consumers Power Company or Dow Chemical Company. Control of traffic on Dow owned roads within the exclusion area by Consumers in the event of an emergency, is under the same agreement referred to in Subsection 2.1.2.1.

The only railway within the exclusion area is the Consumers owned spur tracks serving the power block area. All rail traffic on these spur tracks will be under the control of Consumers.

Portions of the Tittabawassee River and Bullock Creek are included within the exclusion area. There is no commercial river traffic on these areas and little pleasure boat traffic. Arrangements have been made with the Midland County Sheriff's Office and the Bay City post of the Michigan State Police for removal and exclusion of river traffic in the event of an emergency. | 16

2.1.2.4 Abandonment or Relocation of Roads

There are no public roads remaining within the site boundaries or the exclusion area. Those portions of Miller Road, Sasse Road, River Road, and Stewart Road which previously traversed the site have been abandoned by governmental action. The access road across the S 1/2 of Section 28 from the site to Poseyville Road is a private road owned, maintained, and controlled by Consumers.

2.1.3 POPULATION DISTRIBUTION

2.1.3.1 Population Within 10 Miles

Within 10 miles of the plant, the 1970 estimated population was 72,706; within 5 miles, there were 48,501 residents. The following communities are the only significant population groupings within 10 miles of the plant:

	Population	Location
Auburn	1,919	7 mi E
Midland	34,921	Plant partially annexed by city N
Sanford	818	9 mi NW

Figure 2.1-3 shows the location of these communities relative to the plant site.

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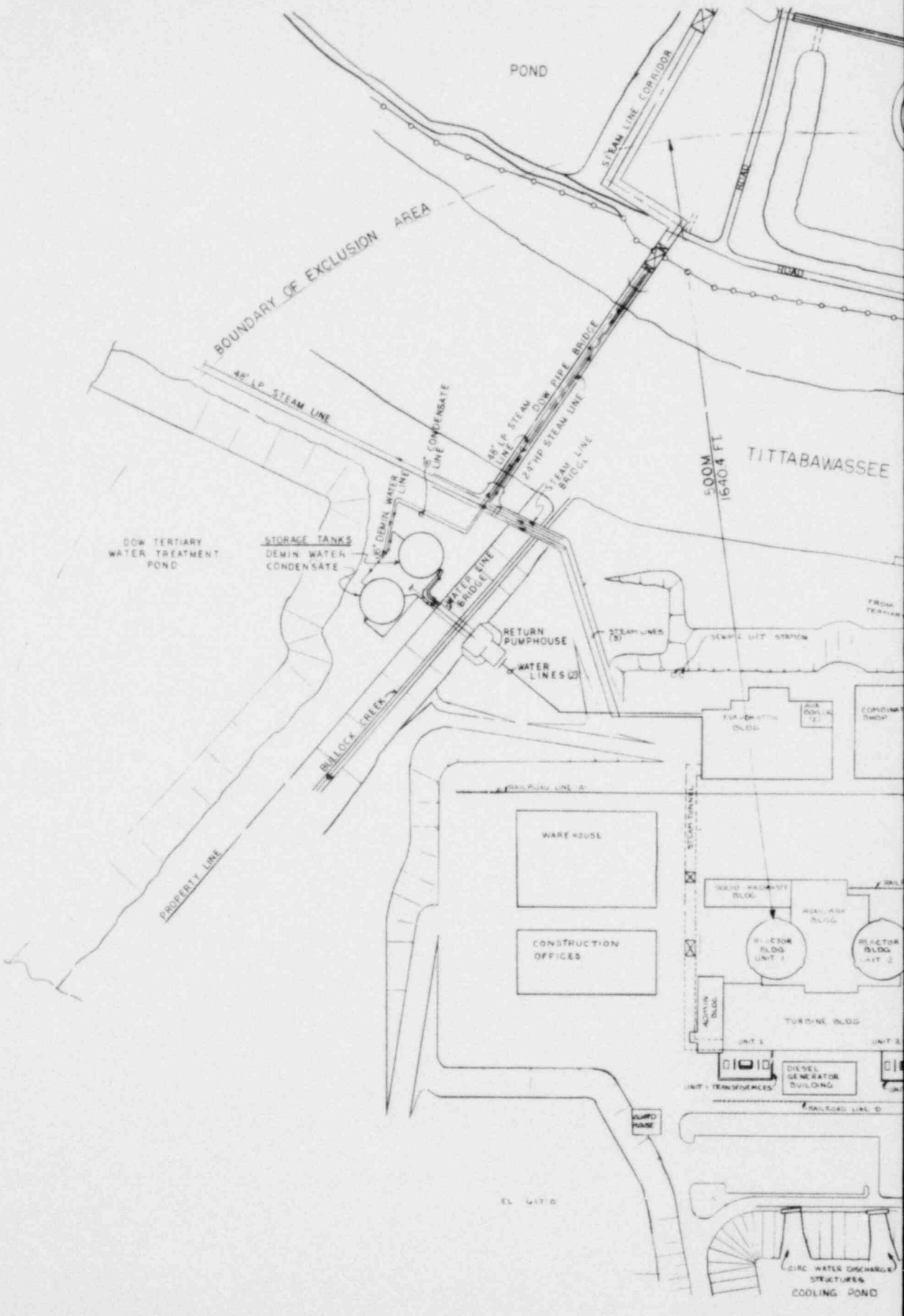
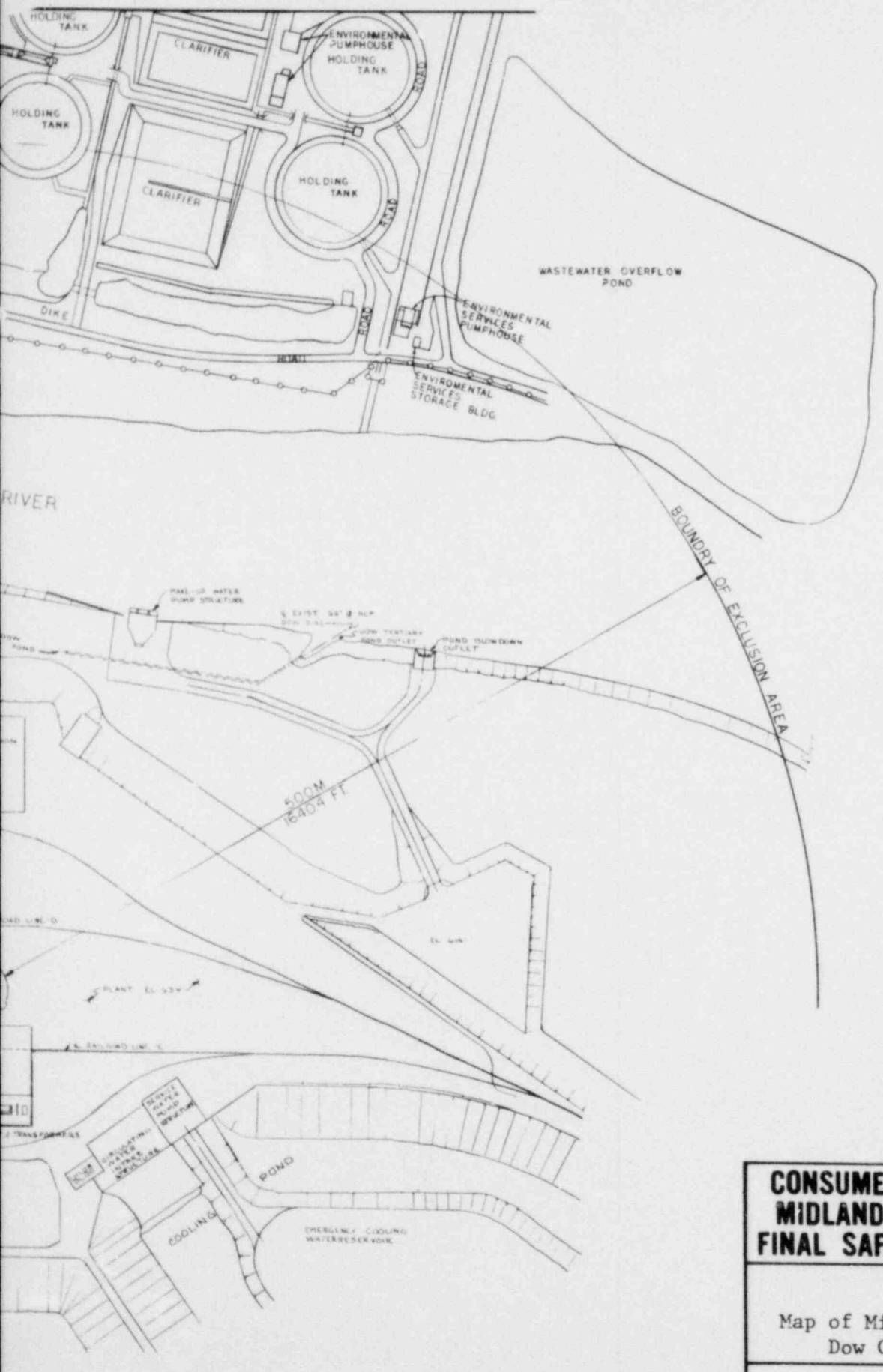

POND
STEAM LINE CORRIDOR
ROAD
ROAD
BOUNDARY OF EXCLUSION AREA
48" LP STEAM LINE
DOW PIPE BRIDGE
48" LP STEAM LINE
28" HP STEAM LINE
8" CONDENSATE LINE
6" DEMIN. WATER LINE
STEAM LINE BRIDGE
500M
1640.4 FT.
TITTABAWASSEE
DOW TERTIARY WATER TREATMENT POND
STORAGE TANKS
DEMIN. WATER
CONDENSATE
WATER LINE BRIDGE
RETURN PUMPHOUSE
WATER LINES (2)
STEAM LINES (3)
SEWAGE LIFT STATION
FROM TREATMENT
BULLOCK CREEK
PROPERTY LINE
WAREHOUSE
CONSTRUCTION OFFICES
RAILROAD LINE A
STORE TANK
SOLID WASTE BLDG.
REACTOR BLDG. UNIT 1
REACTOR BLDG. UNIT 2
ADMIN BLDG.
TURBINE BLDG.
UNIT 1
UNIT 2
DIESEL GENERATOR BUILDING
UNIT 1 TRANSFORMERS
RAILROAD LINE D
PUMP HOUSE
EL 617.0
CIRC WATER DISCHARGE STRUCTURES
COOLING POND



CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Map of Midland Plants of the Dow Chemical Company

FSAR Figure 2.1-1A

TABLE 2.2-4

DOW CORNING STORAGE TANK DESCRIPTION

Chemical	Number of Tanks and Quantity (gallons)	Symbol[1]	
Fuel oil (#6)	1 @ 1,000,000 2 @ 125,000	1 2	
Hydrofluoric acid	1 @ 10,000	3	
Methyl chloride	4 @ 20,000	4	
Anhydrous HCl	3 @ 30,000[2]	5	1
Chlorosilanes	Numerous varying from 10,000 to 20,000[3]	6	24
Acetylene	[3]		24
Ammonia	1 @ 10,000	7	
Miscellaneous storage of solvents	Numerous 100,000 total	8	

[1] See Figure 2.2-5 for location

[2] This storage in rail cars instead of tanks

[3] Dow Corning plans to expand the storage facilities for chlorosilanes and acetylene in 1980. Present plans call for addition of three 60,000 gallon chlorosilane spheres. Additional information on new acetylene storage capacity will be provided by amendment. 24 27

TABLE 2.2-5

CHEMICAL COMPOUNDS STORED OR TRANSFERRED AT
THE DOW CHEMICAL COMPANY, MICHIGAN DIVISION, MIDLAND, MICHIGAN

Compound	Container	Distance to Nuclear Plant Control Room (meters)	Maximum Quantity (tons)	Storage Conditions Temperature (°C)	Storage Conditions Pressure (psig)
Chlorine	Storage sphere	2,440	2,000	-34	0
	Railroad tank car	800	90	25	82
Anhydrous hydrochloric acid	Tank	1,220	125	-29	150
	Railroad tank car	800	75	-29	150
Vinyl chloride	Horton sphere	1,700	550	25	43
	Railroad tank car	800	85	25	43
Methyl bromide	Tank	2,250	65	0	0
	Railroad tank car	800	70	25	17
Bromine	Tank	1,200	90	45	0
	Railroad tank car	800	50	25	0
Ammonia	Railroad tank car	800	80	25	135
Methyl chloride	Railroad tank car	800	88	25	70

12

2.4.11.4 Future Controls

The cooling pond is sized to sustain plant operation for 100 days and shut down in the event the river flow is too low to permit withdrawal. The probability of a drought exceeding 100 days and causing the plant to shut down is very small. No plans are known for any projects upstream or downstream of the plant site which would significantly affect the low flows of the Tittabawassee River at the Midland site.

2.4.11.5 Plant Requirements

The service water system provides treated cooling water for various components during normal plant operation and provides cooling water to engineered safety features equipment during a design basis accident. A description of the service water system including water requirements is included in Subsection 9.2.1.

The service water pumps take suction from the open channel connecting the emergency cooling water reservoir to the service water pump structure. The emergency cooling water reservoir is a depressed area in the main cooling pond which will provide 272 acre-feet of storage capacity in the event of loss of the cooling pond. The stored quantity of water available is sufficient without makeup for the safe shutdown and cooldown of both units for a period of at least 30 days in both normal and emergency conditions, as described in Subsection 9.2.5.

The sump invert elevation for the service water pumps is elevation 593.25. During normal operation, the water surface of the cooling pond is at elevation 627, which provides a pump submergence of 33.75 feet. The minimum design operating water level for the emergency cooling water reservoir is at elevation 602.5 following the design basis accident after 30 days. Under this condition, the pump submergence is 9.25 feet. The minimum required pump submergence is 5.25 feet.

The major requirement for offsite water is makeup for the main cooling pond, supplied from the Tittabawassee River. The cooling pond has been sized to provide capacity sufficient to satisfy the plant's full power operation cooling needs during both an assumed 100 day drought period and normal operating conditions. The above analyses were based on no stream withdrawals made from the river due to low river flow. 18

2.4.11.6 Heat Sink Dependability Requirements

Provisions for warning of impending low flow, comparison of minimum flow estimates with project requirements, and low water safety factor are not applicable because the ultimate heat sink is independent of the Tittabawassee River during plant operation.

The discussion of the ultimate heat sink design bases and conformance to Regulatory Guide 1.27 is provided in detail in Subsection 9.2.5 and Appendix 3A, respectively. The normal plant water supply and the onsite storage of all necessary shutdown cooling water is discussed in Subsection 2.4.11.5.

2.4.12 DISPERSION, DILUTION, AND TRAVEL TIMES OF ACCIDENTAL RELEASES OF LIQUID EFFLUENTS IN SURFACE WATERS

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With the exception of two condensate storage tanks, other tanks that may potentially contain quantities of radioactive effluent are located within buildings or are protected with dikes to prevent the possibility of contaminating surface water directly. The two condensate tanks are located approximately 75 feet north of the cooling pond and the volume of each tank is 300,000 gallons. Failure of these tanks would result in the release of their contents to the cooling pond. The condensate storage tank may contain radioactivity in the event of steam generator tube leak. However, because the amount of water received from the condenser will be smaller than the amount of water supplied to the condenser, the condensate storage concentrations will be much smaller than steam concentrations discussed Section 11.1. It is anticipated that the concentrations in the condensate storage tank will be at or below 10 CFR 20 concentration limits to an unrestricted area. Thus the initial dilution afforded by the cooling pond and the subsequent dilution at the discharge point will ensure that the concentrations in the nearest surface water supply will be much lower than the 10 CFR 20 limits.

2.4.13 GROUNDWATER

2.4.13.1 Description and Onsite Use

The site is located in the lower peninsula of Michigan near the center of the Michigan Basin, a broad, shallow structural basin of Paleozoic sedimentary rocks up to 14,000 feet thick. These rocks are covered by unconsolidated Pleistocene glacial drift that regionally is about 200 to 300 feet thick. Details of the regional and site geology are discussed in Subsection 2.5.1.

2.4.13.1.1 Regional Aquifers

2.4.13.1.1.1 Drift Aquifers

Most of the groundwater development of Michigan's lower peninsula is in the sand and gravel zones present in the glacial deposits, with rural areas depending almost entirely on these aquifers for water supply. Several municipalities such as Ann Arbor, Northville, Alma, St. Louis, and Cadillac all get a part of their

water supply from these sand and gravel aquifers.[20] Where moraines and till plain features dominate, yields are generally less than 50 gpm, and where the drift is thin, or has a low permeability, water is obtained from either wells in the bedrock or from surface water sources.

Recharge of aquifers present in the drift occurs either by direct infiltration of precipitation, principally in areas where the aquifer is at or very near the surface, or, for the more deeply buried drift aquifers, recharge is indirectly through more shallow drift aquifers.[20]

2.4.13.1.1.2 Bedrock Aquifers

The bedrock units that are extensively tapped as a source of water are the Saginaw formation, Marshall formation, Coldwater shale, Berea sandstone, Traverse group, Detroit River group, and Bass Islands dolomite. Of these, the Saginaw, Marshall, Berea, and the Detroit River group generally yield the greatest quantities of water with some wells producing as much as 300 gpm.[21]

The Saginaw formation, basically a shale, contains beds of sandstone that are important aquifers. In the Grand River drainage basin near Lansing, these sandstone beds yield as much as 35 million gallons per day.[21] While in other areas of the southern peninsula, the Saginaw formation is not only substantially less permeable, but also commonly highly mineralized (exceeding 1,000 ppm dissolved solids).

The Marshall formation is another productive aquifer, and is used by several cities for water supply. This formation is mostly sandstone with some shale. Large diameter wells yield from 100 to 1,000 gpm with the water being generally very hard but otherwise of good chemical quality.[21]

The Coldwater shale is regionally considered to be an aquiclude. However, it can yield small supplies to wells where a few interbedded sandstone beds are in contact with adjacent unconsolidated drift deposits. Where the formation is not deeply

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27

of movements experienced and they will be used to provide confirmation of predicted settlements. Future survey settlement measurements will be submitted yearly via FSAR revision until commercial operation. Permanent benchmarks and control monuments have been established at the site and used for survey reference points. Periodic elevation checks against the benchmarks and control monuments will be measured. | 8

2.5.4.13.2 Survey Frequency

a. During Construction

For Seismic Category I and II structures, survey measurements will be made every 60 days.

b. During Plant Operation

1. For Seismic Category I and II structures, survey measurements will be made every 90 days during the first year of operation.

2. Frequency of survey measurements for subsequent years will be established after evaluating the measurements taken during the first year.

c. Seismic Category I and II Yard Tanks | 27

1. Survey measurements will be made after the tanks are erected and just prior to hydrostatic testing of the tanks.

2. During hydrostatic testing

3. Immediately after the hydrostatic testing is complete with the tanks empty

4. At the completion of filling of tanks for plant operation

5. At 90 day intervals for the first year of plant operation

6. Frequency survey measurements for subsequent years will be established after evaluating the measurements taken during the first year. | 15

d. General Survey Frequency Requirements | 27

The survey frequency for all measurements shall conform to the following requirements.

1. A maximum allowable extension shall not exceed 25% of the specified frequency.

2. A total maximum allowable extension for any three consecutive measurements shall not exceed 3.25 times the specified frequency. | 27

2.5.4.13.3 Subsidence Surveillance Monitoring Program | 16

A discussion on the effects of salt mining operations in the plant vicinity is presented in Subsection 2.5.1.2.5.4.1. | 15
Included is reference to the subsidence monitoring program initiated to determine any ground movement caused by the removal | 17
of salt. The surveys of the 27 monitoring points are included in Table 2.5-26. The information contained in this table will be | 18
updated periodically. Similar surveys will be made in accordance with the requirements of Subsections 6.2.4.1.2 and 6.1.4.1.3 of | 17
the environmental report. The details and locations of subsidence surveillance benchmarks are shown in Figure 2.5-88.

2.5.4.14 Construction Notes

The earthwork operation was started in July 1969 and was suspended between May 1970 and August 1973. During the first construction period, the work generally involved the clearing of selected portions of the cooling pond and plant site, and the

Table of Contents (continued)

Section	Title	Page	
3.9.2.2	Seismic Qualification Testing of Safety-Related Mechanical Equipment	3.9-8a	26
3.9.2.3	Dynamic Response Analysis of Reactor Internals Under Operational Flow Transients and Steady-State Conditions	3.9-10	8
3.9.2.4	Preoperational Flow Induced Vibration Testing of Reactor Internals	3.9-10	
3.9.2.5	Dynamic System Analysis of the Reactor Internals Under Faulted Condition	3.9-11	8
3.9.2.6	Correlations of Reactor Internals Vibration Tests With the Analytical Results	3.9-12	8
3.9.3	ASME CODE CLASS 1, 2, AND 3 COMPONENTS, COMPONENT SUPPORTS, AND CORE SUPPORT STRUCTURES	3.9-12	8
3.9.3.1	Loading Combinations, Design Transients, and Stress Limits	3.9-12	8
3.9.3.2	Pump and Valve Operability Assurance .	3.9-15	8
3.9.3.3	Design and Installation Details for Mounting of Pressure Relief Devices in ASME Code Class 1 and 2 Systems . .	3.9-18b	15
3.9.3.4	Component Supports	3.9-18c	
3.9.4	CONTROL ROD DRIVE SYSTEMS	3.9-18g	20
3.9.4.1	Descriptive Information on CRD Systems	3.9-18g	
3.9.4.2	Applicable CRDS Design Specifications	3.9-21	
3.9.4.3	Design Loads, Stress Limits, and Allowable Deformations	3.9-23	
3.9.4.4	CRDS Performance Assurance Program . .	3.9-23	3
3.9.5	REACTOR PRESSURE VESSEL INTERNALS	3.9-25	
3.9.5.1	Design Arrangement	3.9-25	

Table of Contents (continued)

Section	Title	Page	
3.9.5.2	Design Loading Conditions	3.9-31	
3.9.5.3	Design Loading Categories	3.9-31	
3.9.5.4	Design Bases	3.9-31	
3.9.6	INSERVICE TESTING OF PUMPS AND VALVES . .	3.9-31	| 27
3.10	SEISMIC QUALIFICATION OF SEISMIC CATEGORY I INSTRUMENTATION AND ELECTRICAL EQUIPMENT . .	3.10-1	
3.10.1	SEISMIC QUALIFICATION CRITERIA	3.10-1	
3.10.2	METHODS AND PROCEDURES FOR QUALIFYING ELECTRICAL EQUIPMENT AND INSTRUMENTATION	3.10-1	
3.10.2.1	Seismic Qualification of Non-NSSS Equipment	3.10-1	
3.10.2.2	Seismic Qualification of NSSS Equipment	3.10-3	
3.10.3	METHODS AND PROCEDURES OF ANALYSIS OR TESTING OF SUPPORTS OF ELECTRICAL EQUIPMENT AND INSTRUMENTATION	3.10-4	| 7
3.10.4	OPERATING LICENSE REVIEW	3.10-5	
3.10.4.1	Non-NSSS Equipment	3.10-5	| 19
3.10.4.2	NSSS Equipment	3.10-39	| 26
3.11	ENVIRONMENTAL DESIGN OF MECHANICAL AND ELECTRICAL EQUIPMENT	3.11-1	
3.11.1	EQUIPMENT IDENTIFICATION	3.11-2	
3.11.2	QUALIFICATION TESTS AND ANALYSES	3.11-2	
3.11.2.1	Component Environmental Design and Qualification for Normal Operation . .	3.11-2	

Table of Contents (continued)

Section	Title	Page
3.11.2.4	Control Room Area	3.11-6
3.11.2.5	Service Water Pump Structure	3.11-6
3.11.2.6	Equipment Located Outside	3.11-7
3.11.3	QUALIFICATION TEST RESULTS	3.11-7
3.11.4	LOSS OF VENTILATION	3.11-7
3.11.5	ESTIMATED CHEMICAL AND RADIATION ENVIRONMENT	3.11-9
	References	3.11-10
3A	CONFORMANCE WITH NRC REGULATORY GUIDES	
3B	(Not used in Midland FSAR)	
3C	Computer Programs Used In Structural Analysis	
3D	Seismic Analysis of Piping Systems	

| 20

CHAPTER 3
DESIGN OF STRUCTURES, COMPONENTS, EQUIPMENT, AND SYSTEMS

TABLES

Section and Number	Title
Section 3.1	
None	
Section 3.2	
3.2-1	Design Criteria Summary
3.2-2	Code Requirements for Components and Quality Groups (Balance of Plant)
3.2-3	Major Components Design Code
3.2-4	General Items Design Code
3.2-5	NSSS Fluid Systems' Classification and Correlation
3.2-6	Equipment Safety Classifications for NSSS Supplied Equipment
Section 3.3	
3.3-1	Tornado Wind Protected Components and Tornado Resistant Enclosures
Section 3.4	
3.4-1	Water Level (Flood) Design
3.4-2	Typical Representative Internal Flooding Analysis Results
Section 3.5	
3.5-1	Reactor Building Missile Characteristics (NSSS)
3.5-2	Missile Characteristics (Other Than NSSS)
3.5-3	Unit 1 Damage Probability P_4 for Seismic Category 1 Equipment Due to Turbine Missiles | 8
3.5-4	Compressive Strengths of Concrete Used in Barriers Considered in Turbine Missile Study
3.5-5	Missile Dimensions

Tables (continued)

Section and Number	Title	
3.9-38	Summary of Calculated Versus Allowable Stresses for Vaneaxial Fans (M-157)	
3.9-39	Primary Plus Secondary Stress Summary for Nuclear Wye Strainers (M-336)	
3.9-40	Summary of Calculated Versus Allowable Stresses for Service Water Traveling Water Screens (M-020)	
3.9-41	Summary of Calculated Versus Allowable Stresses for Service Water Self-Cleaning Strainers (M-180)	16
3.9-42	Summary of Calculated Versus Allowable Stresses for Decay Heat Removal Heat Exchanger (M1.18)	
3.9-43	Summary of Stresses for ASME Tanks (M-090)	
3.9-44	Summary of Calculated Versus Allowable Stresses for Fuel Pool Cooling Heat Exchangers (M-055)	
3.9-45	Deleted	17
3.9-46	Deleted	27
3.9-47	Summary of Calculated Stresses for Auxiliary Building Crane (M-093)	16
3.9-48	Summary of Calculated Versus Allowable Stresses for Air Operated Globe Valve (J-255A)	
3.9-48a	Summary of Calculated Versus Allowable Stresses for Control Room Air Handling Control Valves (J-255A)	24
3.9-48b	Summary of Calculated Versus Allowable Stresses for Control Room Air Pressurization Control Valves (J-255A)	26
3.9-49	Summary of Calculated Versus Allowable Stresses for Component Cooling Water Heat Exchanger (M-051)	16
3.9-50	Summary of Calculated Versus Allowable Stresses for Emergency Diesel Fuel Oil Transfer Pump (M-019)	

Tables (continued)

Section and Number	Title	
3.9-51	Summary of Actual Versus Allowable Stresses for the ASME Code Class 2 and 3 Tanks and Vessels Other Than NSSS (M-061, M-064)	16
3.9-52	Summary of Stresses for Seal Return Cooler (M1.14)	24
3.9-53	Summary of Calculated Versus Allowable Stresses for Letdown Heat Exchanger (M1.13)	
3.9-54	Summary of Calculated Versus Allowable Stresses for RCS Purification Demineralizer (M1.2)	
3.9-55	Summary of Calculated Versus Allowable Stresses for Makeup Tank (M1.15)	16
3.9-56	Summary of Calculated Versus Allowable Stresses for Manual Cylinder Air Cylinder (J-253)	
3.9-57	Summary of Calculated Versus Allowable Stresses for Instrument and Manual Signal Air Cylinder (J-255B)	
3.9-58	Loading Combinations and Summary of Calculated Versus Allowable Stresses for Service Water Sluice Gates (C-24)	
3.9-59	Loading Combinations and Stress Limits for Air Locks and Equipment Hatch (C-50B)	18
3.9-60	Summary of Actual Versus Allowable Stresses for Air Locks and Equipment Hatch (C-50B)	
3.9-61	Borated Water Storage Tanks Shell Stresses	
3.9-62	Stress Summary For Hydraulic Shock Suppressor	
3.9-63	Summary of Calculated Versus Allowable Stresses for Reactor Building Penetration Flued Heads	19
3.9-64	Summary of Calculated Versus Allowable Stresses For Ductwork and Supports	
3.9-65	Summary of Maximum Versus Allowable Stresses For Fuel Transfer Tubes	

Criterion 4 - ENVIRONMENTAL AND MISSILE DESIGN BASES

Structures, systems, and components important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents. These structures, systems, and components shall be appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit.

RESPONSE

Environmental and missile design bases are in accordance with General Design Criterion 4. Structures, systems, and components important to safety are designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents, assuming that non-related cataclysmic events do not occur simultaneously. These structures, systems, and components are appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures or from postulated events occurring inside or outside the nuclear power unit.

Discussion of dynamic effects associated with the postulated rupture of piping is contained in Section 3.6. Missile protection is discussed in Section 3.5. Reactor coolant pump integrity is discussed in Subsection 5.2.6. Section 3.11 contains a discussion of design environmental conditions.

Flood level is discussed in Subsection 2.4.2 and flood protection is discussed in Subsection 3.4.2.

Criterion 5 - SHARING OF STRUCTURES, SYSTEMS, AND COMPONENTS

Structures, systems, and components important to safety shall not be shared among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units.

RESPONSE

Structures, systems, and components are shared only to the extent that such sharing does not affect the safety-related capabilities of the system or component to perform adequately in the separate reactor facilities. Shared structures, systems, and components (including related power and instrumentation systems) are as follows:

a. Fuel pool and fuel pool cooling system (Section 9.1)

b. Service water system (Subsection 9.2.1)

c. Building heating, cooling, and ventilating systems (Section 9.4)

d. Plant heating (Subsection 9.4.11)

e. Fire protection system (Subsection 9.5.1)

f. Makeup demineralizer system, demineralizer water storage and transfer system (Subsection 9.2.3)

g. Cooling water pond and service water pump structure (Subsection 10.4.5)

h. Parts of the chilled water system associated with the other systems described here (Subsection 9.2.9)

i. Domestic water

j. Parts of the component cooling water system associated with the waste gas and liquid radwaste systems | 27

k. Primary makeup water system

l. Auxiliary building, administration building, control room, laboratories, turbine building, diesel generator building, solid radwaste building, oily water treatment building, evaporator and auxiliary boiler building, combination shop building (Sections 1.2 and 3.8)

m. Radioactive waste treatment system (Chapter 11)

n. Instrument and service air system (Subsection 9.3.1)

Criterion 21 - PROTECTION SYSTEM RELIABILITY AND TESTABILITY

The protection system shall be designed for high functional reliability and inservice testability commensurate with the safety functions to be performed. Redundancy and independence designed into the protection system shall be sufficient to assure that (1) no single failure results in loss of the protection function and (2) removal from service of any component or channel does not result in loss of the required minimum redundancy unless the acceptable reliability of operation of the protection system can be otherwise demonstrated. The protection system shall be designed to permit periodic testing of its functioning when the reactor is in operation, including a capability to test channels independently to determine failures and losses of redundancy that may have occurred.

RESPONSE

The protection systems have been designed for high functional reliability and inservice testability commensurate with the safety functions to be performed. The redundancy and independence designed into the protection system are sufficient to ensure that no single failure results in loss of any protection function and that removal from service of any component or channel does not result in loss of the required minimum redundancy unless the acceptable reliability of operation of the protection systems can be otherwise demonstrated.

The protection systems have been designed to permit periodic testing of their functioning when the reactor is in operation, including a capability to test channels independently to determine failures and loss of redundancy that may have occurred.

The reactor protection system (RPS) employs four independent channels which have identical protection capabilities. The instrument strings necessary for protection are identical, from sensors to channel trip outputs, and have no components common to two channels. The reactor will trip in the event two of the four channels trip.

A single failure can, in the worst case, prevent one RPS channel from tripping since the channels are completely independent. This means that during a single failure in the RPS, two out of the three channels that are functioning properly must trip in order to trip the reactor. During testing, a channel may be bypassed so that a trip in that channel will not contribute to a coincidence trip of the reactor. A trip of two of the remaining three channels is necessary to trip the reactor so that a single failure will require the two remaining channels to trip. Thus, under no circumstances will the system be prevented from initiating protective action during a single failure.

Removal of a module required for protection from an RPS channel will cause that channel to trip, so that only one channel of the

other three must trip to cause a reactor trip. Thus, sufficient redundancy has been built into the system to cover this situation.

The ESFAS consists of the B&W supplied ECCAS and the nine other owner-supplied ESFAS subsystems.

The ECCAS is a four channel redundant system employing two-out-of-four coincidence between measured variables. Upon detection of out-of-limit conditions of these variables, it initiates operation of the high- and low-pressure injection systems. The ECCAS system will tolerate the failure of one of the four channels without losing the ability to perform its assigned functions, similar to the design employed by the RPS described above.

The other ESFAS subsystems (see Subsection 7.3.3) consist of four redundant channels employing a two-out-of-four coincidence between measured variables. Upon detection of out-of-limit conditions of these variables, ESFAS initiates, as necessary, reactor building isolation, reactor building cooling, reactor building sprays, main steam and feedwater isolation, auxiliary feedwater actuation, control room isolation, fuel pool emergency ventilation, maximum cooling from the component cooling system, and containment sump recirculation to the reactor building sprays and decay heat removal pumps. | 27

The loss of vital ac bus power in the ESFAS sensor strings will initiate a trip of that portion of the logic associated with the affected instrument string, with the exception of reactor building spray and recirculation activation sensor channels, which are energized to trip.

The loss of any one vital dc bus which powers the ESFAS system logic will not initiate system actuation. The loss of two out of the four ac buses used, however, will actuate all safety features except the reactor building sprays and recirculation activation.

Removing modules from a sensor channel will initiate a trip in that portion of the logic associated with the affected instrument string.

Removing logic modules from one digital actuation channel does not prevent the redundant channel from initiating the ESF system function.

Provision has been made for test and bypass of each ESFAS trip bistable independently as described in Subsections 7.3.3 and 7.3.3.4.

The testing schemes of both the RPS and the ESFAS enable system testing while the reactor is operating. Each channel is capable of being tested independently so that operation of individual

Criterion 23 - PROTECTION SYSTEM FAILURE MODES

The protection system shall be designed to fail into a safe state or into a state demonstrated to be acceptable on some other defined basis if conditions such as disconnection of the system, loss of energy (e.g., electric power, instrument air), or postulated adverse environments (e.g., extreme heat or cold, fire, pressure, steam, water, and radiation) are experienced.

RESPONSE

Each reactor protection system (RPS) channel is powered from a different primary 120Vac preferred source. If a channel experiences a loss of power, that channel will trip, reducing the channel trip logic to one-out-of-three coincidence. Loss of power to more than one channel will cause the reactor to trip since the two-out-of-four channel trip coincidence will have been satisfied.

Each analog channel of the engineered safety features actuation system (ESFAS) is supplied power from a different battery-backed 120Vac preferred bus. Loss of power to an analog subsystem will cause that subsystem to trip, except in subsystems employing energize to trip sensor logic (RBSAS and RAS) where trip action on loss of power would be undesirable from a plant operation standpoint. | 27

The digital subsystems of the ESFAS are powered from separate, battery-backed 125Vdc buses. Each digital subsystem is normally deenergized and must be energized to trip. Loss of power to a digital subsystem will not cause actuation of the associated safety features systems. In this way, trip action that would be undesirable under normal conditions would not be initiated for a loss of power. Since the ESFAS is designed to meet IEEE Std 279-1971, the single failure or loss of power to a digital subsystem will in no way hinder the redundant remaining digital subsystem from performing its intended function. The fact that power has been lost to a digital subsystem will be continuously annunciated to the operator. The system is designed so that manual actuation of ESFAS subsystems can be accomplished in the control room.

The protection systems are designed to perform their intended functions under adverse environmental conditions which could result from any design accident. Equipment used in the systems is tested to ensure that it meets environmental specifications.

Both the RPS and the ESFAS are fully discussed in Chapter 7.

Criterion 24 - SEPARATION OF PROTECTION AND CONTROL SYSTEMS

The protection system shall be separated from control systems to the extent that failure of any single control system component or channel, or failure or removal from service of any single protection system component or channel which is common to the control and protection systems leaves intact a system satisfying all reliability, redundancy, and independence requirements of the protection system. Interconnection of the protection and control systems shall be limited so as to assure that safety is not significantly impaired.

RESPONSE

The protection systems have been separated from control systems to the extent that failure of any single control system component or channel, or failure or removal from service of any single protection system component or channel that is common to the control and protection systems, leaves intact a system satisfying all reliability, redundancy, and independence requirements of the protection system as required by IEEE Std 279. Interconnection of the protection and control systems is generally accomplished by electrical isolation to ensure that safety is not impaired by failures in the control system.

Separation in these systems is discussed in Chapter 7.

Criterion 27 - COMBINED REACTIVITY CONTROL SYSTEMS CAPABILITY

The reactivity control systems shall be designed to have a combined capability, in conjunction with poison addition by the emergency core cooling system, of reliably controlling reactivity changes to assure that under postulated accident conditions and with appropriate margin for stuck rods the capability to cool the core is maintained.

RESPONSE

The reactivity control systems have been designed to have a combined capability, using control rods in conjunction with soluble poison (boron) addition by the emergency core cooling system, of reliably controlling reactivity changes to ensure that, under postulated accident conditions and with appropriate margin for stuck rods, the capability tc cool the core is maintained.

The reactivity control system consists of control rods and soluble boron addition. The reactor is designed so that the fully inserted control rods will provide a shutdown margin of at least 1% $\Delta k/k$ with the single most reactive control rod fully withdrawn.

The borated water storage tank (BWST) provides the source of injection water for the emergency core cooling systems. The borated water in the BWST is maintained at a minimum boron concentration of 2,270 ppm. When injected into the reactor coolant system, this borated water can maintain subcritical reactor conditions.

Controls for the control rods are discussed in Chapter 7. Boron addition is discussed in Chapter 9.

Criterion 28 - REACTIVITY LIMITS

The reactivity control systems shall be designed with appropriate limits on the potential amount and rate of reactivity increase to assure that the effects of postulated reactivity accidents can neither (1) result in damage to the reactor coolant pressure boundary greater than limited local yielding nor (2) sufficiently disturb the core, its support structures or other reactor pressure vessel internals to impair significantly the capability to cool the core. These postulated reactivity accidents shall include consideration of rod ejection (unless prevented by positive means), rod dropout, steam line rupture, changes in reactor coolant temperature and pressure, and cold water addition.

RESPONSE

The reactivity control systems have been designed with appropriate limits on the potential amount and rate of reactivity increase to ensure that the effects of postulated reactivity accidents can neither result in damage to the reactor coolant pressure boundary greater than limited local yielding nor sufficiently disturb the core, its support structures, or other reactor pressure vessel internals to impair significantly the capability to cool the core. These postulated reactivity accidents include consideration of rod ejection, steam line rupture, changes in reactor coolant (RC) temperature and pressure, and cold water addition.

The reactor design meets this criterion with safety features that limit the maximum reactivity insertion rate. These include rod group withdrawal interlock, soluble boron concentration reduction interlock, maximum rate of dilution water addition, and dilution time cutoff. In addition, the rod drives and their controls have an inherent feature that limits overspeed in the event of malfunctions. Ejection of the control rod of maximum worth will not lead to coolant boundary rupture or to internal damage that would interfere with emergency core cooling. Provisions have been included to isolate a ruptured steam line in a time and manner ensuring that the core will remain intact for effective core cooling. The reactor system has been designed to avoid any postulated reactivity accidents that would result in a reactor coolant temperature or pressure change of sufficient magnitude to damage the reactor coolant pressure boundary. The design of the RC system ensures that no credible addition of cold water to the core would damage the system.

The reactor system is discussed in Chapter 5, and controls are discussed in Chapter 7. Accident conditions are evaluated in Chapter 15. | 27

TABLE 3.2-1 (continued)

System/Component	FSAR Section	Location	Quality Group	Design Code/ Standard	Seismic Category
INSTRUMENTATION AND CONTROLS					
Reactor Protection System (RPS)	7.2	C,A	NA	IEEE-279	I
Emergency Core Cooling Actuation System (ECCAS)	7.3.2	C,A	NA	IEEE-279	I
ESFAS Subsystems (BOP)	7.3.3	C,A			
Sensors		C	NA	IEEE-279	I
Cabinets		A	NA	IEEE-279	I
Manual controls and instrument readouts		A	NA	IEEE-279	I
Systems Required for Safe Shutdown	7.4				
Auxiliary feedwater control		A	NA	IEEE-279(4)	I
Atmospheric steam relief		A	NA	IEEE-279(4)	I
Control rod drive control system trip portion		C	NA	IEEE-279(4)	I
Makeup and purification system controls		A	NA	IEEE-279(4)	I
Makeup and purification letdown isolation valves		A	NA	IEEE-279(4)	I
Other controls		A	NA	IEEE-279(4)	I
Auxiliary shutdown control panel		A	NA	IEEE-279(4)	I
Pressurizer heaters and controls banks 5 and 6		To be provided by amendment			27

TABLE 3.2-1 (continued)

System/Component	FSAR Section	Location	Quality Group	Design Code/ Standard	Seismic Category
Safety-related Display Information	7.5				
Reactor trip monitoring		A,C	NA	IEEE-279(4)	I
Engineered safety features monitoring		A,C	NA	IEEE-279(4)	I
Control rod position indication		A,C	NA	NA	NA
All Other Systems Required for Safety	7.6				
Instrument and control power supply systems		A	NA	IEEE-279(4)	I
Decay heat removal isolation valve interlocks		A,C	NA	IEEE-279(4)	I
Core flood tank isolation valve control		A,C	NA	IEEE-279(4)	I
Reactor coolant letdown cooler valve interlocks		A	NA	IEEE-279(4)	I
Control Systems Not Required for Safety	7.7				
Unit process control system		C,A	NA	SIP	NA
Integrated control system		C,A,T	NA	SIP	NA
Control rod drive control systems (less trip portion)		C,A	NA	SIP	NA
Turbine-generator		A,T	NA	NA	NA

TABLE 3.2-1 (continued)

System/Component	FSAR Section	Location	Quality Group	Design Code/ Standard	Seismic Category
Evaporator Building Heating, Ventilation, and Air Conditioning	9.4.13				
Motors		E	NA	NEMA MG-1	NA
Fans(5)		E	NA	AMCA	NA
Ductwork		E	NA	SMACNA	NA
Dampers		E	NA	SMACNA	NA
Air cooled condensing unit		E	NA	ARI	NA
Miscellaneous Building Heating, Ventilation, and Air Conditioning	9.4.14				
Motors		M,X,Y	NA	NEMA MG-1	NA
Fans		M,X,Y	NA	AMCA	NA
Ductwork		M,X,Y	NA	SMACNA	NA
Hotwater unit heaters		M,X,Y	NA	ARI	NA
Electric unit heaters		M,X,Y	NA	NEC	NA

TABLE 3.2-1 (continued)

System/Component	FSAR Section	Location	Quality Group	Design Code/ Standard	Seismic Category	
AUXILIARY SYSTEMS-OTHER AUXILIARY SYSTEMS						
Emergency Diesel Fuel Oil Storage and Transfer System	9.5.4					
Emergency diesel oil storage tanks		O	C	III-3	I	
Emergency diesel oil day tanks		G	C	III-3	I	
Emergency diesel oil transfer pumps		O	C	III-3	I	
Piping and valves						
Overflow and drain		O,G	D	B31.1	NA	
Other - Non-engine mounted		O,G	C	III-3	I	15
Other - Engine mounted(9)		G	NA	DEMA	I	27
Emergency Diesel Generator Cooling Water System	9.5.5					
Motor driven auxiliary cooling water pumps		C	C	III-3	I	
Diesel generator cooler		G	C	III-3 TEMA-C	I	
Turbocharger air cooler		C	NA	DEMA	I	15
Lube oil cooler		C	C	III-3 TEMA-R	I	
Expansion tank		G	C	III-3	I	
Warming water pump		G	C	III-3	I	
Engine driven cooling water pump		C	D	DEMA	I	
Piping and valves						
Engine mounted(9)		C	NA	DEMA	I	15 27
Not-engine mounted		O,G	C	III-3	I	15

TABLE 3.2-1 (continued)

NEC: National Electrical Code

NEMA 1CS-1 to 110: National Electrical Manufacturers' Association, Industrial Controls and Systems

NEMA MG-1: National Electrical Manufacturers' Association, Motors and Generators

NEMA SM-22: National Electrical Manufacturers' Association, Single Stage Steam Turbine for Mechanical Drive Service

NFPA: National Fire Protection Association

SIP: Standard Industrial Practice

SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.

TEMA-C: Tubular Exchanger Manufacturers Association Class C

TEMA-R: Tubular Exchanger Manufacturers Association Class R

UBC: Uniform Building Code

UL: Underwriters' Laboratories

Seismic Category

I: Construction in accordance with seismic requirements of Regulatory Guide 1.29 and Appendix A to 10 CFR 100

NA: Not Seismic Category I

(2) See referenced FSAR section for additional codes and standards applicable to these structures.

(3) These components and associated supporting structures must be designed to retain structural integrity during and after a Seismic Category I event but do not have to retain operability for protection of public safety. The design basis requirement is prevention of structural collapse and damage to equipment and structures required for protection of the public safety.

(4) For other applicable codes and standards see Section 7.1 and referenced FSAR sections.

(5) Air handling unit fans and unit cooler fans are not rated in accordance with AMCA. The entire unit is rated in accordance with ARI.

TABLE 3.2-1 (continued)

(6) Refer to Subsection10.2.1.3 for further discussion of turbine-generator codes and standards.

(7) Refer to Table3.2-6

(8) The Midland solid radwaste building complies with Section B.V.b of Branch Technical Position ETSB 11-1, with the following clarification. The solid radwaste building seismic analysis is as described in Subsection 3.7.2 of the FSAR, and the design includes the seismic loads during an operating basis earthquake (OBE). Floor response spectra were not generated because the solid radwaste building does not house any Seismic Category I equipment. All the equipment inside is designed for 0.06g horizontal and 0.04g vertical acceleration levels. The construction and inspection procedures comply with the requirements of the ACI 318-71, AISC-1969, and AWS D12.2 codes. Inspection of the subsoil boring logs in the vicinity of the building indicates that the foundation media will not liquify during an OBE. 21

(9) The engine-mounted fuel and cooling water lines are composed of either ASTM A 53 or A 106, Grade A seamless steel pipe. For pipe sections to be bent for formed, ASTM A 106 Grade B is used, with the compatible 106 Grade A pipe. 27

3.6.2.5.13.3 Analysis of Postulated Breaks

The effects on the reactor coolant system following a postulated loss-of-coolant accident such as RCS letdown piping postulated ruptures are provided in Subsection 15.6.5. The RCS letdown piping has been evaluated for postulated breaks as shown in Figures 3.6-58 through 3.6-61. The protection against postulated pipe break effects is given in Tables 3.6-18 and 3.6-19 and discussed in Subsection 3.6.2.5.13.5. The blowdown thrust force at each break location has been calculated using the methodology of the BN-TOP-2[2] cold water model with the RCS as the source of blowdown.

3.6.2.5.13.4 Shutdown Procedures

A break at any of the postulated break locations outside containment in the RCS letdown piping constitutes a 2-1/2 inch or 1-1/2 inch loss-of-coolant accident. The shutdown procedure following a letdown line postulated pipe break outside containment is the same as for breaks inside containment. The shutdown procedure is discussed in Subsection 3.6.2.5.9.4.

3.6.2.5.13.5 Plant Design Features

The RCS letdown piping within the auxiliary building pipeway has been restrained from whipping as shown in Figures 3.6-58 through 3.6-61 and Tables 3.6-18 and 3.6-19. Due to the small blowdown thrust forces associated with RCS letdown piping ruptures outside containment, most of the pipe whip restraints called out in Figures 3.6-59 and 3.6-61 are normal hangers (zero pipe-to-restraint gap) which have been strengthened as necessary to withstand the pipe rupture loadings. The high energy portion of the RCS letdown piping in the north end of the auxiliary building (refer to Figures 3.6-58 and 3.6-60) is physically remote from all safety-related components within the auxiliary building, and thus has not been restrained to prevent pipe whip.

Due to the small blowdown thrust forces associated with RCS letdown piping ruptures outside containment and adequate separation between the letdown piping and other safety-related piping, no jet impingement barriers were required for these breaks outside containment. All of the safety-related structures surrounding this piping (i.e., auxiliary building pipewall walls and miscellaneous interior steel) are adequately designed to withstand the fluid jet loadings associated with these postulated RCS letdown piping ruptures.

3.6.2.5.13.6 Environmental Evaluation

All of the pipeway internal structures and the auxiliary building pipeway walls have been properly designed and vented to withstand the differential pressurization associated with any of the AFW system breaks (refer to Subsection 3.6.2.5.11).

Analysis of a postulated RCS letdown pipe break within the auxiliary building pipeway will be provided by amendment. The design envelope for components within the auxiliary building pipeway required for post-accident operation is provided in Subsection 3.11.1. 27

3.6.2.5.14 Main Feedwater System Piping Outside Containment

3.6.2.5.14.1 General Description

The main feedwater system piping outside containment, as shown in Figures 10.4-8 through 10.4-13, is designed to provide a continuous feedwater supply to the steam generators as described in Subsection 10.4.7.

The main feedwater system seismic and quality classification is indicated in Figures 10.4-8 through 10.4-13.

3.6.2.5.14.2 Evaluation and Identification of High Energy Portions

The high energy portion of the main feedwater system outside containment consists of all piping between the deaerating heaters and the containment. The feedwater system piping is routed from the turbine building to the containment entirely outside the auxiliary building. The feedwater piping passes through a separate chamber outside the auxiliary building (refer to Figures 1.2-5, 1.2-13, 3.6-12, and 3.6-13).

3.6.2.5.14.3 Analysis of Postulated Breaks

The feedwater piping has been anchored in the south wall of the main feedwater isolation valve chamber and the main feedwater piping within the valve chamber was analyzed and designed to meet the provisions of Subsection 3.6.2.1.4 and thus no breaks are postulated to occur in this section of piping.

The high energy feedwater piping within the turbine building has been analyzed for longitudinal slot and circumferential breaks postulated to occur at each tee, elbow, and fitting. The analysis considered the effects of pipe whip and fluid jet impingement, resulting from main feedwater postulated pipe breaks in the turbine building to verify that the south wing walls of the auxiliary building and main feedwater isolation valve chamber

All of the computer programs that are not within the public domain have a verification report prepared and maintained by the sponsor of the program.

The verification report describes the various verification methods and the way they cover all the permitted options and uses of the program. The report includes the following:

a. Description of the program option(s) validated, and the methods to accomplish this

b. Detailed description of test problems, including boundary conditions, mathematical models, and all key parameters

c. Listing of test problem input data checks and reprint of program input and output, or reference to location where this is stored

d. Results from benchmark solution, citing references used

e. Comparison of solutions, evaluation of program validity, and error analysis

Verification for the following computer programs has been submitted for NRC staff review by the San Onofre 2 & 3 FSAR (Docket 50-361 and 50-362)

ME 632
ME 660
ME 661
ME 662
ME 913

Computer Code ME 632 is a predecessor of ME 101. The purpose of both programs is basically identical. ME 101 results have been compared against results from ME 632, and results of hand calculations (13 test problems in all) and the values agree within 2%. The verification report is on file at Bechtel. The ANSYS program has not been utilized for nonlinear analysis. 3

The Frame Analysis Program has been verified by comparison with hand calculations. The resulting values agree within 6%.

3.9.1.2.2 NSSS

Computer programs used for dynamic analysis of the RCS are discussed in Subsection 3.9.1.4. Programs used for analysis of reactor internals and major RCS components are described in Table 3.9-18.

B&W procedures require certification of production computer codes prior to contract use. Each production code has a certification status on the first page of the printout for the code indicating that the code is either unverified (not to be used for contract

work), conditionally certified (may be used for contract work subject to full verification), or fully certified (released for contract work). The certification process includes a careful examination for programming and modeling accuracy, results verification by comparison with analytical or experimental data, and testing of sample cases to typify production use. All major computer codes utilized in the preparation of the stress reports for B&W manufactured components have been certified as described above.

The following computer programs have been previously accepted by the NRC staff during review of the Pebble Springs PSAR (Docket No. 50-514 and 50-515) and the Babcock & Wilcox Standard SAR (B-SAR 205, Docket No. STN 50-561): 3

ABSA 3	91060
STARS	91217
SSHOCK	91232
91035	91249

3.9.1.3 Experimental Stress Analysis

3.9.1.3.1 Seismic Category I Items Other Than NSSS

Experimental stress analysis methods may be used for seismic qualification whenever analytical methods or dynamic testing could not be employed. These qualification programs, where applicable, including test methods and results, will be summarized in Table 3.9-17 for each piece of equipment to which they apply.

3.9.1.3.2 NSSS

Experimental stress analysis methods were not employed for Seismic Category I components within NSSS scope.

3.9.1.4 Considerations for Evaluation of the Faulted Condition

3.9.1.4.1 Seismic Category I Items Other Than NSSS

For statically applied loads, the stress allowables of Appendix F of ASME Section III (see Subsection 3.2.1.2.2 for applicable Code addenda) are used for Code components. For non-Code components, allowables are based on tests or accepted standards consistent with those in the 1974 edition of Appendix F (no addenda) of ASME Section III. 27

Dynamic loads for components loaded in the elastic range are calculated using dynamic load factors, time history analysis, or any other method that assumes linear elastic behavior of the component. A component is assumed to be in the elastic range if yielding across a section does not occur. The limits of the

clearances must bind or seize solidly to adversely affect the valve disk free motion.

In addition, the valve disk hinge loose clearances permit disk self-alignment so that the external differential pressure adjusts the disk seal face to the valve body seal face. This feature minimizes the possibility of leakage and pressure induced deflection loadings on the hinge parts in service.

The external side of the disk is contoured to absorb the impact load of the disk on the reactor vessel inside wall, without transmitting excessive impact loads to the hinge parts as a result of a loss-of-coolant accident.

3.9.5.2 Design Loading Conditions

The design loading combinations and corresponding design stress criteria for the internals are discussed in B&W Topical Reports BAW-10008 (Part 1, Revision 1) and BAW-10051 (Revision 1).

3.9.5.3 Design Loading Categories

Design loadings and the associated design stress limits for the reactor vessel internals are discussed in B&W Topical Reports BAW-10008 (Part 1, Revision 1) and BAW-10051 (Revision 1).

3.9.5.4 Design Bases

The design stress and deformation criteria details for the mechanical design of the reactor vessel internals are presented in B&W Topical Reports BAW-10008 (Part 1, Revision 1), Reactor Internals Stress and Deflection Due to Loss-of-Coolant Accident and Maximum Hypothetical Earthquake, and BAW-10051 (Revision 1 and Supplement 1), Design of Reactor Internals and Incore Instrument Nozzles for Flow-Induced Vibrations.

3.9.6 INSERVICE TESTING OF PUMPS AND VALVES

The preservice and inservice testing program for pumps and valves shall be conducted in accordance with the Pump and Valve Inservice Testing Program for Consumers Power Company Midland Plant Units 1 and 2. 27

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TABLE 3.9-1

SEISMIC CLASS I - SAFETY-RELATED MECHANICAL SYSTEMS AND COMPONENTS

System Component	Equipment Number(1) Unit 1	Unit 2	Code Class(2)	References M/R Number	Loading Combinations(4)	Stress Limits(4)	Stress Summary	Qualification Method Summary(3, 4)	
REACTOR COOLANT AND PRESSURE CONTROL SYSTEM Figures 5.1-1, 5.1-2									
Steam generators (NSSS)	1E-51A,B	2E-51A,B	ASME III-A	M1.06	3.9-4	3.9-4	3.9-10	3.9.1.4.2	
Reactor vessels (NSSS)	1T-51	2T-51	ASME III-A	M1.01	3.9-4	3.9-4	3.9-8	3.9.1.4.2	
Pressurizers (NSSS)	1T-52	2T-52	ASME III-A	M1.10	3.9-4	3.9-4	3.9-9	3.9.1.4.2	
Control rod drive mechanism (CRDM)			ASME III-1	M1.4	See Subsection 3.9.3.1 and BAW-10029, Rev 3				16
Reactor coolant pumps (NSSS)	1P-51A,B,C,D	2P-51A,B,C,D	ASME III-1	M1.07	3.9-5b	3.9-5b	3.9-11, 3.9-12	3.9-17	
Valves (nonmanual)									
Class 1 Valves									
Pressure relief									
(NSSS)	1PSV-0131*	2PSV-0231*	ASME III-1	M-1.11	3.9-3b	3.9-3b	3.9-25	3.9.3.2.2	8
(NSSS)	1PSV-0132*	2PSV-0232*		M-1.11	3.9-3b	3.9-3b	3.9-25	3.9.3.2.2	
Motorized	1MO-0102-1	2MO-0202-1		M-1.27	3.9-3b	3.9-3b	3.9-67	3.9.3.2.3	20
(NSSS)	1MO-0102-2	2MO-0202-2		M-1.27	3.9-3b	3.9-3b	3.9-67	3.9.3.2.3	
	1MO-0110	2MO-0210		M-123E	3A.1.48, I	3A.1.48, I	3.9-28	3.9-17	
	1MO-0111	2MO-0211		M-123B	3A.1.48, I	3A.1.48, I	3.9-28	3.9-17	16
Solenoid	1SV-0127*	2SV-0227*		J-256	3A.1.48-7	3A.1.48-2	3.9-28	3.9-17	
	1SV-0128*	2SV-0228*		J-256	3A.1.48-7	3A.1.48-2	3.9-28	3.9-17	
(NSSS)	1SV-0102	2SV-0202		M-1.11	3.9-3b	3.9-3b	3.9-66	3.9.3.2.3	20

TABLE 3.9-1 (continued)

System Component	Equipment Number (1) Unit 1	Unit 2	Code Class (2)	References M/R Number	Loading Combinations (4)	Stress Limits (4)	Stress Summary	Qualification Method Summary (3,4)	
Class 2 Valves									
Solenoid	1SV-0122*	2SV-0222*	ASME III-2	J-256	3A.1.48-7	3A.1.48-6	3.9-28	3.9-17	
	1SV-0123*	SV-0223*		J-256	3A.1.48-7	3A.1.48-6	3.9-28	3.9-17	
	1SV-0150*	2SV-0250*		J-256	3A.1.48-7	3A.1.48-6	3.9-28	3.9-17	
	1SV-0151*	2SV-0251*		J-256	3A.1.48-7	3A.1.48-6	3.9-28	3.9-17	16
	1SV-0155*	2SV-0255*		J-256	3A.1.48-7	3A.1.48-6	3.9-28	3.9-17	
Solenoid air cylinder	1SV,1XV-0126*	2SV,2XV-0226*		M-129A	3A.1.48-7	3A.1.48-6	3.9-28	3.9-17	
	1SV,1XV-0153*	2SV,2XV-0253*		M-129A	3A.1.48-7	3A.1.48-6	3.9-28	3.9-17	
	1SV,1XV-0154*	2SV-2XV-0254*		M-129A	3A.1.48-7	3A.1.48-6	3.9-28	3.9-17	
Class 3 Valves									
Pressure relief	1PSV-0147	2PSV-0247	ASME III-3	M-140	3A.1.48-7	Code Case 1711	3.9-29A	3.9-17	25 18
Structural Components Snubbers for RC Pumps	See component support systems Subsection 3.9.3.4								
Piping									
RC piping			ANSI B31.1		3.9-5a	3.9-5a	3.9-15	3.9.1.4.2	20
Class 1 Piping	None	None	ASME III-1	-	3A.1.48-7	3A.1.48-1	3.9-15	(5)	16 7
MAKEUP AND PURIFICATION SYSTEM Figures 9.3-31 - 9.3-34									
Letdown coolers (NSSS)	1E-57A,B	2E-57A,B	Tubside ASME III-1 Shellside ASME III-3	M1.13	3.9-3b	3.9-3b	3.9-53	3.9-17	
Seal return coolers (NSSS)	1E-59A,B	2E-59A,B	Tubeside ASME III-3 Shellside ASME VIII	M1.14	3.9-3b	3.9-3b	3.9-52	3.9-17	27

TABLE 3.9-1 (continued)

System Component	Equipment Number[1] Unit 1	Unit 2	References Code Class [2]	M/R Number	Loading Combinations [4]	Stress Limits [4]	Stress Summary	Qualification Method Summary [3,4]	
CCW pump	1P-73A*,B*	2P-73A*,B*	ASME III-3	M-053	3A.1.48-7	3A.1.48-5	3.9-26	3.9-17	16
	OP-73(shared)		ASME III-3	M-053	3A.1.48-7	3A.1.48-5	3.9-26	3.9-17	

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TABLE 3.9-1 (continued)

System Component	Equipment Number[1] Unit 1	Unit 2	Code Class [2]	References M/R Number	Loading Combinations [4]	Stress Limits [4]	Stress Summary	Qualification Method Summary [3,4]	
MAIN STEAM AND TURBINE STEAM Figures 10.3-1 through 10.3-4									
Valves (nonmanual)									
Class 2 valves									
Pressure relief									
(NSSS)	1PSV-3102A*,B*	2PSV-3202A*,B*	ASME III-2	M-1.12	3.9-3b	3.9-3b	3.9-28	3.9.3.2.2	
(NSSS)	1PSV-3103A*,B*	2PSV-3203A*,B*		M-1.12	3.9-3b	3.9-3b	3.9-28	3.9.3.2.2	
(NSSS)	1PSV-3104A*,B*	2PSV-3204A*,B*		M-1.12	3.9-3b	3.9-3b	3.9-28	3.9.3.2.2	
(NSSS)	1PSV-3105A*,B*	2PSV-3205A*,B*		M-1.12	3.9-3b	3.9-3b	3.9-28	3.9.3.2.2	
(NSSS)	1PSV-3106A*,B*	2PSV-3206A*,B*		M-1.12	3.9-3b	3.9-3b	3.9-28	3.9.3.2.2	16
(NSSS)	1PSV-3107A*,B*	2PSV-3207A*,B*		M-1.12	3.9-3b	3.9-3b	3.9-28	3.9.3.2.2	
(NSSS)	1PSV-3108A*,B*	2PSV-3208A*,B*		M-1.12	3.9-3b	3.9-3b	3.9-28	3.9.3.2.2	
(NSSS)	1PSV-3109A*,B*	2PSV-3209A*,B*		M-1.12	3.9-3b	3.9-3b	3.9-28	3.9.3.2.2	
Motorized	1MO-3126*	2MO-3226*	ASME III-2	M-117	3A.1.48, I	3A.1.48, I	3.9-28	3.9-17	17
	1MO-3177A*,B*	2MO-3277A,B*		M-117	3A.1.48, I	3A.1.48, I	3.9-28	3.9-17	
Solenoid	1SV-3198	2SV-3298	ASME III-2	J-256	3A.1.48-7	3A.1.48-6	3.9-28	3.9-17	
Solenoid/air cylinder	1SV,1XV-3111A*,B*	2SV,2XV-3211A*,B*	ASME III-2	M-118A	3A.1.48, I	3A.1.48, I	3.9-28	3.9-17	16
Manual signal air cylinder	1PV-3101A,B	2PV-3201A,B	ASME III-2	J-253	3A.1.48, I	3A.1.48, I	3.9-56	3.9-17	20
FEEDWATER AND CONDENSATE Figures 10.4-9 through 10.4-13									
Aux feedwater pump (electric)	1P-005A*	2P-005A*	ASME III-3	M-014	3A.1.48-7	3A.1.48-5	By amendment	3.9-17	27 25
Aux feedwater pump (turbine driven)	1P-005B*	2P-005B*	ASME III-3	M-014	3A.1.48-7	3A.1.48-5	By amendment	3.9-17	27

TABLE 3.9-1 (continued)

System Component	Equipment Number[1] Unit 1	Unit 2	Code Class[2]	References M/R Number	Loading Combinations[4]	Stress Limits[4]	Stress Summary	Qualification Method Summary[3,4]	
Valves (nonmanual)									
Class 2 valves									
Motorized	1MO-3865A*,B*	2MO-3965A*,B*	ASME III-2	M-117	3A.1.48, I	3A.1.48, I	3.9-28	3.9-17	18
	1MO-3870A*,B*	2MO-3970A*,B*		M-117	3A.1.48, I	3A.1.48, I	3.9-28	3.9-17	
Solenoid/air cylinder	1SV,1XV-3866A*,B*	2SV,2XV-3966A*,B*	ASME III-2	M-118B	3A.1.48, I	3A.1.48, I	3.9-28	3.9-17	16
	1SV,1XV-3866A1*, B1*	2SV,2XV-3966A1*, B1*							
Solenoid	1SV-3887A1*,B1*	2SV-3987A1*,B1*	ASME III-2	J-256	3A.1.48-7	3A.1.48-6	3.9-28	3.9-17	
Class 3 valves									
Motorized	0MO-3932 (shared)	ASME III-3	ASME III-3	M-132	3A.1.48, I	3A.1.48,I	3.9-28	3.9-17	
	0MO-3856*(shared)			M-120	3A.1.48, I	3A.1.48, I	3.9-28	3.9-17	23
	2MO-3956* (shared)			M-120	3A.1.48, I	3A.1.48, I	3.9-28	3.9-17	
	1MO-3868A,B	2MO-3968A,B		M-120	3A.1.48, I	3A.1.48, I	3.9-28	3.9-17	16
	1MO-3872A*,B*	2MO-3972A*,B*		M-117	3A.1.48, I	3A.1.48, I	3.9-28	3.9-17	
	0MO-3893A*,B* (shared)			M-132	3A.1.48, I	3A.1.48, I	3.9-28	3.9-17	
	0MO-3993A*,B* (shared)			M-132	3A.1.48, I	3A.1.48, I	3.9-28	3.9-17	
Motorized level control	1LV-3875A*,B*	2LV-3975A*,B*	ASME III-3	J-255B	3A.1.48, I	3A.1.48, I	By amendment		26 18
Solenoid	1SV-3808	2SV-3908	ASME III-3	J-256	3A.1.48-7	3A.1.48-6	3.9-28	3.9-17	16
	1SV-3869A*,B*	2SV-3969A*,B*		J-256	3A.1.48-7	3A.1.48-6	3.9-28	3.9-17	
Wye strainers	1YS-3803	2YS-3903	ASME III-3	M-336	3A.1.48-7	Code Case 1635-1	3.9-39	3.9-17	
Solenoid/air cylinder	1SV,1XV-3889*	2SV,2XV-3989*	ASME III-3	M-118A	3A.1.48-7	3A.1.48-6	By amendment		27

TABLE 3.9-10A

STRESS SUMMARY FOR CORE FLOODING TANKS

The core flooding tank was classified as a Class C vessel according to ASME Code, Section III. Therefore, the requirements given in ASME Code, Section VIII were used as the design criteria.

The shell and head thicknesses were determined in accordance with Section VIII, Paragraphs UG-27 and UG-32(d), respectively.

All nozzle and opening sizing and reinforcement calculations were in accordance with Paragraphs UG-27(c), UG-37(b), and UG-40.

All nozzles were checked for end stresses.

A Bijlaard Analysis of shell stresses due to attachment loadings was done for the 14.0 inch outlet nozzle.

The manway cover and bolting were determined by the requirements given in Paragraphs UG-34(c)2, and UA-49.

The dry and wet weights were calculated yielding values of 77,833 and 166,079, respectively. The dry and wet centers of gravity were 99.0 inches and 98.5 inches, respectively, above the datum line of the vessel shell. 14

The four support lugs were spaced at 90 degree intervals around the vessel shell. The lugs were located at the vessel center of gravity so that there would be no overturning moment under horizontal shock loading.

B&W Program 91217, Bijlaard Analysis of Shell Stresses Due to Attachment Loadings, was run for the four support lugs.

The two lifting lugs were attached on the upper head and spaced 180 degrees apart. The lugs were sized using a load factor of 2.0g in the vertical direction and 0.03g in the horizontal direction.

The shell stresses induced by the lifting lug were justified by means of the Bijlaard Analysis.

An evaluation of the core flood tank shows that the tank is exempted from a fatigue analysis per the 1968 ASME Code, Section III, Paragraph N-415.1.

The analysis of the head stresses due to the external loads applied to the outlet nozzle and the internal pressure yielded the following results: 26 14

TABLE 3.9-10A (continued)

Case I - Design Condition

maximum primary membrane + pressure shell stresses

$S = 22.148$ ksi $\leq S_{allowable} = 1.5S_m = 26.25$ ksi

14

Case II - Operating Condition

maximum primary + secondary shell stresses

$S = 49.88$ ksi $\leq S_{allowable} = 3S_m = 52.5$ ksi

26

The analysis of the shell stresses due to the external loads on the support lugs and the internal pressure yielded the following results:

Case I - Design Loads + OBE Loads

maximum primary + secondary shell stress

$S = 21.93$ ksi $\leq S_{allowable} = 3S_m = 52.5$ ksi

Case II - Design Loads + Two OBE Loads

maximum primary + secondary shell stress

$S = 25.581$ ksi $\leq S_{allowable} = 3S_m = 52.5$ ksi

14

The analysis of the shell stresses due to the external loads on the lifting lugs yielded the following results:

Case I - Uprighting of Core Flooding Tank

$S = 8.88$ ksi $\leq 1.5S_m = 26.25$ ksi

Case II - Vertical Lift of Core Flooding Tank

$S = 22.12$ ksi $\leq 1.5S_m = 26.25$ ksi

27

The analysis of the 14.0 inch outlet nozzle and stresses yielded the following results:

Case I - Design Condition

$S = 11.463$ ksi $\leq 1.5S_m = 26.25$ ksi

14

e II - Operating Condition

$S = 28.799$ ksi $\leq 3S_m = 52.5$ ksi

TABLE 3.9-17 (continued)

disturbances was analyzed by computer analysis utilizing the ICES-STRUDL computer program. The dynamic analysis indicated that for the range of seismic frequencies, the pump assembly could be treated statically. Nozzle loads, seismic loads, and normal operating loads were imposed on the computer model and a stress analysis of the entire assembly was performed. Manual stress calculations were performed on the motor and pump holddown bolts, anchor bolts, support frame, pump pedestal, discharge and suction nozzle and flanges, pump casing, and bearing housing to frame bolting.

A computer analysis was performed separately on the pump shaft for the purpose of frequency, stress, and deflection evluation for the faulted condition. The computer model included effects of pump shaft, impellers, bearings, bushings, pump/motor coupling, motor shaft or rotor, and motor bearings. 25

Other analyses performed included maximum stress evaluation of the seal cooling with tubing and piping.

Analysis Results

To be provided by amendment. 27

F. ASME Class 1, 2, or 3 Pump and Valve Operability Assurance (Subsection 3.9.3.2)

For the purpose of pump operability assurance, a functional capability study was performed with material analysis of pump bearing loads, coupling key analysis, thrust bearing retainer bolting, flexible coupling analysis, and impeller clearance. The results of these analyses are to be provided by amendment. 25 27

TABLE 3.9-17 (continued)

Turbine Driven Auxiliary Feedwater Pumps (M-014)

Items: Turbine Driven Pumps 1P-005-B and 2P-005-B

Reference: M014-125

A. Dynamic Analysis (Subsection 3.9.1.2)

1. Type of analysis - computer model

2. Computer program - ICES-STRUDL

3. Description - The natural frequency of the pump/turbine assembly and shaft assembly as described in Analysis Method (Item E) below was used to determine frequencies of interest during faulted loading condition.

B. Static Analysis (Subsection 3.9.1.3)

1. Type of analyses - manual and computer analyses 25

2. Computer program - ICES-STRUDL

3. Description - As discussed in Items E and F below, the STRUDL program was utilized to perform force and stress analyses of the pump assembly and shaft assembly. The computer program was further utilized to perform a deflection analysis of the shaft for the purpose of a functional evaluation. Various manual analyses were performed to evaluate adequacy of subassemblies.

C. Experimental Stress Methods (Subsection 3.9.1.3)

None

D. Evaluation of the Faulted Condition (Subsection 3.9.2.2)

Refer to Qualification Analysis Method and Analysis Results, below.

E. Seismic Qualification Analysis Method (Subsection 3.9.2.2)

Analysis Method

The main components of the pump assembly, including bearings, baseplate, turbine, and pump were modeled as an assemblage of structural elements connected by node points at element interfaces. The response of the postulated seismic

TABLE 3.9-17 (continued)

disturbances was analyzed by computer analysis utilizing the ICES-STRUDL program. The dynamic analysis indicated that for the range of seismic frequencies the pump assembly could be treated statically. Nozzle loads, seismic loads, and normal operating loads were imposed on the computer model and a stress analysis of the entire assembly was performed. Manual stress calculations were performed on the turbine and pump holddown bolts, anchor bolts, support frame, pump pedestal, discharge and suction nozzle and nozzle flanges, pump casing, and bearing housing to frame bolting.

A computer analysis was performed separately on the pump shaft for the purpose of frequency stress and deflection evaluation for the faulted condition. The computer model included effects of the pump shaft, impellers, bushings, pump/turbine coupling, turbine shaft, and rotor and bearings. 25

Other analyses performed included maximum stress evaluation of seal cooling water tubing and piping.

Analysis Results

To be provided by amendment. 27

F. ASME Class 1, 2, or 3 Pump and Valve Operability Assurance (Subsection 3.9.3.2)

For the purpose of pump operability assurance, a functional capability study was performed which included analyses of pump bearing loads, coupling key analysis, thrust bearing retainer bolting, flexible coupling analysis, and impeller clearance. The results of these analyses are to be provided by amendment. 25 27

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TABLE 3.9-17 (continued)

Reactor Building Crane (M-092)

Reference: Bechtel Vendor Print 7220-M-92-34 | 27

Items: 1H-51, 2H-51 | 2

A. Dynamic Analysis (Subsection 3.9.1.2)

None

B. Static Analysis (Subsection 3.9.1.2)

1. Type of analysis - manual analysis

2. Computer program - none

3. Description - A simple harmonic motion 1 mass and 1 spring solution was used. The girder simple beam frequency is calculated and the corresponding acceleration is found from the response spectra. Inertia forces are applied to the girders based on the acceleration g values and girder weight.

C. Experimental Stress Methods (Subsection 3.9.1.3)

None

D. Evaluation of the Faulted Conditions (Subsection 3.9.1.4)

None

E. Seismic Qualification Testing or Analysis (Subsection 3.9.2.2)

The static analysis described above was used to seismically qualify the reactor building cranes for structural integrity. Operability during and subsequent to occurrences of OBEs does not apply. Refer to Table 3.9-69 for a stress summary of the reactor building crane. | 20

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TABLE 3.9-17 (continued)

Motor Operated Gate and Globe Valves (M-123B)

Items: 1MO-0110, 2MO-0210
1MO-0111, 2MO-0211
1MO-0328, 2MO-0428 | 2
1MO-0330 A, B; 2MO-0430 A, B
1MO-0329, 2MO-0429 | 18
1MO-0341 A, B, C, D; 2MO-0441 A, B, C, D | 2

Reference: Bechtel Vendor Prints M123B-48-1 | 27

A. Dynamic Analysis (Subsection 3.9.1.2)

None

B. Static Analysis (Subsection 3.9.1.2)

1. Type of analysis - manual calculations per ASME code

2. Computer program - none

3. Description - See seismic qualification Paragraph E.

C. Experimental Stress Methods (Subsection 3.9.1.3)

None | 2

D. Evaluation of the Faulted Conditions (Subsection 3.9.1.4)

Elastic methods of analysis were used exclusively.

E. Seismic Qualification Testing or Analysis (Subsection 3.9.2.2)

Natural frequency was determined using a single spring-mass model of the valve extended structure and manually calculating frequency using the cantilever equation from Formulas for Stress and Strain, Fourth Edition, Roark. All frequencies calculated were significantly above 33 Hz.

A conservative stress analysis was performed for the valve bonnet yoke to show that the valve was not overstressed during operation in any installed orientation under seismic conditions. Highlights of the analysis included:

Seismic inertial loads of 3.0 g were assumed to act simultaneously in the vertical direction and one horizontal

TABLE 3.9-17 (continued)

direction. In addition, a deadweight load of 1.0 g was assumed to act with the vertical seismic load causing a 4.0 g total vertical load. The resulting transverse and axial loads on the valve bonnet yoke could individually vary in magnitude from 0 to 5.0 g depending on the orientation of the yoke axis with respect to the horizontal and vertical axes (i.e., depending on the installed position of the valve). To bracket these loading effects, a conservative model which assumes a 5.0 g simultaneous loading in the yoke transverse and axial directions was used.

Reactions in the yoke due to valve actuation loads for normal operating conditions, including packing friction were included in the analysis. 2

Stresses were calculated at the weakest and highest loaded sections on the valve bonnet yoke.

Primary membrane and primary membrane-plus-bending stress intensities were calculated and compared to 1.0 S_m and 1.5 S_m, respectively, where S_m is the ASME Code Section III allowable stress for the bonnet material at 500F. 14 2

Results - Refer to FSAR Table 3.9-28 for a stress summary. 27 16

TABLE 3.9-17 (continued)

Positive Displacement Hydrazine Pump (M-374)

Items: 1P-41A&B, 2P-41A&B

References: Vendor information is unavailable at this time. The following is based on requirements for seismic qualification as outlined in the specifications.

A. Dynamic Analysis (Subsection 3.9.1.2)

None

B. Static Analysis (Subsection 3.9.1.2)

None

C. Experimental Stress Methods (Subsection 3.9.1.3)

None

D. Evaluation of the Faulted Condition (Subsection 3.9.1.4)

None

E. Seismic Qualification Testing or Analysis (Subsection 3.9.2.2)

Pump, motor, and all auxiliary equipment associated with the pump will be seismically qualified by shake table testing. The pump assembly will be mounted to the shake table in a manner that will approximate the actual inservice mounting conditions as closely as possible. This will include using the actual size and type of mounting bolts, mounting brackets, flanges, etc.

Actual operating pressures and temperatures will be simulated during testing, and the pump's operating performance will be monitored during testing to meet the requirements of functional operability for an active pump.

The type of motion that will be used as input for the test will be multifrequency, complex controllable at one-third octave internals. This motion will be applied over the entire frequency range of 1 to 40Hz and will ensure that any resonances will be excited. The time-history of accelerations used during low level and full scale tests will be measured by either the strain gage or servo type accelerometer.

TABLE 3.9-17 (continued)

The final results of the qualification test and analysis will be provided by amendment. | 27

TABLE 3.9-28 (continued)

servative to guarantee the integrity of the main flange joint for all the specified conditions.

(2) The stress intensity and primary membrane stress is calculated for the guide "ears" designed to maintain the guide in its position in the guide slot. These stresses are self-limiting secondary stresses and must be less than $3.0S_m$. 16

TABLE 3.9-28 (continued) | 9

Purchase Order:	7220-M-123B	
Manufacturer:	Target Rock Corporation	
Valve Types:	4"-600 lb motor operated gate valves (1MO-0328, 1MO-0329, 2MO-0428, 2MO-0429)	
	6"-600 lb motor operated gate valves (1MO-0330A and B, 2MO-0430A and B)	8
	2-1/2"-1,500 lb motor operated globe valves (1MO-0341A, B, C, and D, 2MO-0441A, B, C, and D)	
	2-1/2"-1,535 lb motor operated globe valves[4] (1MO-0110, 2MO-0210, 1MO-0111, 2MO-0211)	14
Stress Summary:[1]	Valves having operators and other features of extended proportions shall be able to withstand an inertial load of 3.0 g in any direction to the normal operating loads.	8

	Yoke Stress			
Valve	Primary Membrane Stress (ksi)[2] Actual/Allowable	Primary Membrane Plus Bending Stress (ksi)[3] Actual/Allowable	Natural Frequency of Valve Assembly (Hz) Actual/ Allowable	14
4"-600 lb	1.595/18.000	5.965/27.000	115/≥33	
6"-600 lb*	1.560/18.000	6.310/27.000	94/≥33	
2-1/2"-1,500 lb	4.055/18.000	11.945/27.000	73/≥33	27
2-1/2"-1,535 lb[4]	2.860/17.900	10.145/26.850	88/≥33	14

[1] In order to conservatively bracket the normal operating and 3.0 g seismic inertial loads, a conservative model which assumes a 5.0 g simultaneous loading in the yoke transverse and axial directions is used. Stresses were calculated at the weakest and highest loaded sections of the valve bonnet yoke. | 8

[2] Allowable stresses for primary membrane = 1.0 S_M (ASME Code, Section III allowable at operating temperature)

[3] Allowable stresses for primary membrane plus bending = 1.5 S_M (ASME Code, Section III, allowable at operating temperature) | 14

[4] ASME Code, Section III, Class I valves (nonactive)

TABLE 3.9-28 (continued)

Purchase Order: 7220-M-168
Manufacturer: Henry Pratt Company
Valve Types: 18"-150 lb motor-operated butterfly valves (1MO-5324A and B, 1MO-5336A and B, 2MO-6224A and B, 2MO-6236A and B) 9
Stress Summary: The valves are designed for a 3.0 g seismic load in the horizontal and vertical directions in addition to the normal operating loads.

Component	18"-150 lb Valves Calculated Stress (ksi)	Allowable (ksi)
Valve Body		
Primary membrane stress in crotch region (P_m)	1.063	17.500=1.0 S_m
Primary membrane stress in body (P_m)	1.364	17.500=1.0 S_m
Primary plus secondary stress (S_n)	7.164	52.500=3.0 S_m
Pipe reaction stress		
Axial	1.549	26.250=1.5 S_m
Bending	3.031	26.250=1.5 S_m
Torsional	3.031	26.250=1.5 S_m
Disk		
Combined bending stress	2.296	17.500=1.0 S_m
Shear tear out of shaft through disk	3.709	10.500=0.6 S_m
Shear stress across disk hub welds	3.328	7.200=0.6 S_m
Shaft		
Total combined stress	26.051	33.700=1.0 S_m
Torsional shear stress	9.189	20.220=0.6 S_m
Disk Pins		
Maximum shear pin stress	5.689	8.160=0.6 S_m 9
Bearing stress on pin	2.253	13.600=1.0 S_m
Shaft Bearing		
Compressive stress	3.207	4.000=1.0 S_m
Cover Cap		
Shear tear out of bolts	2.289	10.500=0.6 S_m
Combined stress in cover cap bolts	9.994	25.000=1.0 S_m
Combined stress in cover cap	6.668	17.500=1.0 S_m
Thrust Bearing		
Bearing stress on collar	816	8.800=1.0 S_m
Shear stress on spring pin	3.441	5.280=0.6 S_m
Bearing stress on spring pin	2.289	8.800=1.0 S_m
Operator Mounting		
Combined stress in trunnion bolt (max)	26.352	30.000=1.0 S_m
Combined stress in bonnet bolts (max)	16.827	24.000=1.0 S_m
Combined stress in operator bolt	3.042	24.000=1.0 S_m
Combined stress in bonnet body	501	12.600=1.0 S_m
Combined shear stress in bonnet weld	4.974	7.200=0.6 S_m
Combined stress in trunnion body	1.767	17.500=1.0 S_m

TABLE 3.9-28 (continued)

Natural Frequencies of Valve Components (Hz)			
Body		23,754	≥33
Banjo		2,705	≥33
Cover		711	≥33
Bonnet		554	≥33
Maximum Deflection of Bonnet Assembly (in.)		0.00003	(1)

9

(1) Maximum displacements computed indicate that they are sufficiently small and will not limit the operation of the stem or operator. Machining tolerances will adequately accommodate these movements.

Valve Types: 48"-150 lb motor-operated butterfly valves (1MO-5316A and B, 1MO-5309-5309A and B, 2MO-6216A and B, 2MO-6209A and B)

Stress Summary: The valves are designed for a 3.0 g seismic load in the horizontal and vertical directions in addition to the normal operating loads.

Component	48"-150 lb Valves Calculated Stress (ksi)	Allowable (ksi)	
Valve Body			
Primary membrane stress in crotch region (P_m)	1.310	17.500=1.0 S_m	27
Primary membrane stress in body (P_m)	1.174	17.500=1.0 S_m	
Primary plus secondary stress (S_n)	5.393	52.500=3.0 S_m	
Pipe reaction stress			
Axial	2.241	26.250=1.5 S_m	
Bending	8.181	26.250=1.5 S_m	
Torsional	5.114	26.250=1.5 S_m	
Disk			
Combined bending stress	8.257	17.500=1.0 S_m	
Shaft			
Total combined stress	22.391	33.700=1.0 S_m	
Tensile stress in shaft retainer bolts	11.746	33.000=1.0 S_m	
Hub Blocks			
Beaming stress on keyways	9.035	17.500=1.0 S_m	
Combined stress on hub block bolts	27.006	33.000=1.0 S_m	
Shaft Bearing			
Compressive stress	7.411	4.000=1.0 S_m	

TABLE 3.9-28 (continued)

Cover Cap		
Shear tear out of bolts	1.990	10.500=0.6 S_m
Combined stress in cover cap bolts	12.504	25.000=1.0 S_m
Combined stress in cover cap	1.185	17.500=1.0 S_m
Thrust Bearing		
Bearing stress on collar	1.142	3.000=1.0 S_m
Shear stress in adjusting screw	10.820	33.700=1.0 S_m
Combined stress in retainer bolts	8.210	33.000=1.0 S_m
Operator Mounting		
Combined stress in trunnion bolt (max)	10.117	30.000=1.0 S_m
Combined stress in bonnet bolts (max)	6.23	25.000=1.0 S_m
Combined stress in oprator bolt	7.278	25.000=1.0 S_m
Combined stress in bonnet body	1.716	12.600=1.0 S_m
Combined shear stress in bonnet weld	1.605	7.200=0.6 S_m
Combined stress in trunnion body	1.876	17.500=1.0 S_m
Natural Frequencies of Valve Components (Hz)		
Body	4,209	$\geq$33
Banjo	861	$\geq$33
Cover	1,756	$\geq$33
Bonnet	462	$\geq$33
Maximum Deflection of Bonnet Assmbly (in)	0.000032	(1)

27

(1) Maximum displacements computed indicate that they are sufficiently small and will not limit the operation of the stem or operator. Machining tolerances will adequately accommondate these movements.

TABLE 3.9-28 (continued)

Purchase Order: 7220-J-256
Manufacturer: Target Rock Corporation
Valve Types: Miscellaneous solenoid operated globe valves (Target Rock Corp. Project 76B Series)
Stress Summary: Due to the structural similarities among the J-256 solenoid operated globe valves. For analysis purposes the valves were broken into three groups and a single conservative stress analysis was performed for each of these groups. These valves have been designed for a 3.0 g seismic load in the vertical direction and a 4.5 g seismic loading in the horizontal direction. The valve groups are as follows:

Group	Body Material	Valve Models	Design Temperature (°F)	Operating Pressure (ksi)
A	316 L + SA-105	76B - 001, 003, 004, 005, 006, 007, 020, 022, 025, 037, 049, 050, 051, 052	140	2,500
B	316 + SA-105	76B - 009, 023, 010, 011,016, 019, 026, 027, 028, 029, 030, 031, 032, 033, 038, 039, 040, 046, 047, 048	200	3,200
C	316 L	76B - 012, 013, 014, 021, 045	200	3,200
D	316 + SA-105	76B - 034, 035, 036	344	1,670
E	SA-105 +316 L	76B - 024, 043, 044 042, 043, 044, 053	600	2,500

The following criteria were used to group the valves:

1. Clearances between bonnet tubes and plungers. The bonnet plungers of the valves within a group, if not the same, at least have the same od dimension to make the parts fit with comparable clearances.

2. The weight and center of gravity of the valve portions above the body's neck are the same.

The set of parameters selected to represent each group is the most severe one among the valves of the group.

TABLE 3.9-46

This table has been deleted. 27

TABLE 3.9-47

SUMMARY OF CALCULATED STRESSES FOR
AUXILIARY BUILDING CRANE (M-093)

Summary of calculated stress in ksi:

	OBE	SSE
Vertical	1.99	3.98
Lateral (N/S)	7.38	8.24
Longitudinal (E/W)	0.053	0.106

Resultant seismic stresses were obtained using the square-root-of-the-sum-of-the-squares summation: 16

OBE σmax = 7.64 ksi
SSE σmax = 9.15 ksi

Operating stresses were calculated assuming the hoist cable to be rigid using the relationships:

$$\sigma_o = \frac{\text{equivalent weight x girder length}}{4 \text{ x girder section modulus}}$$

= 13.83 ksi

Total stresses:

13.83 + 7.64 = 21.47 ksi (OBE)
13.83 + 9.15 = 22.98 ksi (SSE)

the required Mid and SSE response spectra for equipment with 5% damping, and also noting that the racks will be mounted with four racks connected side-to-side, it was concluded that the subject instrument rack is qualified for Seismic Category I service on Midland Units 1 and 2. | 1

Rack Mounted Instrumentation and Power Supplies - In general all of the input/output and computing cards performed well. Some exceptions were noted, however, and in each case Foxboro has identified the problem and incorporated a fix in their equipment design. Foxboro also conducted a retest of specific items where they were necessary. | 4

Correlation of the peak accelerations experienced at the nests to the worst case accelerations found in the instrument rack during its 1.0g test showed that the nest mounted modules were subject to acceleration levels which conservatively exceeded those obtained during the 1.0g test of the rack. (Note: 1.0g test of instrument rack was sufficient to qualify it for use in Midland Units 1 and 2.) | 1

Based on the above results, it was concluded that the subject rack mounted instrumentation and power supplies are qualified for Class 1E service on Midland Units 1 and 2. | 11 | 1

Panel Mounted Electronic Controllers - Test results and conclusions will be provided by amendment, following submittal of vendor test report. | 12 | 15

3.10.4.1.19 Engineered Safety Features Actuation System (ESFAS) (J-207Q) | 2

a. Equipment Identification - The ESFAS consists of actuation cabinets (AC) 1C44 and 2C44, sensor cabinets (SC) 1C43 and 2C43, and emergency core cooling (CC) actuation system conditioning cabinets 1C35 and 2C35. | 11

b. Method of Qualification - Only one AC cabinet, one SC cabinet, and one CC cabinet were seismically tested. The three cabinets were partially assembled, nonoperating, deliverable enclosures. The enclosures contained all structural members that affect cabinet stiffness, including Power Strut channel for relay, wiring, and terminal block mounting. The enclosures contained blank panels to simulate control and power supply panels. The unwired enclosures were dummy loaded with extra Power Strut channels where wiring, relays, and terminal blocks are to be mounted. The enclosures were loaded with these dummy weights to simulate deliverable cabinet weights and center of gravity. | 2 | 27 | 2 | 27 | 2 | 27 | 2 | 27 | 2

The devices, including power supplies, relays, switches, fuses, terminal blocks, indicator lights, wiring, cable ties, and cable clamps are qualified based upon previous seismic test of operating devices. The seismic tests for qualification of these previously qualified devices are described in Wyle Laboratories Reports 43259-1 and 43497-1. | 2 | 27 | 2 | 11

Any device not qualified by previous seismic test was installed into the applicable enclosure and was seismically tested simulataneously with the enclosures. The following devices were tested with the enclosures: | 27

AC Cabinet	SC Cabinet	CC Cabinet
Logic module	Isolation module	Switches
Sequencer module	Alarm and indicating module	Relays
Relays		

| 2

The enclosure and device mountings were seismically qualified by tests in accordance with IEEE Std 344-1975 and Regulatory Guide 1.100. The TRS will envelop the RRS at the required damping value. Previous seismic tests of similar enclosures indicated damping values of 3.4 to 9.3%. IEEE Std 344-1975, Table I, lists typical damping values of 2% for operational basis earthquake (OBE) level tests and 4% for safe shutdown earthquake (SSE) level tests for welded steel structures. Therefore, a 2% damping level RRS was used for OBE and SSE tests. | 27 | 2 | 27

During qualification testing of the enclosure and the applicable devices, the acceleration levels at specific device locations were monitored. The devices were qualified on the basis of previous tests of operable devices. The acceleration levels at the devices during the operational tests must envelop the acceleration levels at the specific device locations. | 2 | 27 | 2

Most of the devices proposed for the Midland ESFAS are identical to or similar in physical characteristics to devices that have been qualified by previous seismic testing. A list of devices to be installed into the Midland ESFAS, with a cross-reference to previously qualified devices, is on file with the test report. | 27 | 2

c. Test Method - The channel bases were bolted to the test table. The cabinets were bolted to the channel bases in the same manner they will be installed in the plant. The AC and SC cabinets were joined at the top (per plant configuration) as well as being bolted to the channel bases, and the SC cabinet used a CC cabinet base. The front-to-back and vertical directions were tested first. | 27

After the channel bases were bolted in place and the cabinets were installed onto the bases, control accelerometers were mounted onto the test table and 12 accelerometers were installed into the cabinets. 27

Exploratory Tests - Axis Y and Axis Z - Exploratory tests consisted of a single axis, continuous 1 octave per minute sweep frequency search using a sinusoidal steady-state input of 0.2g from 1 to 35Hz to determine equipment resonances. The horizontal and vertical axes, identified as Axis Y and Axis Z, were tested. 2 27 2 11 2 27

OBE Proof Tests - Axis Y and Axis Z - Five OBE proof tests were conducted on the cabinets. The cabinets were subjected to simultaneous horizontal and vertical inputs of random motion consisting of frequencies spaced 1/3 octave apart over the frequency range of 1 to 35Hz. The amplitude of each 1/3 octave frequency was independently adjusted in an iterative process in each axis until the TRS envelops the RRS at a damping of 2% by a spectrum analyzer. 2 27 2 27 11

The cabinets were excited by horizontal and vertical input accelerations that are phase incoherent for a period of 30^{+3}_{-0} seconds. Following the tests, the equipment was examined for damage and hardware was retightened if necessary. 27 11

SSE Proof Test - Axis Y and Axis Z - One SSE proof test was conducted on the cabinets. The cabinets were subjected to simultaneous horizontal and vertical inputs of random motion consisting of frequencies spaced 1/3 octave apart over the frequency range of 1 to 35Hz. The amplitude of each 1/3 octave frequency was independently adjusted in an iterative process in each axis until the TRS envelops the RRS at a damping of 2% by a spectrum analyzer. 27 11 2 27 2

The cabinets were excited by horizontal and vertical input accelerations that are phase incoherent for a period of 30^{+3}_{-0} seconds. Following the test, the equipment was examined for damage and hardware was retightened if necessary. 27 2 27

The cabinets and channel bases were then rotated 90 degress about a vertical axis, rebolted to the simulator table, and the test procedure outlined above was repeated. 27 2

d. Test Results and Conclusions - The engineered safety features actuation system AC, SC, and CC specimens were subjected to simulated seismic excitations which equaled or exceeded those specified for the Midland plant control room area. Visual inspection of the specimens upon completion of the SSE level tests indicated that there were no broken or cracked welds, structural failures, or broken parts, and all hardware was present and secure. All devices tested concurrently with the cabinets operated within specified limits before, during, and after the simulated seismic event. It was thereby demonstrated that the equipment possesses sufficient int grity to withstand, without compromise of structure or function, the seismic environment of the Midland plant. It is therefore concluded that the ESFAS is qualified for service on the Midland plant Units 1 and 2.

3.10.4.1.20 Seismic Instrumentation (J-214)

a. Equipment Qualified:

Strong motion accelerometers - 2YX-9300, 2YX-9301, 2YX-9302, 2YX-9303, and 2YX-9304
Seismic switch - 2YX-9307
Seismic triggers - 2YX-9305 and 2YX-9306
Recording units - 2YR-9312, 2YR-9313, 2YR-9314, 2YR-9315, and 2YR-9316
Annunciator - 2YAN-9311
Power supply - 2YY-9309
System cabinet - 0C228
Peak recording accelographs - 2YE-9317
Peak strain gages - 2YE-9319 and 2YE-9320

b. Method of Qualification - Seismic equipment was qualified by device test per IEEE Std 344-1975 and Regulatory Guide 1.100. 18 17

c. Test Method - Prior to qualification testing, the seismic equipment is visually examined for evidence of damage due to shipping. Results of the visual examination and equipment identification information are recorded on a receiving inspection data sheet.

The equipment is bolted (using 3/4 inch cap screws) to a test fixture which is welded to the seismic test machine. The equipment is attached to the test machine in a manner that simulates normal inservice use as closely as possible. 17

The equipment is functionally tested prior to, during, and upon completion of the seismic test.

referred to as the Code). Orifice plates are supplied with a certification of materials per NC-2130 of the Code and are tested in compliance with the Code.

Orifice plates are considered qualified for service in Seismic Category I piping by virtue of their compliance to the Code. 2

3.10.4.1.32 Venturi Tubes (Nuclear Service) (J-242Q) 27

Qualification - Venturi tubes are Seismic Category I pressure boundary items only and are required to maintain pressure during and after a seismic event. They are supplied in accordance with the applicable requirements of the ASME Boiler and Pressure Vessel 2

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Code, Section III, Division 1, Classes 2 or 3 (hereafter referred to as the Code). Venturi tubes are supplied with a certification of materials and are tested in compliance with the Code. 2

a. Equipment Identification - Venturi Tubes

1FE-1618A	1FE-1902	1FE-1990A	1FE-3803
1FE-1618B	1FE-1906	1FE-1990B	2FE-3903
2FE-1718A	2FE-1932	2FE-1990A	
2FE-1718B	2FE-1936	2FE-1990B	

b. Method of Qualification - Seismic Category I nuclear service venturi tubes will be qualified by analysis or test in accordance with applicable requirements of the ASME Boiler and Pressure Vessel Code, Section III, Division 1, Class 3. 27

c. Test Method - The test method will be provided by amendment following approval of vendor test procedures.

d. Test Results and Conclusions - The test results and conclusions will be provided by amendment following submittal of the vendor test report.

3.10.4.1.33 Sight Flow Gages (Nuclear Service) (J-234Q) 2

a. Equipment Identification - 1-1/2 and 2 inch flapper type sight flow gages. 13

b. Qualification - Sight flow gages are "in-line" devices and as such constitute Seismic Category I pressure boundary items and are required to maintain pressure during and after a seismic event. They are supplied in accordance with the applicable requirements of the ASME Boiler and Pressure Vessel Code, Section III, Division 1, Class 2 or 3 (hereafter referred to as the Code). Sight flow gages are supplied with a certification of materials and are tested (including pressure test to 1.5 times design pressure) in compliance with the Code. 2 11 13

Sight flow gages are considered qualified for service in Seismic Category I piping by virtue of their compliance to the Code. 2

3.10.4.1.34 Thermowells (Nuclear Service) (J-229Q and J-233Q)

a. Equipment Identification - Thermowells are supplied as part of RTD or temperature switch assemblies. For non-NSSS supplied temperature systems on Seismic Category I 27

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equipment or piping, the thermowells, and in some instances RTDs, are the only parts of the assemblies that are safety-related. | 27

b. Qualification - Thermowells used on Seismic Category I piping or equipment are required to maintain pressure during and after a seismic event. They are supplied in accordance with the applicable requirements of the ASME Boiler and Pressure Vessel Code, Section III, Division 1, Class 2 or 3 (hereafter referred to as the Code). Thermowells are supplied with a certification of materials and are tested (including pressure test to 1.5 times design pressure) in compliance with the Code. | 2 | 11 | 13 | 2

Thermowells are considered qualified for service on Seismic Category I systems by virtue of their compliance to the Code.

3.10.4.1.35 Installation Details (Nuclear Service) (J-218Q)

All field mounted instruments are installed in accordance with Bechtel Standard Details. The Standard Details define the materials required and provide a schematic representation of the impulse lines for a particular installation to aid the installer in designing the actual routing. (See Table 1.7-14 for a listing of typical installation details for Seismic Category I service.) Materials specified are based on the requirements of the ASME Boiler and Pressure Vessel Code, Section III, Division 1 (hereafter referred to as the Code), where applicable. | 11 | 11

Before actual installation, isometric drawings of the proposed installation are generated identifying all materials and weld connections as required. Sufficient flexibility is incorporated in the design, and sufficient supports are provided, so that the normal and accident, thermal, and seismic loads do not exceed the Code allowable stress limits. Such drawings are submitted for review for Code compliance and seismic analysis before being released for construction.

For seismic analysis of the installation, the seismic stresses are evaluated using the Modified Spectrum Method. This method assumes the piping/tubing system may be considered seismically acceptable if it can be divided into a series of spans. These spans are generally separated by guides (two mutually perpendicular restraints normal to the pipe) at each change of direction, at all extended masses, at each tee, and at a maximum spacing on straight runs of piping as determined by dynamic calculations based on a modified spectrum curve.

The spectrum curve for a particular building elevation will be modified so that the flexible side of the peak of the curve will remain constant at the peak spectral acceleration for decreasing frequencies.

3.10.4.1.36 Sonic Level Transmitters (J-297Q) | 15

a. Equipment Identification - 1LT-5201A, 1LT-5201B, 2LT-5221A, 2LT-5221B, 1LT-1212, 1LT-1211, 2LT-1312, 2LT-1311, 0LT-1875A, 0LT-1875B, 0LT-1875C, 0LT-1875D | 17

b. Method of Qualification - Sonic level transmitters will be required to be qualified by device test or similarity per IEEE Std 344-1975 and Regulatory Guide 1.100. | 15

c. Test Method - The test method will be provided by amendment following selection of vendor and approval of vendor test procedures. | 26

d. Test Results and Conclusions - Test results and conclusions will be provided by amendment following submittal of vendor test report. | 15 | 26

simultaneously with the vertical axis (longitudinal simultaneously with vertical, then lateral simultaneously with vertical). The horizontal and vertical input acceleration levels were phase-incoherent during the multifrequency tests.

Random Multifrequency Tests - The test items were subjected to 30 second simultaneous horizontal and vertical inputs of phase-incoherent random waveform motion consisting of frequency bandwidths spaced one-third octave apart over the frequency range of 1.0 to 40Hz to envelop the RRS. The amplitude of each one-third octave frequency was independently adjusted in each axis until the TRS envelop the RRS within the limitations of the test machine. The resulting table motion was analyzed by a spectrum analyzer at a 1% damping factor for the SSE and OBE, and plotted at one-third octave intervals over the frequency range of 1 to 250Hz.

A minimum of five OBE tests were applied to the test items prior to application of an SSE test in each test orientation. The zero period acceleration (ZPA), as well as other areas of the RRS, was exceeded in order to meet the peak responses of the curves. 24

Excitation Control - Control accelerometers were mounted on the table at locations near the bases of the test items.

Electrical Monitoring - Twelve channels were used to monitor the operation of the test items (ohms and milliamperes) prior to and after the test program.

Electrical Powering - Standard dc power at 10 amperes or less was furnished for operation of the transmitter during the test program.

Functional Test - The baseline functional tests for output resistance and insulation resistance were conducted before the start of seismic testing and again after completion of seismic testing.

Post-Test Inspection - Upon completion of the qualification program, the equipment was visually inspected. The equipment was disassembled to the extent necessary to perform the inspection. The condition of the equipment was recorded.

In-Process Inspection - The test records were checked for quality of performance after each test.

The test items were examined for possible damage following all severe tests such as the structural resonance test. All important test effects were logged. | 24

d. Test Results and Conclusions - Test results and conclusions will be submitted by amendment. | 27

3.10.4.1.41 Electronic Field Transmitter - Nuclear (J-245Q)

a. Equipment Identification - Electronic field transmitters which are classified as seismic Category I functional are as follows:

1PT-7220A,B,C,&D, 2PT-7225A,B,C,&D, 1PT-1698A&C, 2PT-1798A&C, 2PT-3218A,B,C,&D 1PT-3134A,B,C,&D, 2PT-3234A,B,C,&D, 1PT-3118A,B,C,&D, 1PT-1629A,B,C,&D, 2PT-1729A,B,C,&D, 1LT-3875AB,AD,BA,&BC, 2LT-3975AB,AD,BA,&BC, 1LT-3875AA,AC,BB,&BD, 2FT-0402, 2FT-0403, 1FT-0302, 1FT-0303, 1PT-0391A,B,&C, 1PT-0392C, 2PT-0491A,B,&C, 2PT-0492C, 1PT-2123, 1PT-2124, 2PT-2223, 2PT-2224, 1PT-1975A&B, 2PT-1975A&B, 0PT-6580A1,A2,B1,&B2, 1FT-5725A&B, 2FT-5725A&B, 1FT-1057A&B, 2FT-1157A&B, 2FT-3969A&B, 1FT-3869A&B, 1FT-1990A&B, 2FT-1990A&B, 0FT-6575A&B, 0PDT-1827, 0PDT-1828, 0PDT-1829, 0PDT-1830, 0PDT-1831, 0PDT-6575A&B, 2LT-1318A,B,C,&D, 1LT-1627A,B,C,&D, 2LT-1727A,B,C,&D, 1LT-1218A,B,C,&D, 2LT-3975AA,AC,BB,&BD, 1PT-1612A&B, 2PT-1712A&B, 1LT-1630A&B, 2LT-1730A&B, 1LT-0161A&B, 2LT-0261A&B, 1PT-38000A1,A2,A3,&A4, 1PT-38000B1,B2,B3,&B4, 2PT-39000A1,A2,A3,&A4, 2PT-39000B1,B2,B3,&B4 | 19 | 20 | 19 | 20

b. Method of Qualification - Electronic field transmitters are qualified by individual type tests per IEEE Std 344-1975. | 24

c. Test Method - Four transmitters of Model 1152 and two transmitters of Model 1153 Series A were tested. The transmitters were mounted on individual test fixtures using their normal mounting means and were operational during the test. The seismic test program consisted of resonance search and biaxial random multifrequency testing. Seismic tests were performed according to IEEE Std 344-1975. | 19

d. Test Results and Conclusions - Electronic field transmitters tested under a prescribed simulated seismic environment possessed sufficient integrity to withstand the testing conditions without compromise of structures or electrical functions.

In contrast, the expected net seismic g loading was:

$$g \text{ net} = \sqrt{(1.5)^2 + (1.64)^2}$$

$$g \text{ net} = 2.22g$$

Therefore, the combined seismic loads are much less than the system's design capability.

3.10.4.2.2.3 Pressurizer Heater Banks 5 and 6 | 27

To be provided by amendment.

3.11 ENVIRONMENTAL DESIGN OF MECHANICAL AND ELECTRICAL EQUIPMENT

Environmental design criteria for the facilities conform to 10 CFR 50, Appendix A, General Design Criteria 4, Environmental and Missile Design Bases. Compatibility of equipment with environmental conditions is provided to fulfill the following design criteria: | 2

a. For normal operation, systems and components required to mitigate the consequences of a design basis accident (DBA) or for safe shutdown are designed to remain functional after exposure to the following environmental conditions:

   1. Representative design temperatures maintained at the equipment location during normal operation by the ventilating and cooling system are described in Section 9.4 and Subsection 6.2.2.2. Temperature values are given in Table 3.11-2.

   2. The relative humidity values given in Table 3.11-2

   3. Atmospheric pressure

   4. Maximum expected integrated radiation exposures for 40 years during normal operation are not to exceed those values given in Table 3.11-2 for specific areas | 15

b. In addition to the normal operation environmental requirements given in Item a above, mechanical and electrical systems and components required to mitigate the consequences of a DBA or to attain a safe shutdown are designed to remain functional after exposure to the following environmental conditions:

   1. Components inside containment - The specific values of temperature, pressure, humidity, radiation, and chemical environment inside containment after a design basis loss-of-coolant accident (LOCA) or main steam line break accident are given in Table 3.11-3. The post-LOCA radiation dose rate is calculated assuming that 100% of the core noble gas inventory, 25% of the core halogen inventory, and 1% of the core solid fission product inventory as listed in Table 15A-2 are in the containment atmosphere, in accordance with TID-14844[1] and consistent with the recommendations of Regulatory Guide 1.4. The total calculated dose is the | 27

integrated dose from the time of the LOCA to 30 days post-LOCA. A detailed listing of these environmental conditions is given in Table 3.11-3. | 14

2. Components outside containment which are required to mitigate the consequences of a design basis LOCA. The expected temperature and humidity environmental conditions by plant area are specified in Table 3.11-3. In computing the expected integrated accident radiation dose at the equipment location, it is assumed that 50% of the core halogen inventory and 1% of the core solid fission product inventory, as listed in Table 15A-2, are in the recirculation water after a design basis LOCA.

3.11.1 EQUIPMENT IDENTIFICATION

Table 3.11-1 lists and categorizes systems and individual components required to mitigate a design basis accident, to attain safe shutdown, or which are otherwise essential to prevent a significant release of radioactive material to the environment. The major component categories (e.g., motor operated valves, pump motors, cables, pressure boundaries, etc) in each system and the location of the components by area are also provided. Specific equipment and components for each system are discussed in the appropriate section as referenced in Table 3.11-1. Normal and DBA environmental conditions, including temperature, pressure, relative humidity, radiation, and pH, are given in Tables 3.11-2 and 3.11-3 respectively. Equipment vibration responses are discussed in Subsection 3.9.2. The duration that each item of equipment is required to operate in a DBA environment is specified in Table 3.11-1. | 27

3.11.2 QUALIFICATION TESTS AND ANALYSES

When sufficiently reliable data are available and proven analytical methods are known, environmental qualification may be based on analysis. If such analytical methods are not feasible, qualification is based on environmental testing.

Both type testing and specific testing may be used. Where equipment has proven reliable for long periods in the required envelope of service, qualification may be based on prior operating experience.

3.11.2.1 Component Environmental Design and Qualification for Normal Operation

Equipment listed in Table 3.11-1 is designed for 40 years of continuous operation in the most severe temperature, pressure, humidity, and radiation environment which exists at the equipment location during normal operation, assuming proper routine

TABLE 3.11-1

IDENTIFICATION AND LOCATION OF MECHANICAL AND ELECTRICAL SAFETY-RELATED SYSTEMS AND COMPONENTS

System Component	MR and Equipment Numbers Unit 1	Unit 2	Qualification Test No. (See Table 3.11-4[4])	Required Duration of operation for DBA and safe Shutdown[2] LOCA	MSLB	Safe S/D	Equipment Location Legend[3] Area Unit 1/ Unit 2	Elevation	Remarks	
REACTOR COOLANT AND PRESSURE CONTROL SYSTEM Figures 5.1-1, 5.1-2										7
Steam generators[1]	MR M1.06 1E-51A,B	2E-51A,B	See Subsection 3.11.2.2.c	C	C	C	2/4a	593'-6"		8
Reactor vessels	MR M1.01 1T-51	2T-51	See Subsection 3.11.2.2.c	C	C	C	2/4a	603'		20
Pressurizers[1]	MR M1.10 1T-52	2T-52	See Subsection 3.11.2.2.c	C	C	C	2/4e	639'		
Pressurizer heaters	To be provided by amendment									14
Pressurizer heater connector assemblies	MR M1.10 To be provided by amendment									27
Control rod drive mechanisms (trip portion)	MR M1.4		15	C	C	C	2/4i	659'		8
Reactor coolant pumps	MR M1.07 1P-51A,B,C,D	2P-51A,B,C,D	See Subsection 3.11.2.2.c	NA	NA	NA	2/4e	634'		20
Valves										
Pressure safety valves	MR M1.11 1PSV-0131* 1PSV-0132*	2PSV-0231* 2PSV-0232*		See remarks			2/4e	567'	Pressure safety valves are	18

TABLE 3.11-1 (continued)

System Component	MR and Equipment Number Unit 1	Unit 2	Qualification Test No. (See Table 3.11-4)[4]	Required Duration of operation for DBA and safe Shutdown[2] LOCA	MSLB	Safe S/D	Equipment Location Legend[3] Area Unit 1/ Unit 2	Elevation	Remarks	
										8
										14
									designed to protect the primary system from overpressure continuously when the system is in operation.	18
	MR M1.27									
Motorized	1MO-0102-1	2MO-0202-1	By amendment	NA	I	I	2/4b	660'		
	1MO-0102-2	2MO-0202-2	By amendment	NA	I	I	2/4b	660'		
	MR M-123B									27
	1MO-0110	2MO-0210	1,23	NA	ST	ST	2/4b	666'-6"		
	1MO-0111	2MO-0211	1,23	NA	I	I	2/4i	673'		
Solenoid										14
	MR J-256									
	1SV-0122*	2SV-0222*	4	C	C	NA	(6)	(6)		
	1SV-0123*	2SV-0223*	4	C	C	NA	(6)	(6)		
	1SV-0127*	2SV-0227*	4	C	C	NA	(6)	(6)		
	1SV-0128*	2SV-0228*	4	C	C	NA	(6)	(6)		19
	1SV-0150*	2SV-0250*	4	C	C	NA	(6)	(6)		
	1SV-0151*	2SV-0251*	4	C	C	NA	(6)	(6)		
	1SV-0155*	2SV-0255*	4	C	C	NA	(6)	(6)		
	MR M-129A									
Solenoid/air cylinder	1SV,1XV-0126*	2SV,2XV-0226*	16	C	C	NA				14
	1SV,1XV-0153*	2SV,2XV-0253*	16	C	C	NA				
	1SV,1XV-0154*	2SV,2XV-0254*	16	C	C	NA				
Snubbers for RC pumps				C	C	C	2/4e	see remarks	All RC pump snubbers are located within secondary shield wall between 634'-0" and 650'-0".	18
										7

TABLE 3.11-1 (continued)

System Component	MR and Equipment Number Unit 1	Unit 2	Qualification Test No. (See Table 3.11-4)[4]	Required Duration of operation for DBA and safe Shutdown[2] LOCA	MSLB	Safe S/D	Equipment Location Legend[3] Area Unit 1/ Unit 2	Elevation	Remarks	
Hydrazine tank vacuum breaker line valves	1SV-1263A*,B*	2SV-1363A*,B*	4	C	C	NA	1/2	614'-0"		8 14 8 24
Valves										18
	MR M-125C									
Motor operated containment isolation valves	1MO-1405*	2MO-1405*	23,25	NA	NA	NA	3	611'		
	MR M-125A									
	1MO-1411*	2MO-1411*	23,25	NA	NA	NA	3	629'-6"		20
Solenoid/air cylinder	MR M-125C									
	1MO-1416*	2MO-1416*	23,25	NA	NA	NA	3	601'-9"		
	MR M-125C									18
	0SV,0XV-1443 (shared)		23,25				3	599'		
	0SV,0XV-1444 (shared)		23,25				3	599'		19
FUEL POOL COOLING Figure 9.1-1										
Fuel pool cooling heat exhhangers	MR M-55									27
	0E-76A,B,C,D (shared)		16	C	C	C	3f	599'		
Fuel pool cooling pumps	MR M-56									
	0P-76A,B (shared)		16	C	C	C	3f	599'		
COMPONENT COOLING WATER Figures 9.2-7 through 9.2-10										7
	MR M-51									14
Component cooling water heat exchangers	1E-73A,B	2E-73A,B	16	C	C	C	1d/1d	599'		
			16	C	C	C	1b/1b	584'		25
	MR M-52									
CCW pump motors	0P-73 (shared)		By amendment	C	C	C	1d	584'		
	1P-73A	2P-73A	By amendment	C	C	C	1/1d	599'		26
	1P-73B	2P-73B	By amendment	C	C	C	1/1d	584'		

TABLE 3.11-1 (continued)

System Component	MR and Equipment Number Unit 1	Unit 2	Qualification Test No. (See Table 3.11-4)[4]	Required Duration of operation for DBA and safe Shutdown[2] LOCA	MSLB	Safe S/D	Equipment Location Legend[3] Area Unit 1/ Unit 2	Elevation	Remarks	
	MR M-53									14
CCW pumps	0P-73 (shared)		16	C	C	C	1d	584'		
	1P-73A	2P-73A	16	C	C	C	1d/1d	599'		18
	1P-73B*	2P-73B*	16	C	C	C	1d/1d	584'		
	MR M-64									14
CCW surge tanks	1T-73A,B	2T-73A,B	16	C	C	C	1v/1v	674'		
Valves										
	MR M-132									16
Decay heat cooler influent valves	1MO-1607A,B*	2MO-1707A,B*	23,25	C	C	NA	1	584'		
CCW pump suction valves	1MO-1610A,B*	2MO-1710A,B*	23,25	C	C	C	1	584'/599'		19
CCW heat exchanger bypass valves	1MO-1620A,B*	2MO-1720A,B*	23,25	C	C	C	1	599'/584'		
CCW heat exchanger discharge valves	1MO-1623A,B*	2MO-1723A,B*	23,25	C	C	C	1	599'/584'		16
	MR M-125C									18
Containment isolation valves	1MO-1655*	2MO	23,35	C	C	NA	1	599'		19
										14
	MR M-120									
	1MO-1660*	2MO-1760*	23,25	C	C	NA	1	614'		
	1MO-1661A*	2MO-1761A*	1,23	C	C	NA	2/4	593'		
	1MO-1661B*	2MO-1761B*	23,25				1	614'		19
	MR M-132									
CCW booster pump suction shutoff	1MO-1685A*	2MO-1785A*	23,25	See remarks			1	584'	Open during normal and accident conditions; may be closed by hand signal to isolate CCW booster pump.	16
CCW system valves	1MO-1685B*	2MO-1785B*	23,25	See remarks for above item			1	599'		19
										7

TABLE 3.11-1 (continued)

System Component	MR and Equipment Number Unit 1	Unit 2	Qualification Test No. (See Table 3.11-4)(4)	Required Duration of operation for LBA and safe Shutdown(2) LOCA	MSLB	Safe S/D	Equipment Location Legend(3) Area Unit 1/ Unit 2	Elevation	Remarks	
	MR M-163									14
Recirculating air cooling unit fans	1VV-57A,B,C,D	2VV-57A,B,C,D	5	See remarks					Fans are subcomponents of recirculating air cooling units.	16 7
Valves										14
	MR M-168									
RB purge air supply valves	1MO-5309A	2MO-6209A	1,23	C	C	NA	2k/4k	688'-6"		
	1MO-5309B	2MO-6209B	23,25	C	C	NA	3s	688'-6"		
RB purge air exhaust valves	1MO-5316A	2MO-6216A	1,23	C	C	NA	2k/4k	688'-6"		
	1MO-5316B	2MO-6216B	23,25	C	C	NA	3s	688'-6"		
RB air room supply valves	1MO-5324A*	2MO-6224A*	1,23	C	C	NA	2j/4j	676'-0"		
	1MO-5324B*	2MO-6224B*	23,25	C	C	NA	3s	676'-0"		
RB air room exhaust valves	1MO-5336A*	2MO-6236A*	1,23	C	C	NA	2j/4j	676'-0"		18
	1MO-5337B*	2MO-6236B*	23,25	C	C	NA	3s	676'-0"		
	MR M-120									
H supply duct	1MO-5343A*	2MO-6243A*	1,23	C	C	NA	2d/4d	614'		
	1MO-5343B*	2MO-6243B*	23,25	C	C	NA	1j	614'		
H exhaust duct	1MO-5355A*	2MO-6255A*	1,23	C	C	NA	2k/4k	688'-6"		
	1MO-5355B*	2MO-6255B*	23,25	C	C	NA	3s	688'-6"		27

TABLE 3.11-1 (continued)

System Component	MR and Equipment Number Unit 1	Unit 2	Qualification Test No. (See Table 3.11-4) [4]	Required Duration of operation for DBA and safe Shutdown [2] LOCA	MSLB	Safe S/D	Equipment Location Legend [3] Area Unit 1/ Unit 2	Elevation	Remarks	
HEATING, VENTILATING, AIR CONDITIONING AUXILIARY BUILDING Figure 9.4-3 through 9.4-7										8
	MR M-150									14
Emergency fuel handling area exhaust air filtering units	0VM-94A,B (shared)									8
Electric heater and heater controls			43	NA	NA	NA	lu	659'		26
Relative humidity controls			44	NA	NA	NA	lu	659'		23
High temperature			45	NA	NA	NA	lu	659'		16
	M-154									
Damper and valves										18
Solenoid/air cylinders	OSV-5455A,B/OXV-5455A,B (shared)		16	NA	NA	NA	lu	659'		
	OSV-5461A,B/OXV-5461A,B (shared)		16	NA	NA	NA	lu	659'		
	M-347									
Electrohydraulic operator	OFV-5444A,B (shared)		24	NA	NA	NA	lu	659'		24
	OMO-5445A,B (shared)		24	NA	NA	NA	lu	659'		
	M-347									
Backdraft	OBF-5401A,B (shared)		16	NA	NA	NA	30/30	659'		
	OBF-5402A,B (shared)		16	NA	NA	NA	30/30	659'		
	MR M-157									16
Fuel handling area emergency exhaust fans	0VV-86A,B (shared)		35	NA	NA	NA	lu	659'		25 16
	MR M-149									
Decay heat removal room coolers	1VM-50A,B	2VM-50A,B	16	C	C	NA	lc/lc	584'		7

TABLE 3.11-1 (continued)

System Component	MR and Equipment Number Unit 1	Unit 2	Qualification Test No. (See Table 3.11-4)[4]	Required Duration of operation for DBA and safe Shutdown [2] LOCA	MSLB	Safe S/D	Equipment Location Legend[3] Area Unit 1/ Unit 2	Elevation	Remarks	
	MR M-56									8 14 8 14
Safeguards chilled waters pumps	1VP-02A*,B*,C*, D*	2VP-02A*,B*,C*,D*	16	C	C	C	lo/lo	646'		24
	MR M-146									14
Auxiliary safeguard chiller oil pumps	1VP-59A,B	2VP-59A,B	16	C	C	C	lo/lo	646'		18 14
	MR M-64									
Safeguards expansion tanks	1VT-03A,B	2VT-03A,B	16	C	C	C	3r/3r	685'		16
Safeguards chilled water air separators	1VT-23A,B	2VT-23A,B	16	C	C	C	lo/lo	645'		25
Valves										14
	MR M-146									20
Pressure relief	1PSV-5716A_2,B_2, A_3,B_3,A_4,B_4,A_5, B_5	2PSV-5716A_2,B_2, A_3,B_3,A_4,B_4,A_5, B_5	16	See remarks					All pressure relief valves are self-contained automatically actuated devices which are required continuously for over-pressure protection.	14 16 14
	MR J-256									
Safeguards chiller oil cooler supply valve	1SV-5720A*,B*	2SV-5720A*,B*	4	C	C	C	lo/lo	645'		24 14

TABLE 3.11-1 (continued)

System Component	MR and Equipment Number Unit 1	Unit 2	Qualification Test No. (See Table 3.11-4)(4)	Required Duration of operation for DBA and safe Shutdown(2) LOCA	MSIB	Safe S/D	Equipment Location legend(3) Area Unit 1/ Unit 2	Elevation	Remarks	
Control room A/H unit 3-way valve	MR J-255A 0TV-5755A*,B* (shared)		By amendment	C	C	C	3r	685'		8 14 8 14 26 14
Wye strainers	MR M-336 0YS-5710 1YS-5709A,B,C,D	0YS-5712 2YS-5709A,B,C,D	16 16	See remarks			1/1	645'	The pressure boundary retention must be maintained during all accident conditions.	7
HVAC CONTROL ROOM BATTERY ROOM SWITCHGEAR ROOM AND CABLE SPREADING ROOM Figures 9.4-1,9.4-2										
Control room pressurization tank	MR M-64 0VT-28A,B (shared)		16	C	C	C	UG	626'		14 27 23
Control room air handling unit	MR M-149 0VM-01A,B (shared)		16	C	C	C	3r	685'		14 16
MCR recirculating air filter units High temperature alarm system	MR M-150 0VM-79A,B (shared)		45	C	C	NA	3r	685'		21 26 21 23 21
Control room recirculating filter fan	MR M-157 0VV-03A,B (shared)		35	C	C	NA	3r	685'		16 17

TABLE 3.11-1 (continued)

System Component	MR and Equipment Number Unit 1	Unit 2	Qualification Test No. (See Table 3.11-4)(4)	Required Duration of operation for DBA and safe Shutdown(2) LOCA	MSLB	Safe S/D	Equipment Location Legend(3) Area Unit 1/ Unit 2	Elevation	Remarks	
Current transformer monitors										8 14 8
	MR M1.07									
Monitors for reactor coolant pumps	1P-51A	2P-51A	18	See remark		C	3g/3g	614'	Items required prior to DBA.	14
	1P-51B,C	2P-51B,C	18			C	3k/3k	634'-6"	Items not required post-LOCA or MSLB.	
	1P-51D	2P-51D	18			C	3g/3g	614'		
DC power supply equipment										
	MR E-12									
125V batteries and racks	1D-01*	2D-01*	9	C	C	C	3h/3h	614'	IEEE Std 323-1974 is applicable.	
	1D-02*	2D-02*	9	C	C	C	3h/3h	614'		
	MR E-11									14
125V, 300 amp battery chargers	1D-15*	2D-15*	18	C	C	C	3h/3h	614'	Equipment purchased prior to 11/15/74.	
	1D-17*	2D-17*	18	C	C	C	3h/3h	614'		
	1D-25*	2D-25*	18	C	C	C	3h/3h	614'		
	1D-27*	2D-27*	18	C	C	C	3h/3h	614'		
	MR E-45									16
125Vdc distribution panels	1D-11*	2D-11*	39	C	C	C	3h/3h	614'	IEEE Std 323-1974 is applicable.	
	1D-12*	2D-12*	39	C	C	C	3h/3h	614'		18
	1D-21*	2D-21*	39	C	C	C	3h/3h	614'		
	1D-22*	2D-22*	39	C	C	C	3h/3h	614'		
	MR E-49									
Battery fused disconnect switch	1D-13*	2D-13*	36	C	C	C	3h/3h	614'	IEEE Std 323-1974 is applicable.	16
	1D-23*	2D-23*	36	C	C	C	3h/3h	614'		
	MR E-13									
125Vdc power distribution center	1D-10*	2D-10*	18	C	C	C	3h/3h	614'	Equipment purchased prior to 11/15/74.	
	1D-20*	2D-20*	18	C	C	C	3h/3h	614'		

TABLE 3.11-1 (continued)

System Component	MR and Equipment Number Unit 1	Unit 2	Qualification Test No. (See Table 3.11-4)[4]	Required Duration of operation for DBA and safe Shutdown[2] LOCA	MSLB	Safe S/D	Equipment Location Legend[3] Area Unit 1/ Unit 2	Elevation	Remarks	
Cable and associated equipment										8 14 8 7
Cables										
5kV and 8kV power cable	MR E-21		2	C	C	C	DB, SW, OS underground, aux bldg		Equipment purchased prior to 11/15/74.	14 27
600V insulated power cable	MR E-22		3	C	C	C	DB, SW, OS underground, aux bldg, inside containment		IEEE Std 323-1974 is applicable.	14 7
600V control cable	MR E-26		19	C	C	C	DB, SW, OS underground, aux bldg, inside containment		IEEE Std 323-1974 is applicable.	14 7
Instrument and specialty wire	MR E-60		21	C	C	C	DB, SW, OS underground, aux bldg, inside containment		IEEE Std 323-1974 is applicable.	14 7

TABLE 3.11-4 (continued)

Qual Test No. Reference Table 3.11-1	Type of Equipment/ Test Reference	Test Procedures	Test Results	
		Std 323-1974. The sample equipment shall be finally inspected, and its status and condition shall be recorded.		25
45	HIGH TEMPERATURE ALARM SYSTEM	To be provided by amendment	To be provided by amendment	
46	HAZARDOUS GAS MONITORS	To be qualified in accordance with IEEE Std 323-1974. Details of the test procedures will be provided by amendment	To be provided by amendment	
47	RADIATION MONITORS	To be qualified in accordance with IEEE Std 323-1974. Details of the test procedures will be provided by amendment	To be provided by amendment	26
48	HYDROGEN MONITORS	To be qualified in accordance with IEEE Std 323-1974. Details of the test procedures will be provided by amendment	To be provided by amendment	
49	PRESSURIZER HEATERS	To be provided by amendment	To be provided by amendment	27

APPENDIX 3A

CONFORMANCE WITH NRC REGULATORY GUIDES

This appendix discusses the conformance of plant design with the guidelines presented in the NRC Regulatory Guides.

Where the design differs from the Regulatory Guide or where the guide has been qualified by an interpretation of the guide, these variances are discussed in detail in this appendix.

In 1975 CPCo initiated a program with the NRC for an in-depth review regarding implementation of certain Regulatory Guides on the Midland plant. The primary purpose of this special effort was to review the Midland plant compliance with the regulatory guidelines during active engineering, procurement, and construction rather than during the FSAR review when these activities would be essentially complete. This special review program resulted in the following NRC letters which either accepted or provided staff comments on CPCo's positions.

Discipline	Regulatory Guides	NRC Letters
Electrical, I&C	1.6, 1.9, 1.11, 1.22, 1.32, 1.40, 1.41, 1.45, 1.47, 1.53, 1.62, 1.63, 1.73, 1.75, 1.81	Sept 29, 1976, S.A. Varga to S.H. Howell
Structural Engr	1.10, 1.12, 1.15, 1.18, 1.19, 1.35, 1.57, 1.60, 1.61, 1.90, 1.92	June 8, 1976, K. Kniel to S. H. Howell
Materials Engr	1.2, 1.14, 1.31, 1.34, 1.36, 1.43, 1.44, 1.50, 1.65, 1.66, 1.71	Sept 24, 1976, S.A. Varga to S.H. Howell
Mechanical Engr	1.20, 1.26, 1.29, 1.46, 1.48, 1.67, 1.72	Sept 24, 1976, S.A. Varga to S.H. Howell
Miscellaneous	1.1, 1.4, 1.7, 1.13, 1.25, 1.27, 1.42, 1.49, 1.52, 1.59	Sept 29, 1976, S.A. Varga to S.H. Howell
Quality Assurance	1.37, 1.38, 1.39, 1.54, 1.58, 1.64, 1.88, 1.94	Aug 12, 1977, S.A. Varga to S.H. Howell

10

Subsequent to receiving the above referenced letters, some of the Midland plant positions have changed to comply with the NRC comments, or require additional clarification due to reinterpretation of Regulatory Guide contents. These changes to the original CPCo positions have been incorporated into those in this appendix.

Regulatory Guides which at time of preparation of this appendix (April 1, 1977) were not issued for use but were only under development and issued for comment have not been addressed, except that additional Regulatory Guides referenced in NRC Questions 400.2, 400.3, and 400.4 are addressed in this appendix. | 27

Regulatory Guide 1.17 - PROTECTION OF NUCLEAR POWER PLANTS AGAINST INDUSTRIAL SABOTAGE (Rev. 1, 6/73)

RESPONSE

The Midland Nuclear Power Plant Security Plan addresses the physical and administrative features of nuclear plant security operations. Security hardware at the plant and administrative tasks which the plant and other corporate areas must perform are described in the security plan. The plan establishes the physical protection requirements, or equivalent, of 10 CFR 73.55(b) through (h) and, when implemented, will meet the general performance requirements of 10 CFR 73.55(a). 27

Regulatory Guide 1.18 - STRUCTURAL ACCEPTANCE TEST FOR CONCRETE PRIMARY REACTOR CONTAINMENTS (Rev. 1, 12/28/72)

RESPONSE

The degree of compliance with Regulatory Guide 1.18 for Midland Units 1 and 2 is described in FSAR Subsections 14.2.7 and 3.8.1.7.

The implementation of this Regulatory Guide and its applicability to the Midland plant have been reviewed by the NRC staff and found to be acceptable. This evaluation is in the NRC letter to CPCo dated June 8, 1976, on the subject of Regulatory Guides in the Structural Engineering Category.

Regulatory Guide 1.19 - NONDESTRUCTIVE EXAMINATION OF PRIMARY CONTAINMENT LINER WELDS (Rev. 1, 8/11/72) | 14

RESPONSE

The guidelines for nondestructive examination of liner plate welds comply with Regulatory Guide 1.19, except for the testing frequencies, which are in accordance with proposed ASME Pressure Vessel Code Section III Div. 2 as issued for trial use and comment in 1973.

This position has been reviewed by the NRC staff and found to be acceptable. This evaluation is in the NRC letter to CPCo dated June 8, 1976, on the subject of Regulatory Guides in the Structural Engineering Category.

Regulatory Guide 1.20 - VIBRATION MEASUREMENTS ON REACTOR INTERNALS (12/29/71)

RESPONSE

The degree of compliance with Regulatory Guide 1.20 for Midland Units 1 and 2 is described in FSAR Subsection 14.2.7 and in B&W Topical Report BAW-10038.

The NRC, in a September 24, 1976, letter from S.A. Varga, Chief, Light Water Reactors Branch 4, to S.H. Howell, on the subject of Mechanical Regulatory Guides, has accepted the position for the Midland plant that B&W is in full compliance with the guidelines of Regulatory Guide 1.20 for reactor internals similar to a valid prototype design. The Oconee Unit 1 reactor internals serve as a valid prototype for 177-FA units such as Midland 1 and 2.

The surveillance specimen holder tubes were qualified by a vibration measurement program conducted at Davis-Besse Unit 1 and described in B&W Topical Report BAW-10039. 27

Regulatory Guide 1.21 - MEASURING, EVALUATING, AND REPORTING RADIOACTIVITY IN SOLID WASTES AND RELEASES OF RADIOACTIVE MATERIALS IN LIQUID AND GASEOUS EFFLUENTS FROM LIGHT-WATER-COOLED NUCLEAR POWER PLANTS (Rev. 1, 6/74)

RESPONSE

Measuring and reporting of effluents from Midland Units 1 and 2 will be done in accordance with Regulatory Guide 1.21 as specified in the Radiological Effluent Technical Specifications. 27

Regulatory Guide 1.22 - PERIODIC TESTING OF PROTECTION SYSTEM ACTUATION FUNCTIONS (2/17/72)

RESPONSE

The reactor protection system incorporates a testing scheme which complies with this guide using the methods given in Section D, Paragraphs 2(b) and (d). Utilizing logic test switches on the front face of the RPS reactor trip module, the output from any RPS channel can be tripped so that the associated control rod drive control system trip device (trip breaker) will open. This operation can be performed without disrupting station operation since at least two trip devices in parallel must trip in order to cause rod insertion. Each protection channel has a key operated bypass switch to allow channel bypass without initiating a reactor trip. Bypass channel logic and administrative procedures permit only one channel to be bypassed at one time. The key switches are interlocked so that if one switch is in the bypass position, another switch placed in its bypass position will have no effect. Actuation of the bypass switch initiates a visual alarm on the main console which remains in effect during and after a channel bypass. The RPS is a four channel protection system; thus, during online testing, the system will operate in a 2-out-of-3 coincidence. Test circuits allow the operator to completely test the reactor protection system channels at any time during reactor operation. | 14

The emergency core cooling system actuation and the engineered safety features system actuation comply with this guide using the methods given in Section D, Paragraph 2(b) or (d) depending on whether the equipment can be actuated on line.

This position has been reviewed by the NRC staff and found to be acceptable. This evaluation is in the NRC letter to CPCo dated September 29, 1976, on the subject of Regulatory Guides in the Electrical, Instrumentation, and Control Systems Category.

Regulatory Guide 1.64 - QUALITY ASSURANCE REQUIREMENTS FOR THE DESIGN OF NUCLEAR POWER PLANTS | 17

RESPONSE

The degree of compliance with Regulatory Guide 1.64 for Midland Units 1 and 2 is as contained in Section 17. | 10 | 16

Regulatory Guide 1.65 - MATERIAL AND INSPECTIONS FOR REACTOR VESSEL CLOSURE STUDS (10/73)

RESPONSE

For the equipment within the B&W scope of supply, the degree of partial compliance with this Regulatory Guide is as follows:

Reactor vessel closure stud material meets one of the material specifications listed in the Regulatory Guide. Adequate fracture toughness is assured by compliance with the fracture toughness requirements of the ASME Code (prior to the Summer 1973 addenda). Specified minimum yield strengths are in accordance with Appendix G of 10 CFR 50. Specific information on fracture toughness, tensile properties, and inspection is found in Topical Report BAW-10046P. Measured maximum tensile strengths vary and readings slightly in excess of 170 ksi occasionally may occur. These are allowable providing the fracture toughness properties comply with the ASME Code (prior to the Summer 1973 addenda). The operating environment is not conducive to stress corrosion cracking, and, therefore, 170 ksi is considered a guideline tensile strength rather than an upper limit. Metal plating is not applied.

Inspection is in accordance with the ASME Code requirements for sizes over 4 inches.

After fabrication, but before use, the reactor vessel closure studs are coated with a lubricant film to protect them against galling. Before removal of the closure head, the studs are raised and secured with the closure head. After removal of the closure head, the head and studs are stored in an area within the containment well separated from the refueling canal. After any inadvertent exposure to corrosive media (borated water) spills or leaks, the closure components will be promptly cleaned up. In addition, O-ringed seal plugs and alignment studs are provided to protect the vessel flange threads. The intent of Paragraph C.4.a is satisfied through the performance of volumetric and surface examinations as required by the summer 1978 addendum of the Section XI Code, Table IWB-2500-1. 27

This B&W position has been determined to be acceptable to the NRC as indicated in the NRC letter to CPCo dated September 24, 1976. on the subject of Regulatory Guides in the Materials Engineering Category.

Regulatory Guide 1.83 - INSERVICE INSPECTION OF PRESSURIZED WATER REACTOR STEAM GENERATOR TUBES (Rev. 1, 7/75)

RESPONSE

Degree of compliance is as discussed in FSAR Subsection 16.3/4.4.5. | 27

Regulatory Guide 1.84 - CODE CASE ACCEPTABILITY, ASME SECTION III DESIGN AND FABRICATION (Rev. 8, 11/76)

RESPONSE

a. Reference: Paragraph C.1 of the Regulatory Guide

It is intended to comply with Position C.1 of Regulatory Guide 1.84 by specifying or permitting only those Code cases listed in Regulatory Position C.1 of the guide for the design and fabrication of ASME Section III components. This position applies to ASME Section III components procured after the initial issue of Regulatory Guide 1.84 (July 1, 1974) and with the understanding that application to the commission for acceptance of selected Code cases issued after the latest revision of the Regulatory Guide may be made.

b. Reference: Paragraph C.2 of the Regulatory Guide

It is intended to comply with Position C.2 of Regulatory Guide 1.84 with the understanding that acceptable Code cases annulled by action of the ASME Council but which were specified in procurement of components prior to annulment shall remain valid for the duration of the purchase order.

c. Reference: Paragraph C.3 of the Regulatory Guide

It is intended to comply with Position C.3 of Regulatory Guide 1.84 with the understanding that Code cases revised by action of the ASME Council but which are specified in procurement of components prior to revision remain for the duration of that purchase order.

d. Reference: Paragraphs C.4 and C.5 of the Regulatory Guide

It is intended to comply with these positions subject to the conditions listed above in the responses to Positions C.1 through C.3.

After obtaining the spectrum-averaged cross-sections for each material in the lattice, the fuel may be depleted (burned) at the power level specified in the input. The depletion equations are solved numerically by assuming constant flux over a small finite time interval. The flux is normalized to power after each time interval. Isotopic buildup and burnout are based on a second order approximation to the integral of the time-dependent differential depletion equations. After each depletion step, the neutron spectrum may be recalculated to take into account the buildup of fission products, the conversion of fertile material, and the burnup of fissionable isotopes. At each time step, the concentration of each material and its few-group constants may be stored on a special output tape and used to construct cross-section fits for the PDQ07 and FLAME3 multidimensional spatial codes.

Special provisions in NULIF allow changes to be made at any time step during depletion. Application of this feature allows one to change power level, soluble boron concentration, fuel temperature, moderator temperature, etc. The code will also iterate on a specified material concentration to give a specified eigenvalue.

In some lattice studies, it is desirable to include the effects of water holes (vacant control rod positions), control rod cells, lumped burnable poison (LBP) cells, and instrument cells on the homogenized coefficients of the lattice. In this case, provision is made to use the "supercell" model, which has also been called the "subregion x" model. In this model, one cell type (usually the fuel cell) is designated as the primary cell. Other cells in the lattice are called x_1, x_2, x_3 depending on the number of different cell types (up to three are allowed). Flux depression factors for each of the x cells relative to the primary cell are obtained from spatial calculations on the lattice. By inputting these flux depression factors along with descriptions of the subregion x cells, the flux depression factors are combined with those calculated for the primary cell to give overall flux depression factors for each material in the lattice. These depression factors are applied to each of the 80 groups before computation of the flux spectrum. In this way, the final lattice spectrum is influenced by the number and type of each different cell in the lattice. For example, water holes interspersed within a lattice of fuel cells will soften the overall spectrum of the lattice when compared to an all-fuel-cell lattice.

FEW-GROUP COEFFICIENT FITS (HAFIT, FLAFIT) - The changes in core nuclear cross-sections and coefficients due to changes in material concentrations and core properties are represented through a system of few-group coefficient fits. The coefficients are fit to a primary variable, which represents the combined effect of many isotopic variables, along with several secondary variables. The primary variable is fuel burnup expressed as megawatt-days per initial metric ton of fuel (MWd/t). At any time during core operation, this variable is a measure of the

total energy extracted from a given volume of fuel. Secondary variables include moderator temperature, fuel temperature, moderator specific volume, soluble boron concentration, initial fuel enrichment, LBP concentration, xenon 135 concentration, presence of control rods, etc. Given a fixed core and fuel assembly geometry, region (or local) few-group cross-sections are fit as functions of region (or local) material concentrations and temperatures only.

Coefficient fits for the PDQ07 diffusion program are obtained from the HAFIT program.[27] HAFIT retrieves selected nuclear data from one or more NULIF fit tapes and, based on a defined fitting procedure, constructs coefficient table sets and function tables that are consistent with the HARMONY system format.

Coefficient fits for the FLAME3 nodal code are produced by the FLAFIT program.[11] FLAFIT retrieves selected data from the NULIF fit tape and, based on a defined fitting procedure, constructs coefficient function tables which are compatible with the Lagrange interpolation scheme used in FLAME3.

4.3.3.1.4 Nuclear Design Codes

Nuclear design calculations are performed with the PDQ07[7] and FLAME3[11] programs. Figure 4.3-97 illustrates the relationships between data files and computer programs in this area.

DESIGN CALCULATIONS WITH PDQ07 - Because of the large amount and diversified nature of the design computations that are performed with PDQ07, this area is discussed in several topical reports. These include BAW-10116,[28] on fuel assembly calculations and the use of fitted nuclear data, BAW-10117,[7] the user's manual for B&W's version of PDQ07, and BAW-10118A,[29] on techniques and procedures for core calculations. Other topical reports in this series are BAW-10119,[1] on power peaking uncertainty, and BAW-10120,[5] which compares core physics calculations to measurements. Because the details of specific design calculations are discussed in these reports, only a summary of PDQ07 procedures and design capability is given here. |27 |26

Basically, PDQ07 is a few-group, diffusion-depletion program used to obtain spatial neutron flux and material distributions (in one, two, or three dimensions) throughout a reactor core during its operating life. PDQ07 calculations are performed in two major steps. First, an iterative method obtains the nonnormalized, few-group neutron fluxes at discrete spatial mesh points from the initial geometric and material description of the core and reflector. An initial source guess is required for the iterative method, and an eigenvalue, which is a measure of core

Fuel radius, cm	S/M, cm^2/g	U-238 resonance integral, barns NULIF	Hellstrand
0.25	0.7843	26.92	27.70 ± 1.11
0.50	0.3922	20.41	20.80 ± 0.83
1.00	0.1961	15.92	15.93 ± 0.64
2.00	0.0980	13.05	12.48 ± 0.50

The agreement with Hellstrand's integral values is quite good.

The temperature dependence of the uranium 238 resonance integral is of primary importance in determining the power coefficient of reactivity for an operating PWR core. This coefficient increases rapidly, an effect that is caused by increased resonance absorption in uranium 238 as the fuel temperature increases (Doppler effect). The temperature dependence of the resonance integral has been measured by Hellstrand,(4) and his results are represented by the formula:

$$R(T)/R(T_o) = 1 + \alpha (\sqrt{T} - \sqrt{T_o}) \qquad (4)$$

When the reference temperature, T_o, is fixed, the temperature dependence of the resonance integral is determined by the value of the slope, α. Hellstrand(4) shows that α is a function of S/M according to the formula:

$$\alpha = 0.0058 + 0.0059\ S/M \qquad (5)$$

when T is given in degrees Kelvin

The values of α computed by the NULIF program are compared below with Hellstrand's measured data for a range of S/M values and for a UO_2 density of 10.2 g/cc.

Fuel radius, cm	S/M cm^2/g	$\alpha(K^{-\frac{1}{2}})$ NULIF	Hellstrand
0.25	0.7843	0.0100	0.0097 ± 0.0006
0.50	0.3922	0.0083	0.0078 ± 0.0006

1.00	0.1961	0.0071	0.0068 ± 0.0005
2.00	0.0980	0.0066	0.0063 ± 0.0005

The results compare very well; all values are within the range of experimental uncertainty.

4.3.3.2.2 Comparison With Other Codes

The subroutine AMOP in NULIF computes the microgroup (80-group) flux depression factors for a cylindrical unit cell using the ABH method.[26] Using these flux depression factors, the TAME subroutine of NULIF computes the cell average microgroup neutron (P_0 and P_1) spectrums by an iterative method. To verify this method, cells of various compositions encompassing the reference core design values were analyzed with the integral transport code THERMOS.[48] In making this comparison, identical microgroup (80-group) cross-section libraries were used in both the NULIF and THERMOS programs. Typical results for a low-enriched (2.1% by weight uranium 235) UO_2 fuel pin cell composed of fuel, cladding, and associated water are tabulated below. | 5

Cell average value	NULIF	THERMOS
Σ_a	0.5963	0.5914
Σ_f	0.3795	0.3760
$\nu\Sigma_f/\Sigma_a$	1.546	1.545

| 3

The agreement is excellent, demonstrating the validity of the assumption of space-energy separation of flux variables for these cells.

NULIF isotopic calculations have been compared to experimental data obtained from the Yankee Rowe reactor.[49] Excellent agreement has been found for plutonium buildup as shown in Figure 4.3-111. | 5

4.3.3.2.3 Comparisons with Hot Operating Core Data

This subsection presents comparisons of data obtained during zero power physics testing, power escalation, and normal power operation in B&W's operating reactors, with analytical results. The measurement techniques are described in detail in BAW-10120,[5] Comparison of Core Physics Calculations with Measurements; the calculational procedures are discussed in BAW-10118A,[29] Core Calculational Techniques and Procedures. | 27

REACTIVITY - As a part of zero power physics testing, all rods out critical boron concentrations are measured. Two-dimensional

29. J.J. Romano, Core Calculational Techniques and Procedures, B&W-10118A (October 1977), B&W, Lynchburg, Virginia | 25 | 27

30. Deleted | 26

31. C.W. Mays, Verification of the Three-Dimensional FLAME Code, BAW-10125A (April 1976), B&W, Lynchburg, Virginia

32. T.C. Engelder, et al, Measurement and Analysis of Uniform Lattices of Slightly Enriched UO_2 Moderated by D_2O-H_2O Mixtures, BAW-1273 (January 1962), B&W, Lynchburg, Virginia

33. Physics Verification Program - Quarterly Technical Report No. 1, January - June 1966, BAW-3647-1 (July 1966), B&W, Lynchburg, Virginia

34. P.W. Davison, et al, Yankee Critical Experiments - Measurements on Lattices of Stainless-Steel-Clad Slightly Enriched Uranium Dioxide Fuel Rods in Light Water, YAEC-94 (April 1959), Westinghouse Commercial, Pittsburgh, Pennsylvania

35. V.E. Grob, et al, Multi-Region Reactor Lattice Studies - Results of Critical Experiments in Loose Lattices of UO_2 Rods in H_2O, WCAP-1412 (March 1960), Westinghouse Commercial, Pittsburgh, Pennsylvania

36. J.R. Brown, et al, Kinetic and Buckling Measurements on Lattices of Slightly Enriched Uranium and UO_2 Rods in Light Water, WAPD-176 (January 1958), Westinghouse Bettis, Pittsburgh, Pennsylvania | 1

37. E.G. Taylor, Saxton Plutonium Program - Critical Experiments for the Saxton Partial Plutonium Core, WCAP-3385-54 (December 1965), Westinghouse Commercial, Pittsburgh, Pennsylvania

38. R.D. Leamer, et al, PuO_2-UO_2 Fueled Critical Experiments WCAP-3726-1 (July 1967), Westinghouse Commercial, Pittsburgh, Pennsylvania

39. M.N. Baldwin and R.H. Clark, Physics Verification Program, Final Report, BAW-3647-3 (March 1967), B&W, Lynchburgh, Virginia

40. M.N. Baldwin and M.E. Stern, Physics Verification Program - Part III, Task 4, Summary Report, BAW-3647-20 (March 1971), B&W, Lynchburg, Virginia

41. M.N. Baldwin, et al, Physics Verification Program, Part III, Tasks 2 and 3, Final Report, BAW-3647-16 (April 1970), B&W, Lynchburg, Virginia

42. H.A. Hassan and W.A. Wittkopf, Three-Dimensional Power Distribution Analysis, BAW-10061 (June 1973), B&W, Lynchburg, Virginia

43. M.N. Baldwin and G.T. Fairburn, Physics Verification Program - Part III, Tasks, 5, 6, and 7, Summary Report BAW-3647-24 (March 1972), B&W, Lynchburg, Virginia | 5

44. R.I. Smith, and L.D. Williams, Measurements for Prototypical Plutonium Recycle Cores in Pressurized Water Reactors, LRC-9031 (March 1973), B&W, Lynchburg, Virginia | 5

45. R.I. Smith, et al, Measurements of Critical Boron Concentrations, Relative Power Distributions, and Foil Activations, LRC-9035 (June 1973), B&W, Lynchburg, Virginia | 5

46. M.N. Baldwin, Physics Verification Program, Part III, Task 11, Quarterly Report, January-March 1974 BAW-3647-30 (July 1974), B&W, Lynchburg, Virginia | 5

47. E. Hellstrand and G. Lundgren, "The Resonance Integral for Uranium Metal and Oxide," Nuclear Science & Engineering, Vol 12 (1962), pp 435-436 | 5

48. H.C. Honeck, THERMOS - A Thermal Transport Code for Reactor Lattice Calculations, BNL-5826 (May 1962), Brookhaven National Laboratory, Upton, N.Y. | 5

49. R.J. Nodvik, Evaluation of Mass Spectrometric & Radiochemical Analysis of Yankee Core 1 Spent Fuel, WCAP-6068 (March 1966), Westinghouse Electric Corporation, Pittsburgh, Pennsylvania | 5

performing its required functions. The data accumulated during the test provide a basis for acceptance or rejection and also serve as a reference for comparison of later operational data. In addition to the mechanism production acceptance testing, other parts of the drive, such as the stators and position indications, undergo additional subassembly testing to ensure their proper functional capability.

Once the CRDMs are onsite, a number of additional tests are performed to ensure correct operation of the mechanisms. These tests include stator and thermocouple electrical resistance checks, a minimum latching current test, a minimum unlatching current test, and a minimum run current test.

In addition to the functional tests, trip time testing of the CRDMs is performed as per Regulatory Guide 1.68 and as modified by the B&W position in Appendix 3A.

4.6.3.2 Control Rod Drive Control System (CRDCS) Testing

The control rod drive control system (CRDCS) is similar to the systems licensed and operated in several operating plants. The CRDCS is given a preoperational and calibration test by the vendor in accordance with a B&W approved test procedure. Each CRDCS is given a complete functional composite test by the vendor in accordance with an approved B&W test procedure before being shipped to the field. This is a production acceptance test used to verify the design of the system and the performance of the as-built hardware.

Once the system is onsite, additional tests are performed to ensure correct operation of the system. These tests consist of:

a. Calibration of position amplifiers, power supplies, setpoint detectors, group average amplifiers, etc

b. Functional testing of control logic, control circuits, and power conversion equipment

c. Verification of position and power patch arrangement

d. Verification of the Class 1E circuit breaker trip time

e. Verification of the functional operation of the control panel

f. Trip testing of CRDCS power supply breakers actuated by the reactor protection system

The manufacturer's composite test and the customer's onsite functional test are used to verify the adequacy of the CRDCS in performing its safety and control functions.

4.6.4 INFORMATION FOR COMBINED PERFORMANCE OF REACTIVITY SYSTEMS

The accidents that take credit for two or more reactivity control systems are described in Chapter 15. See Table 15.0-4 for listing of systems assumed to function during accidents. Reactivity control is provided by control rods and soluble boron. The CRDCS provides a positive means of inserting the control rods. The emergency core cooling system (ECCS), which consists of the high-pressure injection system, low-pressure injection system, and core flooding systems, provides the means of injecting soluble boron in the reactor coolant system following a postulated accident. Isometrics for the ECCS are shown in Figures 3.6-8, 3.6-9, 3.6-20, 3.6-21, 3.6-22, and 3.6-23. The chemical addition system, Subsection 9.3.8, in conjunction with the makeup and purification system, provides for reactivity changes resulting from planned normal power changes and is capable of initiating and maintaining cold shutdown in the reactor; since these systems are not required for Chapter 15 accidents, evaluation of postulated malfunctions is not addressed. | 27

4.6.5 EVALUATION OF COMBINED PERFORMANCE

Reactivity control for Chapter 15 accidents is provided by control rod insertion via the CRDCS and by soluble boron via the ECCS. The CRDCS and ECCS are not susceptible to common mode failures because of physical separation and diversity of design. Table 4.6-2 lists possible causes of common mode failures and the resultant effect upon combined performance. The CRDM portion of the CRDCS was evaluated for mechanical failure of a significant number of control rods to insert into the reactor core by trip of loss of power to the CRDM stator coils. Simultaneous mechanical common mode failures of the trip function in all CRDMs was demonstrated to be not credible. The results of this analysis are presented in Topical Report BAW-10101P. The ac trip breakers and related equipment were evaluated for possible common mode failures. Prevention of trip capability because of the proximity of Class 1E and non-Class 1E circuitry in the areas of the breaker enclosure is not credible. Electrical shorts downstream of the trip breakers, which would be capable of retaining a number of rods withdrawn, was investigated and it was found that no credible power source is available to produce this situation. | 27

Common mode failures involving the trip breaker undervoltage coil were also postulated. If sufficient dirt/grease accumulated on the armature extension of this coil, the undervoltage device could be held closed, thereby holding the ac trip breakers closed, even if a trip condition was present. Periodic mechanical adjustments of the trip breaker undervoltage coils are necessary. Therefore, it is also conceivable that an improper adjustment of the setting screw could cause the undervoltage device to fail to function. These failures will be prevented by | 3

Tables (continued)

Section and Number	Title	
5.3-3	Specimen Content of Each Capsule Contained in Midland NSS-12 and NSS-13 Reactor Vessels	
5.3-4	Baseline Specimens for Both the Midland NSS-12 and NSS-13 Reactor Vessels	8
5.3-5	Compact Fracture Specimen Dimensions	
5.3-6	Dosimeter Neutron Detecting Elements	
5.3-7	NSS-12 and NSS-13 Withdrawal Schedules	
Section 5.4		
5.4-1	Reactor Coolant Pump Design Data	
5.4-2	Summary of RC Pump Design Quality	
5.4-3	Loading Conditions and Stress Limits: Code Class 1 Pressure Vessels	
5.4-4	Loading Combination and Stress Limits for Reactor Coolant System Piping (NSSS Scope)	27
5.4-5	Nondestructive Examinations	
5.4-6	DHR Valve Description	
5.4-7	Decay Heat Removal System Heat Exchanger Data Primary Condition	
5.4-8	Decay Heat Removal System Heat Exchanger Data Secondary Condition	
5.4-9	DHR Pump Available and Required NPSH	
5.4-10	DHR System Relief Valves	
5.4-11	Mode Diagram for the DHR System	
5.4-12	Decay Heat Removal System Failure Modes and Effects Analysis	
5.4-13	Pressurizer Relief Discharge System Design Data	
5.4-14	Leakage Cracks in Decay Heat Removal System Piping	14

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TABLE 5.1-5

STEAM GENERATOR DESIGN DATA

Item	Data per Steam Generator	
Steam conditions at full load, outlet nozzles		
Steam flow, lb/h	5.12×10^6	
Steam temperature, °F	570 (35F superheat)	
Steam pressure, psig	910	
Feedwater temperature, °F	430	
Reactor coolant flow, lb/h	65.7×10^6	
Reactor coolant side		
Design/operating pressure, psig	2,500/2,151	
Design/operating temperature, °F		
Inlet	650/604	27
Outlet	650/554	
Hydrotest pressure, psig	3,125	
Coolant volume (hot), ft^3	2,041.3	27
Secondary side		
Design/operating pressure, psig	1,050/910	
Design temperature, °F	600	
Hydrotest pressure, psig	1,312.5	
Net volume, ft^3	3,219.8	27
Dimensions		
Tubes, od/min wall, in.	0.625/0.034	
Overall height (including skirt), ft/in.	73/2-1/2	
Shell, od, in.	151-1/8	
Shell minimum thickness (at tubesheets and feedwater connect), in.	6.625	
Shell minimum thickness, in.	4.1875	
Tubesheet, thicknesses, in.	24	
Dry weight, lb	1,144,500	
Exposed tube length, ft/in.	52/1-3/8	
Nozzles - reactor coolant side		
Inlet nozzle id., in.	36	
Outlet nozzle, id., in.	28	
Drain nozzle, in.	1, Sch 160	
Manway id., in.	16	
Handholes, in.	5	

TABLE 5.1-5 (continued)

Item	Data per Steam Generator	
Nozzles - secondary side		
Steam nozzle od, in.	24	27
Vent nozzle, in.	1-1/2, Sch 80	
Drain nozzle, in.	1-1/2, Sch 80	
Drain nozzle, in.	1, Sch 80	
Level sensing nozzle, in.	1, Sch 80	
Thermowell id., in.	3/8	
Manway id., in.	16	
Feedwater nozzle, in.	3, Sch 80	27
Auxiliary feedwater nozzle, in.	6, Sch 80	
Handholes dia, in.	5	

TABLE 5.1-6 (continued)

Frequency, Hz	60	
Insulation class	F	
Starting current (full voltage), A	4,000 max	
Power (nameplate), hp	9,000	
Power input (hot reactor coolant), bhp	6,250	26
Power input (cold reactor coolant), bhp	8,450	
Rotor moment of inertia, $lb\text{-}ft^2$	70,000	
Motor weight, lb	100,000	

TABLE 5.1-7

REACTOR COOLANT SYSTEM PIPING DESIGN DATA

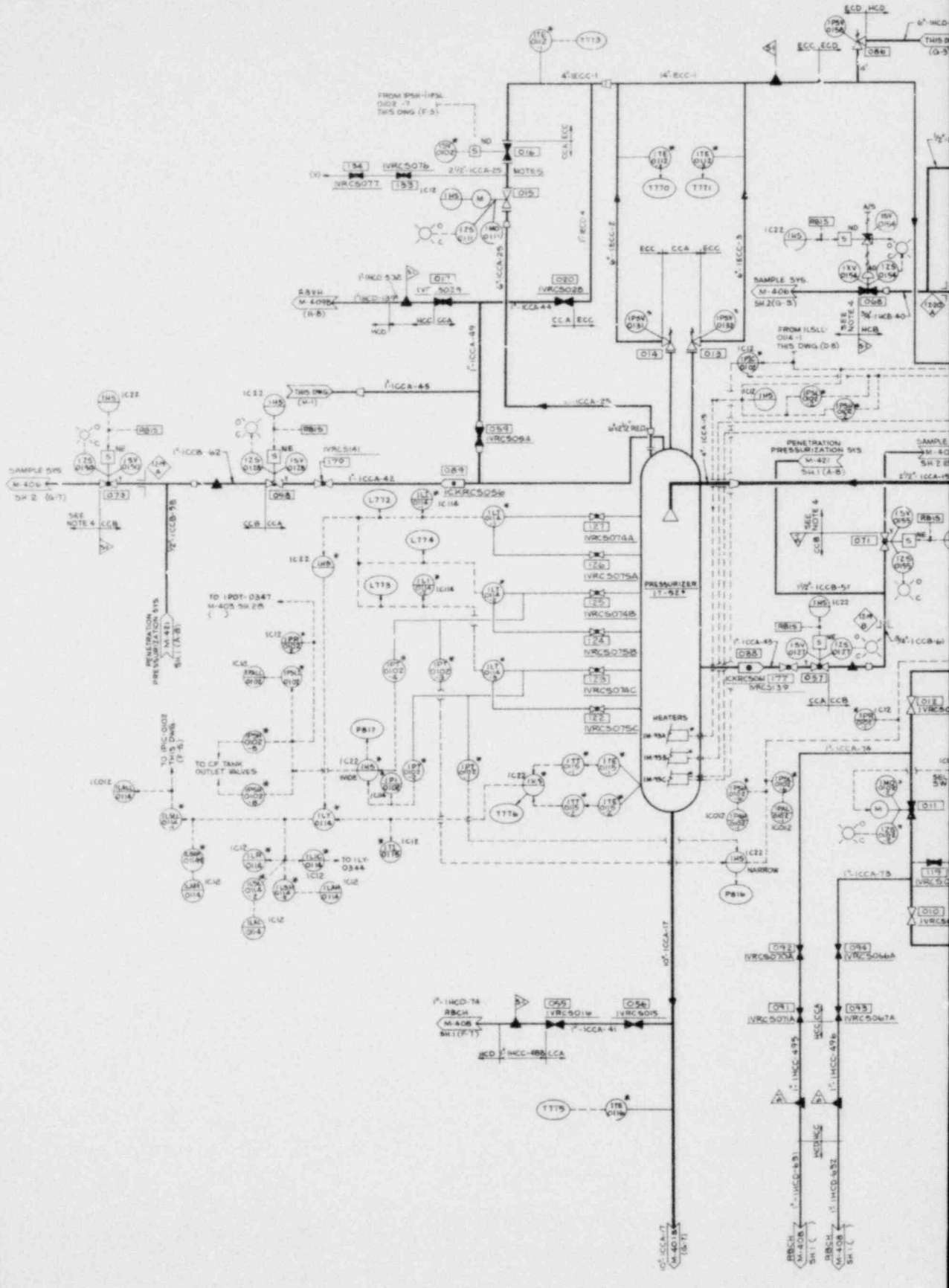
Reactor Inlet Piping		
Pipe, id., in.	28	
Design pressure/temperature, psig/°F	2,500/650	
Operating pressure/temperature, psig/°F	2,242/554	27
Hydrotest pressure, psig	3,125	
Minimum thickness, in.	2-1/16	27
Coolant volume (hot-system total), ft^3	1,039	
Dry weight, system total, lb (estimated)	217,414	27
Reactor Outlet Piping		
Pipe, id., in.	36	
Design pressure/temperature, psig/°F	2,500/650	
Operating pressure/temperature, psig/°F	2,175/604	27
Hydrotest pressure, psig	3,125	
Minimum thickness, in.	2-5/8	27
Coolant volume (hot-system total), ft^3	965	
Dry weight, system total, lb (estimated)	199,487	
Pressurizer Surge Piping		
Pipe size, in.	10, Sch 140	
Design pressure/temperature, psig/°F	2,500/670	
Operating pressure/temperature, psig/°F	2,215/650	
Hydrotest pressure, psig	3,125	
Coolant volume, hot, ft	23.5	
Dry weight, lb (estimated)	5,516	
Pressurizer Spray Piping		
Pipe size, in.	2-1/2, Sch 160	
Design pressure/temperature, psig/°F	2,500/650	
Operating pressure/temperature, psig/°F	2,245/575	
Hydrotest pressure, psig	3,125	
Coolant volume, hot, ft^3	3.4	
Dry weight, lb (estimated)	4,368	

TABLE 5.1-7 (continued)

Nozzles

Function	No.	Size, in.	Material	
On reactor inlet piping				
High-pressure injection	4	2-1/2 Sch 160	Carbon steel, SS clad[1]	
Pressurizer spray	1	2-1/2 Sch 160	Stainless steel	
Drain/letdown	1	2-1/2 Sch 160	Carbon steel, SS clad[2]	
Drain	3	1-1/2 Sch 160	Inconel	
Level indicating	1	3/4 Sch 160	Inconel	27
Thermowell, id.	4	3/8	Inconel	
Fast response temp conn	4	0.623	Inconel	
On reactor outlet piping				
Decay	1	12 Sch 140	Carbon steel, SS clad[1]	
Vent	2	1 Sch 160	Inconel	
Conn on flowmeters	8	1 Sch 160	Inconel	
Pressure sensing	4	3/4 Sch 160	Inconel	
Thermowell, id.	2	3/8	Inconel	
Fast response temp conn	6	0.623	Inconel	
Surge line	1	10 Sch 140	Carbon steel, SS clad[1]	
On pressurizer surge piping				
Drain	1	1 Sch 160	Stainless steel	
On pressurizer spray piping				
Auxiliary spray	1	2-1/2 Sch 160	Stainless steel	
Spray valve bypass	2	2-1/2 Sch 160	Stainless steel	
Drain	2	1 Sch 160	Stainless steel	27
Vent	2	1 Sch 160	Stainless steel	
Temperature connection	1	1-1/2 Sch 160	Stainless steel	

[1] With stainless steel safe end added after stress relief
[2] With Inconel safe end


PRESSURIZER
17-52
HEATERS
1M-15A
1M-15B
1M-15C
PENETRATION PRESSURIZATION SYS
M-421
SH 1 (A-8)
SAMPLE SYS
M-406
SH 2 (G-7)
SAMPLE SYS.
M-406
SH 2(G-5)
RBCH
M-408
SH 1 (F-7)
RBCH
M-408
SH 1 (C-7)
RBCH
M-408
SH 1 (C-7)
TO IPDT-0347
M-405 SH 2B
TO IPIC-0102
THIS DWG
(F-6)
TO CF TANK
OUTLET VALVES
FROM IPSH-1PSH
0103 -7
THIS DWG (F-8)
FROM ILSLL
0114-1
THIS DWG (D-8)
SEE NOTE 4
SEE NOTE 6
WIDE
NARROW
ECD HCD
ECC ECD
ECC CCA ECC
CCA ECC
CC A ECC
HCC CCA
HCD
CCA CCB
CCB CCA
ICKRC5056
IVRC5039
IVRC5074A
IVRC5075A
IVRC5074B
IVRC5075B
IVRC5076C
IVRC5075C
IVRC5054
IVRC5028
IVRC5077
IVRC5076
IVRC5014
IVRC5016
IVRC5015
IVRC5071A
IVRC5067A
IVRC5073A
IVRC5066A
IVRC5012
IVRC5010
IVRC5011
IVRC5009
IVRC5013
IVRC5008
IVRC5007
IVRC5006
IVRC5005
IVRC5004
IVRC5003
IVRC5002
IVRC5001
IVRC5000
IVRC5119
IVRC5118
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IVRC5115
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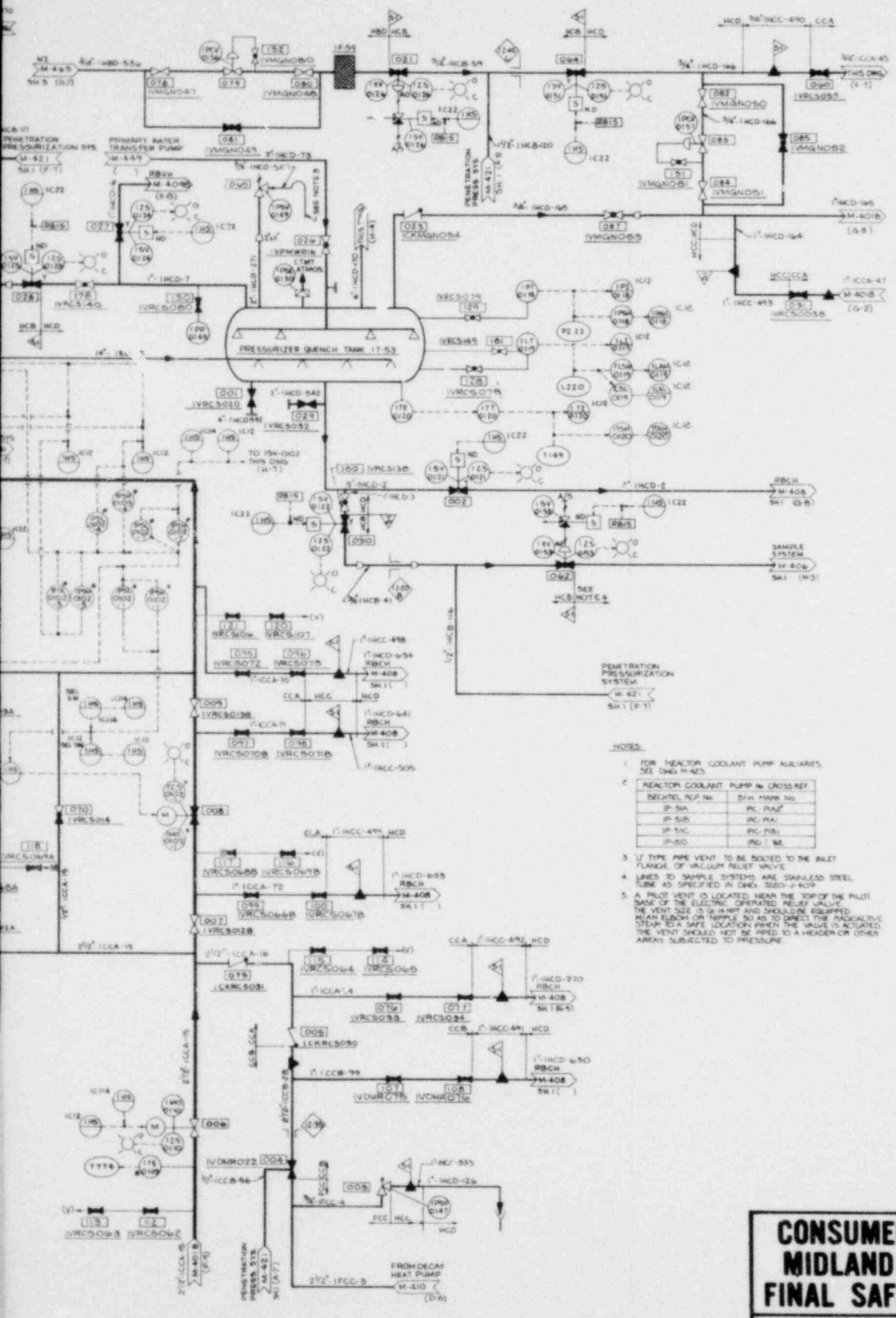
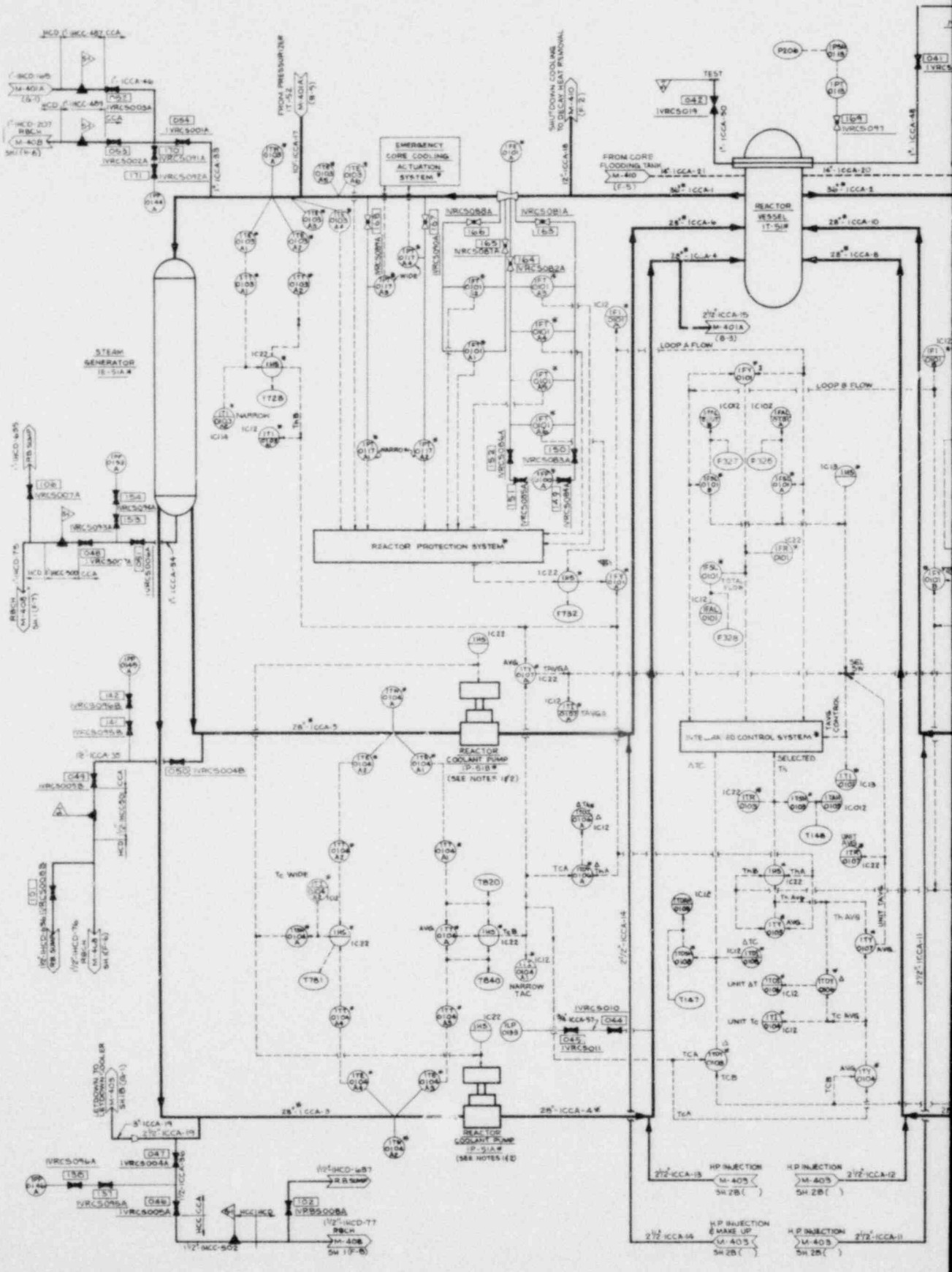
IVRC5004
IVRC5003
IVRC5002
IVRC5001
IVRC5000

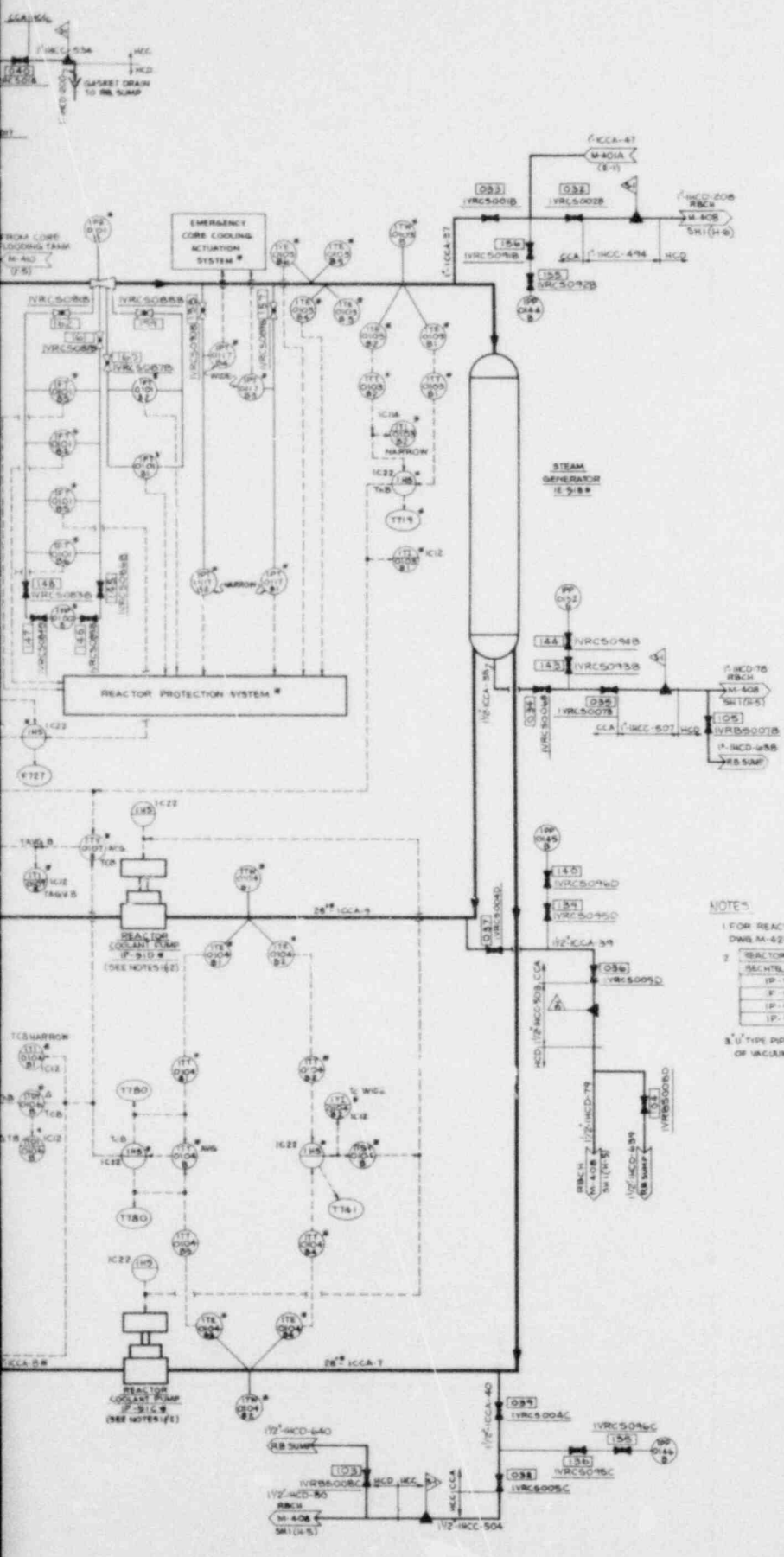


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Reactor Coolant and
Pressure Control - Unit 1
(M-401A, Rev 0)

FSAR Figure 5.1-1, sh. 1


EMERGENCY CORE COOLING ACTUATION SYSTEM
REACTOR VESSEL
STEAM GENERATOR
REACTOR PROTECTION SYSTEM
INTEGRATED CONTROL SYSTEM
REACTOR COOLANT PUMP
LOOP A FLOW
LOOP B FLOW
TOTAL FLOW
NARROW
SELECTED
UNIT ΔT
UNIT Tc
UNIT TAVG
NARROW TAC
FROM CORE FLOODING TANK
TEST
HP INJECTION
HP INJECTION & MAKE UP
TO LETDOWN COOLER



NOTES:

1. FOR REACTOR COOLANT PUMP AUXILIARIES, SEE DWG. M-425.
2.

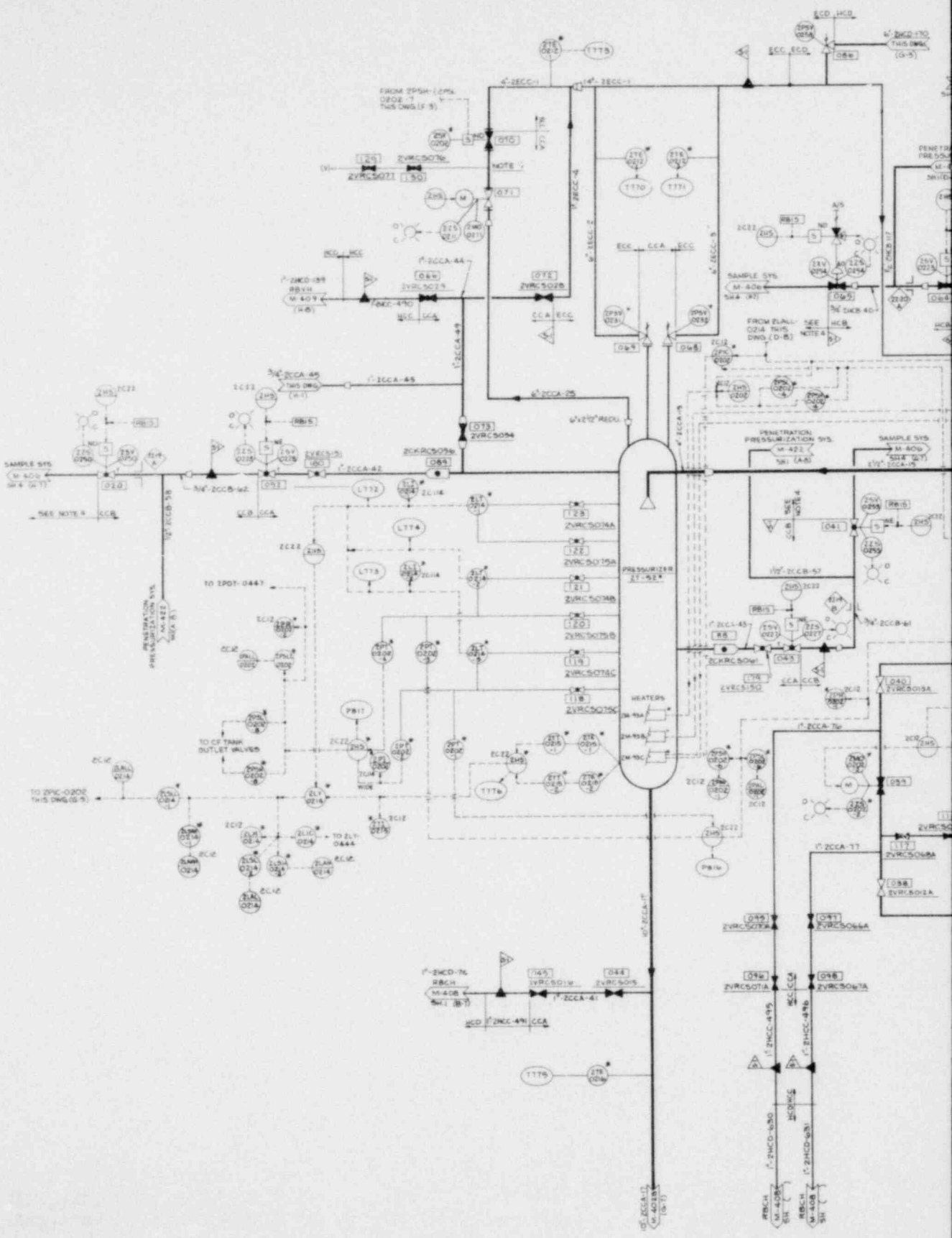
REACTOR COOLANT PUMP NO. CROSS REF.	
(BECHTEL RCP NO.)	(B&W MARK NO.)
IP-51A	IRC-P1A2
IP-51B	IRC-P1A1
IP-51C	IRC-P1B1
IP-51D	IRC-P1B2

3. 'U' TYPE PIPE VENT TO BE BOLTED TO THE INLET FLANGE OF VACUUM RELIEF VALVE.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Reactor Coolant and
Pressure Coolant - Unit 1
(M-401B, Rev 0)

FSAR Figure 5.1-1, sh. 2


PRESSURIZER
2T-92
HEATERS
2M-93A
2M-93B
2M-93C
SAMPLE SYS
M-406
PENETRATION PRESSURIZATION SYS.
M-422
TO ZPDT-0447
TO CF TANK OUTLET VALVES
TO ZPIC-0202
FROM ZPSH-LCPX
0202-7
FROM ZLALL-0214 THIS DWG. (D-8)
SEE NOTE 4
SEE NOTE 5
2CKRC5056
2CKRC5061
2CKRC5150
ZVRC5027B
ZVRC5029
ZVRC5076A
ZVRC5075A
ZVRC5074B
ZVRC5073B
ZVRC5076C
ZVRC5075C
ZVRC5019A
ZVRC5068A
ZVRC5012A
ZVRC5077A
ZVRC5066A
ZVRC5071A
ZVRC5067A
ZVRC5015
ZVRC5014
ZVRC5077B
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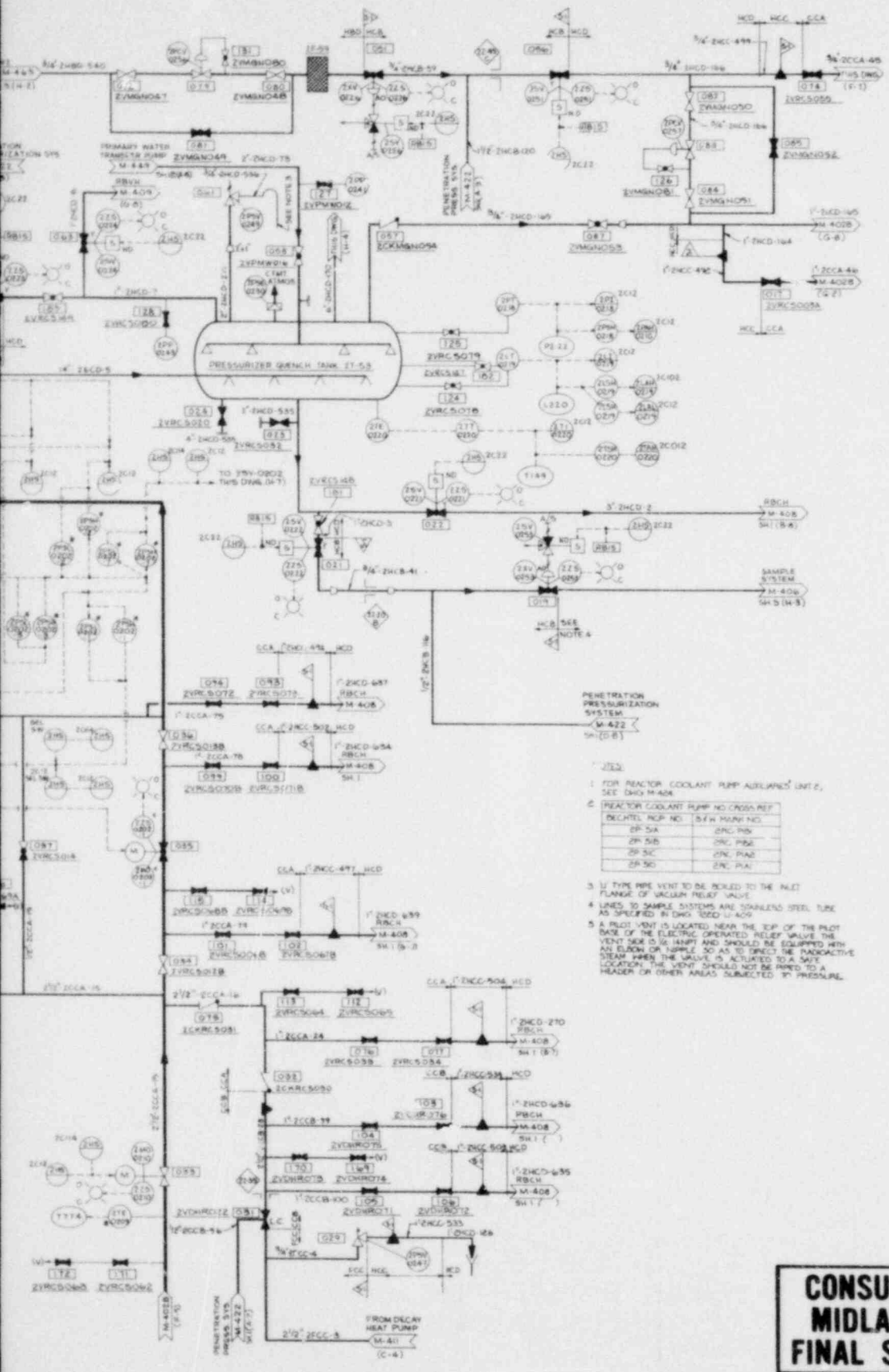
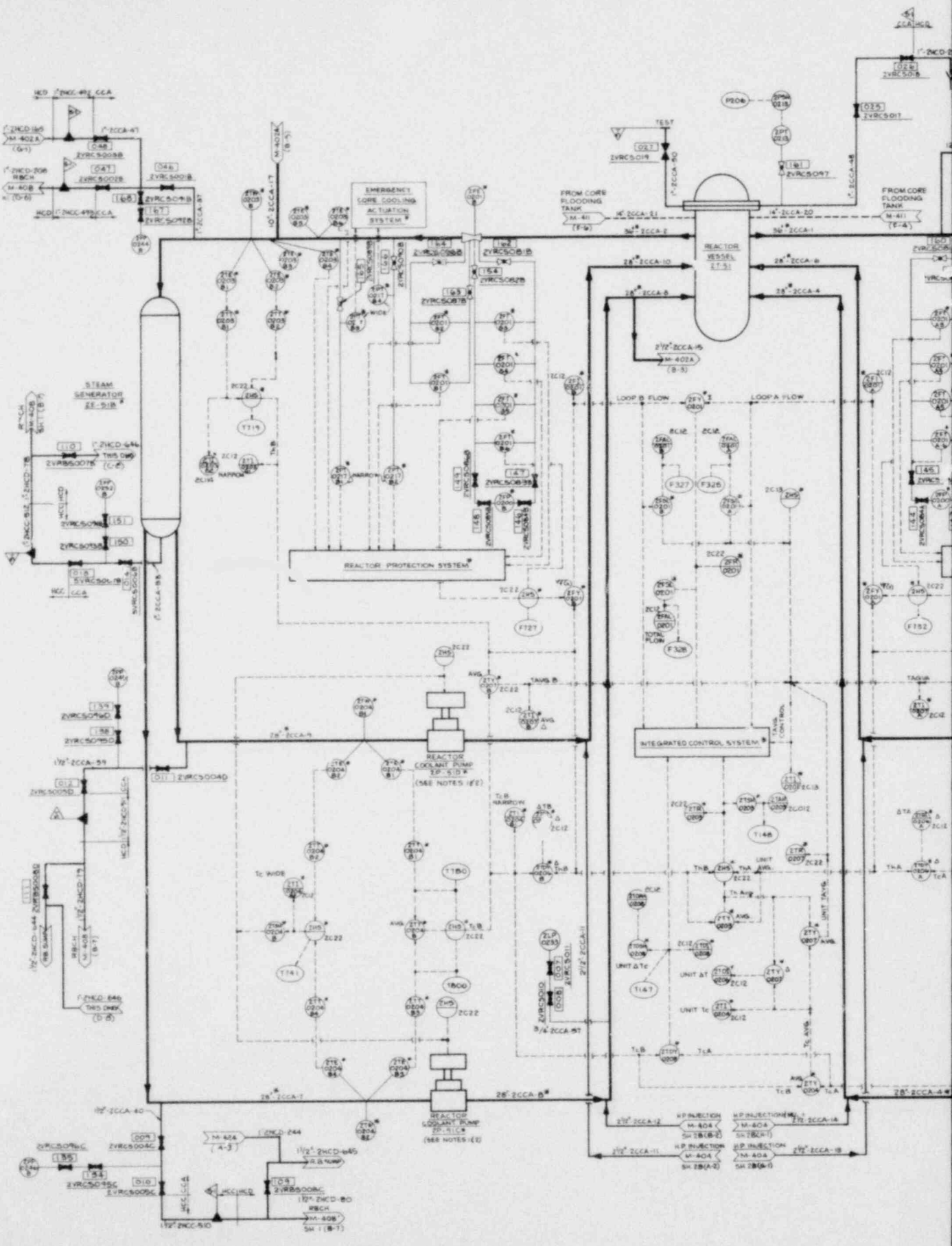
ZVRC5117

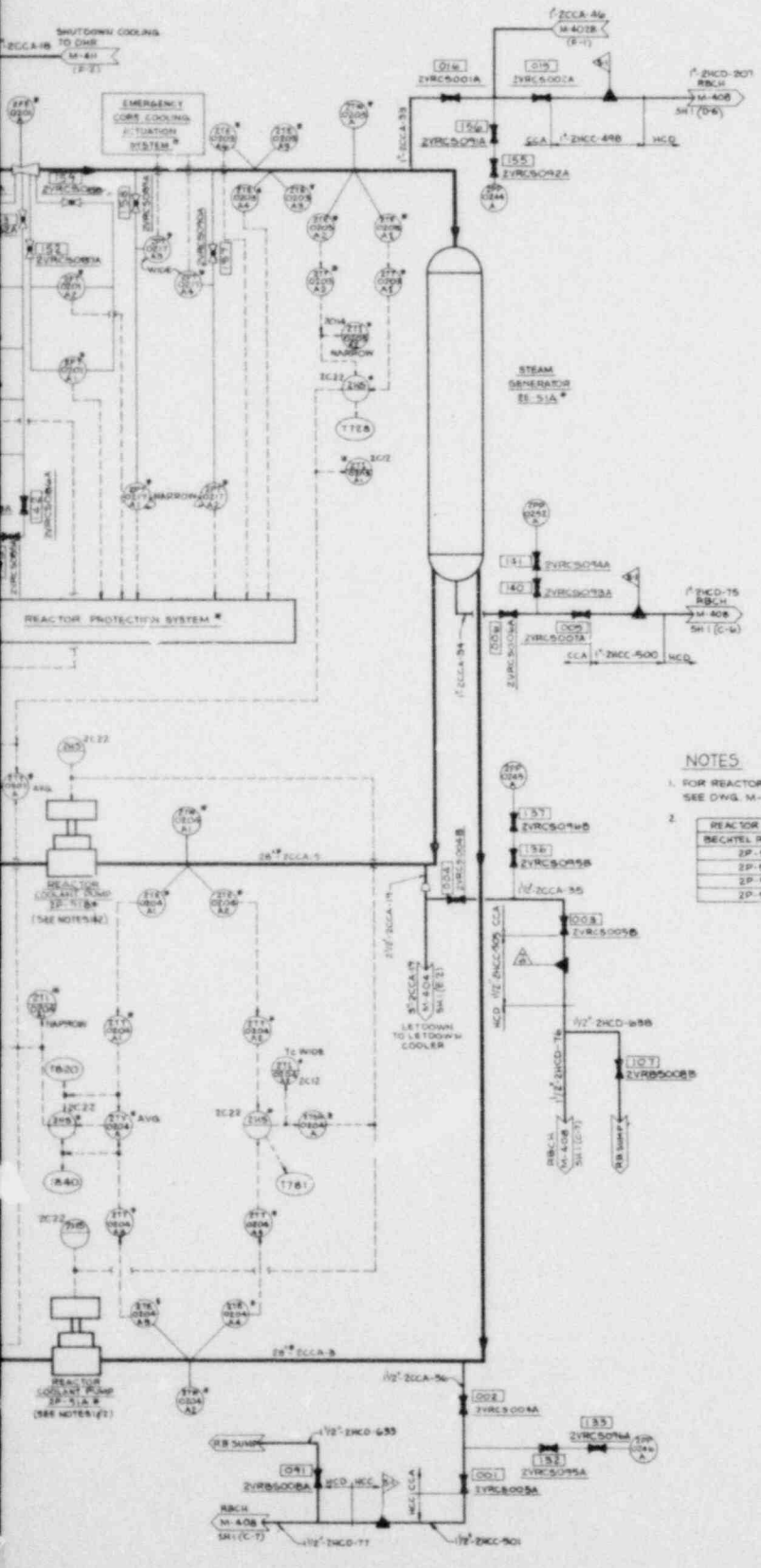


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Reactor Coolant and Pressure Control - Unit 2
(M-402A, Rev 0)

FSAR Figure 5.1-2, sh. 1


EMERGENCY CORE COOLING ACTUATION SYSTEM
REACTOR VESSEL
STEAM GENERATOR
REACTOR PROTECTION SYSTEM
INTEGRATED CONTROL SYSTEM
REACTOR COOLANT PUMP
FROM CORE FLOODING TANK
LOOP B FLOW
LOOP A FLOW
TEST
TOTAL FLOW
UNIT ΔT
UNIT Tc
UNIT Tavg
H.P. INJECTION
NARROW
WIDE


GASKET DRAIN TO RB SUMP
SHUTDOWN COOLING TO DHR
EMERGENCY CORE COOLING ACTUATION SYSTEM
STEAM GENERATOR 35-51A
REACTOR PROTECTION SYSTEM
REACTOR COOLANT PUMP 2P-51A
REACTOR COOLANT PUMP 2P-51B
LETDOWN TO LETDOWN COOLER
RB SUMP
RBCH
NARROW
WIDE
T.C. IN108
T.C. OUT
AVG.
28" 2CCA-5
28" 2CCA-6
2CCA-33
2CCA-34
2CCA-35
2CCA-36
2CCA-46
2HCD-207
2HCD-75
2HCC-498
2HCC-500
2HCC-501
2HCD-77
2HCD-693
2HCD-78
2HCD-658
2HCD-659
2HCD-660
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2HCD-696
2HCD-697

5.4 COMPONENT AND SUBSYSTEM DESIGN

5.4.1 REACTOR COOLANT PUMP/MOTOR UNIT

5.4.1.1 Design Basis

The reactor coolant (RC) pumps are designed to provide flow of coolant between the reactor vessel and the steam generators. The pumps are designed in accordance with the requirements of the ASME Code, Section III. The design considers all facets of plant operation for a 40 year life, including preoperational testing, normal operation, abnormal operation, and accident conditions. | 27

5.4.1.2 Description

The RC pumps are single-stage, single-suction, constant-speed, vertical, centrifugal pumps. Each of these pumps employs a sealing system consisting of mechanical seal assemblies arranged in a removable cartridge and a seal leakage chamber to prevent RC fluid leakage to the atmosphere. Each mechanical seal is designed for full reactor coolant system (RCS) pressure. A view of the pump is shown in Figure 5.4-1 and the principal design parameters are listed in Table 5.4-1. The performance characteristics are shown in Figure 5.4-2. | 27

The pump casing consists of a bottom suction inlet passage, which delivers the coolant to the pump impeller, and a multivane diffuser that discharges to the volute. A hydrostatic bearing is located immediately above the pump impeller. The pump casing is welded into the piping system, and the pump internals can be removed for inspection or maintenance without removing the casing from the piping.

Each pump has a separate, single-speed, top-mounted electric drive motor, which is connected to the pump by a removable portion of the coupling. A motor support stand is used as the transition piece between the motor and the pump, which, in conjunction with the removable portion of the coupling, allows pump seal replacement without removing the drive motor. The hydrostatic bearing, the internal seal cooler, and the seal cartridge containing the mechanical seals are mounted on and extend within the lower flange of the motor support stand. The shaft is sealed using a mechanical seal system containing a combination of face-type mechanical seals in series. Water for lubricating and cooling the seals is injected below the first mechanical seal at a pressure to give flow into the pump. Most of the injection water flow passes into the pump casing through a close-running restriction bushing, and the remainder flows upward through the mechanical seals. Pressure breakdown devices carry a small flow in parallel with the face-type mechanical seals and are designed to equalize the pressure drops, so that each seal takes a portion of the total pressure. Staging flow from the pressure breakdown devices leaves the pump through the controlled

bleedoff line to join the return line to the injection water supply system. Any leakage past the last seal is discharged into a standpipe where it is mixed with fresh water from the demineralized water system. The standpipe contains a high/low level alarm and an overflow and drain to the pump seal drain tank. 27

Component cooling water is also furnished to the pump as a backup to the seal injection water system. The cooling water flows to an internal heat exchanger that cools the water entering the mechanical seals. The heat exchanger is sized to provide enough cooling capacity to prevent excessive heating of the mechanical seals upon loss of seal injection water.

The RC pump motors are totally enclosed with air-to-water heat exchangers to provide closed circuit cooling air flow through the motor. The motors are equipped with an anti-reverse device to prevent back-rotation of the RC pump. A flywheel on the motor shaft is provided for the additional rotational inertia necessary to continue reactor coolant flow for coastdown requirements. Radial bearings are provided for the motor and are lubricated by oil. In addition to radial bearings, oil-lubricated thrust bearings are provided within the motor. These bearings are designed to carry the full thrust of the pump and motor unit. Heat is transferred from the combination thrust and upper guide bearing lubricating oil to a cooling water system by a heat exchanger mounted on the structure and from the lower guide bearing lubricating oil by a heat exchanger submerged in the oil reservoir. A thrust-bearing, oil-lift system is provided to ensure the establishment of oil films simultaneously on both the up- and down-thrust bearing surfaces during startup and shutdown of the RC pump. A hydrodynamic oil film is established on the thrust bearing surfaces during normal operation. 27 27

5.4.1.3 Safety Evaluation

The safety evaluation of the structural integrity of the reactor coolant pump/motor is found in Subsection 3.9.3 and the summary of the reactor coolant pump design quality is shown in Table 5.4-2.

5.4.1.3.1 Reactor Coolant Pump

The RC pump (Figure 5.4-1) comprises pressure-retaining parts covered by the ASME Code as well as pump components such as pump hydraulic parts (impeller, diffuser), rotating assembly, and seal system, none of which are covered by the ASME Code.

By code definition, pressure-retaining parts are the casing, motor support stand bottom flange that forms the pump casing closure, closure studs and nuts, and the heat exchanger and piping to the first terminal flange. The parts that form a part of the reactor coolant pressure boundary (RCPB) are classified

quality group A, Seismic Category I. Parts of the heat exchangers exposed to component cooling water are classified quality group C, Seismic Category I. In addition, the loss of one of the two diverse cooling sources (seal injection water or component cooling) or a single failure of a pressure boundary in the heat exchanger will not expose the pump seals to severe temperature or pressure transients.

STRUCTURAL SUPPORTS - The pump-motor unit is supported by the piping system. Attachment points for seismic and LOCA restraints and snubbers are provided on top and bottom flanges of the motor support stand. The pump-motor support and restraint system is described in Subsection 5.4.14. These supports are designed as Seismic Category I structures. Loadings for this design are derived from the dynamic analysis of the RCS and supporting structures as described in Section 3.7.

PUMP HYDRAULIC PARTS - The diffuser is a structural portion of the pump volute, and its attachment is designed for operating hydraulic and seismic forces associated with the pump. The impeller is the rotating part of the pump hydraulics and is also designed for operating hydraulic forces. It is held within its running clearances by a stiff shaft and pump bearing assembly. The stiffness of this system is functionally determined by the critical speed criterion specified by B&W. This criterion requires the combined pump and motor to have a calculated critical speed at least 1.3 times the running speed. In the unlikely event that the impeller should momentarily impact one side of the wear ring, the labyrinth grooves (creating a small contact area) in the ring would prevent seizure.

ROTATING ASSEMBLY - As pointed out above, the rotating assembly design maintains its rotor dynamic characteristics within limits that produce smooth pump operation in this size range. The pump bearing is conservatively designed for normal operational and seismic loads.

In summary, pressure-retaining parts comply with quality group classifications of Regulatory Guide 1.26, and the pressure boundary, rotating assembly, and structural supports comply with the Seismic Category I requirements of Regulatory Guide 1.29 in that the seismic design event will not cause a breach of the RCPB during a seismic occurrence.

5.4.1.3.2 Reactor Coolant Pump Motor

The RC pump motor is designed, fabricated, erected, and tested in accordance with the rules of the applicable NEMA and IEEE standards. Coastdown capability after the loss of electric power to the RC pump motor is provided by the mechanical power derived from the kinetic energy contained in a flywheel secured to the motor shaft.

The flywheel meets the requirements of NRC Regulatory Guide 1.14 as described in Subsection 5.4.1.7. This item also meets the requirements of the B&W QA program described in Topical Report BAW-10096A, which complies with 10 CFR 50, Appendix B.

5.4.1.4 Evaluation

The total stress resulting from thermal expansion, pressure, and mechanical and seismic loadings is considered in the design of the RC pumps. The total stresses expected in the pumps are within the maximum allowed by the ASME Code, Section III.

During the pump performance test program the RC pump/motor shaft axial and orbital displacements were monitored at the lower end of the coupling train and were found to be within the specified limits.

5.4.1.5 Tests and Inspections

All RCPB materials and associated fabrication procedures will meet the requirements of the specified code. Table 5.4-5 lists the inspections to be performed.

5.4.1.6 Pump Motor Overspeed Protection

The maximum speed that the rotor of the pump motor could attain during a loss-of-coolant accident (LOCA) due to the RC pump being driven as a turbine is being evaluated as discussed in the Regulatory Guide position for Guide 1.14, Reactor Coolant Pump Flywheel Integrity, found in Appendix 3A.

5.4.1.7 Pump Flywheel Integrity

Reactor coolant pump motor flywheel integrity is assured by compliance with provisions of Regulatory Guide 1.14 as stated in the response to Regulatory Guides (Appendix 3A). Information confirming the criteria for flywheel integrity, not included in the B&W statement "R.G. 1.14 Reactor Coolant Pump Flywheel Integrity" (Appendix 3A), is listed below (Subsections 5.4.1.7.1 to 5.4.1.7.6). | 27

5.4.1.7.1 Nil-Ductility Transition (NDT) Temperature Requirement (R.G. 1.14 C1a)

The highest NDT recorded on all flywheel material for the Midland plant was -170F confirming that each flywheel met the specified NDT of -50F.

5.4.1.7.2 Charpy V-Notch (Cv) Upper Shelf Energy Requirement (R.G. 1.14 C1b)

Figure 3A.1.14-1 of Appendix 3A shows the lowest upper shelf of the absorbed energy (70 ft-lb) of all of the flywheel materials used for the Midland plant confirming that all flywheels meet the minimum (50 ft-lb) specified.

5.4.1.7.3 Volumetric (Ultrasonic) Examination Requirement (R.G. 1.14 C1d)

All of the Midland plant flywheels received a 100% volumetric (ultrasonic) examination as described in R.G. 1.14, the results of which showed no reportable indications.

5.4.1.7.4 Liquid Penetration Examination Requirement (R.G. 1.14 C1f)

All of the Midland plant flywheels received a liquid penetration examination, the results of which showed no reportable indication.

5.4.1.7.5 Combined Primary Stress at the Design Speed (1,500 rpm)

The combined primary stresses at the design speed of 1,500 rpm, due to centrifugal forces (22,582 psi) and the interference fit of the wheel on the shaft (4,050 psi), are 26,632 psi which is 31% of the 85,000 psi specified yield strength of the material or less than the 1/3 of specified yield strength that is specified at the normal operating speed of the flywheel.

Subsection 5.4.1.7 is written to amplify the response for Regulatory Guide Position 1.14, given in Section 3A. Section 3A (Paragraph C.1 of Regulatory Guide 1.14) explains that the material, A-543-70 Grade B, used for flywheels, exhibits fracture-toughness characteristics which are in excess of the requirement, 100 K ksi (dynamic), found in Paragraph C.1.c of the Guide. To relate the flywheel-material toughness to flywheel safety, an analysis was made to determine the nonductile failure characteristics of the flywheel. Nonductile failure characteristics are shown in Figure 3A/1.14-3, where "a" (see FSAR Figure 3A/1.14-3) is the minimum crack size observable by nondestructive examination. 8 27

5.4.1.7.6 Overspeed Test

One of the eight flywheels supplied to the Midland plant was successfully tested at 125% of the normal speed of the flywheel (1,500 rpm) as was suggested in a formal meeting with the NRC to provide additional assurance of flywheel integrity and provide an acceptable degree of compliance with Position C.3 of Regulatory

Guide 1.14 by performing a "type test" on one of these eight flywheels.

The successful conclusion of the flywheel spin test was witnessed by the nuclear supplier and performed (at the RC pump motor vendor's manufacturing facility) in conformance with a previously approved test procedure that specified rotating the flywheel at 125% of normal operating speed (1,500 rpm) with an examination of the flywheel before and after the flywheel had been rotated at sustained 1,500 rpm, for assurance that the flywheel integrity had not been impaired as a result of the test. The spin test has been completely documented in a test report for retention by CPCo.

5.4.1.8 Loss of Cooling Water Analysis

Component cooling water is used as the primary source of cooling the reactor coolant pump motor bearings and is used as a secondary source of cooling for the reactor coolant pump seals. The primary source for cooling the reactor coolant pump seals is seal-injection water from the makeup and purification system, which is designated as Seismic Category I, and is classified Quality Group B in accordance with Regulatory Guide 1.26. The reactor coolant pump, as described in Subsection 5.4.1.2, contains a hydrostatic bearing which operates in and at the temperature of the primary system fluid. Loss of component cooling water and/or seal injection will have no adverse effect on the operation of the bearing. The reactor coolant pump motor bearings are cooled only by component cooling water and a failure of the nonseismic component cooling water (CCW) system will result in higher temperatures in the motor bearings when the unit is operating. An analysis performed by the General Electric Company demonstrates that the reactor coolant pump motors are capable of operating without component cooling water for a period greater than 30 minutes without loss of function. The General Electric report analytically demonstrates that the oil-lubricated bearings in the reactor coolant pump drive motor will operate without failure for up to 62 minutes following a postulated loss of component cooling water. The GE report, Analysis of Bearing Failure on LM&G 9,000 HP Vertical Pump Motor Resulting from Oil Cooler Failure, dated October 10, 1977, is summarized below. 3 18 3

> The effect of lubricant cooling system failure on the safe operation of the 9,000 hp vertical pump motors being supplied for the Consumers Power Company Midland plant, Units 1 and 2, was investigated. Cooling system failure was assumed to occur during normal operation such that all lubricant coolers remained full of coolant. Normal operating conditions were defined as

N = motor speed = 1,200 rpm

Toil = mean oil reservoir temperature = 120F

T_m = mean metal temperature around the bearings = 120F

W_{th} = net thrust load on the thrust bearing = 89, 150 (Up) lb

W_{ug} = maximum upper guide bearing load = 2,500 lb

W_{lg} = maximum lower guide bearing load = 8,000 lb

As long as the motor remained energized, its speed was assumed constant at 1,200 rpm.

The purpose of this investigation was to estimate the thermal history of the motor bearings from cooling system failure to imminent bearing failure and to correlate thrust bearing thermocouple data to expected maximum film temperatures. Coupling of babbitt failure data with this information provides a basis for selecting a motor shutdown criteria which ensures a normal coast-down. A "normal coast-down" was considered to imply steady deceleration of the motor subsequent to deenergization with half speed reached within 30 seconds. 3

Analysis of the bearing systems indicated the Kingsbury thrust bearing would fail first. Since operating experience with babbitt bearings indicates that failure initiates with plastic flow of the babbitt, imminent bearing failure was assumed coincident with lubricant film temperatures corresponding to babbitt creep. Data has been obtained for defining the yield temperature of tin babbitt as a function of local stress, or equivalently, local oil film pressure. For the nominal film pressure of 840 psi, found in the present thrust bearing, the corresponding babbitt yield temperature was about 370F. Continued operation with bearing temperatures at or near this value would probably result in babbitt failure and, eventually, in shaft seizure. Short-term operation with film temperatures up to 330F could probably be tolerated as long as the minimum film thickness was greater than

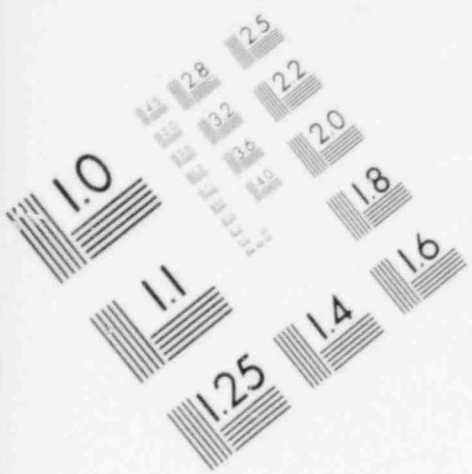
0.2 mils (nominally 10.0 times the rms surface roughness of the bearing).

The transient thermal response of the upper and lower reservoirs were determined. The upper reservoir reached critical conditions more rapidly. Film temperatures of 275, 300, and 330F were reached in the Kingsbury thrust bearing after 21.0, 34.0, and 62.0 minutes, respectively. The correlation between film temperature in the thrust bearing and the corresponding expected thermocouple measurement is presented in Figure 5.4-16. Figure 5.4-17 presents the expected time variation in the measured thrust bearing temperatures. An initial temperature of 150F was selected on the basis of Byron Jackson pump test data. 3

A thermocouple temperature of 268F (corresponding to a film temperature of 330F) is shown on Figure 5.4-17 and is reached in 62 minutes following a loss of component cooling water. If the loss of cooling water were to occur when the motor was operating near the bearing-alarm setpoint of 192F, there would be 50 minutes of motor operation before the bearing temperatures reached the threshold of a failure. 16 3

The above times and temperatures are based upon calculations performed on the bearing system supplied for the motors for these plants. The temperature ramp rate calculated above will be verified by performing a loss of component cooling water test on one of the RCP motors during plant hot functional testing. During this test with the plant at normal operating conditions, component cooling water will be secured to the upper and lower motor bearing oil pots and the bearing temperature versus time carefully monitored. The test will be terminated at the bearing upper alarm setpoint or at a temperature mutually agreed upon with the motor vendor. This test will not only verify the accuracy of the thrust bearing temperature ramp rate, but will also show that the thrust bearing is most likely to fail first. 27

Tests on motors with similar bearing systems have shown the initial bearing heatup ramp rates to be in the order of 2 to 3F per minute. Therefore, the initial 4F ramp rate calculated and depicted in Figure 5.4-17 is considered a conservative value. These times and temperatures are only given as a measure to depict the conservatism in the design and operation of these motors and is not to imply that normal operation to these limits is to be expected or allowed. Operating procedures are to be established that will address the loss of component cooling water and shutdown limits for high bearing temperatures. Experience has shown that under normal steady-state operating conditions, the bearing temperatures will be approximately 150F. However, because of variables involved, the range of these temperatures 18



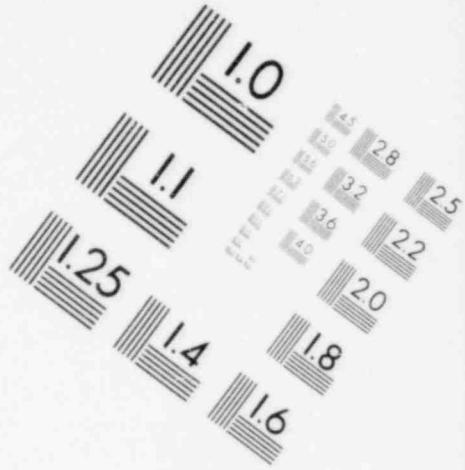
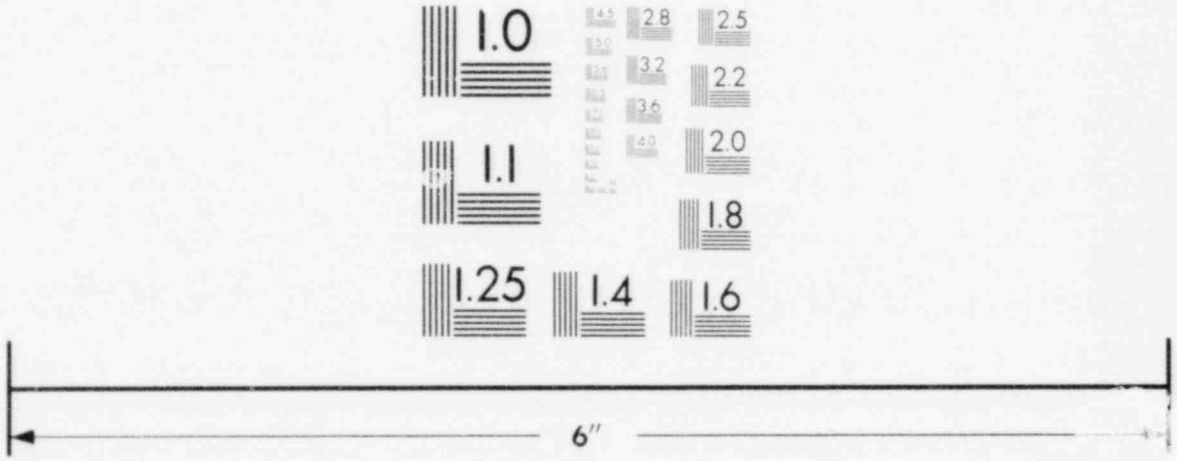
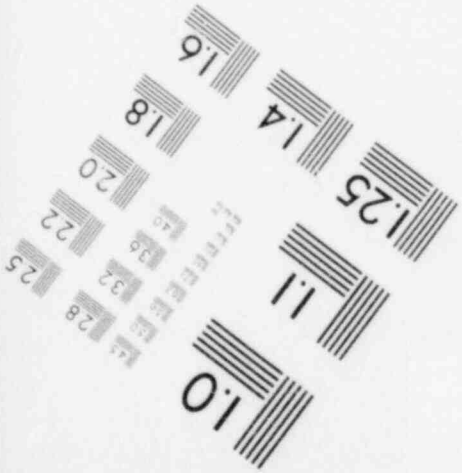
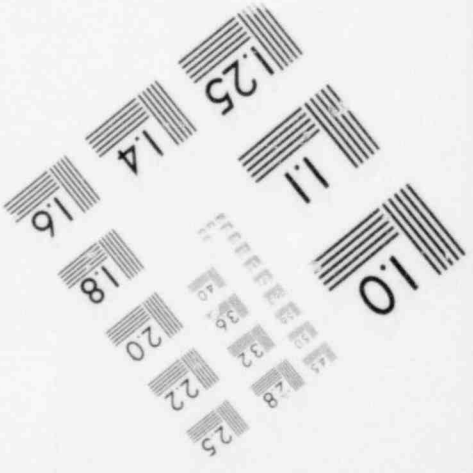


IMAGE EVALUATION
TEST TARGET (MT-3)



MICROCOPY RESOLUTION TEST CHART





may be as much as ±10F between motors. The major variables affecting these temperatures are bearing surface finish, bearing clearances, the condition of the oil, amount of oil in the oil pot, condition of the heat exchanger, and the bearing load. Because of the interaction of these variables, it is not practical to expect the operating temperatures or the heatup ramp rate of any two motors to be identical. For this reason, the normal procedure is to establish the operating temperature of each motor and then set the bearing alarm setpoint 10 to 15F higher to eliminate spurious alarm signals. Upon receiving the alarm signal, the operator must monitor the bearing temperatures continuously and shut the pump unit down if the temperature exceeds approximately 192F. Also, the procedure will include a secondary shutdown function if CCW is lost for (later) minutes and cannot be reinstated. 18 27

It should be emphasized that these temperature limits are set very conservatively to protect the equipment for prolonged service lifetime and are not an indication of pending seizure. It is contended that the loss of CCW to the reactor coolant pumps will not result in an instantaneous seizure of a single pump and, further, that instantaneous seizure of two pumps simultaneously is not a credible event because of normal operating variables. Even if bearing temperatures are allowed to exceed 268F for any length of time and a limiting condition of the babbitt metal is considered, an increasing coefficient of friction as well as an increasing retarding torque is expected. This will more realistically result only in an abbreviated coastdown. 18

As discussed above, even though it is contended that a postulated mechanistic instantaneous seizure of a pump rotor due to a loss of CCW to the RC pump will not occur and is not a credible event, this event was hypothesized and analyzed in Section 15.3.

5.4.2 STEAM GENERATORS (PWR)

The steam generators are designed to remove heat generated in the reactor system by producing superheated steam in the secondary side. Table 5.1-5 lists the values used as the design basis. The steam generators are designed in accordance with Section III of the ASME Code for Class A vessels. This design also considers any structural effect resulting from vibration, whether induced by operational or environmental conditions. Included in the design consideration are all facets of plant operation for a 40 year life.

The steam generator tubes are sized for the reactor coolant side pressures and temperatures, using methods specified in Section III, Article 4 of the ASME Code. The design data are specified in Table 5.1-5. The supporting effects of secondary side pressure are not considered in sizing the tubes. The tubes are designed for the system transients specified in Table 3.9-2. The

applicable design stress intensity limits are as shown in Table 5.4-3.

DESCRIPTION - The steam generator is shown in Figure 5.4-3. The steam generator is a vertical, straight tube and shell heat exchanger producing superheated steam which is controlled to maintain a constant throttle pressure over the power range.

STEAM GENERATOR OPERATION - Figure 5.4-4 shows the flowpaths in the steam generator. Reactor coolant enters the upper hemispherical head through a single inlet nozzle, flows downward through the tubes, and discharges through two outlet nozzles in the lower hemispherical head. The high-pressure parts of the unit are the hemispherical heads, tubesheets, and straight Inconel tubes between tubesheets.

The shell, the outside of the tubes, and the tubesheets form the boundaries of the steam producing section of the vessel. Within the shell, the tube bundle is surrounded by a baffle, which is divided into two sections. The upper part of the annulus between the shell and baffle is the superheater outlet, and the lower part is the feedwater inlet heating zone. Tube supports hold the tubes in a uniform pattern along their length.

Vents, drains, instrumentation nozzles, and inspection openings are provided on the shell side of the unit. The reactor coolant side has manways and inspection openings on both heads, and a drain nozzle for the bottom head. Venting of the reactor coolant side of the unit is accomplished by a vent connection on the reactor coolant inlet pipe to each unit. The unit is supported by a skirt attached to the bottom head.

autoclave tests were conducted to determine if preferential attack on OTSG tubing in service may be expected at tube support areas. The results of the wear test were used to predict a maximum tube wear of 2 mils after 40 years of vibration under the test conditions. This amount of wear will not reduce the tube wall below the minimum pressure thickness and is well within the tube thinning margins defined above. The results of the autoclave tests indicated that there was no preferential corrosive attack on the wear surfaces.

5.4.2.1 Steam Generator Materials

5.4.2.1.1 Selection and Fabrication of Materials

The selection and fabrication of materials is in accordance with ASME Code Section III for Class A vessels for pressure retaining components on both the primary and steam or secondary side of the steam generator. The pressure retaining materials used in the steam generator are listed in Table 5.2-3. As noted, the primary side materials are austenitic stainless steel, alloy 600 (NiCrFe alloy), or ferritic materials weld-overlay-clad with these materials. Secondary side materials, with the exception of the alloy 600 tubing, are carbon or low alloy steel. The suitability of these materials under expected operating conditions is well documented.

Fabrication and processing of materials is discussed as part of the RCPB in Subsection 5.2.3. The upper and lower tubesheet primary faces are clad with Inconel 600 weld metal to facilitate welding of the tubes to the tubesheets. The tubes are mechanically rolled for a short length into the tubesheet and welded using the automatic tungsten inert gas process. All welding and weld inspections are performed in accordance with the requirements of Sections III and IX of the ASME Code. After completion of the vessel, the entire steam generator, including the tubing, is subjected to a stress relief heat treatment at 1,100-1,150F.

Cleanliness controls utilized in fabrication and construction are discussed in Subsection 5.2.3.4. Since the once-through steam generator is completely shop assembled, cleanliness during shipment can be readily maintained.

The code cases used in the materials design for the steam generator are discussed in Subsection 5.2.1.2.

The pressure-retaining ferritic materials for both the RCPB of the steam generator were ordered and tested in accordance with the fracture toughness criteria of the ASME Code and addenda listed in Table 5.2-1. This information is provided in Subsection 5.2.3.3.1. The Charpy V-notch requirements of the referenced specification were met at a temperature of 40F or lower. All pressure retaining components on the steam side of

the steam generator were ordered to and tested in accordance with the requirement for the RCPB of the steam generator.

5.4.2.1.2 Steam Generator Design

Corrosion control and water chemistry characteristics of the once-through steam generator design with regard to the performance of steam generator materials are discussed in Subsection 5.4.2.1.3.

The straight shell, straight tube design of the once-through steam generator eliminates U-bends in the tubes and allows the use of a special tube support plate design throughout the unit. This broached support plate design provides necessary tube support while permitting considerable flow past the tubes without concentration of contaminants or solids buildup between the support plate tube. Also, the once-through steam generator is given a full vessel stress relief which effectively reduces residual stresses on the tubing and provides a microstructure apparently more resistant to stress corrosion cracking.

The tube-to-tubesheet closure is described in Subsection 5.4.2.1.1. The tube-to-tubesheet crevice area has not been shown to be an area of major concern in operating nuclear steam generators. Only one recirculating steam generator of current generation design has exhibited secondary side failure in the tube-to-tubesheet crevice even though several have been operated under extremely adverse water chemistry conditions. 27

5.4.2.1.3 Compatibility of the Steam Generator Tubing with the Primary and Secondary Coolant

The primary and secondary system water chemistry requirements are listed in Table 5.2-4.

Corrosion control of the steam and feedwater systems is maintained by using high purity feedwater containing volatile chemical additives for oxygen and pH control. Hydrazine is added to the feedwater to chemically react with any oxygen remaining in the deaerated feedwater. Ammonia is added to the feedwater to adjust the pH to a level that provides corrosion control of the feedwater train materials. Ammonia also provides corrosion control of the steam cycle materials because of its volatility in the steam generators. These corrosion control measures apply during normal operation as well as in the unlikely event of boric acid introduction from the primary system. Because of the

TABLE 5.4-1

REACTOR COOLANT PUMP DESIGN DATA

Item	Data per Unit
Number of pumps	4
Design pressure, psig	2,500
Hydrotest pressure (cold), psig	3,125
Design temperature, °F	650
Operating speed (nominal), rpm	1,185
Pumped fluid temperature, °F	70 to 580
Developed head, ft	327
Capacity, gpm	88,000
Hydraulic efficiency, percent	86
Seal water injection (max steady-state), gpm	8-10
Seal water return (max), gpm	1
Pump nozzle id., in.	28
Overall unit height, ft	27'-2-1/4"
Water volume, ft^3	98
Motor stator frame diameter, ft	7'-7"
Pump-motor moment of inertia, $lb\text{-}ft^2$	70,000
Motor data:	
Type	Squirrel-cage induction, single speed
Voltage	6,600
Phase	3
Frequency, cps	60
Starting	Across-the-line
Input (hot reactor coolant), hp	6,900
Input (cold reactor coolant), hp	9,400

27

27

TABLE 5.4-3

LOADING CONDITIONS AND STRESS LIMITS: CODE CLASS 1 PRESSURE VESSELS

Loading Conditions		Stress Intensity Limits	
Normal condition	a.	$P_m \leq S_m$	
	b.	P_m (or P_L) + $P_b \leq 1.5S_m$	
	c.	P_m (or P_L) + P_b + $Q \leq 3.0S_m$	
Upset condition	a.	$P_m \leq S_m$	
	b.	P_m (or P_L) + $P_b \leq 1.5S_m$	
	c.	P_m (or P_L) + P_b + $Q \leq 3.0S_m$	
Emergency condition	a.	$P_m \leq 1.2S_m$ or S_y, whichever is larger	27
	b.	P_m (or P_L) + $P_b \leq 1.5$ ($1.2S_m$) or $1.5S_y$ whichever is larger	
Faulted condition	a.	$P_m \leq C_L$ or $2/3\ S_\mu$	3
	b.	P_m (or P_L) + $P_b \leq C_L$ or $2/3\ S_\mu$	

where

P_m = primary general membrane stress intensity
P_L = primary local membrane stress intensity
P_b = primary bending stress intensity
S_m = allowable stress value from ASME B&PV Code, Section III, Nuclear Vessels
S_y = minimum specified material yield (ASME B&PV Code, Section III)
C_L = collapse load defined in ASME B&PV Code, Section III
S_μ = ultimate strength of material at temperature

TABLE 5.4-4

LOADING COMBINATIONS AND STRESS LIMITS FOR REACTOR COOLANT SYSTEM PIPING (NSSS SCOPE)

Loading Conditions	Combination of Loads	Stress Limits (Rev USAS B31.7-1968)
Design pressure loading	Internal design pressure	$P_m \leq 1.0\ S_m$ at design temperature calculated according to Equations 1, 2, and 3
Design condition	Dead weight loads + internal pressure + OBE	$P_L + P_b \leq 1.5\ S_m$ at operating temperature calculated according to Equation 9 or Appendix F
Operating condition - normal and upset	Dead weight loads + thermal loads + internal pressure + OBE + thermal gradients	$P_L + P_b + P_e + Q \leq 3\ S_m$ at operating temperature calculated according to Equation 10 or Appendix F, except as permitted by 1-705.4 (4-4-77 Revision)
Emergency condition	Dead weight loads + Internal pressure + SSE	$P_L + P_b \leq 2.25\ S_m$ at operating temperature calculated according to Equation 9 or Appendix F
Faulted condition	Dead weight loads + internal pressure + DBE + LOCA (LOCA applies to piping far removed from LOCA break)	[1] $P_L + P_b \leq 3.0\ S_m$ at operating temperature calculated according to Equation 9 or [1] $P_m \leq S^*_m$ [1] $P_L \leq 1.5\ S^*_m$ [1] $P_L + P_b \leq 1.5\ S^*_m$ at operating temperature

27

[1] Equation in accordance with Section III of ASME Code (1977) with Winter 1978 Addenda, where S^*_m is according to Appendix F of ASME Code.

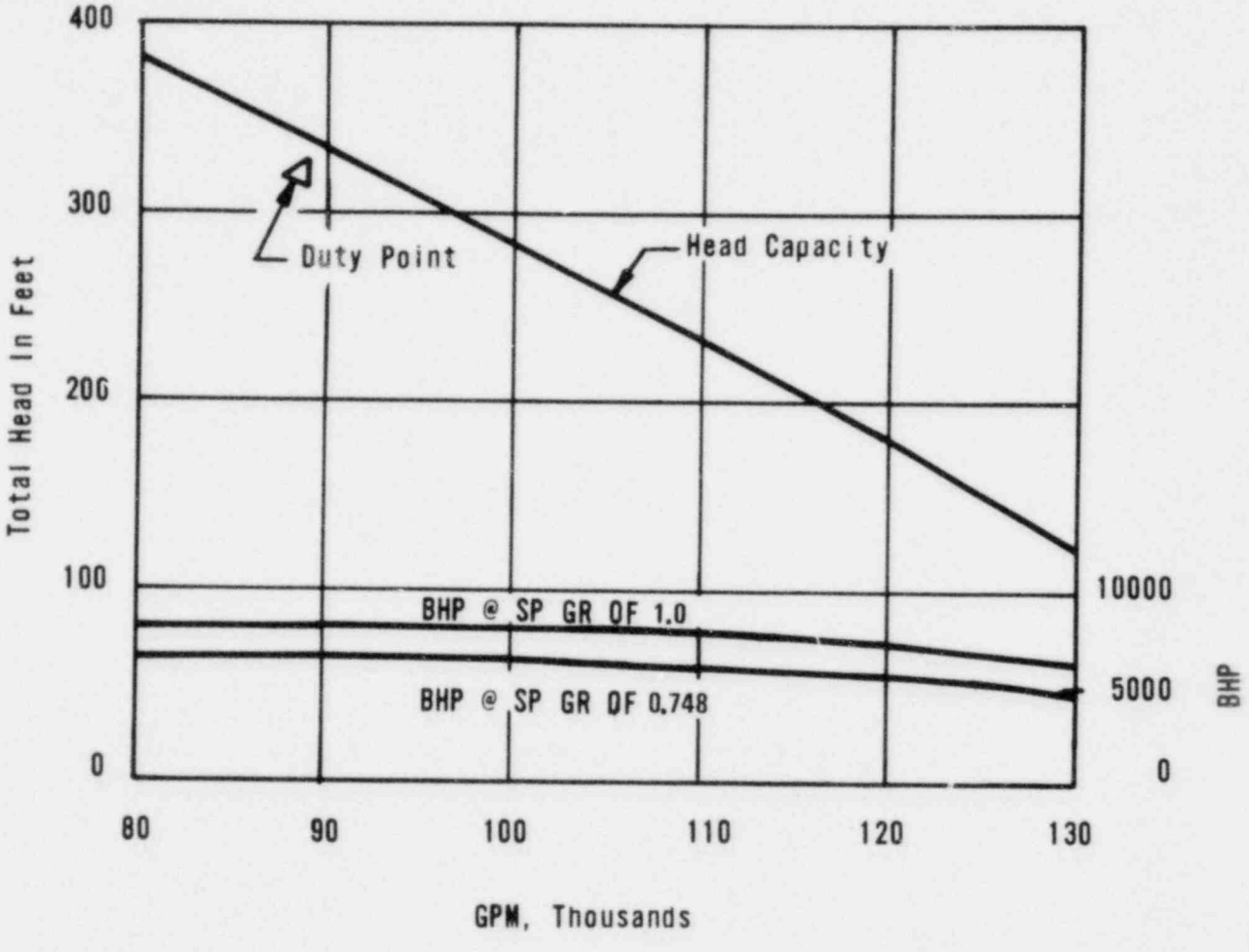
TABLE 5.4-5

NONDESTRUCTIVE EXAMINATIONS

Component	RT	UT	PT	MT	ET
Reactor Vessel					
Forgings					
Flanges		X(1)		X	
Studs, bar		X			
Studs after final machining				X	
Skirt adaptor		X(1)		X	
Nozzle belt forgings		X(1)		X	
Main nozzle forgings		X(1)		X	
Dutchman forging		X(1)		X	
CRD mechanism adaptor		X	X		
CRD mechanism housing		X	X		
Plates					
Head and shell plate		X(1)		X(+)	
Support skirt		X(1)		X(+)	
Instrumentation tubes	X or	X	X		
Closure O-rings		X	X		
Weldments					
Longitudinal and circumferential main seams	X	X(+)		X	
CRD mechanism adaptor to shell			X		
CRD mechanism adaptor to flange	X		X		
Inlet, outlet, core flooding nozzles	X	X(+)		X	
Instrumentation nozzle connection			X		
Nozzle safe-ends, weld deposit		X(+)	X			27
Temporary attachment after removal			X or	X	
All accessible welds after hydrotest			X or	X	
O-ring closure weld	X		X		
Cladding, sealing surfaces		X(2)(+)	X		
Cladding, all other		X(3)(+)	X		

TABLE 5.4-5 (continued)

Component	RT	UT	PT	MT	ET
Weld preparation surfaces prior to welding			X or	X	
Steam Generator					
Tubesheet					
Forging		X(1)		X	
Cladding		X(2)(4)	X		
Heads					
Plate		X(1)		X(4)	
Cladding		X(3)(4)	X		
Shell					
Plates		X(1)		X	
Tubes		X			X(4)
Nozzles (forgings)		X		X	
Studs, bar		X			
Studs after final machining				X	
Weldments					
Shell, longitudinal as deposited by submerged arc	X			X	
Shell, longitudinal as deposited by electroslag	X	X		X	
Shell, circumferential	X			X	
Cladding, sealing surfaces		X(2)(4)	X		
Cladding, all other		X(3)(4)	X		
Nozzle to shell and head	X			X	
Level sensing and drain connections	X			X	
Instrument connections			X		
Support skirt		X		X	
Tube-to-tubesheet(4)			X		



CONSUMERS POWER COMPANY MIDLAND PLANT UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Reactor Coolant Pump Performance Characteristics
FSAR Figure 5.4-2

Figures (continued)

Section and Number	Title	
6.2-117	Steam Generator Compartments Pressure Differential Response for a 4.27 Ft^2 RC Pump Discharge Break	11
6.2-118	Steam Generator Compartments Pressure Differential Response for a 4.27 Ft^2 RC Pump Discharge Break	
6.2-119	Miscellaneous Instrumentation Reactor Building Unit 1	12
6.2-120	Miscellaneous Instrumentation Reactor Building Unit 2	
6.2-121	Reactor Vessel Compartments Pressure Response	
6.2-122	Reactor Vessel Compartments Pressure Response	
6.2-123	Reactor Vessel Compartments Pressure Response	
6.2-124	Reactor Vessel Compartments Pressure Response	
6.2-125	Reactor Vessel Compartments Pressure Response	
6.2-126	Reactor Vessel Compartments Pressure Response for a 4.27 Ft^2 Cold Leg Break	14
6.2-127	Reactor Vessel Compartments Pressure Response for a 4.27 Ft^2 Cold Leg Break	
6.2-128	Reactor Vessel Pressure Differential Response for a 4.27 Ft^2 Cold Leg Break	
6.2-129	Reactor Vessel Pressure Differential Response for a 4.27 Ft^2 Cold Leg Break	
6.2-130	Reactor Vessel Pressure Differential Response for a 4.27 Ft^2 Cold Leg Break	
6.2-131	Reactor Vessel Pressure Differential Response for a 4.27 Ft^2 Cold Leg Break	
6.2-132	Reactor Vessel Pressure Differential Response for a 4.27 Ft^2 Cold Leg Break	
6.2-133	Reactor Vessel Pressure Differential Response for a 4.27 Ft^2 Cold Leg Break	

Figures (continued)

Section and Number	Title	
6.2-134	Reactor Vessel Pressure Differential Response for a 4.27 Ft^2 Cold Leg Break	19
6.2-135	Primary Shield Plug Detail	
6.2-136	Reactor Building Spray Solution Flowpath to Containment Sump During Recirculation	15
6.2-137	Temperature History - Containment Liner and Wall for Maximum Containment Atmospheric Temperature	
6.2-138	Illustration of Jet Area Directed Into Reactor Vessel Cavity for Subcompartment Pressurization	19
Section 6.3		
6.3-1	Makeup and Purification Units 1 & 2	16
6.3-2	Decay Heat Removal and Core Flooding System Units 1 & 2	27
6.3-3	HPI Flow vs RCS Pressure	
6.3-4	LPI Flow vs RCS Pressure	
6.3-5	HPI Pump Performance Curves	
6.3-6	HPI Flow Splits for HPI Line Break Affected Train	
Section 6.4		
6.4-1	Definition of Control Room Envelope	
6.4-2	Definition of Control Room Envelope	
6.4-3	Control Room Equipment Arrangement	
6.4-4	Location of Outside Air Intakes	
Section 6.5		
6.5-1	Hydrogen Vent Exhaust System Inside Containment	
6.5-2	Hydrogen Vent Exhaust Piping Outside the Containment	

Figures (continued)

Section and Number	Title	
6E-37	Uplift Force on RC Pump Furthest From Pressurizer Due to 4.27 Ft^2 Pump Discharge Break	
6E-38	Plan Views of Reactor Coolant Pump Adjacent to Pressurizer for Calculating Forces and Moments	
6E-39	Lateral Forces on RC Pump Adjacent to Pressurizer Due to 14.14 Ft^2 Hot Leg Break	
6E-40	Moments on RC Pump Adjacent to Pressurizer Due to 14.14 Ft^2 Hot Leg Break	26
6E-41	Uplift Force on RC Pump Adjacent to Pressurizer Due to 14.14 Ft^2 Hot Leg Break	
6E-42	Lateral Forces on RC Pump Adjacent to Pressurizer Due to 4.27 Ft^2 Pump Discharge Break	
6E-43	Moments on RC Pump Adjacent to Pressurizer Due to 4.27 Ft^2 Pump Discharge Break	
6E-44	Uplift Force on RC Pump Adjacent to Pressurizer Due to 4.27 Ft^2 Pump Discharge Break	
6E-45	Section and Plan View of Seal Plate	27

The main steam isolation valves will shut fully within 5 seconds after steam line isolation is initiated.

Piping restraints and pipe whip barriers between the main steam lines prevent a rupture in one line from causing a blowdown from more than one steam generator. No single active component failure will result in the failure of one main steam isolation valve to operate. Redundant main steam isolation signals, described in Subsection 7.3.3, are utilized to assure isolation valve closure in the event of a single isolation signal failure.

The effect on the reactor coolant system after a steam line break and the offsite radiation exposure after a steam line break outside containment are discussed fully in Subsection 15.1.5. The containment pressure transient following a main steam line break inside containment is discussed in Subsection 6.2.1.

SAFETY EVALUATION THREE - Upon detection of high radioactivity, isolation valves in the reactor building air purification and cleanup system, discussed in Subsection 9.4.9, and the combustible gas control system, discussed in Subsection 6.2.5, are shut to prevent the release of radioactivity to the environment. Isolation of the containment access purge systems is discussed in Subsection 7.3.3. Airborne radioactivity monitoring is discussed in Subsection 12.3.4.

SAFETY EVALUATION FOUR - The containment isolation system is designed in accordance with 10 CFR 50 Appendix A, General Design Criterion 54. Leakage detection capabilities provided and the leakage detection test program are discussed in Subsection 6.2.6. Redundancy of valves and reliability of the isolation system are assured by conformance with the other safety design bases stated in Subsection 6.2.4.1. Redundancy and reliability of the actuation system are covered in Subsection 7.3.3.

Penetrations meeting General Design Criteria 55 and 56, as noted in Table 6.2-27, have redundant isolation valve schemes to ensure that no single failure will prevent the system as a whole from performing its isolation function. Penetration schemes consisting of one locked closed isolation valve inside containment and one locked closed isolation valve outside containment are locked closed during normal operation and during post-LOCA operation. If one valve were to fail, the second locked closed isolation valve acts as a redundant backup valve. Penetration schemes consisting of one automatic isolation valve and one locked closed valve have as the automatic isolation valve a fail closed air operated valve or a motor operated valve (fail as is) that is in the normally closed position. A check valve is not used as the automatic isolation valve outside containment. This isolation scheme could sustain a failure of either valve and still perform its intended function. The isolation scheme containing two automatic isolation valves is again designed so that the motor operated valves which fail as is upon loss of power will normally obtain power from redundant Class 1E power

sources to assure closure when automatically actuated. Air operated valves are designed such that on loss of air the valve will be in the position that assures greatest plant safety. Two motor operated valves in series are powered from separate ESF buses, as noted in Table 6.2-28. This assures that a common mode electrical or mechanical failure would not prevent isolation. A check valve may be used as the redundant backup valve inside containment.

Containment penetrations meeting the requirements of General Design Criterion 57, for closed system isolation, are able to withstand failure of the single isolation valve in the penetration line since all leakage through this valve would be contained in the closed system whether the direction of flow is into or out of the containment.

SAFETY EVALUATION FIVE - Lines which penetrate the containment and which either are part of the reactor coolant pressure boundary, connect directly to the containment atmosphere, or do not meet the requirements for a closed system except instrument sensing lines, if applicable, are listed in Tables 6.2-27 and 6.2-28. Each penetration is provided with one of the following valve arrangements conforming to the requirements of 10 CFR 50 Appendix A, General Design Criteria 55 and 56:

a. One locked closed manual isolation valve inside and one locked closed manual isolation valve outside containment

b. One automatic isolation valve inside and one locked closed manual isolation valve outside containment

c. One locked closed manual isolation valve inside and one automatic isolation valve outside containment (a simple check valve is not used as the automatic isolation valve outside containment)

d. One automatic isolation valve inside and one automatic isolation valve outside containment (a simple check valve is not used as the automatic isolation valve outside containment)

Isolation valves outside containment are located as close to the containment as practical. Upon loss of actuating power, air operated and solenoid operated automatic isolation valves fail closed except for those valves in the reactor building sample lines and the reactor coolant pump seal water supply lines. | 27

A single isolation valve outside containment is used for the reactor building emergency sump recirculation line penetrations, 1Z-29, 30 and 2Z-29, 30. A single failure can be accommodated by the following features:

a. Each reactor building sump line will be enclosed by a sleeve welded to the penetration nozzle at the reactor building sump and attached to a bellows assembly which

TABLE 6.2-6 (continued)

Accident Phase	Time Interval (s)	Mass Flowrate (lbm/s)	Enthalpy (Btu/lbm)
	20.00 - 21.00	9.498589E+3	5.577691E+2
	21.00 - 22.00	8.679100E+3	4.978661E+2
	22.00 - 23.00	8.106419E+3	4.141717E+2
	23.00 - 24.00	7.480820E+3	3.226732E+2
	24.00 - 24.40	6.488250E+3	2.592379E+2
Reflood	24.40 - 34.40	0	0
	34.40 - 39.40	1.126310E+2	1.200868E+3
	39.40 - 44.40	1.584900E+2	1.193419E+3
	44.40 - 54.40	1.758300E+3	2.043900E+2
	54.40 - 64.40	2.540340E+2	1.060429E+3
	64.40 - 74.40	2.759830E+2	1.058870E+3
	74.40 - 84.40	2.888789E+2	1.030549E+3
	84.40 - 94.40	2.981611E+2	9.777833E+2
	94.40 - 104.40	3.051900E+2	9.231754E+2
	104.40 - 114.40	3.103900E+2	8.700216E+2
	114.40 - 124.40	3.152139E+2	8.251381E+2
	124.40 - 134.40	3.190369E+2	7.880310E+2
	134.40 - 144.40	3.218300E+2	7.577758E+2
	144.40 - 154.40	3.256931E+2	7.306910E+2
	154.40 - 164.40	3.270939E+2	7.136116E+2
	164.40 - 174.40	3.280611E+2	6.930508E+2
	174.40 - 184.40	3.285711E+2	6.711028E+2
	184.40 - 194.40	3.290569E+2	6.492068E+2
	194.40 - 204.40	3.295839E+2	6.287625E+2
	204.40 - 214.40	3.306321E+2	6.104320E+2
	214.40 - 224.40	3.313681E+2	5.953984E+2

TABLE 6.2-7

ASSUMPTIONS USED IN ANALYSIS OF INADVERTENT CONTAINMENT SPRAY SYSTEM ACTUATION

Item	Assumed Value
Containment	
Initial temperature, °F	120
Initial pressure, lb/in.²a	14.7
Relative humidity, %	100
Net free volume (minimum), ft³	1.6698×10^6
Outside ambient temperature, °F	-30
Outside ambient pressure, lb/in.²a	14.7
Passive heat sinks, per Table 6.2-11 with:	
inside surface heat transfer coefficient, $\frac{Btu}{h\text{-}ft^2\text{-}^oF}$	2(1)
outside surface heat transfer coefficient, $\frac{Btu}{h\text{-}ft^2\text{-}^oF}$	2
Containment Spray System	
Number of trains in operation	2
Flowrate per train, gal./min	1,175
Borated water storage tank inventory, gal.	500,000
Borated water temperature, °F	40
Spray efficiency, %	100
Other	
Negligible heat input to containment from primary and secondary system components	
Ideal gas behavior of air in containment	

(1) For heat flow from heat sinks to containment atmosphere, modified Tagami heat transfer coefficient used for heat flow from containment atmosphere to heat sink.

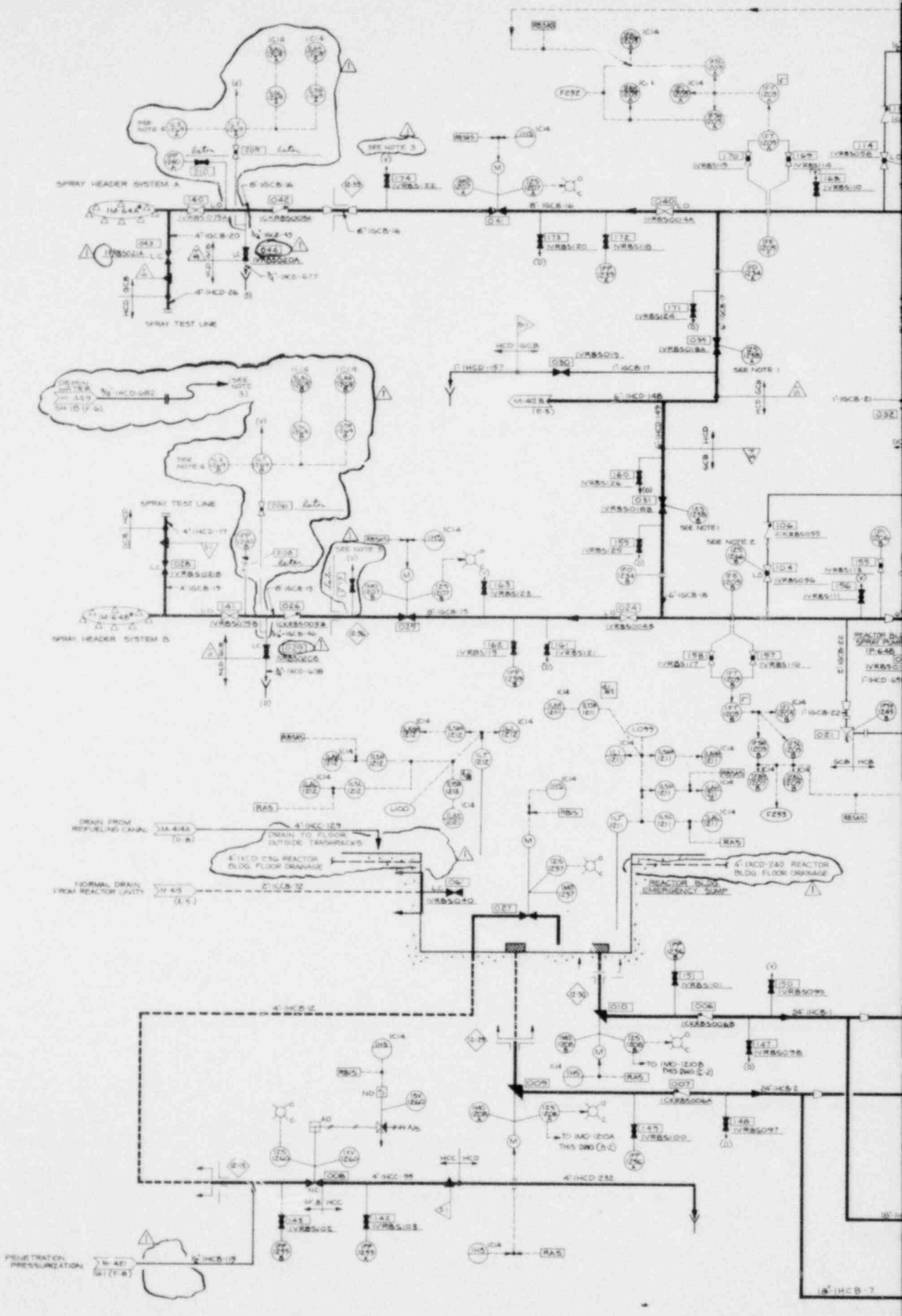
TABLE 6.2-24

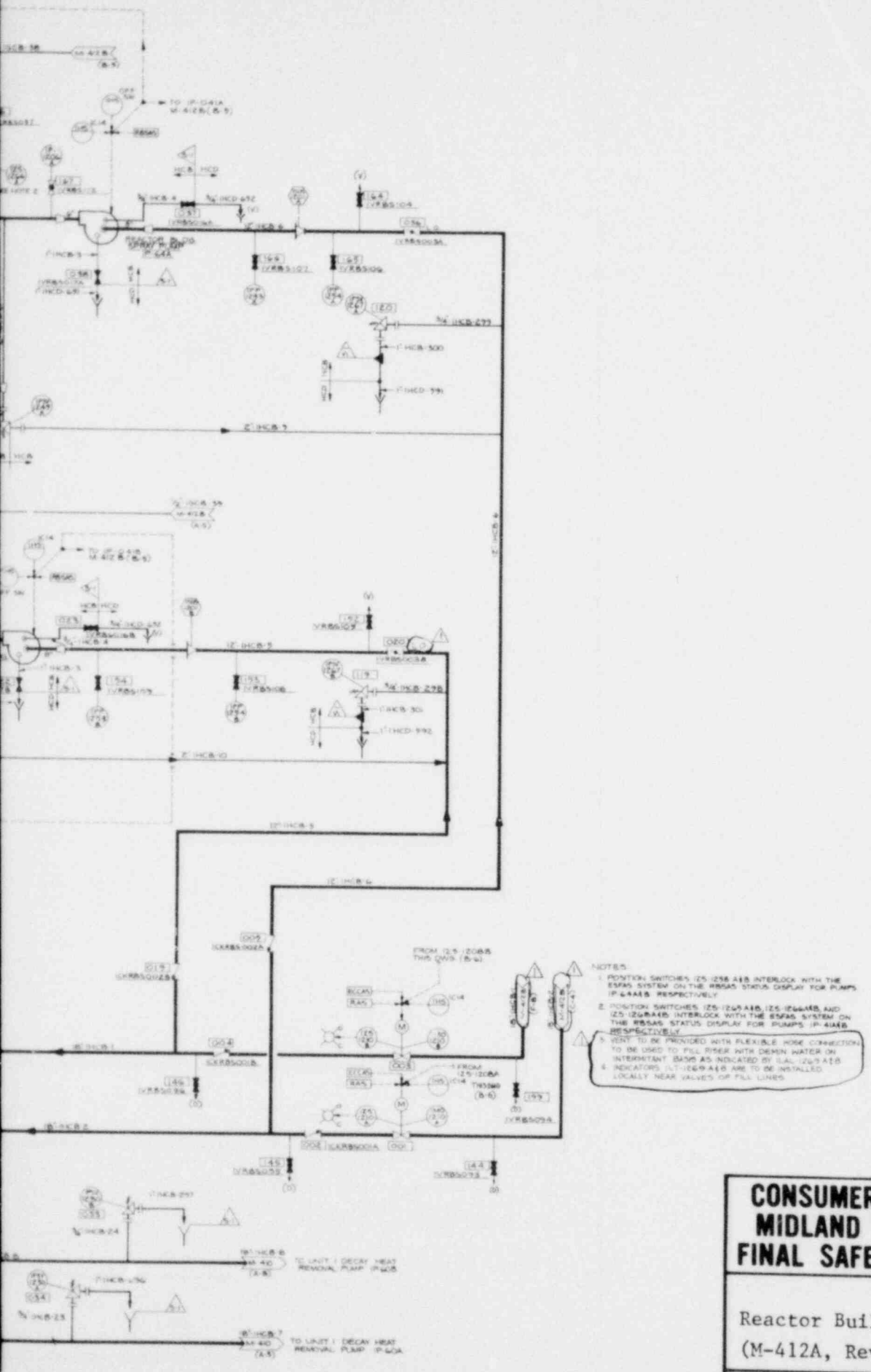
CONTAINMENT SPRAY SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Component	Failure Modes	Effects
Spray pump	Fails to function	The other train will still continue to function; it will still provide full design iodine removal and 50% heat removal capability.
Spray nozzles	Clogged	The spray system's two trains are functioning simultaneously. Each spray header has 82 nozzles. If any of these nozzles should become clogged, the rest will still continue to function. Clogging of the spray nozzles is not likely to occur as the inner screen mesh of the containment recirculation sump is smaller than the clearances of the spray header, the spray pump, and the spray nozzles.
Valves	Fails to open	Valving is independent in the two trains and so are their controls. If a valve on one train fails to open on actuation signal the other train will still function. Because the trains are redundant, if one train fails, the other train has the capability to supply spray in containment of sufficient iodine removal capability and correct pH, in the event of failure of the other train. 27
Motors	Loss of offsite	There are two independent backup systems for offsite power failure. Each system consists of an emergency generator, battery, and inverters.
	Loss of one diesel generator after loss of offsite power	One complete train of containment sprays lost. Redundancy will provide full iodine removal and 50% of total heat removal capability.

TABLE 6.2-24 (continued)

Component	Failure Modes	Effects
Sump suction line between the sump penetration and the containment isolation valve	Leak in line	The piping between the sump and the valve is enclosed in a guard pipe assembly which is leaktight at containment design pressure.

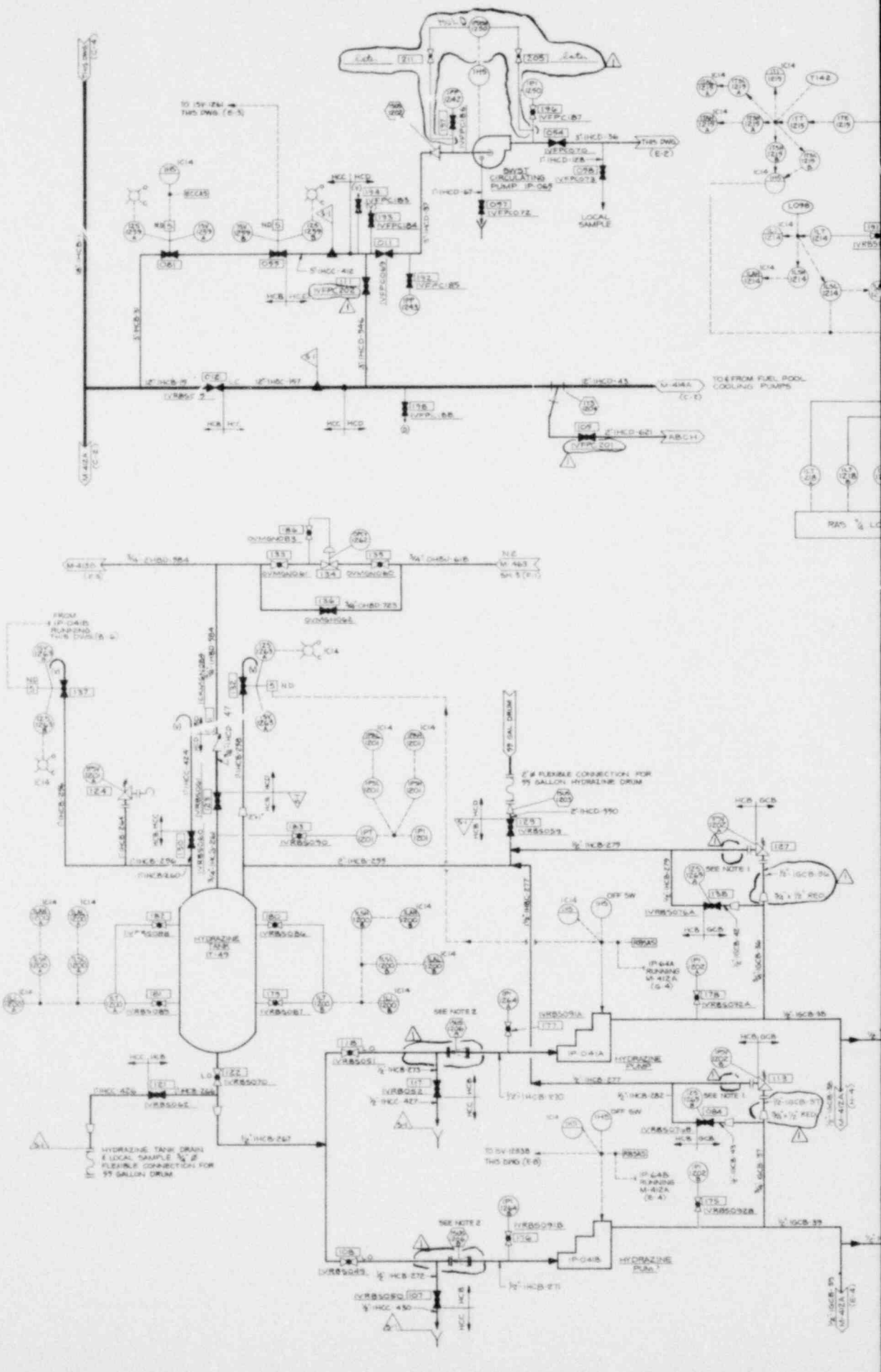

SPRAY HEADER SYSTEM A
SPRAY TEST LINE
SPRAY HEADER SYSTEM B
SPRAY TEST LINE
DRAIN FROM REFUELING CANAL
4"HCC-129
DRAIN TO FLOOR OUTSIDE TRAINRACKS
4"HCD-236 REACTOR BLDG. FLOOR DRAINAGE
NORMAL DRAIN FROM REACTOR CAVITY
2"HCB-32
4"HCD-240 REACTOR BLDG. FLOOR DRAINAGE
REACTOR BLDG. EMERGENCY SUMP
4"HCB-12
4"HCC-95
4"HCD-232
PENETRATION PRESSURIZATION
2"HCB-119
18"HCB-7
SEE NOTE 1
SEE NOTE 2
SEE NOTE 3
SEE NOTE 4
SEE NOTE 5
TO (MD-1210B THIS DWG (B-2)
TO (MD-1210A THIS DWG (B-2)

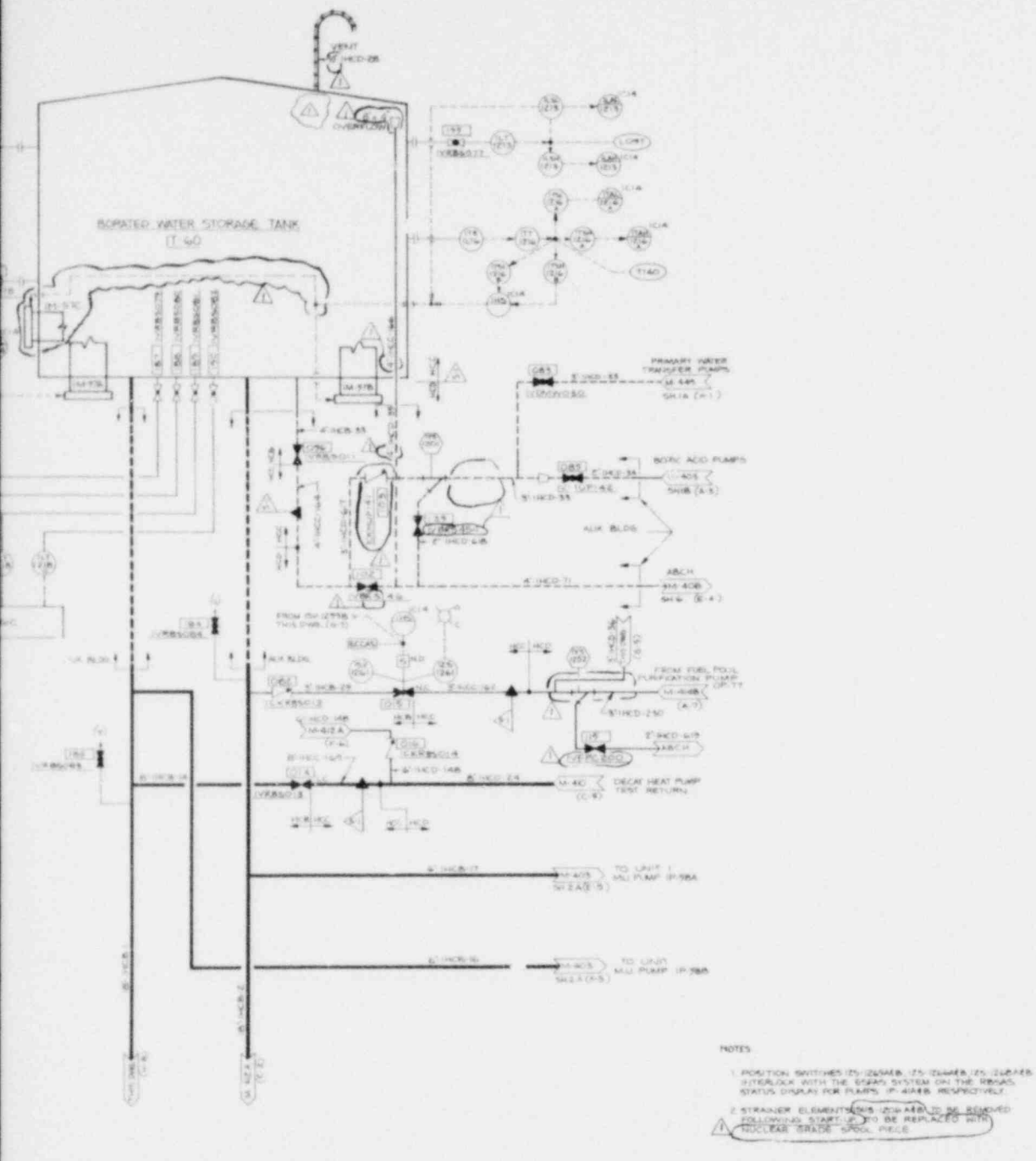


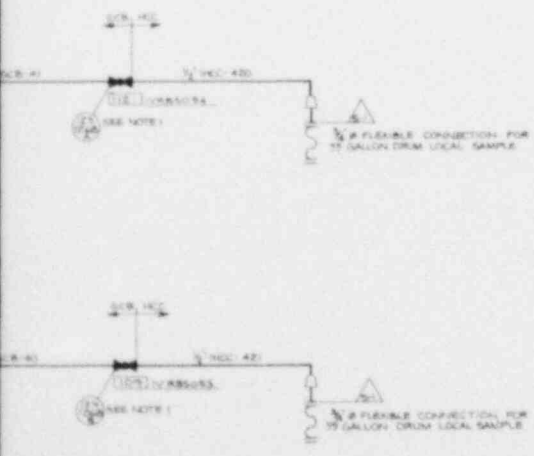
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Reactor Building Spray - Unit 1
(M-412A, Rev. 1)

FSAR Figure 6.2-51, sh. 1


TO SV-1261 THIS DWG. (E-5)
8" HCB-3
8" HCB-19
12" HCB-197
8" HCD-346
8" HCD-43
TO & FROM FUEL POOL COOLING PUMPS
SV-1261A (C-2)
SV-412A (C-2)
SV-412A (C-1)
SV-412A (C-4)
SV-412A (E-4)
SV-412A (E-3)
SV-412A (E-2)
SV-412A (E-1)
SV-412A (B-1)
SV-412A (B-2)
SV-412A (B-3)
SV-412A (B-4)
SV-412A (C-4)
SV-412A (C-3)
SV-412A (C-2)
SV-412A (C-1)
SV-412A (D-1)
SV-412A (D-2)
SV-412A (D-3)
SV-412A (D

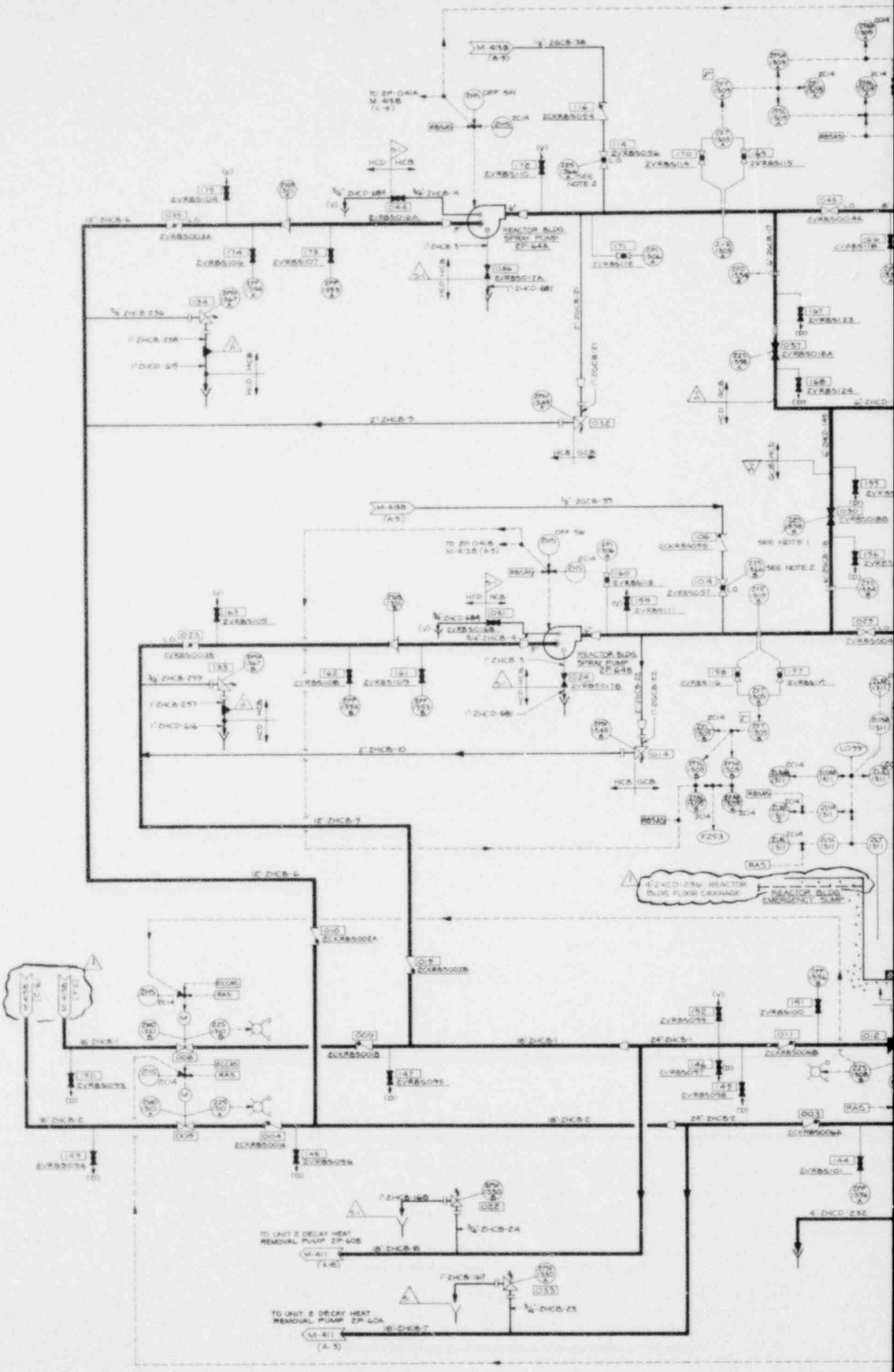


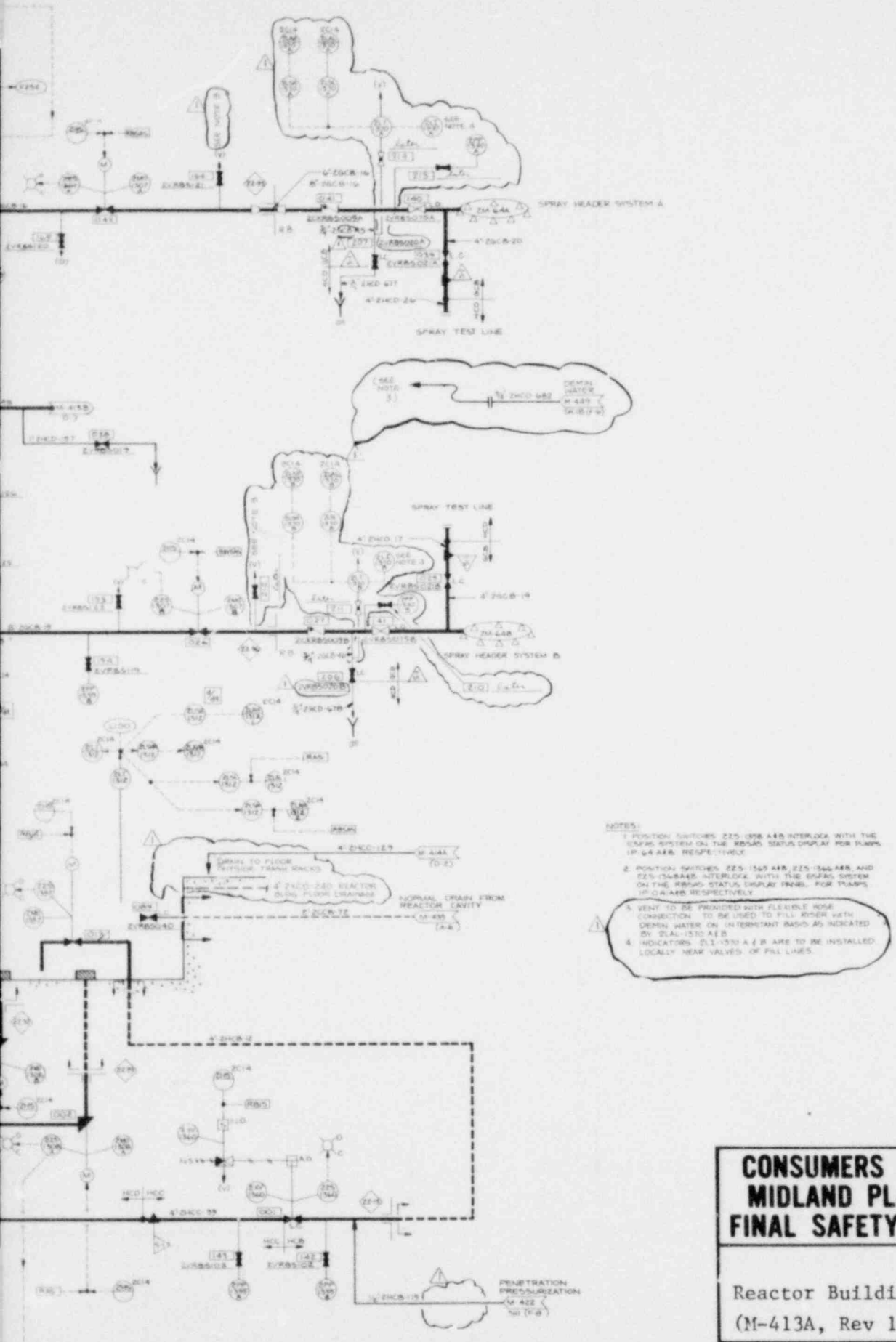


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Reactor Building Spray - Unit 1
(M-412B, Rev. 1)

FSAR Figure 6.2-51, sh. 2


REACTOR BLDG SPRAY PUMP ZP-64A
REACTOR BLDG SPRAY PUMP ZP-64B
REACTOR BLDG EMERGENCY SUMP
TO UNIT 2 DECAY HEAT REMOVAL PUMP ZP-60B
TO UNIT 2 DECAY HEAT REMOVAL PUMP ZP-60A
SEE NOTE 1
SEE NOTE 2
SEE NOTE 3



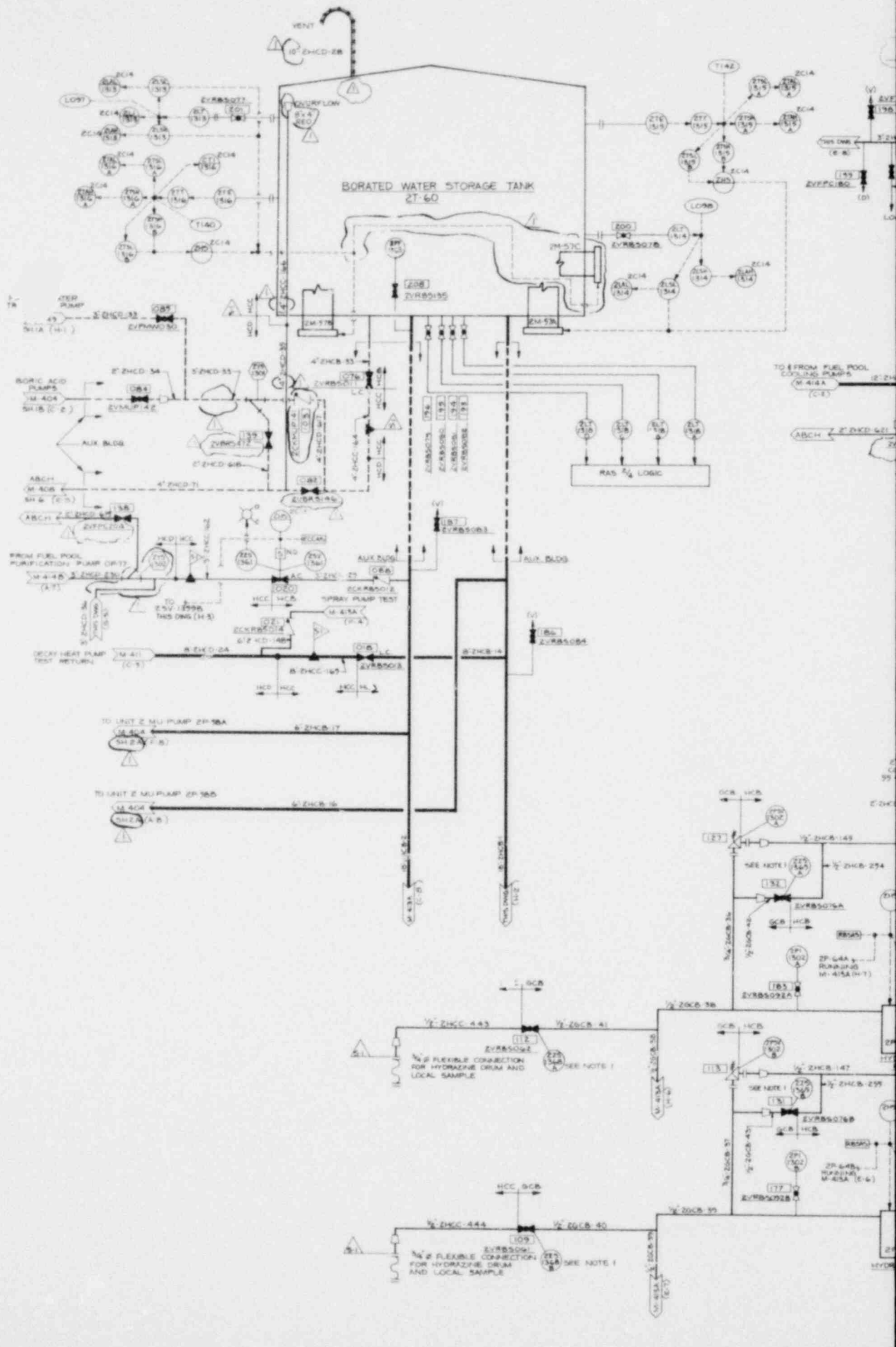
NOTES:

1. POSITION SWITCHES ZZS-1358 A&B INTERLOCK WITH THE ESFAS SYSTEM ON THE RBSAS STATUS DISPLAY FOR PUMPS 1P-6A&B, RESPECTIVELY.
2. POSITION SWITCHES ZZS-1365 A&B, ZZS-1366 A&B, AND ZZS-1368A&B, INTERLOCK WITH THE ESFAS SYSTEM ON THE RBSAS STATUS DISPLAY PANEL, FOR PUMPS 1P-0A/A&B, RESPECTIVELY.
3. VENT TO BE PROVIDED WITH FLEXIBLE HOSE CONNECTION TO BE USED TO FILL RISER WITH DEMIN. WATER ON INTERMITANT BASIS AS INDICATED BY ZLAL-1530 A,E,B.
4. INDICATORS ZLI-1570 A & B ARE TO BE INSTALLED LOCALLY NEAR VALVES OF FILL LINES.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Reactor Building Spray - Unit 2
(M-413A, Rev 1)

FSAR Figure 6.2-52, sh. 1


BORATED WATER STORAGE TANK
2T-60
VENT
10" ZHCD-28
OVERFLOW
8" x 4" RED
ZVRB5077
ZVRB5078
ZVRB5085
ZVRB5086
ZVRB5087
ZVRB5088
ZVRB5089
ZVRB5090
ZVRB5091
ZVRB5092
ZVRB5093
ZVRB5094
ZVRB5095
ZVRB5096
ZVRB5097
ZVRB5098
ZVRB5099
ZVRB5100
ZVRB5101
ZVRB5102
ZVRB5103
ZVRB5104
ZVRB5105
ZVRB5106
ZVRB5107
ZVRB5108
ZVRB5109
ZVRB5110
ZVRB5111
ZVRB5112
ZVRB5113
ZVRB5114
ZVRB5115
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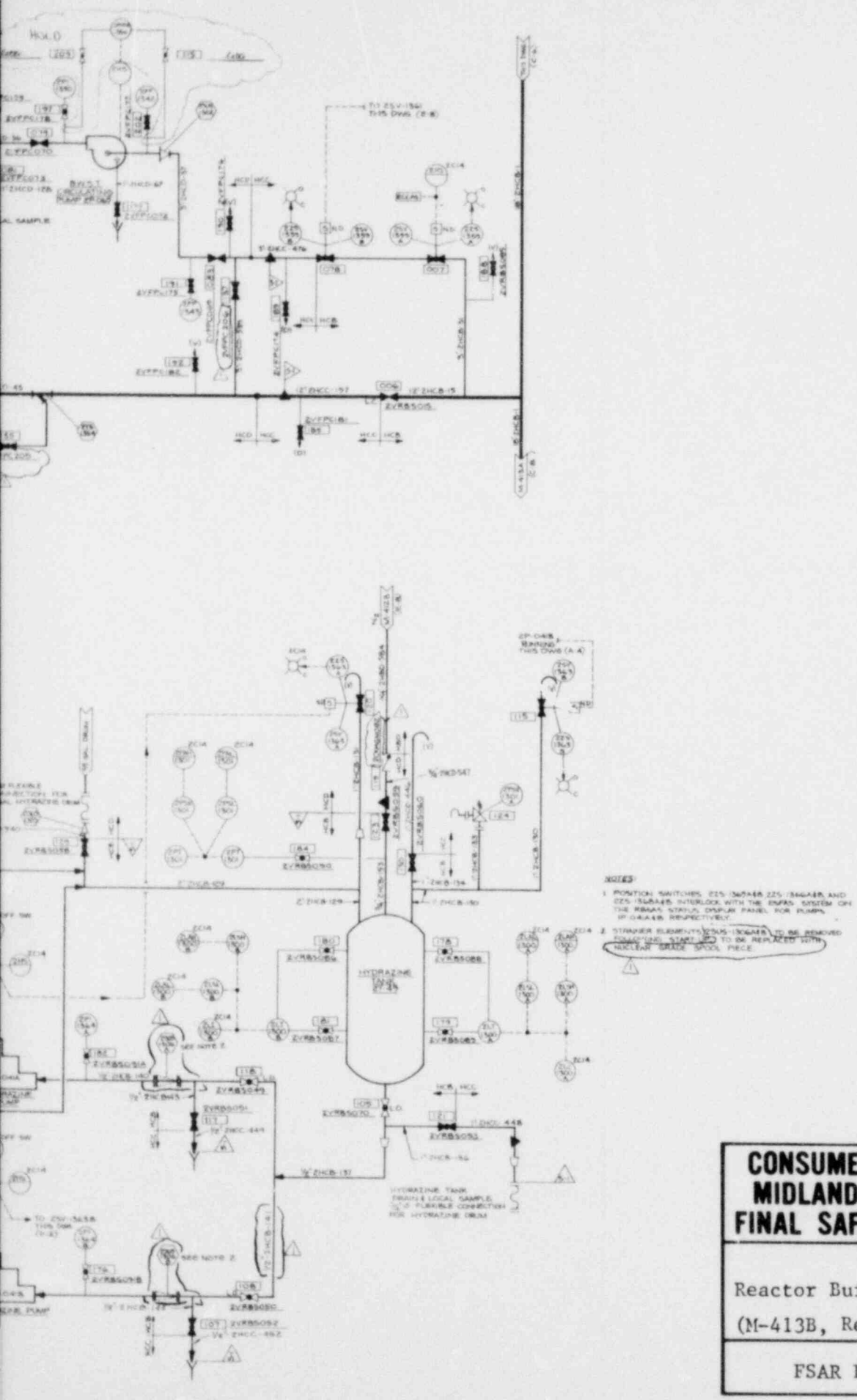
ZVRB5122
ZVRB5123
ZVRB5124



CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Reactor Building Spray - Unit 2
(M-413B, Rev 1)

FSAR Figure 6.2-52, sh. 2

temperature changes or isolation valve leaks when the DHR system is in a normal valve lineup or in the normal DHR operating mode. The relieved fluid will be routed to the liquid waste system. Various other relief valves are located in the decay heat removal system for overpressurization protection. Table 6.3-4 gives the details of those valves which are pertinent to the ECCS. Refer to Table 5.4-10 for information on all relief valves of the decay heat removal system.

Cross-over connections are provided between the discharge line from each DHR removal cooler and the suction side of the HPI pumps. These connections provide adequate npsh to permit operation of the HPI pumps for high-pressure injection while in the containment sump recirculation mode. This operation will be required if a small leak causes the RCS pressure to remain above the point where the low-pressure injection is effective, the inventory of the BWST is exhausted, and the LPI suction is from the containment sump.

6.3.2.2.4 Pump Characteristics

Pumps used in the ECCS are considered to be of a proven design because each pump is performance tested to ensure capacity, total developed head, brake horsepower, efficiency, and npsh. During the preinstallation tests, sufficient data are taken to generate head capacity, brake-horsepower capacity, efficiency capacity, and npsh capacity curves between zero (shutoff) flow and 1.05 times specified runout flow. No minus tolerance or margin is allowed with respect to capacity, total head, or efficiency at the rated or specified conditions. A 5% plus tolerance is allowed with respect to rated capacity at rated head and speed. Vibration and lube oil temperature in excess of specified values are causes for nonacceptance. All pump components are designed for an accumulated radiation dose of 10^7 rads without degradation. The HPI and LPI pump seals are designed to accept the temperature, water chemistry, and pressure conditions that would be encountered during a LOCA. The HPI and LPI pump casings are tested by methods described in the ASME Code, Section III. Pumps in both systems are hydrostatically tested and are qualified to withstand a pressure of 1.5 times the design pressure. The system is so designed that periodic tests may be performed on a pump during operation of the plant to ensure operability and ready availability. Predicted curves of total dynamic head, npsh efficiency, and BHP versus flow are shown in Figure 9.3-44 for the HPI pump and in Figure 5.4-14 for the LPI pump. The power requirements and npsh (required and available) for these pumps, as well as the parameters used in the calculation of the available npsh, are listed in Table 6.3-10. All ECCS pump motors are air cooled. Insulation for these motors is rated Class B. The motors are capable of starting at a reduced voltage and accelerating to full speed.

15 27 27 27 15

6.3.2.2.4.1 NPSH Calculation for LPI and HPI Pumps

The npsh available was calculated for the LPI pumps for various operating modes as follows:

a. Operation during normal plant cooldown

b. Suction from BWST during injection mode post-LOCA

c. Suction from containment sump during recirculation mode post-LOCA

The third mode is the operating mode which results in the lowest npsh available for the LPI pumps. The npsh calculation for this mode only is summarized because it involves the highest velocities and lowest available static head.

For the LPI pumps, the piping and instrumentation diagrams are given in FSAR Figures 5.4-10, 5.4-11, 6.2-51, and 6.2-52. The pressure-temperature curves for post-LOCA conditions for the containment atmosphere and sump water are given for various LOCAs in FSAR Figures 6.2-2 through 6.2-15.

To ensure a wide margin of safety in calculating the npsh available for the LPI pumps, various conservative assumptions were applied. In accordance with Regulatory Guide 1.1, the vapor pressure at the pump was set equal to the containment pressure during recirculation. Under this assumption, the npsh available equals the static head due to the fluid level in containment minus the head losses due to sump entrance losses and suction piping losses. 19

The static head utilized for npsh was based on the minimum containment water level for post-LOCA recirculation conditions resulting from minimum fluid inventories in the BWST (300,000 gallons) and minimum escape of reactor coolant from the primary system. Under these assumptions, the minimum level of fluid in the containment post-LOCA during recirculation is 597.55 feet elevation. The centerline elevation of the LPI pumps is 571'-2-1/2". Therefore, the minimum static head available is 26.34 feet.

To calculate piping losses, the minimum sump water temperature that occurs post-LOCA was used for conservatism.

Because viscosity of the recirculation fluid varies inversely with temperature, the greatest viscosity and, therefore, the highest piping losses occur at minimum sump fluid temperature. From the pressure-temperature curves (FSAR Figures 6.2-2 to 6.2-15), the minimum sump water temperature occurs at the end of LOCA and equals 138F.

Piping losses were calculated utilizing the Darcy-Weisback equation as follows:

$$h_L = 0.0311fLQ^2/d^5 = 0.00259(fL/D+K)Q^2/d^4$$

where

h_L = piping loss

f = friction factor (obtained from Moody diagram)

Re = Reynolds number

L/D = equivalent length of resistance to flow in pipe diameters

k = velocity head loss resistance coeeficient

Q = flow in pipe

d = inside diameter of pipe

Values of Q were calculated with the reactor building spray pump running at 1,500 gpm and the LPI pumps running at 4,500 gpm.

Table 6.3-13 summarizes the values of the variables applied to the Darcy formula. The values of L/D and k in the table include losses attributed to the sump entrance, valves, pipes, and fittings. Data for values were obtained from vendor test reports. Data for entrance losses and losses through pipe and fittings were obtained from Crane Technical Paper 410 (1976). 19

From Table 6.3-13, sump entrance and piping losses are equal to 5.19 feet. Therefore, npsh available equals 21.15 feet (minimum available static head of 26.34 feet less 5.19 feet maximum entrance and piping losses).

For the high-pressure injection pumps, npsh available was analyzed for the high-pressure injection mode which occurs during the injection mode post-LOCA.

For the HPI pumps, this mode provides the smallest npsh available in conjunction with the HPI pump operating at maximum flowrate conditions (maximum npsh required). The calculation utilized conservative assumptions. The HPI pumps were assumed operating at runout (600 gpm) in conjunction with the LPI pump running well at runout (4,500 gpm) and the reactor building spray pumps running at maximum design conditions. Available static head was calculated assuming the BWST empty. Vapor pressure was calculated at the lowest estimated barometric pressure and 110F, which is well above the maximum BWST fluid temperature conditions. Under these conditions, the minimum npsh available was 41 feet, which is well above the npsh required for the pumps (30 feet). The HPI pumps do not draw suction directly from the containment sumps. Adequate npsh is ensured during recirculation containment if HPI pumps are required because they take suction from the LPI pump discharge.

6.3.2.2.5 Heat Exchanger Characteristics

The decay heat removal coolers are designed to remove sensible heat and decay heat generated during a normal shutdown. Following a LOCA, each cooler is capable of cooling the injection water recirculating from the sump to remove decay heat and thus provide adequate core cooling. The heat transfer characteristics of these coolers, when cooling the core by recirculating the water from the reactor building sump, are given in Table 6.3-1.

6.3.2.2.6 ECCS Flow Diagrams

The flow diagrams of the ECCS are shown in Figures 6.3-1, 6.3-1A, and 6.3-2 with node points located to describe emergency conditions. The temperature pressure, and design flowrates at these nodes are listed in the respective flow diagrams. | 27

6.3.2.2.7 Valves

All valves in the ECCS will be inspected in accordance with codes given in Table 6.3-2. Electric motor operators for the valves are designed to operate under emergency conditions. The ECCS isolation valves outside containment are described in Table 6.3-5.

The seats and disks of the ECCS valves are manufactured from materials that resist galling and seizing. All remotely operated valves are back-seating units equipped with stem leakoff provisions. | 3

6.3.2.2.8 ECCS Relief Valves

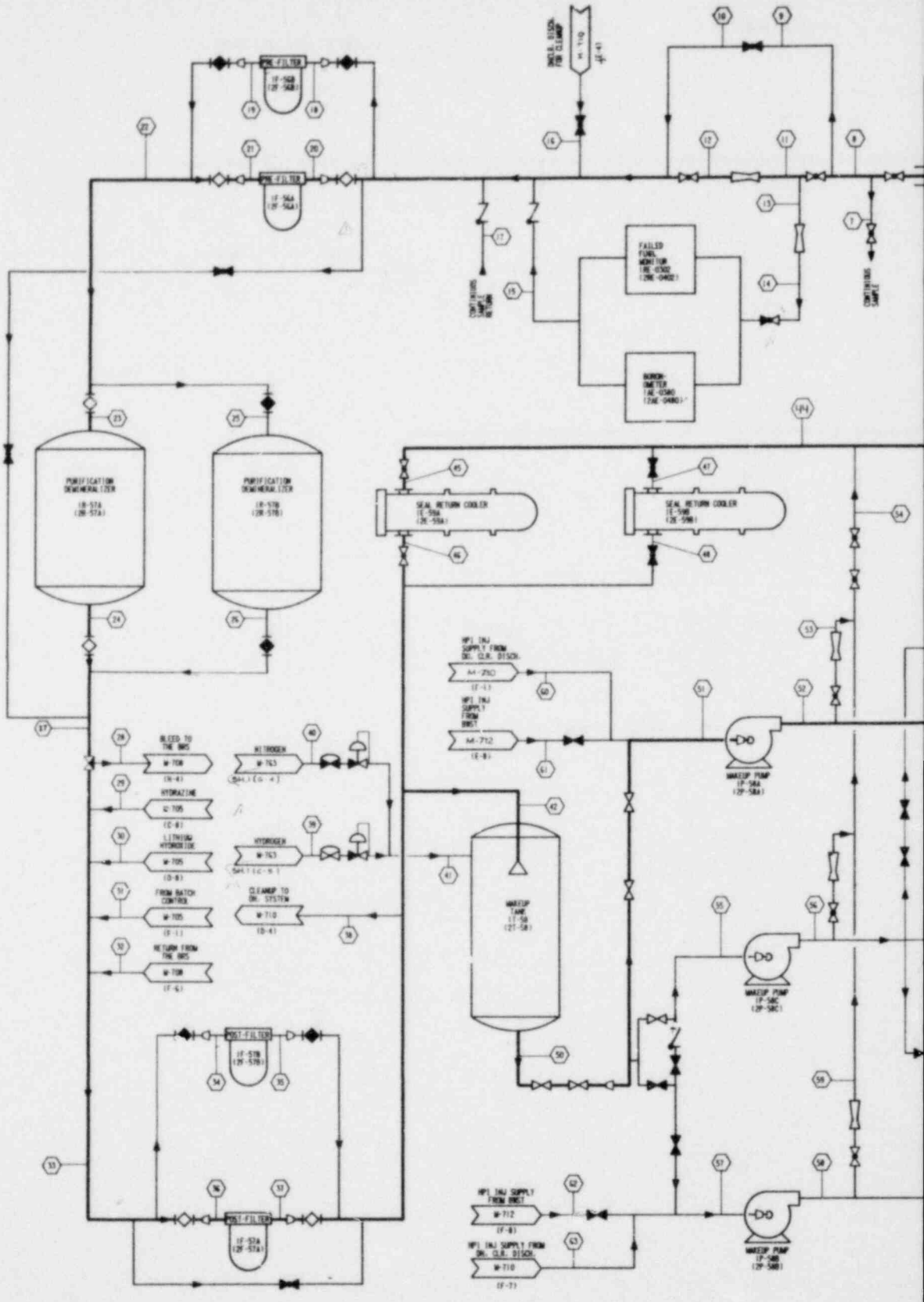
The capacities, settings, and functions of the relief valves in the ECCS are listed in Table 6.3-4. These relief valves are of the self-actuated, direct, spring loaded type.

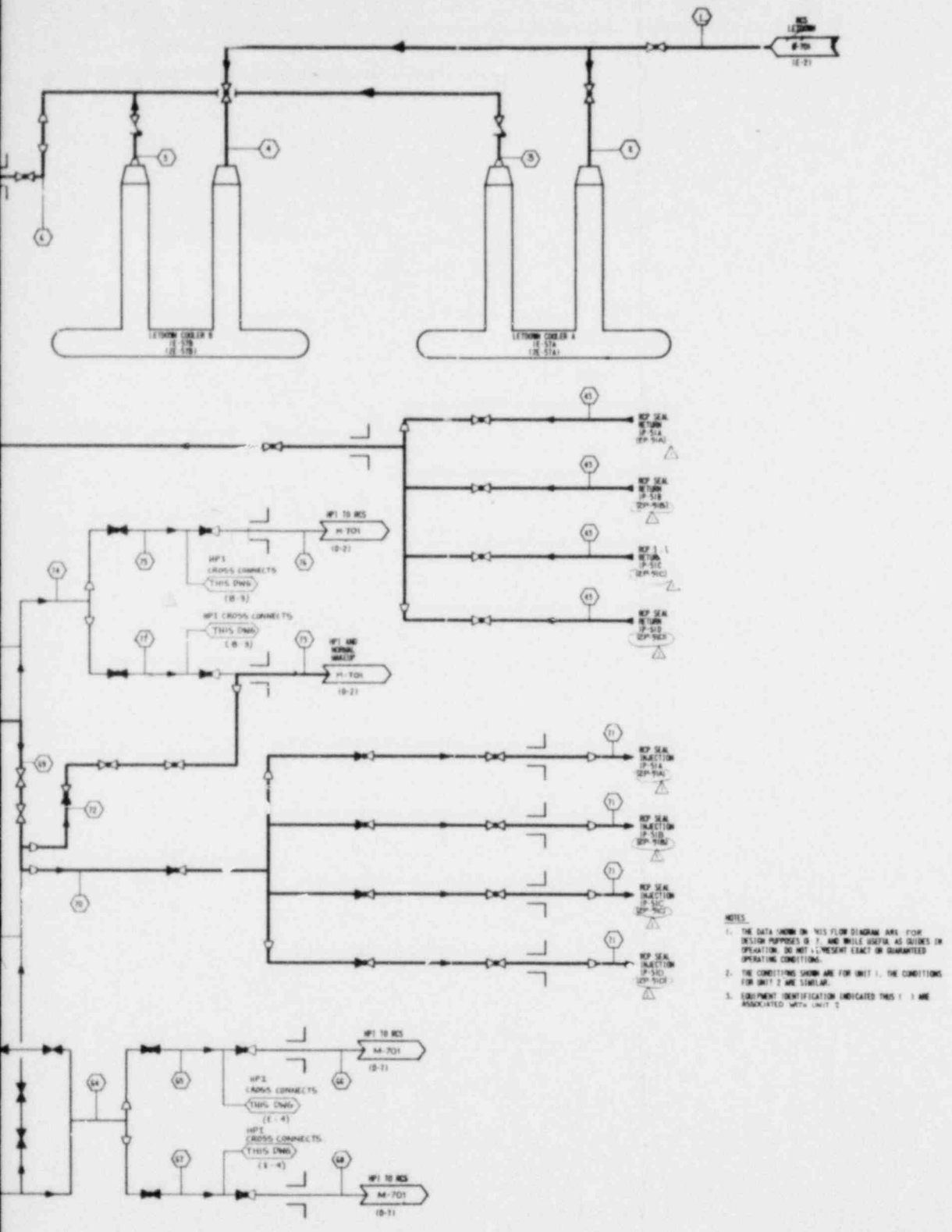
6.3.2.2.9 Control Circuits and Alarms

6.3.2.2.9.1 Core Flooding System

The electric motor operated isolation gate valves at the CF tank outlets are required to be open anytime the reactor is critical. The control circuits for these valves include the following features:

a. Redundant position indication (open or closed) that is not dependent on power being available to the valve controller, is provided for each valve. The indicators are located in the control room.


PRE-FILTER
PRE-FILTER
FAILED FUEL MONITOR
BORON-METER
PURIFICATION DEMINERALIZER
PURIFICATION DEMINERALIZER
SEAL RETURN COOLER
SEAL RETURN COOLER
BLEED TO THE WMS
HYDRAZINE
LITHIUM HYDROXIDE
FROM BATCH CONTROL
RETURN FROM THE WMS
NITROGEN
HYDROGEN
CLEANUP TO DR. SYSTEM
MAKEUP TANK
MAKEUP PUMP
MAKEUP PUMP
MAKEUP PUMP
POST-FILTER
POST-FILTER
POST-FILTER



NOTES:

1. THE DATA SHOWN ON THIS FLOW DIAGRAM ARE FOR DESIGN PURPOSES ONLY, AND WHILE USEFUL AS GUIDES IN OPERATION, DO NOT REPRESENT EXACT OR GUARANTEED OPERATING CONDITIONS.
2. THE CONDITIONS SHOWN ARE FOR UNIT 1. THE CONDITIONS FOR UNIT 2 ARE SIMILAR.
3. EQUIPMENT IDENTIFICATION INDICATED THUS (1) ARE ASSOCIATED WITH UNIT 1

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Makeup and Purification
Units 1 & 2
(M-703 sh 1, Rev 1)

FSAR Figure 6.3-1, sh. 1

NORMAL OPERATION

POINT	○	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
PRESSURE	(PSIG)	2142	2127	2126	2127	2126	2123	2109	2109	------	------	2105	61-72	2106	81-92	54-63	------	54-65	------	------	37-47	36-41	38-44	32-38	33-39
TEMPERATURE	(°F)	554	554	120	554	120	120	120	120	AMBIENT	AMBIENT	120	129	129	129	120	AMBIENT	120	AMBIENT	AMBIENT	120	120	120	120	120
FLOW	(GPM)	60	30	22.5	36	22.5	45	2	43	0	0	35	35	10	10	10	0	2	0	0	45	45	45	45	45

POINT	○	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55 THROUGH 68	69	70	71	72	73	74
PRESSURE	(PSIG)	110	70	74	65	59	58	47	----	----	43	58	57	2877	84	60	NOT APPLICABLE / NOTE 4	2875	2875	2170	2870	2858	----
TEMPERATURE	(°F)	AMBIENT	AMBIENT	120	140	140	140	120	AMBIENT	AMBIENT	120	120	120	176	176	176	AMBIENT	176	176	176	176	176	AMBIENT
FLOW	(GPM)	0	4(SLPM)	149	1	104	104	104	0	0	104	149	149	149	100	100	0	49	52	8	17	17	0

WARMUP LETDOWN

POINT	○	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
PRESSURE	(PSIG)	2141	2100	2098	2100	2098	2085	1939	1939	1900	200	1933	123-298	1933	143-298	116-195	------	116-195	------	------	86-190	82-138	8-137	45-122	64-121
TEMPERATURE	(°F)	554	554	120	554	120	120	120	120	120	120	120	120	120	120	120	AMBIENT	120	AMBIENT	AMBIENT	120	120	120	120	120
FLOW	(GPM)	86.8	93.4	70	93.4	70	140	2	138	83	83	45	45	16	10	10	0	2	0	0	140	140	140	70	70

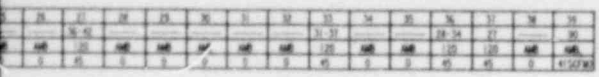
POINT	○	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55 THROUGH 68	69	70	71	72	73	74
PRESSURE	(PSIG)	110	70	74	67	61	60	49	----	----	45	58	77	2606	86	62	NOT APPLICABLE / NOTE 4	2605	2560	2170	2595	2348	----
TEMPERATURE	(°F)	AMBIENT	AMBIENT	120	140	140	140	120	AMBIENT	AMBIENT	120	120	120	176	176	176	AMBIENT	176	176	176	176	176	AMBIENT
FLOW	(GPM)	0	4(SLPM)	244	1	104	104	104	0	0	104	244	244	244	100	100	0	149	52	8	112	112	0

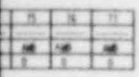
HIGH PRESSURE INJECTION, SUCTION FROM THE RWST

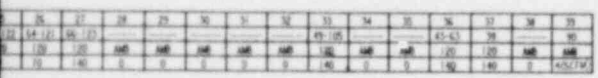
POINT	○	1 THROUGH 50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
PRESSURE	(PSIG)	NOT APPLICABLE / NOTE 4	23	1150	------	------	------	------	34	1161	------	27	------	23	------	1179	780	677	867	677	1137	1136
TEMPERATURE	(°F)	AMBIENT	40-106	50-116	AMB	AMB	AMB	AMB	40-106	50-116	AMB	40-106	AMB	40-106	AMB	50-116	50-116	50-116	50-116	50-116	50-116	50-116
FLOW	(GPM)	0	500	498	0	0	0	0	500	498	0	500	0	500	0	498	249	249	249	249	32	32

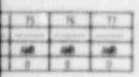
HIGH PRESSURE INJECTION, SUCTION FROM THE DECAY HEAT REMOVAL SYSTEM

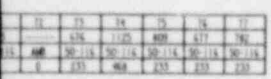
POINT	○	1 THROUGH 50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
PRESSURE	(PSIG)	NOT APPLICABLE / NOTE 4	178	1305	------	------	------	------	178	1305	------	------	182	------	182	1283	924	821	1051	821	1292	1290
TEMPERATURE	(°F)	AMBIENT	120	130	AMB	AMB	AMB	AMB	120	130	AMB	AMB	120	▼	120	130	130	130	130	130	130	130
FLOW	(GPM)	0	500	498	0	0	0	0	500	498	0	0	500		500	498	249	249	249	249	32	32

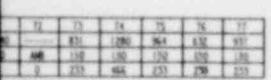




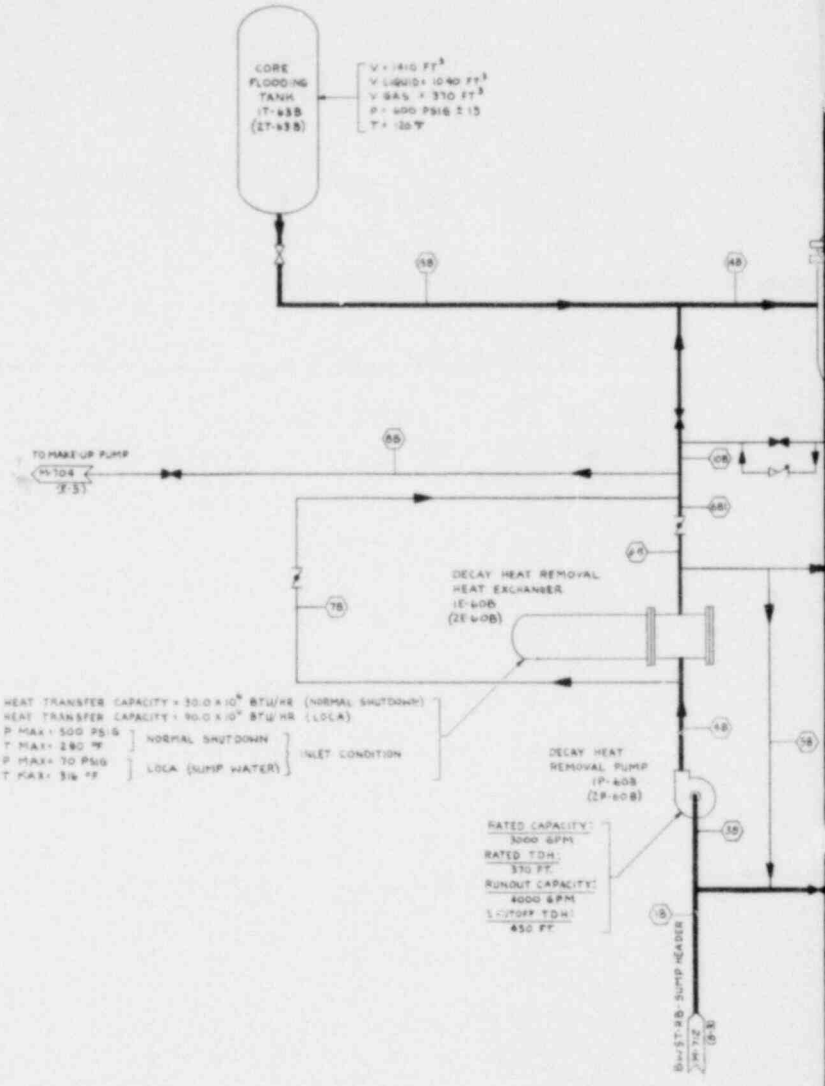








CONSUMERS POWER COMPANY MIDLAND PLANT UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Makeup and Purification Units 1 & 2 (M-703 sh 2(Q), Rev 1)
FSAR Figure 6.3-1, sh. 2



HOLD

LOCA PHASE II C/T ON

POINT	○	3A	14A	3B	14B
PRESSURE (PSIG)		600	600	600	600
TEMP	(°F)	120	120	120	120
*FLOW	(GPM)	3077	2700	3077	1060

* MAX FLOW REACHED 4.8 SEC. AFTER R.C. PRES. REACHES 600 PSIG

C.F.T. LINE BREAK LOCA, WITH DIESEL

POINT	○	1A	3A	4A	5A	6A	9
PRESSURE	(PSIG)	36	34	33	36	32.1	1
TEMP	(°F)	60	60	60	60	60	
FLOW	(GPM)	3800	3077	3877	77	3800	3

LOCA - PHASE III A: L.P.I. INJ. FULL BWST 30 MIN. AFTER DBA

POINT	○	1A	3A	4A	5A	6A	9A	10A	14A	1B	3B	4B	5B	6B	9B	10B	14B
PRESSURE	(PSIG)	41	41	200	41	178	80.6	44	58	41	41	200	41	178	80.6	44	58
TEMP	(°F)	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
FLOW	(GPM)	3000	3077	3077	77	3000	3000	3000	3000	3000	3077	3077	77	3000	3000	3000	3000

LOCA PHASE III B: L.P.I. INJ. EMPTY BWST 25 MIN

POINT	○	1A	3A	4A	5A	6A	9
PRESSURE	(PSIG)	34.9	34.8	33	34.5	171	6
TEMP	(°F)	60	60	60	60	60	
FLOW	(GPM)	3000	3077	3077	77	3000	3

LOCA PHASE III A: SUMP RECIRCULATION 30 MIN. AFTER DBA

POINT	○	1A	3A	4A	5A	6A		10A	14A	1B	3B	4B	5B	6B		10B	14B
PRESSURE	(PSIG)	34	34	199	34	181		47	49	34	34	199	34	181		47	49
TEMP	(°F)	190	190	190	190	190		190	190	190	190	190	190	190		110	90
FLOW	(GPM)	3108	3185	3185	77	3000		3000	3000	3108	3185	3185	77	3000		3000	2010

LOCA - PHASE III B: SUMP RECIRCULATION - 10 DAY

POINT	○	1A	3A	4A	5A	6A	9
PRESSURE	(PSIG)	42	42	166	42	140	6
TEMP	(°F)	140	140	140	140	120	
FLOW	(GPM)	3095	3172	3172	77	3078	3

NORMAL COOLDOWN, R.C. @ 280°F, 6 HRS AFTER SHUTDOWN

POINT	○	2A	3A	4A	5A	6A	7A		10A	**12A	14A	2B	3B	4B	5B	6B	7B		10B	**12B	14B	15	**16
PRESSURE	(PSIG)	311	311	448	311	435	640		340	400	339	311	311	448	311	453	640		340	400	339	327	400
TEMP	(°F)	280	280	280	145	145	280		225	145-160	225	280	280	280	145	145	280		225	145-160	225	280	145-160
FLOW	(GPM)	3080	3080	3080	77	1235	1948		3000	0-200	3000	3080	3080	3080	77	1235	1948		3000	0-200	3000	1460	0-200

** USED INTERMITTENTLY DURING COOLDOWN

NORMAL COOLDOWN, R.C. TEMP @ 180°F, 20 HRS. AFTER SHUTDOWN

POINT	○	2A	3A	4A	5A	6A		10A	14A	2B	3B	4B	5B	6B		10B	14B	15
PRESSURE	(PSIG)	19	17	164	17	161		124	125	19	17	164	17	161		124	125	19
TEMP	(°F)	120	140	140	120	120		120	120	140	140	140	120	120		120	120	120
FLOW	(GPM)	3046.5	3046.5	3046.5	77	3046.5		3000	3000	3046.5	3046.5	3046.5	77	3046.5		3000	3000	6054

NORMAL REFUELING MODE R.C. TEMP = 140°

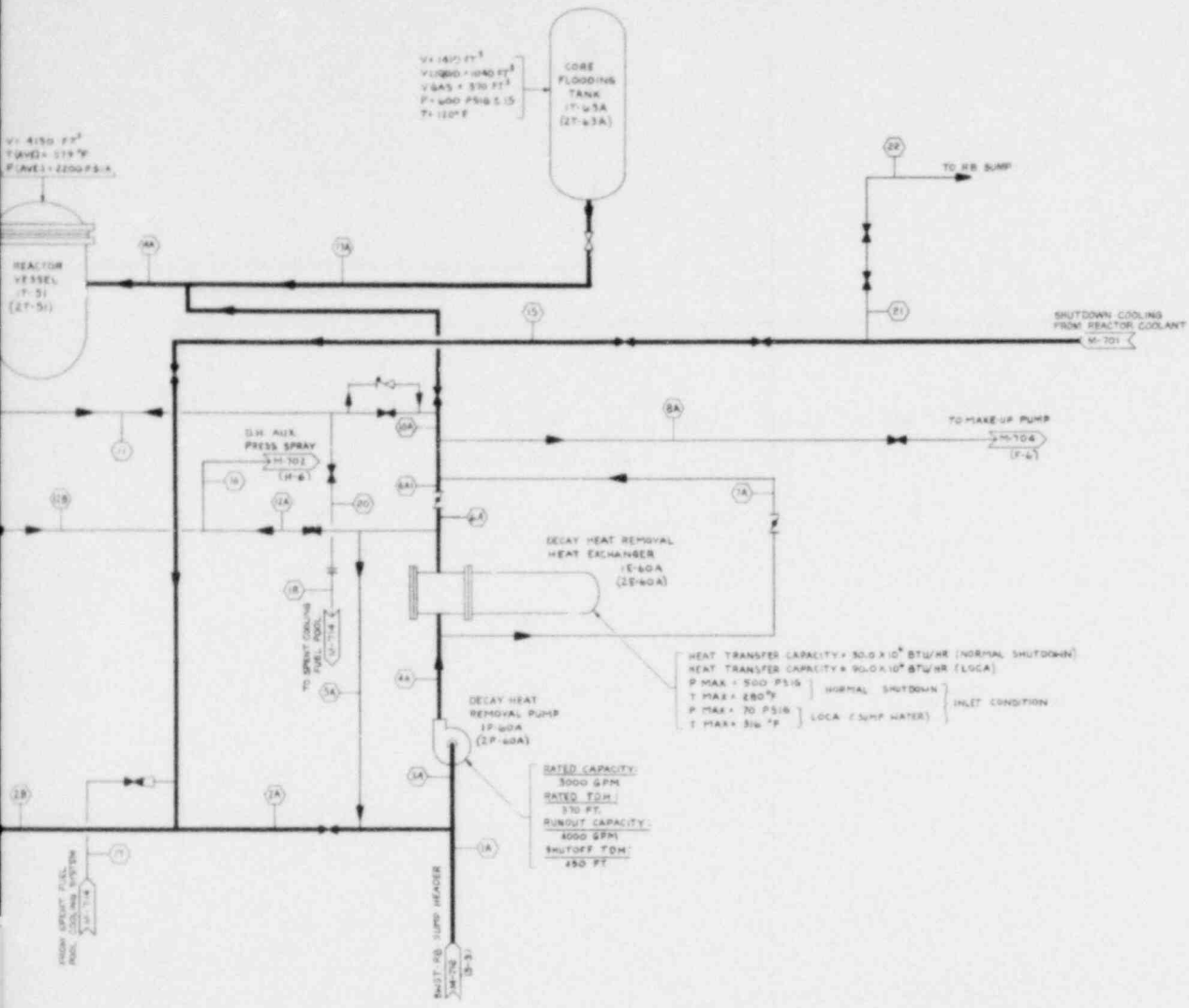
POINT	○	2A	3A	4A	5A	6A	9
PRESSURE	(PSIG)	9	9	157	9	135	
TEMP	(°F)	140	140	140	120	120	
FLOW	(GPM)	3046.5	3046.5	3046.5	77	3000	3

BOOSTER PUMP MODE TO M.U. SYSTEM FROM SUMP

POINT	○	1A	3A	4A	5A	6A	10A	1B	3B	4B	5B	6B	10B
PRESSURE	(PSIG)	14	12	189	12	162	108	14	12	169	12	162	108
TEMP	(°F)	205	205	205	120	120	120	205	205	205	120	120	120
FLOW	(GPM)	500	500	500	85	500	500	500	500	500	85	500	500

SPENT FUEL POOL AUX. COOLING

POINT	○	2A	3A	4A	3B	5B	6B	17	18	20
PRESSURE	(PSIG)	30	30	166	30	30	166	75	75	85
TEMP	(°F)	140	120	120	140	120	120	140	120	120
FLOW	(GPM)	3000	77	3000	3000	77	3000	3000	3000	3000



NOTE:
THE DATA SHOWN ON THIS FLOW DIAGRAM ARE FOR DESIGN PURPOSES ONLY, AND WHILE USEFUL AS GUIDES IN OPERATION, DO NOT REPRESENT EXACT OR GUARANTEED OPERATING CONDITIONS.

CONSUMERS POWER COMPANY MIDLAND PLANT UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Decay Heat Removal and Core Flooding System Units 1 & 2 (M-710, Rev 0)
FSAR Figure 6.3-2

TABLE 6.5-2 (continued)

	Anticipated	Conservative
Effectiveness of fission product removal systems	Refer to Subsection 6.5.2	Refer to Subsection 6.5.2

27

TABLE 6.5-3 HAS BEEN DELETED.

7.4 SYSTEMS INVOLVED IN SAFE SHUTDOWN

Hot shutdown is a stable condition of the reactor achieved shortly after a programmed or emergency shutdown of the plant has taken place. In this condition the reactor is subcritical and the reactor coolant system temperature and pressure are in the normal operating range. Operating limits for hot shutdown are given in Chapter 16. To maintain hot shutdown, it is necessary that the reactivity control systems maintain a subcritical condition of the core and that heat removal systems operate to maintain adequate cooling of the core. For the Midland plant, hot shutdown will be maintained as a safe shutdown condition.

7.4.1 DESCRIPTIONS

7.4.1.1 Safe Shutdown Systems Descriptions

In the event of a unit shutdown, the reactor will initially be brought to a hot (safe) shutdown condition from the main control room. The portions of the reactor protection system required to achieve a safe shutdown condition are described in Section 7.2. The system and component controls, and monitoring indicators provided on the auxiliary shutdown control panel are listed in Subsection 7.4.3. Power for systems required for safe shutdown is from various Class 1E power supplies (see individual control system descriptions and Chapter 8). The specific control systems and monitors used to maintain a safe shutdown condition are tabulated below:

CONTROL SYSTEMS

a. Auxiliary feedwater controls

b. Atmospheric steam relief

c. Control rod drive control system (CRDCS) - trip portion

d. Pressurizer heater controls for heater banks 5 and 6 | 18

e. Necessary makeup and purification system controls

f. Makeup and purification letdown isolation valves

g. Necessary service water system controls

h. Necessary component cooling water system controls

i. Auxiliary feedwater supply switchover | 20

ESSENTIAL MONITORS

a. Water level for each steam generator

b. Pressure for each steam generator

c. Pressurizer water level

d. Pressurizer pressure or reactor coolant pressure

7.4.1.1.1 Auxiliary Feedwater (AFW) Control

On loss of main feedwater, feedwater is automatically supplied to the steam generators from the auxiliary feedwater system. The mechanical and safety aspects of the auxiliary feedwater system are discussed in detail in Subsection 10.4.9. Automatic actuation is from the auxiliary feedwater actuation system (AFWAS) which is one of the engineered safety features actuation systems. A complete discussion of the AFWAS is given in Subsection 7.3.3.2.6. | 27

Subsequent to AFW actuation, control of level in the steam generators is accomplished using the auxiliary feedwater control valve in each AFW loop. These valves are Class 1E motor operated valves with series connected dual starter contacts to allow for redundant control circuits. Control signals for each AFW level control valve are supplied by redundant and independent Class 1E level transmitters on the associated steam generators. Redundant controllers for each valve are located in the main control room and on the auxiliary shutdown control panel. In addition to automatic actuation by the AFWAS, control to the AFW level control valves for startup, shutdown, or emergency operations can be initiated using level control permit switches located on the main and auxiliary shutdown control panels.

Since the AFWAS is discussed in detail in Subsection 7.3.3.2.6, the following material will deal with AFW level control only. | 27

INITIATING CIRCUITS - Auxiliary feedwater level control signals are continuously being generated by level controllers for the associated steam generator but are blocked from reaching the associated normally open valve. Upon AFWAS actuation, the signal blocks are automatically removed and AFW level control commences. The signal blocks may also be manually removed via level control permit switches on main and auxiliary shutdown control panels.

LOGIC - There are two level control signals for each AFW control valve. These signals must both agree to open or close the valve before the valve motor operator will be actuated (two-out-of-two logic). In the event of level transmitter failure, the AFW control valves may be manually controlled by means of the bypass provisions discussed below.

BYPASSES - Bypass of the AFWAS initiating logic is discussed in Subsection 7.3.3.2.6. Bypass of automatic level control may be accomplished by placing the controllers for both channels to the | 27

AFW control valve in the manual mode. In this mode, the level setpoint can be manually changed for manual level control.

The transfer to manual control from the auxiliary shutdown panel (ASP) overrides automatic control capabilities and removes manual operation from the control room. This allows full control from the ASP regardless of the mode selected in the control room. Auto/manual status of the ASP controller is displayed by indicating lights on the control room controller. These indicating lights are used to bring attention to an abnormal condition affecting the associated controls. For design basis information for the auxiliary shutdown panel see Subsection 7.4.3.1.3. 27

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7.4.1.1.5 Makeup and Purification Letdown Isolation Valves

During safe shutdown, it may be necessary to isolate the letdown system to help maintain reactor coolant pressure and volume. The isolation valves involved are part of the ECCS equipment discussed in Section 6.3. If needed, they can be manually actuated via Class 1E switches on the main control panel or the auxiliary shutdown panel.

7.4.1.1.6 Other Controls Required for Safe Shutdown

The other control systems which are used to maintain the unit in the safe shutdown condition are:

a. Necessary service water system controls (Subsection 9.2.1)

b. Necessary component cooling water system controls (Subsection 9.2.2)

c. Pressurizer heater controls (banks 5 and 6)

The control of pressurizer heaters is required to ensure the capability of maintaining reactor coolant pressure during hot safe shutdown and during normal plant operation. The mechanical and overpressurization protection aspects of the pressurizer are discussed in detail in Subsections 5.4.10 and 5.4.11. The pressurizer heater elements are divided into six banks having separate controls. Banks 2 through 6 have on/off controls, whereas bank 1 is controlled to produce a proportional output that increases as pressure decreases from setpoint. Banks 1 through 4 have non-Class 1E controls powered from a battery backed power bus. A detailed description of non-Class 1E heater controls is given in Subsection 7.7.1.8. 18

Heater banks 5 and 6 are controlled by Class 1E instrumentation and both heaters and controls are powered from Class 1E power sources. The Class 1E controlled heater banks 5 and 6 are intended only for use during hot safe shutdown. Controls of Class 1E heater banks are provided both in the main control room and at the auxiliary shutdown panels.

INITIATING CIRCUITS- The Class 1E heater controls are initiated manually, based on pressurizer level and reactor coolant pressure. The operator action can be initiated either from the main control room or from the auxiliary shutdown panels. 27 18

LOGIC - The operator will activate the heaters when the pressurizer level exceeds the low level interlock

setpoint and the RCS pressure is below a desired valve. The heaters will be deenergized automatically if the pressurizer level drops below a predetermined setpoint, or they will be deenergized manually when the designed reactor coolant system pressure is achieved.

BYPASSES - The pressurizer heater controls do not have any bypass controls.

INTERLOCKS - To prevent the operation of heater banks 5 and 6 when the pressurizer level is low, an interlock from two redundant Class 1E pressurizer level strings is provided.

INDICATORS - Class 1E indicators are provided in the main control room and in the auxiliary shutdown panels to indicate the RCS pressure.

REDUNDANCY - Heater banks 5 and 6 have a redundant Class 1E control system. The system includes the redundant Class 1E level and pressure transmitters, interlocks, and indication (for pressure) in the main control room and on the auxiliary shutdown panels. Heater banks 5 and 6 are also redundant, and each is capable of supplying the minimum required kW for maintaining hot safe shutdown. 18

DIVERSITY - The pressurizer heater control systems are not diverse.

ACTUATED DEVICES - Pressurizer heater banks 5 and 6 are the actuated devices.

SUPPORTING SYSTEMS - Power for heater elements of banks 5 and 6 is from Class 1E 460Vac power supplies. Power for the heater control system is from Class 1E 125Vdc power supplies.

PORTIONS NOT REQUIRED FOR SAFETY - All portions of the pressurizer heater controls for banks 5 and 6 are required for safety.

DESIGN BASIS INFORMATION - The design bases of the pressurizer heater control system for banks 5 and 6 (according to Section 3 of IEEE Std 279-1971) are the following:

1. The generating stations conditions which require protective actions are maintaining the reactor coolant pressure during hot safe shutdown by the use of pressurizer heater controls. 20

2. The generating station variables that are required to be monitored and that provide the operator with

the information required to manually control the pressurizer heaters are pressurizer level and RCS pressure. 20 26

3. Reactor coolant pressure and power breaker status are the minimum indications necessary to control the operation of pressurizer heaters adequately.

4. The normal operating reactor coolant system pressure is 2,160 psig. The normal operating pressurizer level is 180 inches.

5. The acceptable range of reactor coolant system pressure during hot shutdown is 2,160 ±50 psig. The acceptable range of pressurizer level during hot shutdown is 40 to 320 inches. 20

6. The pressurizer heater controls are designed for environmental conditions stated in Section 3.11. The range of the environmental parameters for the electrical power supplies is discussed in Chapter 8.

7. The pressurizer heater control systems are Class 1E and designed to withstand the effects of a safe shutdown earthquake, missiles, floods, lightning, wind, etc, without loss of operation, as stated in Section 3.10.

8. The pressurizer heater control systems response times are less than 500ms. System accuracies and range of operation are indicated in Tables 7.5-1 and 7.5-2. 18

DRAWINGS - The complete list of drawings of logic, loop, and electrical schematics are shown in Q&R Figures 7.4-3 through 7.4-10. Control boards will be provided by amendment as indicated in the response to Q&R 031.27. 24 26

7.4.1.1.7 Auxiliary Feedwater Supply Switchover

Normal feedwater supply to auxiliary feedwater pump suction is provided by a nonseismic Category I condensate storage tank. A Seismic Category I makeup supply to auxiliary feedwater pump suction is provided by the service water system through two separate trains to supply feedwater in the event that the condensate storage tank or other sources of water are not available. Each service water system train is isolated from the other so that failure of one does not affect the other. Automatic switchover to service water is actuated by the presence of an AFWAS signal combined with auxiliary feedwater pump low suction pressure. A complete discussion of the AFWAS is given in Subsection 7.3.3.2.6. 20 27

After AFW actuation, switchover to service water is accomplished using a two-out-of-four AFW pump low suction pressure logic. To prevent spurious opening of the service water valves because of normal transients, the low suction pressure must persist for 4 seconds before initiating opening of these valves. Nonseismic Category I portions of the auxiliary feedwater system suction piping from condensate storage tank are isolated concurrent with switchover to service water supply.

INITIATING CIRCUITS - Upon AFWAS actuation combined with a two-out-of-four AFW pump low suction pressure and a delay of 4 seconds, the service water supply valves are automatically initiated open. 20

LOGIC - There are four pressure transmitters for each of the AFW pumps. Two of these transmitters signals must be low and persist for 4 seconds, combined with an AFWAS signal before the service water motor operated valves will be actuated.

MANUAL CONTROL - The service water supply valves can be manually opened from the main control room or the auxiliary shutdown panels. For design basis information for the auxiliary shutdown panel see Subsection 7.4.3.1.3. 27

INTERLOCKS - Auxiliary feedwater supply automatic switchover actuation is interlocked with the AFW pump low suction pressure to avoid any spurious actuation of the switchover.

REDUNDANCY - Redundant AFW suction pressure instrumentation has been used to provide a reliable system. 20

DIVERSITY - The AFW supply switchover control systems are not diverse.

ACTUATED DEVICES - The service water and the condensate storage water supply valves are the actuated devices.

DRAWINGS - Logic diagrams, see Drawings J-226, J-227, and J-299 (submitted with drawings listed in Section 1.7); loop diagrams, see Drawings J-337 and J-338 (submitted with drawings listed in Section 1.7); electrical schematics, see Drawing E-158 (submitted with drawings listed in Section 1.7); control boards, see Drawings J-726, J-908, and J-909 (submitted with drawings listed in Section 1.7); and P&ID's, see Figures 10.4-10 and 10.4-13. 22

7.4.2 ANALYSIS

Systems and equipment used to achieve and maintain safe shutdown are designed to withstand the effects of an SSE concurrent with a loss of offsite power. The following specific plant contingencies have been considered in their design:

a. Loss of Instrument Air Systems

None of the essential monitoring instrumentation or valves required for safe shutdown is pneumatic. Electrical instrumentation is powered from the Class 1E power system. Therefore, the loss of nonseismic Category I instrument air will not degrade instrumentation systems required for safe shutdown of the plant.

b. Loss of Cooling Water to Vital Equipment

Cooling water for emergency systems and equipment is supplied by the component cooling water system which has two 100% redundant loops (See Subsection 9.2.2). Systems like the emergency HVAC system are serviced by two 100% redundant chilled water systems (see Subsection 9.2.10) which are cooled by the essential service water system. Therefore, loss of one chilled water loop or essential service water loop will not degrade emergency system operations. 27

c. Plant Load Rejection, Turbine Trip, and Loss of Offsite Power

In the event of loss of offsite power associated with plant load rejection or turbine trip, power for safe shutdown is provided by the onsite Class 1E power system. The description and analysis of the emergency power system are discussed fully in Section 8.3. The standby diesel generators will provide power for operation of pumps and valves. The station batteries will provide dc power for operation of control and instrumentation systems required to actuate and control essential components.

Specific systems used to maintain safe shutdown are analyzed in the following subsections.

7.4.2.1 Auxiliary Feedwater Control

Since a complete analysis of the AFWAS controls is included in the ESFAS analysis (Subsection 7.3.3.4), this section will address auxiliary feedwater level control only.

CONFORMANCE TO NRC GENERAL DESIGN CRITERIA, REGULATORY GUIDES, AND OTHER STANDARDS - All standards applicable to the auxiliary feedwater controls are indicated in Table 7.1-2. Conformance to NRC General Design Criteria is discussed in Section 3.1. Regulatory Guides are addressed in Appendix 3A.

CONFORMANCE TO IEEE STD 279-1971 - The auxiliary feedwater level controls comply with the following applicable portions of IEEE Std 279-1971:

a. Single-Failure Criterion - Any single failure in the auxiliary feedwater flow controls will not prevent proper initiation of safety function. This is accomplished through the use of completely independent controls for each of the two auxiliary feedwater supply

systems, and redundant control loops for the auxiliary feedwater level control valves.

b. Quality of Components and Modules - Equipment manufacturers are required to use high quality components and modules in equipment construction. Quality control procedures, used during fabrication and testing, verify compliance with this requirement.

c. Equipment Qualification - Type test data are available to verify that the auxiliary feedwater level control equipment meets the performance requirements necessary for achieving the required system response.

d. Channel Independence - Each level control channel is powered from an independent Class 1E power supply. In order to prevent interaction between redundant systems, the controls are wired independently and separated, with no electrical interconnections.

e. System Interaction - The transmission of signals from nonsafety equipment to the auxiliary feedwater control system is buffered by Class 1E, seismically qualified isolators such that no failure of the nonsafety equipment will prevent the protection system from meeting the minimum performance requirements specified in the design bases.

f. Capability for Test and Calibration - Manual testing facilities have been built into the auxiliary feedwater controls for preoperational and online testing.

g. Information Readout - The following are indicated on the main control panels and on the auxiliary shutdown control panel:

   1. Steam generator level

   2. Auxiliary feedwater flow

   3. Auxiliary feedwater pumps running

   4. Auxiliary feedwater cross-tie, isolation, and supply valve positions

h. Identification - Physical identification of safety grade power supplies and safety-related signal channels is done as described in Subsection 8.3.1.3.

CONFORMANCE TO IEEE STD 338-1975 - Conformance to IEEE Std 338 is discussed in Subsection 7.1.2.4. | 27

7.4.2.2 Atmospheric Steam Relief

The safety-related function of atmospheric steam relief is satisfied by the main steam safety valves, which are entirely mechanical. The discussion of these valves is found in Section 10.3. Nonsafety atmospheric steam relief is discussed in Subsection 7.7.1.7.

7.4.2.3 Control Rod Drive Control System (CRDCS) - Trip Portion

CONFORMANCE TO IEEE STD 279 - The CRDCS complies with the following applicable portions of IEEE Std 279-1971:

a. Single-Failure Criterion - Any single failure within the CRDCS will not prevent proper initiation of safety action.

b. Quality of Components and Modules - Equipment manufacturers will be required to use high quality components and modules in equipment construction. Quality control procedures, to be used during fabrication and testing, will verify compliance with this requirement.

c. Equipment Qualification - Type test data are available to verify that the CRDCS equipment meets the performance requirements necessary for achieving the required system response. Refer to Sections 3.10 and 3.11 for discussion of qualification testing. 17

d. Channel Independence - The essential portions of the CRDCS are packaged in four independent and physically separated cabinets to reduce the likelihood of interactions between equipment during maintenance operations or in the event of equipment malfunction.

e. System Interaction - There is no interaction between control systems and the CRDCS trip portion.

f. Capability for Test and Calibration - Manual testing facilities have been built into the CRDCS trip devices for preoperational and online testing in conjunction with the RPS. The test routines are designed to demonstrate that, without interfering with normal reactor or plant operation, the CRDCS trip devices can fulfill their required safety function. All tests may be performed online with the CRDCS, with no sacrifice of independence.

g. Completion of Protecting Action, Once Initiated - Once initiated, the full insertion of the shim safety control rods is dependent only upon gravity. Therefore, the action continues to completion after trip initiation.

reactor coolant system pressure. This is accomplished through the use of completely independent, physically separated, redundant Class 1E controls and power supplies for pressurizer heater banks 5 and 6.

b. Quality of Components and Modules - The pressurizer heater control equipment manufacturers are required to use high quality components and materials in equipment construction. Quality control procedures and quality assurance programs used during fabrication and testing verify compliance with this requirement.

c. Equipment Qualification - Type test data are available to verify that pressurizer Class 1E heater controls meet performance requirements.

d. Channel Integrity - The pressurizer heater control systems are designed to withstand the environmental conditions expected in their respective locations.

e. Channel Independence - Heater banks 5 and 6 and their controls are Class 1E, redundant, physically independent, and separated from each other to prevent interaction between redundant portions. 18

f. System Interaction - The transmission of pressurizer level signals from safety-related equipment to nonsafety-related equipment is buffered by Class 1E, seismically qualified isolators such that no failure of the nonsafety equipment will prevent the safety system from performing the desired function.

g. Derivation of System Inputs - The pressurizer level and the RCS pressure inputs are derived directly from the signals, which are direct measurements of the process variables.

h. Capability for Test and Calibration - Facilities for testing and calibration are provided in the pressurizer control systems.

i. Manual Initiation - Controls for banks 5 and 6 are initiated by operator action and the operator requires only RCS pressure indication.

j. Access to Setpoint Adjustment, Calibration, and Test Points - Administrative control of access to the setpoint adjustments and module calibration are provided.

k. Information Readout - Two Class 1E redundant indications for RCS pressure are provided in the main control room and on the auxiliary shutdown panels for operator action.

l. System Repair - The system is designed to facilitate the replacement, repair, or adjustment of malfunctioning components or modules.

m. Identification - Physical identification of safety grade power supplies and safety-related signal channels is provided as described in Subsection 8.3.1.3. 18

CONFORMANCE TO IEEE STD 338-1975 - Conformance to IEEE Std 338-1975 is discussed in Subsection 7.1.2.4.

7.4.2.8 Auxiliary Feedwater Supply Switchover Control

Because a complete analysis of the AFWAS controls is included in the ESFAS analysis (Subsection 7.3.3.4), this section will address normal auxiliary feedwater supply switchover to service water supply controls only.

CONFORMANCE TO NRC GENERAL DESIGN CRITERION, REGULATORY GUIDES, AND OTHER STANDARDS - All standards applicable to auxiliary feedwater controls are indicated in Table 7.1-2. Conformance to NRC general design criteria is discussed in Section 3.1. Regulatory guides are addressed in Appendix 3A.

CONFORMANCE TO IEEE STD 279-1971 - The auxiliary feedwater supply switchover controls comply with the following applicable portions of IEEE Std 279-1971.

a. Single-Failure Criterion - Any single failure in the auxiliary feedwater supply switchover control will not prevent proper initiation of safety functions. This is accomplished through the use of completely independent controls for each of the two auxiliary feedwater supply systems and redundant pressure transmitters for the auxiliary feedwater supply switchover to service water. 20

b. Quality of Components and Modules - Equipment manufacturers are required to use high quality components in equipment construction. Quality construction procedures used during fabrication and testing verify compliance with this requirement.

c. System Interaction - The transmission of signals from nonsafety equipment to the auxiliary feedwater control system is buffered by Class 1E seismically qualified isolators such that no failure of the nonsafety equipment will prevent the protection system from meeting the minimum performance requirements specified in the design bases.

d. Information Readout - The following are indicated on the main control panels and on the auxiliary shutdown control panel: 27

7.4.3 SHUTDOWN FROM OUTSIDE THE CONTROL ROOM

7.4.3.1 Description

7.4.3.1.1 Hot Shutdown

There are two auxiliary shutdown control panels, one panel for each unit. In the unlikely event that temporary evacuation of the control room is required because of some abnormal station condition, the operators can establish and maintain either or both reactors in a hot shutdown condition from outside the control room through the use of controls located at the corresponding local and auxiliary shutdown control panels. Other controls at appropriate switchgear and at motor control centers are also available if needed for backup. These controls are used as needed for various functions 1 to 8 hours after initiation of hot shutdown. Although the auxiliary shutdown control panel is designed for maintaining hot shutdown from outside the control room, this panel can also be used for certain functions when implementing cold shutdown from outside the control room.

The turbine and reactor must be in the tripped condition to initiate hot shutdown. Procedurally, this will be done by tripping the reactor and consequently the turbine prior to evacuating the control room. It should be noted, however, that this tripping capability also exists outside the control room through manual tripping of the control rod drive system power supplies.

Table 7.4-1 lists the safety-related controls and monitoring indicators provided for hot shutdown on each auxiliary shutdown control panel. Table 7.4-2 lists the nonsafety-related controls and monitoring indicators provided.

7.4.3.1.2 Cold Shutdown

Through the use of controls on the auxiliary shutdown control panel, and at other places outside the main control room, and following administrative procedures, the plant can also be brought to cold shutdown from outside the main control room. The following systems are utilized in addition to the safe shutdown systems listed in Subsection 7.4.1:

a. Reactor chemical addition system

b. Decay heat removal system

All of the cold shutdown systems are manually operated, under administrative control, and coordinated in sequence, during the shutdown time period.

The process parameters to be monitored during the approach to and achieving of cold shutdown are as follows:

a. Pressurizer water level

b. Reactor coolant pressure

c. Reactor coolant wide range cold leg temperature

d. Steam generator water level

e. Reactor coolant boron concentration (sample analysis is acceptable)

f. Makeup tank water level

g. Decay heat removal heat exchanger outlet temperature

h. Letdown cooling heat exchanger outlet temperature

i. Letdown flow

j. Condensate tank water level

k. Borated water storage tank level

After hot shutdown conditions have been achieved, the instrumentation and controls provided outside the main control room in conjunction with control stations provided locally could, with sufficient time, personnel, procedures, and administrative controls, bring the plant to a cold shutdown condition.

On an emergency basis, cooldown can be initiated by local operation of the turbine bypass system valves. All required motors can be started or stopped at their switchgear or motor starters. Therefore, systems that are used for cold shutdown can be operated from outside the control room and include those noted in Subsection 7.4.1, as well as cooling water, decay heat removal, and sampling systems. 27

Instrument indication to monitor essential plant parameters can be obtained from outside the control room at the auxiliary shutdown panel, at the equipment itself, or via the plant computer. Table 7.4-2 lists the nonsafety-related monitoring indicators provided on the auxiliary shutdown control panel. Table 7.4-3 lists other control centers outside the main control room that can be used to establish and maintain hot or cold shutdown. 27

7.4.3.1.3 Design Bases Information

In accordance with NRC General Design Criterion 19, the capability of establishing a hot shutdown condition and maintaining the reactor in a safe status in that mode is considered an essential function. The controls and indications necessary for this function are identified in Subsection 7.4.1.

To ensure availability of the auxiliary shutdown control panel and safety-related local control stations after control room evacuation, the following design features have been utilized:

a. Each auxiliary shutdown control panel, including all safety-related instrumentation mounted on it, is designed to withstand the safe shutdown earthquake with no loss of safety-related functions. The safety-related local control stations are also designed to withstand the safe shutdown earthquake with no loss of safety functions.

b. The safety-related local stations and the auxiliary shutdown control panel, including safety-related controls and indicators, are designed to comply with applicable portions of IEEE Std 279-1971.

In addition to establishing and maintaing hot shutdown, NRC General Design Criterion 19 requires the potential capability for subsequent cold shutdown of the reactor through the use of suitable procedures. To this end, controls and indicators are provided outside the main control room as necessary to achieve cold shutdown. Achieving cold shutdown from outside the main control room is not considered a safety-related function.

DRAWINGS - Layout drawings, see Drawings J-908 and J-909 (submitted with drawings listed in Table 1.7-9).

7.4.3.2 Analysis

The analysis of the control systems required for safe shutdown is found in Subsection 7.4.2. The discussion below is limited to the auxiliary shutdown control panel and essential local control stations.

CONFORMANCE TO NRC CRITERIA, REGULATORY GUIDES, AND OTHER STANDARDS - All standards applicable to safe shutdown from outside the control room are indicated in Table 7.1-2. Conformance to NRC General Design Criteria is discussed in Section 3.1. Regulatory Guides are addressed in Appendix 3A.

CONFORMANCE TO IEEE STD 279-1971 - Each auxiliary shutdown control panel. including safety-related controls and indications and the safety-related local control stations, is designed to conform to applicable portions of IEEE Std 279-1971. The control circuits at each auxiliary shutdown control panel and safety-related local control stations are designed such that any single failure will not prevent proper protective action when required. This is accomplished by fully redundant controls for the systems required for safe shutdown utilizing independent Class 1E power systems.

To prevent interaction between the redundant systems, the control channels are wired independently and separated, with no electrical connections between redundant control systems. Nonessential control circuits and nonessential monitor circuits are physically and electrically isolated from safety-related controls and indications to prevent jeopardizing the reliability of the systems required for safe shutdown.

TABLE 7.4-1

SAFETY-RELATED CONTROLS AND MONITORING INDICATORS,
AUXILIARY SHUTDOWN CONTROL PANEL

Controls

AFWAS channel block pushbuttons

Open/close control of the service water system auxiliary feedwater supply valves

Auxiliary feedwater pump turbine controller

Stop/start control of the motor driven auxiliary feedwater pump

Open/close control of the auxiliary feedwater pump recirculation valves

Open/close control of the main auxiliary feedwater crosstie valve

Open/close control of the auxiliary feedwater discharge cross-connect valves

Open/close control of the steam generator inlet auxiliary feedwater isolation valves

Open/close control of the respective unit's condensate storage tank and condensor hotwell auxiliary feedwater supply valves

Open/close control of the auxiliary feedwater isolation valves

Open/close control of the auxiliary feedwater pump turbine main steam supply block valve

Open/close control of the auxiliary feedwater pump turbine stop valve

Open/close control of the makeup tank isolation valve

Open/close control of the high-pressure injection supply valve

Stop/start control of the makeup pumps

Open/close control of the RC letdown cooler isolation valve

Open/close control of the RC letdown shutoff valve

Jog open/jog close control of the hp injection valve to the RC system

Open/close control of the hp injection and makeup isolation valve

TABLE 7.4-1 (continued)

Stop/start control of the component cooling water pump	
Stop/start control of the spare component cooling water pump	
Stop/start control of the motor driven auxiliary feedwater pump from the alternate power supply	
Stop/start control of the spare makeup pump	
Open/close control of the makeup pump recirculation isolation valve	
On/off control of pressurizer heater banks 5 and 6	18
Monitoring Indicators	
Steam generator water level indicators (on control station)	18
Reactor coolant pressure indicators	
Pressurizer level indicator	27

TABLE 7.4-2

NONSAFETY-RELATED CONTROLS AND MONITORING INDICATORS,
AUXILIARY SHUTDOWN CONTROL PANEL

Controls

Open/close control of the auxiliary feedwater pump turbine steam line drain valves

Open/close control of the auxiliary feedwater pumps' feedwater isolation valves

Atmospheric steam dump valve controller

Open/close control of the auxiliary feedwater pumps' condensate isolation valves

Open/close control of the pressurizer electromatic relief valve | 18

Open/close control of the pressurizer spray valve

Auto/manual selector switch for the pressurizer spray valve

Open/close control of the pressurizer spray isolation valve

Monitoring Indicators

Auxiliary feedwater pump turbine main steam inlet pressure indicator

Auxiliary feedwater pump turbine tachometer

Auxiliary feedwater flow

Condensate storage tank level indicators

Steam generator level startup range

Main steam pressure indicators

Reactor coolant outlet temperature indicators

Pressurizer pressure wide range indicator | 27

Boronometer indicator

Auxiliary feedwater recirculation line-up

Auxiliary feedwater pump suction pressure indicators

Auxiliary feedwater pump discharge pressure indicators | 18

TABLE 7.4-3

OTHER CONTROLS PROVIDED
OUTSIDE THE MAIN CONTROL ROOM

Start/stop controls for both centrifugal makeup pumps
Location: Makeup pump switchgear

Start/stop controls for both boric acid transfer pumps
Location: Reactor chemical addition panels (1C109 and 2C109)

Start/stop controls for the component cooling water pumps
Location: Component cooling water pump switchgear

Start/stop controls for the containment recirculating air cooling units
Location: Reactor building H&V panels (1C150 and 2C150)

Start/stop controls for the control room ventilation unit including the control room air inlet dampers
Location: Fan and damper motor control centers

Start/stop controls for the diesel generators
Location: Each diesel generator local control panel

Start/stop controls for the service water pumps
Location: Service pump switchgear

DRAWINGS - Logic diagrams, see Figures 7.3-1 through 7.3-9; P&IDs, see Figures 6.2-119 and 6.2-120; Electrical Schematics E-374 and E-375 (listed in Table 1.7-15); and panel numbers, see Table 7.5-1. 27

7.5.1.2.2 System Bypass

Bypasses within the ESFAS are indicated on the ESFAS cabinets by lights and are alarmed by the plant annunciator. Examples of such bypasses are the bypass of low reactor coolant pressure actuation of the emergency core cooling systems for startup and shutdown and the bypass of a sensor trip bistable channel for maintenance or testing. Refer to Section 7.3 for details of the bypasses and their respective indication and alarm features. 27

Bypass of ESF equipment operation can be effected a number of ways. Control circuit bypass features for individual devices, breaker test and rackout features, control circuit fuses, screw terminals and electrical connections, and closure of manual valves for system or device testing or maintenance are some of the means by which an ESF system or vital supporting system might be rendered inoperative on a system level. The following describes the system of bypass indication and annunciation provided.

The number of bypass features or devices provided for operational purposes or routine testing is minimized by design, but wherever such features or devices are an integral part of the design and are used more frequently than once a year, and the bypass results in defeating system functions, a means of indication is provided in the bypass section of the ESFAS status display panel on the main control panel. Thus, ESF equipment (pump, valve, fan, etc, including vital support system equipment) or small groups of equipment which must operate upon automatic or manual ESFAS actuation and which warrant bypass indication (as outlined above) are monitored by "not bypassed" status lights indicating availability of that component or group of components. Availability is indicated by an illuminated white status light; thus, any condition resulting in a loss of control power to a monitored device, such as "racking out" a breaker, is indicated by an extinguished lamp on the bypass display. Manual valves in ESF system process lines which are capable of bypassing system function, and which require operation on a frequency greater than once a year, are similarly monitored by status lights via limit switches on the valves.

The status lights for both manual valves and the actuated equipment are arranged in groups on the ESFAS status display panel, according to the ESF system and the train in that system. For example, all of the status lights associated with emergency core cooling actuation system train A are located in one group adjacent to those status lights associated with emergency core cooling actuation system train B. This arrangement provides

obvious indication for the operator to prevent bypass of equipment in both trains.

Rendering equipment inoperative through the use of features provided strictly for infrequent maintenance (not more than once a year) is not specifically and automatically indicated. Such maintenance features include manual valves provided for isolation of equipment for repair, electrical cable connections, screw terminals, or other manual disconnects. However, manual initiation of safety features equipment bypass indication on a system-level basis is provided on the ESFAS status display panel; under administrative control, manual bypass indication can be set up or removed.

7.5.1.2.3 System Status

The information important in evaluating the readiness of the ESF system prior to operation and the status of active components during system operation are displayed for the operator in the main control room. The display information consists of process indicators, indicating lights, alarms, and recorders sufficient in themselves and supplemented by the ESFAS status display panel, the annunciator, and plant computer outputs. Table 7.5-1 lists the display information provided, together with the type of readout, number of channels, their range, accuracy, and location.

Indicators are provided for levels, pressures, flows, and temperatures important to safety features operation. Each of the indicators is driven by an electronic instrument loop consisting of a transmitter, power supply, and any necessary signal conditioners. Where an alarm is provided, the instrument loop includes an alarm unit providing a contact output to the plant annunciator and/or computer. Many of the analog signals are monitored by the plant computer to enable logging of status or alarm information and sequence of events. Recorders are provided in lieu of or in addition to the indicators where a trend or a time history of the process variable is desired.

Indicating lights are provided to monitor ESF equipment status. In addition to the ESFAS bypass display lights described in Subsection 7.5.1.2.2, indicating lights are provided at each control switch for equipment operating status. Each motor driven component (pump, fan, etc) has on and off indicatng lights; each remotely controlled open-closed valve or damper has corresponding open-closed light indication; and each breaker control switch has its associated open-closed indicating light. A red light is used to indicate an operating state; for example, motor running, valve open, or breaker closed. A green light indicates that the equipment is not in an operating state: motor off, valve closed, or breaker open. Amber lights signify breaker tripped, remote, overload, or abnormal condition. A white light (when used) signifies a breaker condition of normal permissive, limit

27

TABLE 7.5-1

ESF SYSTEMS DISPLAY INFORMATION

Displayed Parameter	Type of Readout	Number of Channels Available	Number of Channels Required	Range	Minimum Channel Accuracy, % Full Scale	Indicator Locations	Panel Numbers[1]	
ESF Systems Actuation Displays								5
Control room air intake duct radioactivity[3]	H,G D#	4 4#	1	10^{-1} -10^{4} mR/hr	±20%	CP CP#	0C403 1C32,2C32	
Containment airborne radioactivity[4]	H,G,D# D# D	4# Noble gas 2 Iodine 2 Particulate	1	10^{-7} -1 μ ci/cc 10^{-11} -10^{-4} μ ci/cc 10^{-12} -10^{-4} μ ci/cc	±25%	CP LP# CP#	0C403 1C171, 2C171 1C32, 2C32	
Borated water storage tank level	A#,F F,G,D	4# 2	1 1	0-100%	±2%	SC# CP	1C43, 2C43, 1C14, 2C14	
Reactor building pressure	A#,F E G	4# 1 1	1 1 1	0-100 psia switch (-14.7 to 85.3 psig)	±2%	SC# CP CP	1C43, 2C43 1C22, 2C22 1C14, 2C14	27
Main steam line pressure (@ stm generator)	A#,F A,F G	4# per OTSG 1 per OTSG 1	1 NA 1	0-1,200 psig 0-1,200 psig	±2% ±2%	SC# CP AP CP	1C43, 2C43 1C11, 2C11, 1C114, 2C114 1C14, 2C14	
Steam generator level (full range)	A#,F A,F,G G	4# per OTSG 1 per OTSG 1	1 NA 1	-306-0-312" 0-600" H_2O	±5%	SC# CP#,CP AP# CP	1C43, 2C43 1C11, 2C11, 1D114, 2C114 1C14, 2C14	
Spent fuel pool exhaust duct radioactivity[3]	H,G D#	4 4#	1 1	10^{-1} -10^{4} mR/hr	±20%	CP CP#	0C403 1C32, 2C32	
Reactor coolant pressure	A#	4#	1	0-2,500 psig	±2%	SC#	1C45, 2C45	5 27

TABLE 7.5-1 (continued)

Displayed Parameter	Type of Readout	Number of Channels Available	Number of Channels Required	Range	Minimum Channel Accuracy, % Full Scale	Indicator Locations	Panel Numbers[1]	
Reactor coolant pressurizer pressure (wide range)	E,F,G A	2 1	NA NA	0-2,500 psig	±2%	CP AP	1C12, 2C12 1C114, 2C114	5
Refueling canal exhaust duct monitor	H,G D#	2 2#	1 1	10^{-1} -10^{4} mR/hr	±20%	CP CP#	0C403 1C32, 2C32	27
ESF System Bypass Displays								
Sensor channel bypass	C#,G F	1 per sensor channel	1	On for bypass	NA	SC#,CP	1C43, 2C43, 1C14, 2C14, 1C45, 2C45	
Actuation system signal block (effective only after actuation)	C#,G	1 per system train	1	On for block	NA	SC#,CP#	1C43, 2C43, 0C10, 1C14, 2C14	5
Actuation system test block	C#,G	1 per system train	1	On for test block	NA	SC#,CP	1C44, 2C44, 1C14, 2C14, 1C45, 2C45	
Equipment bypass	C	1 per qualified equipment	1	Off for bypass	NA	CP	0C10, 1C14, 2C14	27

TABLE 7.5-1 (continued)

Displayed Parameter	Type of Readout	Number of Channels Available	Number of Channels Required	Range	Minimum Channel Accuracy, % Full Scale	Indicator Locations	Panel Numbers[1]	
ESF System Status Displays								5
Penetration Pressurization System								
Nitrogen bank pressure	D,F,G	1	NA	0-2,500 psig	±2%	CP	1C24, 2C24	
Pressurized water storage tank								27
- level	D,F,G	1 each tank	NA	0-100%	±2%	CP	1C24, 2C24	
- pressure	D,F,G	1 each tank	NA	0-150 psig	±2%	CP	1C24, 2C24	
Service water pump pit level	D,F	2	NA	0-100%	±2%	CP	0C10	5
Reactor coolant system pressure	A#	2#	1	0-2,500 psig	±2%	CP#,AP#	(5) 1C114, 2C114	27
Hydrazine tank								13
- level	D,G	2	NA	0-100%	±2%	CP	1C14, 2C14	
- pressure	D,G	1	NA	0-20 psig	±2%	Local,CP	1C14, 2C14	27
Borated water storage tank								5
- level	See ESF Systems Actuation Section							
- temperature	D,F,G	2	NA	0-200F	±2%	CP	1C14, 2C14	27
Reactor building emergency sump level	D#,F,G	2	NA	0-100%	±2%	CP,CP#	1C14, 2C14	15
Emergency diesel oil storage tank level	D,F	1 per tank	NA	0-100%	±2%	CP	1C24, 2C24	5

TABLE 7.5-1 (continued)

Displayed Parameter	Type of Readout	Number of Channels Available	Number of Channels Required	Range	Minimum Channel Accuracy, % Full Scale	Indicator Locations	Panel Numbers[1]	
Valve status (open-closed)	C#	1 per valve per system channel	NA	Open-closed	NA	CP#	1C11, 2C11, 1C14, 2C14	5
Equipment status (on-off)	C#	1 per equipment per system channel	NA	On for actuated	NA	CP#	0C10, 1C14, 2C14	15
ESF Systems Performance Displays								
Reactor building spray pump discharge flow	D,F,G	1 per pump	NA	0-1,500 gpm	±2%	CP	1C14, 2C14	
Auxiliary feedwater pump								
- suction pressure	D,F,G	1 per pump	NA	0-100 psig	±2%	CP,AP	1C11, 2C11	
- discharge pressure	D,F	1 per pump	NA	0-1,800 psig	±2%	CP,AP	1C114, 2C114 1C11, 2C11 1C114, 2C114	27
Dump-to-sump line flow	2#	2#	NA	0-100 gpm	±2%	CP#	(By amendment)	
Control room makeup air filter unit								
- diff pressure	E,F,G	1 each filter unit	NA	0-10 in H_2O	±5%	CP	0C20, 0C10	
- flow	E,F,G	1 each filter unit	NA	0-6,000 scfm	±5%	CP	0C20, 0C10	
- charcoal filter inlet temperature	D,G	1 each charcoal filter	NA	160-400F	±2%	CP	0C20, 0C10	27
- charcoal filter outlet temperature	D,G	1 each charcoal filter	NA	160-400F	±2%	CP	0C20, 0C10	

TABLE 7.5-1 (continued)

Displayed Parameter	Type of Readout	Number of Channels Available	Number of Channels Required	Range	Minimum Channel Accuracy, % Full Scale	Indicator Locations	Panel Numbers[1]	
Control room recirculating air filter unit								5
- diff pressure	E,F,G	1 each filter unit	NA	0-10 in H_2O	±5%	CP	0C20, 0C10	5
- flow	E,F,G	1 each filter unit	NA	0-3,000 scfm	±5%	CP	0C20, 0C10	
- charcoal filter inlet temperature	D,G	1 each charcoal filter	NA	160-400F	±2%	CP	0C20, 0C10	27
- charcoal filter outlet temperature	D,G	1 each charcoal filter	NA	160-400F	±2%	CP	0C20, 0C10	
Fuel pool exhaust filter unit								5
- diff pressure	E,F,G	1 each filter unit	NA	0-10 in H_2O	±5%	CP,LP	0C20, 0C151	5
- flow	E,F,G,D	1 each filter unit	NA	9,000-27,000 scfm	±5%	CP,LP	0C20, 0C151	
- charcoal filter inlet temperature	D,G	1 each charcoal filter	NA	160-400F	±2%	CP,LP	0C20, 0C151	
- charcoal filter outlet temperature	D,G	1 each charcoal filter	NA	160-400F	±2%	CP,LP	0C20, 0C151	
Makeup pump discharge header pressure	A	1	NA	0-3,000 psig	±2%	CP	1C12, 2C12	27
High pressure injection to RC system	A,F,G	1 each line	NA	0-300 gpm	±2%	CP	1C14, 2C14	
Decay heat removal pump discharge pressure	D,F	1 per pump	NA	0-500 psig	±2%	CP	1C14, 2C14	5
Decay heat removal heat exchanger discharge flow	A,F,G	1 per heat exchanger	NA	0-5,000 gpm	±2%	CP	1C14, 2C14	
Containment post-LOCA high range area radioactivity	H,G D#	2 2#	1 1	10^{-1}-10^{7} R/hr	±20%	CP CP#	0C403 1C32, 2C32	27

TABLE 7.5-1 (continued)

Displayed Parameter	Type of Readout	Number of Channels Available	Number of Channels Required	Range	Minimum Channel Accuracy, % Full Scale	Indicator Locations	Panel Numbers[1]	
Containment hydrogen concentration	A#	2#	NA	0-10% and 0-5%	±2.5%	CP#,LP#	1C172, 2C172	15
	G	2	NA			CP	0C29	
	E	2	NA			CP	0C29	5
Hydrogen recombiner outlet temperature	A#	1# per recombiner	NA	0-2000F	±2%	LP#	1C184, 2C184	

LEGEND:

Type of Readout

A - Linear scale indicator
B - Log scale indicator
C - Indicator light
D - Digital indicator
E - Recorder
F - Plant computer
G - Plant annunciator
H - CRT display

Indicator Location

SC - System cabinets
CP - Control room
AP - Auxiliary shutdown panel
LP - Local panel

- Class 1E display (essential display)

5

[1] BOP control board and panel arrangement drawings are submitted per Table 1.7-9.
[2] This footnote has been deleted. 26
[3] Monitors mounted inside HVAC ductwork. 23
[4] Noble gas
[5] Control room panel location for these indicators will be determined later. 27

e. Identification of Control Action - Valve status lights are provided to indicate positive action at the system level.

f. Information Readouts - The control equipment has the minimum number of indications necessary, such as a fan failure alarm in the instrumentation cabinets and pressure indication to monitor the proper operation of the valves, to provide its own status and the safety of the system protected.

g. System Repair - The control equipment is of modular construction, and each module shall be plainly instrumented and accessible to facilitate recognition and repair of malfunctions.

h. Capability for Test and Calibration - The cabinet-mounted instrumentation can be calibrated during normal power operation. Power will have been removed from the valve operator after opening the valve and prior to taking the reactor critical. Therefore, a test that includes valve movement can be performed only during plant shutdown.

CONFORMANCE TO BTP EICSB 18 - The provisions of BTP EICSB 18 are incorporated in the design of the core flood tank isolation valve control. Power to the valves is locked out when the operator has ascertained from the position indicators that the valves are open. Redundant Class 1E position indicators are supplied on the main control panel. A more detailed analysis of valve operation can be found in Subsection 6.3.2.2.9.1.

7.6.2.4 Reactor Coolant Letdown Cooler Valve Interlock

CONFORMANCE TO NRC GENERAL DESIGN CRITERIA, REGULATORY GUIDES, AND OTHER STANDARDS - All standards applicable to the reactor coolant (RC) letdown cooler valve interlocks are indicated in Table 7.1-2. Conformance to NRC General Design Criteria is discussed in Section 3.1. Regulatory Guides are addressed in Appendix 3A.

CONFORMANCE TO IEEE STD 279-1971 - The valves and instrumentation for the RC letdown cooler valve interlocks conform to the applicable requirements of Section 4 of IEEE Std 279-1971. Since component cooling water (CCW) outlet pressure and temperature is monitored at each RC letdown cooler and letdown flow is monitored above the R.C. block valve by separate, independent, and redundant sensors and logic channels, which comprise separate, independent, and redundant actuation channels, no single failure can prevent either the RC letdown cooler isolation valve or block valve from performing the protective function. Each redundant channel is powered from a separate Class 1E control and instrument power supply. In order to prevent interaction between

8

the redundant systems, the actuation channels are wired independently and physically separated with no electrical connections between actuation channels. In this way, loss of one channel for any reason (rissile damage, cable tray fire, etc) will not prevent the safety function from being accomplished. In addition, all valves, interlocks, and safety instrumentation are Seismic Category I to assure their operation during and after a safe shutdown earthquake. Sections 4.11 through 4.15 of IEEE Std 279-1971 are not applicable to this safety system.

CONFORMANCE TO IEEE STD 338-1971 - The RC letdown cooler valve interlock system includes provisions to allow testing of the valves during reactor operation. These provisions include control panel mounted hand switches and position indicating lights for control and indication of valve position. The pressure sensors and actuation channels may be tested during reactor shutdown.

CONFORMANCE TO BTP EICSB 3 - The provisions of BTP EICSB 3 are incorporated in the design of the RC letdown cooler valve interlocks. Redundant isolation valves are provided. The valves are in series and utilize diverse actuation signals. Valve position indication is provided in the control room. 21

7.6.2.5 Reactor Coolant Dilution Indication

CONDORMANCE TO NRC GENERAL DESIGN CRITERIA, REGULATORY GUIDES, AND OTHER STANDARDS - All standards applicable to the reactor coolant dilution indication equipment are listed in Table 7.1-2. Conformance to NRC General Design Criteria is discussed in Section 3.1. Regulatory Guides are addressed in Appendix 3A. 26 21

CONFORMANCE TO IEEE STD 344-1975 - The Class 1E dilution indication system is qualified to the standards set forth in IEEE Std 344-1975. 26 21

CONFORMANCE TO BTP EICSB 10 - The provisions of BTP EICSB 10 are incorporated in the design of the Class 1E dilution indication system. 26 21

CONFORMANCE TO IEEE STD 279-1971 - Redundancy of indication is provided by two channels of Class 1E valve position indication. 27

CONFORMANCE TO IEEE STD 323-1974 - Conformance of the valve limit switches to IEEE Std 323-1974 will be provided by amendment when available from the equipment supplier. The dilution flow indicators are mounted on main control boards 1C12 and 2C12 which are in a controlled environment. Therefore, no specific environmental testing has been conducted as indicated in Table 3.11-4, Test 17. Conformance of the electrical equipment (power distribution panels, cables, etc) is discussed in Tables 3.11-1 and 3.11-4. 21

pressure. Important trips are the consequence of thrust bearing wear, low hydraulic pressure, a low condenser vacuum, a high moisture-separator level, or loss of main shaft oil pump discharge pressure. Uncorrected alarm situations such as high differential expansion or the loss of speed monitoring instruments will result in operational trips. The loss of stator cooling will result in a load runback and trip, a typical restrictive function. A complete list of trips is included in Section 10.2. A discussion of the use of Mark II EHC on plants of similar design is not provided since other nuclear plants using the Mark II have not yet reached the operating license stage. 27

Control and supervisory equipment is provided for remote operation of the turbine-generator from the control room. The ability of the station to follow the system load demand is accomplished by the load control unit of the turbine-generator in conjunction with the integrated control system (ICS) regulation of reactor power and steam generation. The turbine speed governor, however, can override the steam pressure controls and the turbine control valves so that the stop valves will close when a loss of generator load causes a turbine overspeed.

7.7.1.5 Plant Computer Systems (Main Unit)

7.7.1.5.1 Design Basis Information

SAFETY DESIGN BASES - A plant computer is not required for safety. No computer inputs are Class 1E circuits. Any computer inputs originating in Class 1E equipment are isolated at their sources.

POWER GENERATION DESIGN BASES - Each of the plant computer's functions is intended to enhance the flexibility of plant operations. As an alarm system for both the NSSS and the balance of plant, the computer is important for efficient power output. Performance calculations assist plant operations in efficient scheduling of maintenance.

7.7.1.5.2 Description

GENERAL DESCRIPTION - Each unit of the Midland plant has its own Bailey 855/50 digital computer to facilitate data logging and analysis for both the nuclear steam supply system (NSSS) and the balance of plant (BOP). The basic computer functions are:

a. To serve as an alarm monitor for each unit

b. To keep a running log of plant sensor data

c. To perform numerical calculations for plant performance indication

d. To provide automatic turbine startup

ALARMS - The computers serve as an alarm monitor for each unit. The status of analog and digital signals is monitored and updated. Analog inputs are checked for exceeding process alarm limits. These limits are preset, but can be changed by the operator. Digital status is monitored and checked against the preprogramed normal condition.

LOGGING AND REVIEW OF DATA - A plant computer measures and stores the value of analog variables at various scan intervals from 1 to 60 seconds each. Digital alarm contacts are monitored each second.

Following specific alarms, a sequence of events review becomes available upon request. A detailed post-trip review of preselected points is kept for 15 minutes before and after an NSSS or turbine trip and is available upon request. A daily periodic review is available.

CALCULATIONS - Calculations to assist plant management consist of fuel management, rod drop tests, and turbine efficiency.

The fuel management programs provide core power distribution, isotopic inventories, reactivity worth, and thermal-hydraulic information.

The rod drop program provides information necessary to evaluate a rod drop test.

Turbine efficiency calculations are made to aid in plant operations.

TURBINE STARTUP - The turbine startup program uses plant inputs and digital computer outputs to the electrohydraulic control and excitation systems for bringing the turbine through the warming, accelerating, and loading stages by sequencing through operator approved status checks.

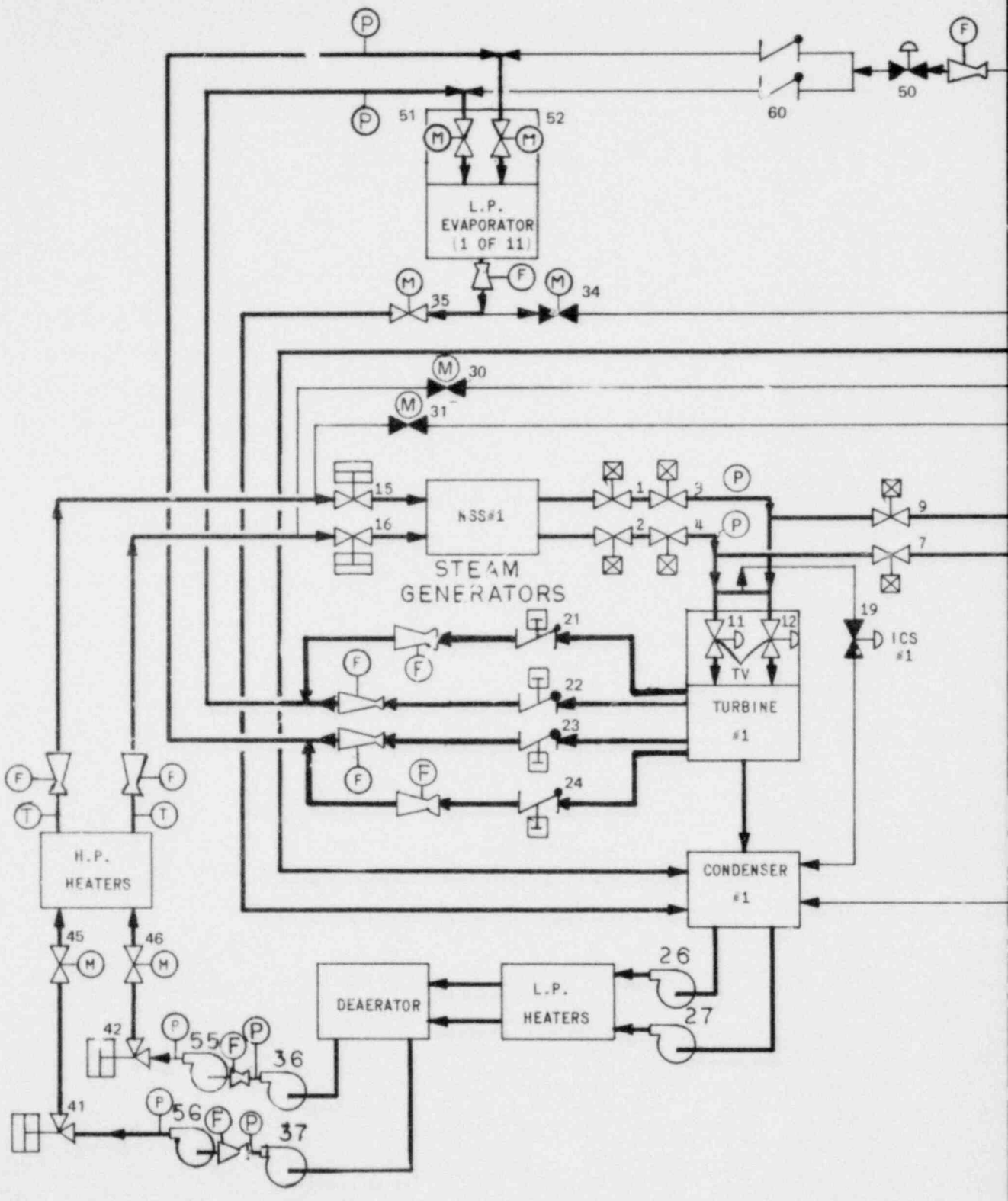
CONTROL ROOM - The plant operator interfaces with the plant computers through two 23 inch CRTs and a 12 inch CRT with a keyboard on the main control board of each unit. An additional 12 inch CRT and keyboard terminal for each unit is mounted at the number one operator's desk. Each unit has an alarm typewriter and a backup line printer in the main control room for printed alarm records, with additional backup provided at the computer programer's console.

TABLE 7.7-2 (continued)

No.	Name	P&ID Valve ID	
20	Unit 2 condenser dump valve (typical: one of four shown)	M-432 2PV-3246A-D	
21	Unit 1 turbine extraction steam check valves (typical: one of two shown)	M-436 1BTV-3613A M-436 1BTV-3614A	
22	Unit 1 turbine extraction steam check valve (typical: one of two shown)	M-436 1BTV-3615A M-436 1BTV-3616A	1
23	Unit 1 turbine extraction steam check valve (typical: one of two shown)	M-436 1BTV-3613B M-436 1BTV-3614B	
24	Unit 1 turbine extraction steam check valve (typical: one of two shown)	M-436 1BTV-3615B M-436 1BTV-3616B	
25	High-pressure evaporator isolation valves	M-460 0MO-6018A/B	
26	Unit 1 condensate pump	M-438 1P-02B	
27	Unit 1 condensate pump	M-438 1P-02A	23
28	Unit 2 condensate pump	M-439 2P-02A	
29	Unit 2 condensate pump	M-439 2P-02B	
30	Unit 1 main feedwater crossconnect valve	M-438 1MO-3827A	27
31	Unit 1 main feedwater crossconnect valve	M-438 1MO-3827B	
32	HP evaporator condensate return valve	M-460 0MO-6014B	
33	HP evaporator condensate return valve	M-460 0MO-6014A	1
34	LP evaporator condensate return valve	M-460 0MO-6009B	
35	LP evaporator condensate return valve	M-460 0MO-6009A	
36	Unit 1 feedwater booster pump	M-438 1P-03B	23
37	Unit 1 feedwater booster pump	M-438 1P-03A	

TABLE 7.7-2 (continued)

No.	Name	P&ID Valve ID	
38	Unit 2 feedwater booster pump	M-439 2P-03B	23
39	Unit 2 feedwater booster pump	M-439 2P-03A	
41	Unit 1 main feedwater control valve	M-438 1FV-3851A	
42	Unit 1 main feedwater control valve	M-438 1FV-3851B	
43	Unit 2 main feedwater control valve	M-439 2FV-3951B	
44	Unit 2 main feedwater control valve	M-439 2FV-3951A	1
45	Unit 1 main feedwater block valve	M-438 1MO-3852A	
46	Unit 1 main feedwater block valve	M-438 1MO-3852B	
47	Unit 2 main feedwater block valve	M-439 2MO-3952B	
48	Unit 2 main feedwater block valve	M-439 2MO-3952A	
49	Unit 2 main feedwater crossconnect valve	M-439 2MO-3927A	27
50	Evaporator pressure reducing valves (typical: one of four shown)	M-460 0PV-6004A-D	1
51	Low-pressure evaporator isolation valves	M-460 0MO-6015A-F	23
52	Low-pressure evaporator isolation valves	M-460 0MO-6015G-L	
53	Unit 2 main feedwater crossconnect valve	M-439 2MO-3927B	27
55	Unit 1 feedwater pump turbine	M-433 1G-02B	
56	Unit 1 feedwater pump turbine	M-433 1G-02A	23
57	Unit 2 feedwater pump turbine	M-434 2G-02B	
58	Unit 2 feedwater pump turbine	M-434 2G-02A	
60	Check valves downstream of pressure reducing valves	M-460 001&014	1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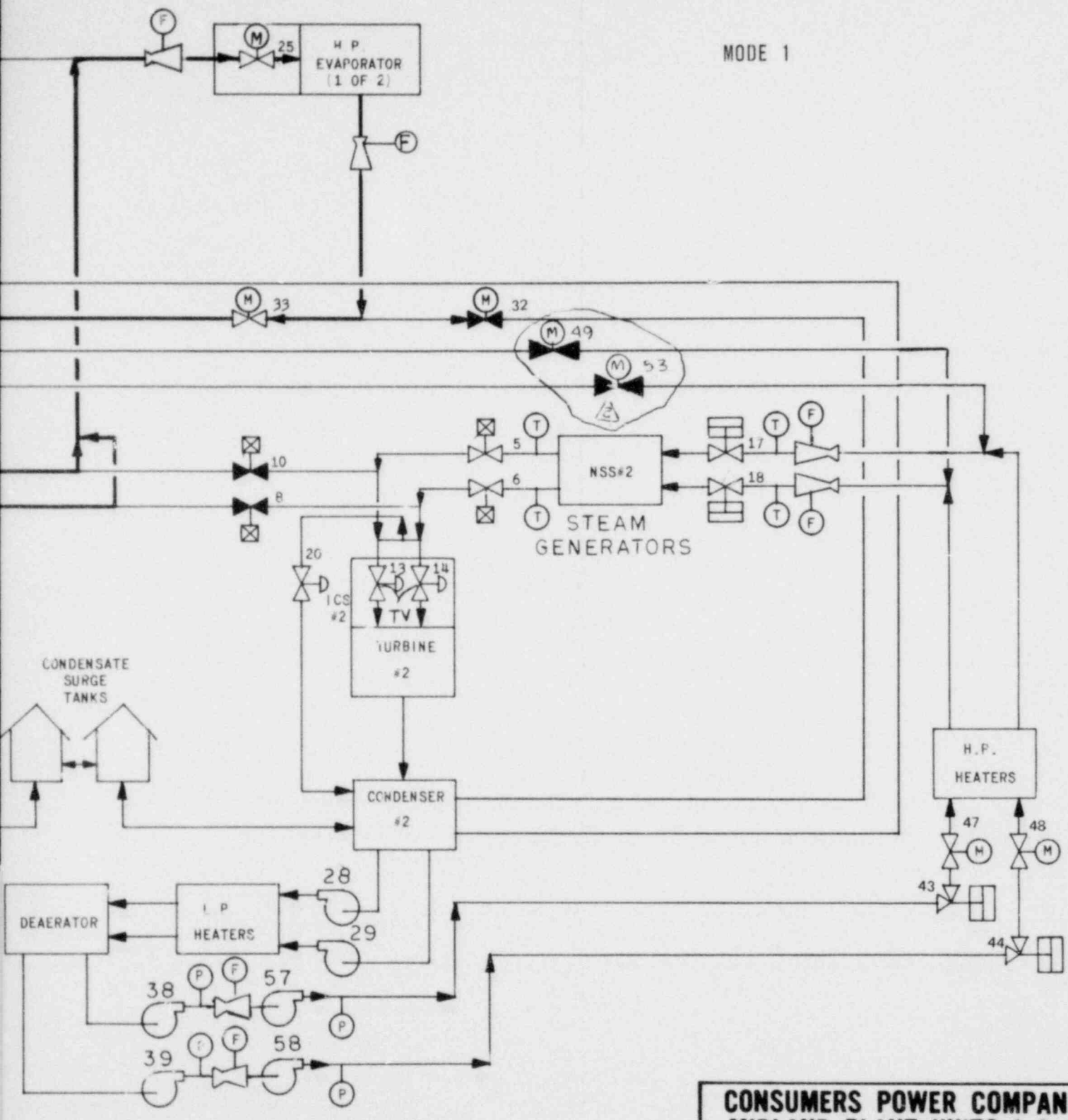
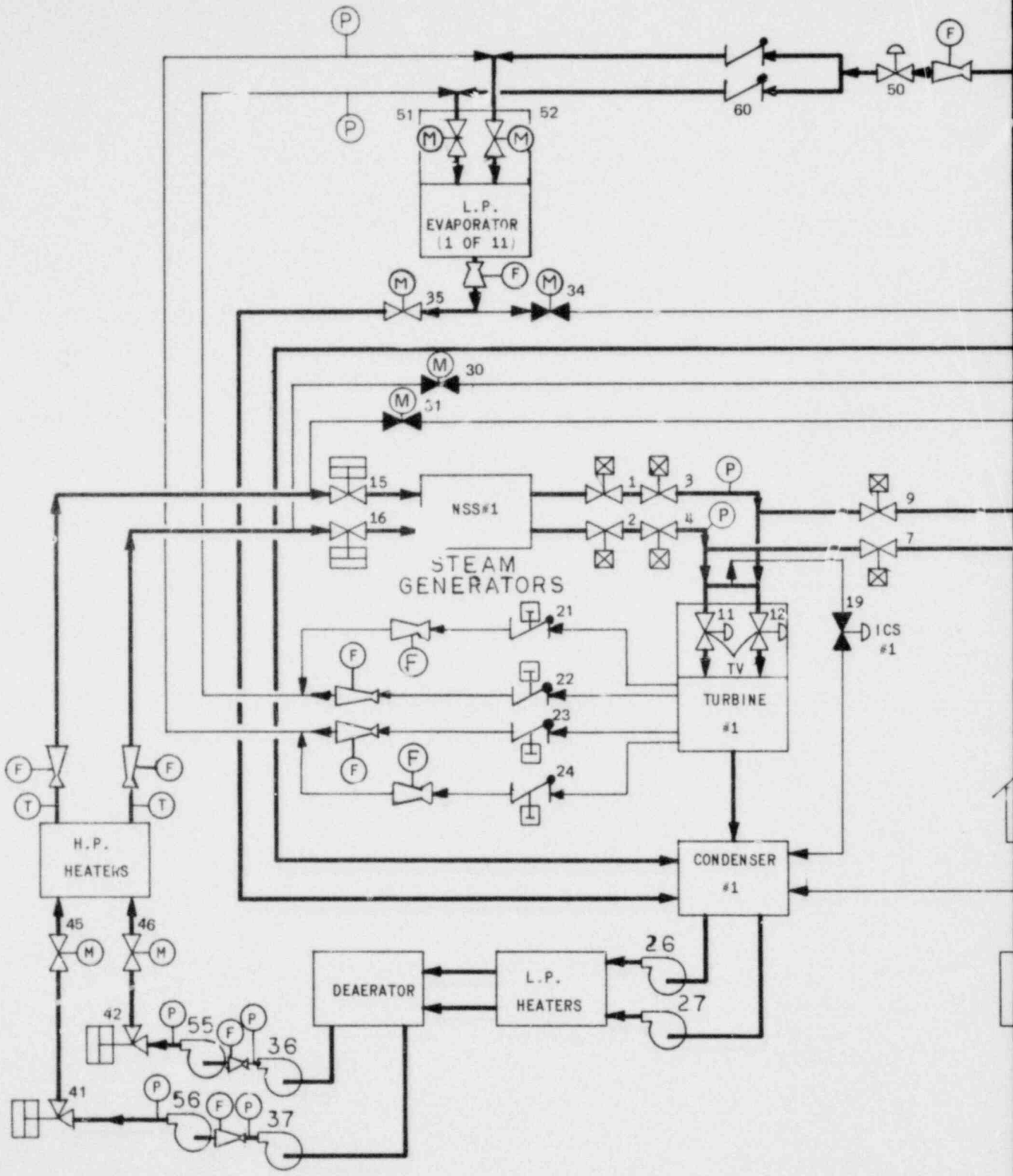


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Process Steam Transfer System
Mode 1
(J590 Rev 2)

FSAR Figure 7.7-8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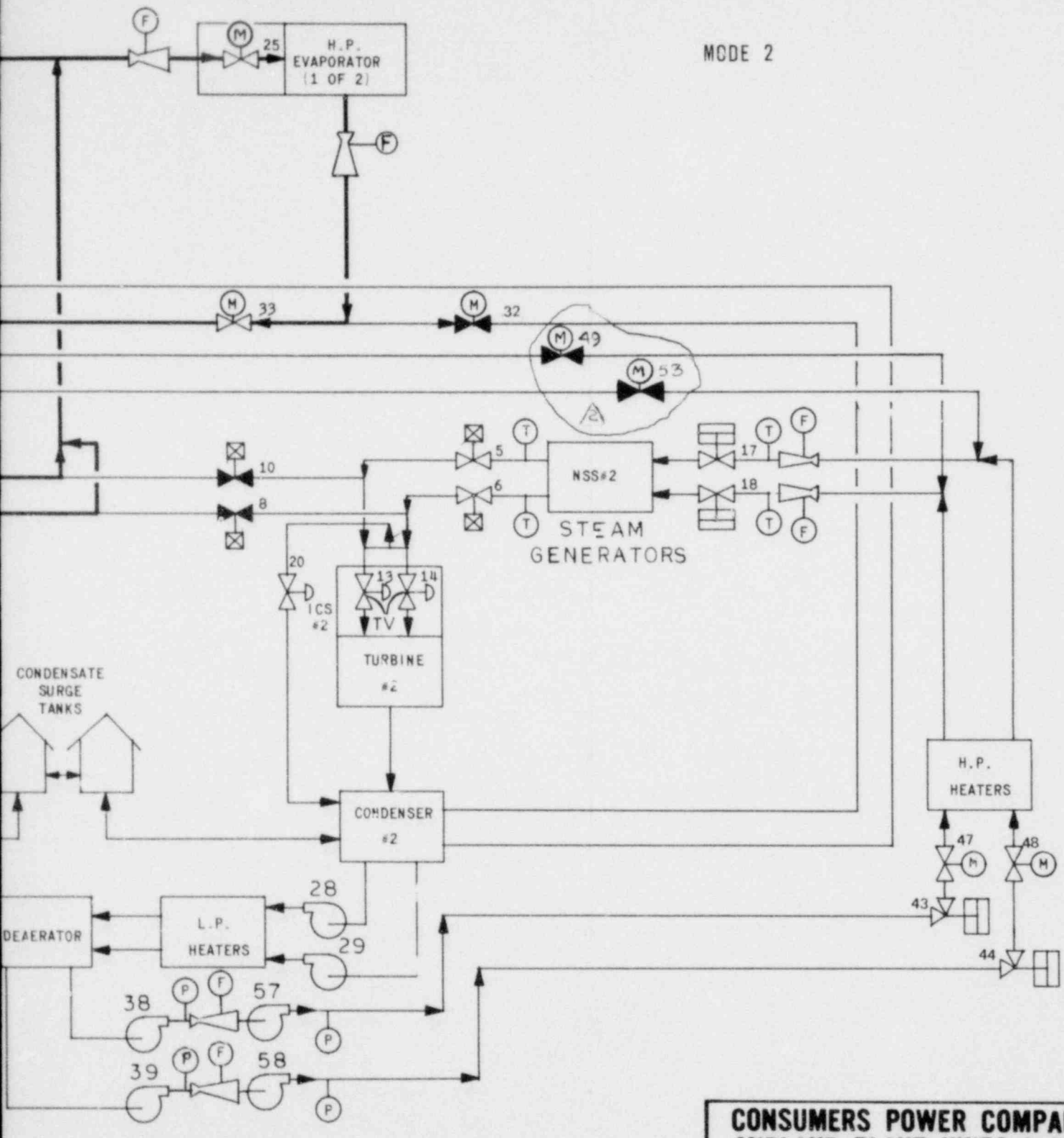
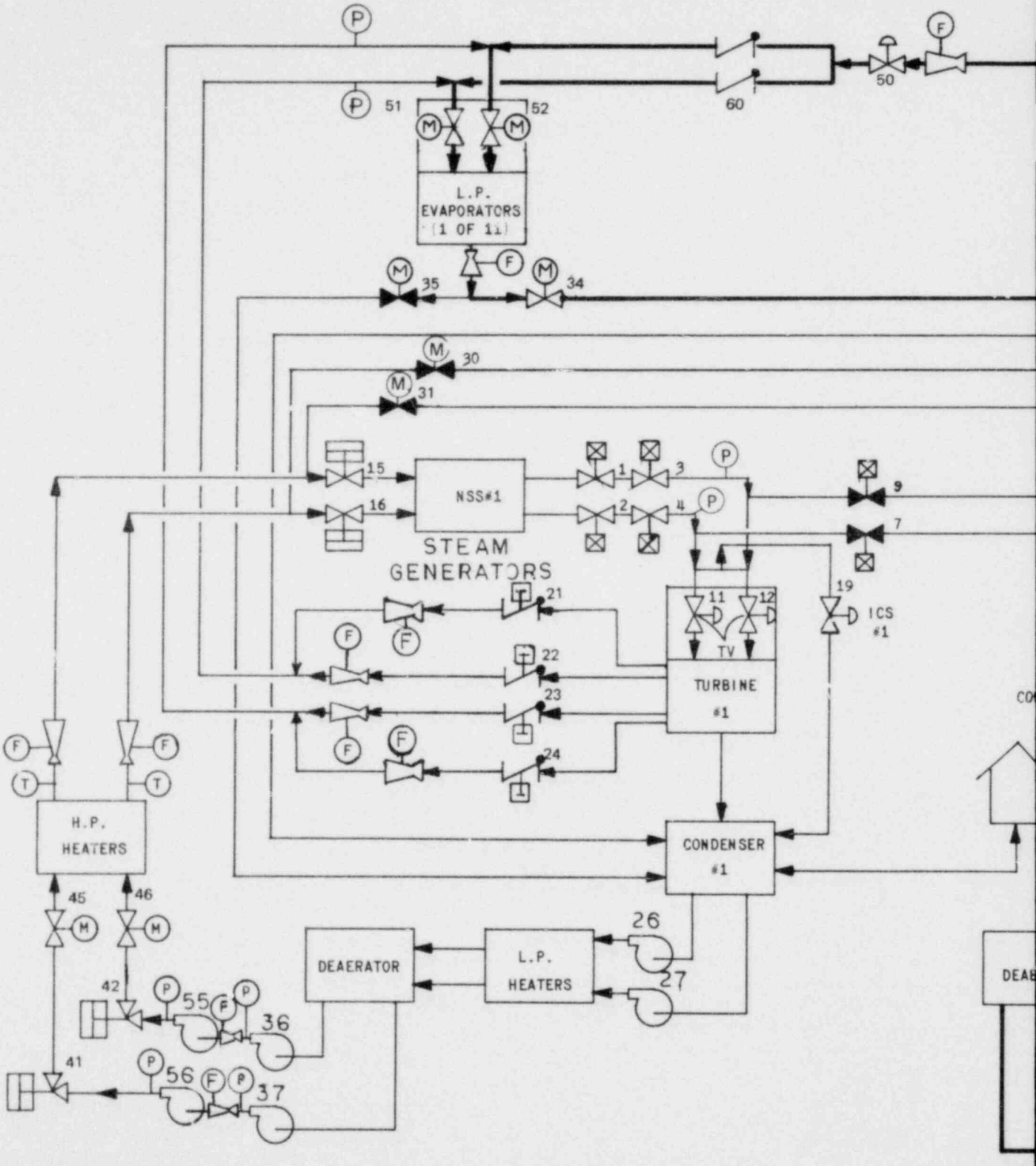


CONSUMERS POWER COMPANY MIDLAND PLANT UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Process Steam Transfer System Mode 2 (J591 Rev 2)
FSAR Figure 7.7-9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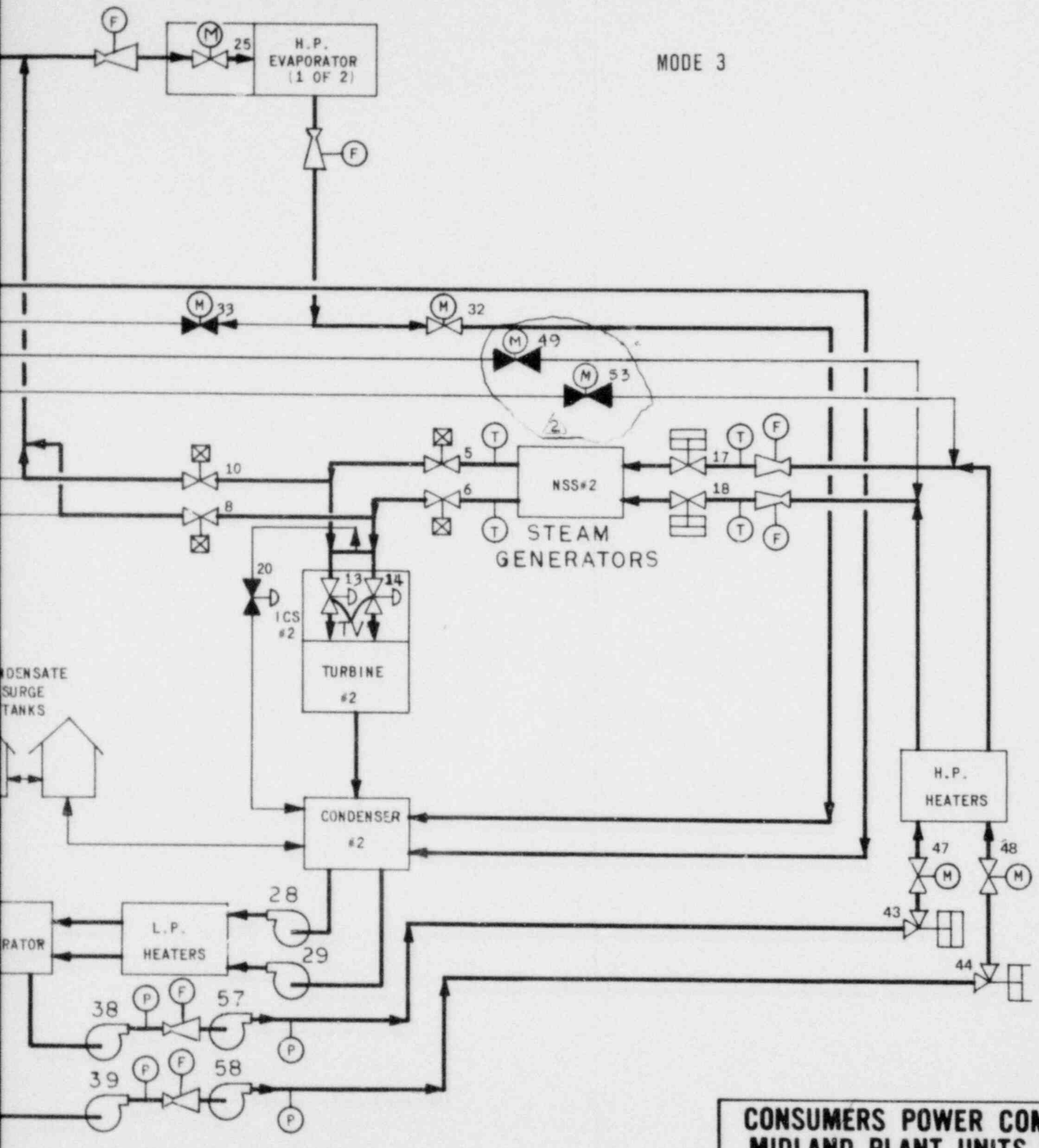
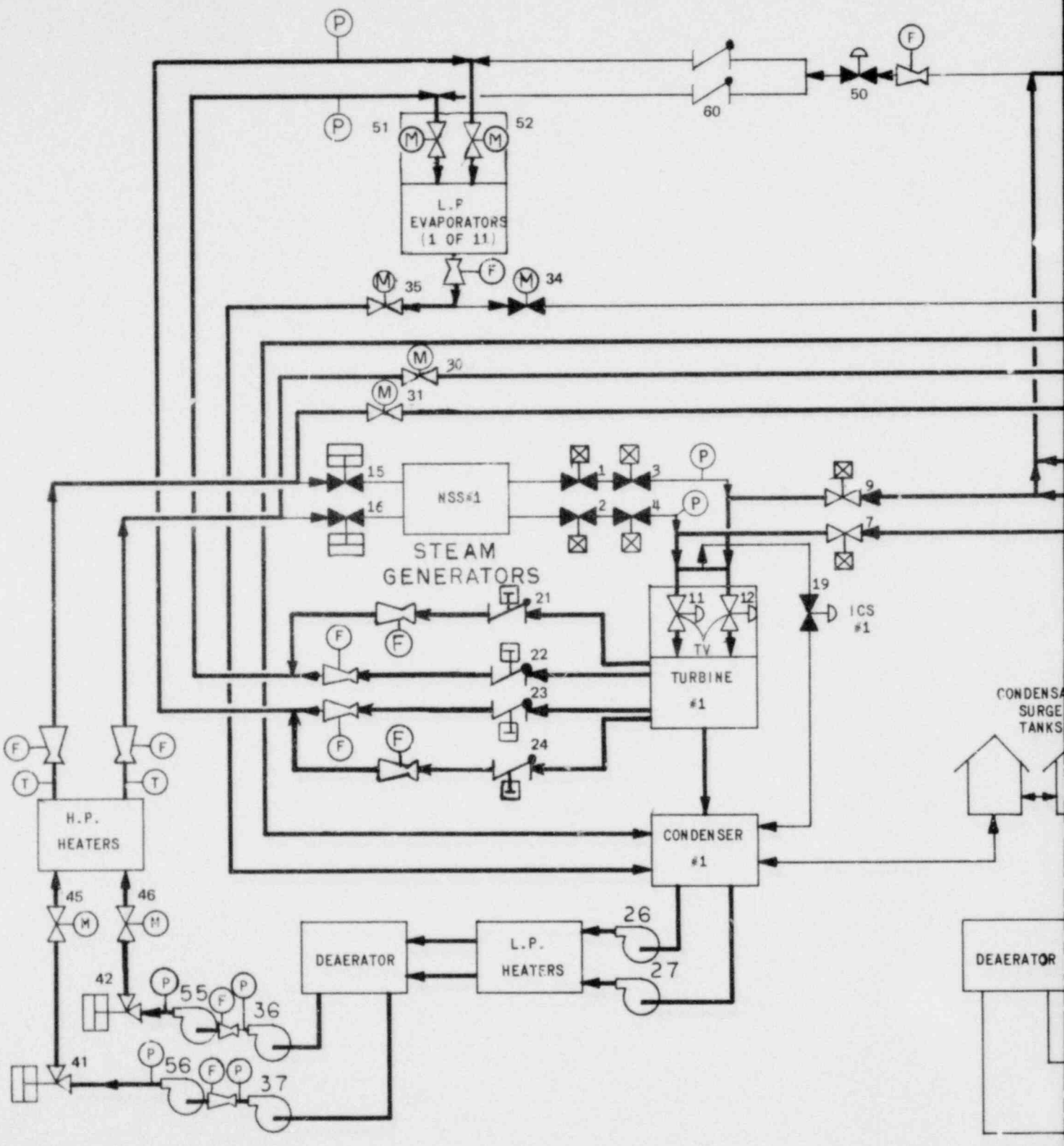


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Process Steam Transfer System
Mode 3
(J-592 Rev 2)

FSAR Figure 7.7-10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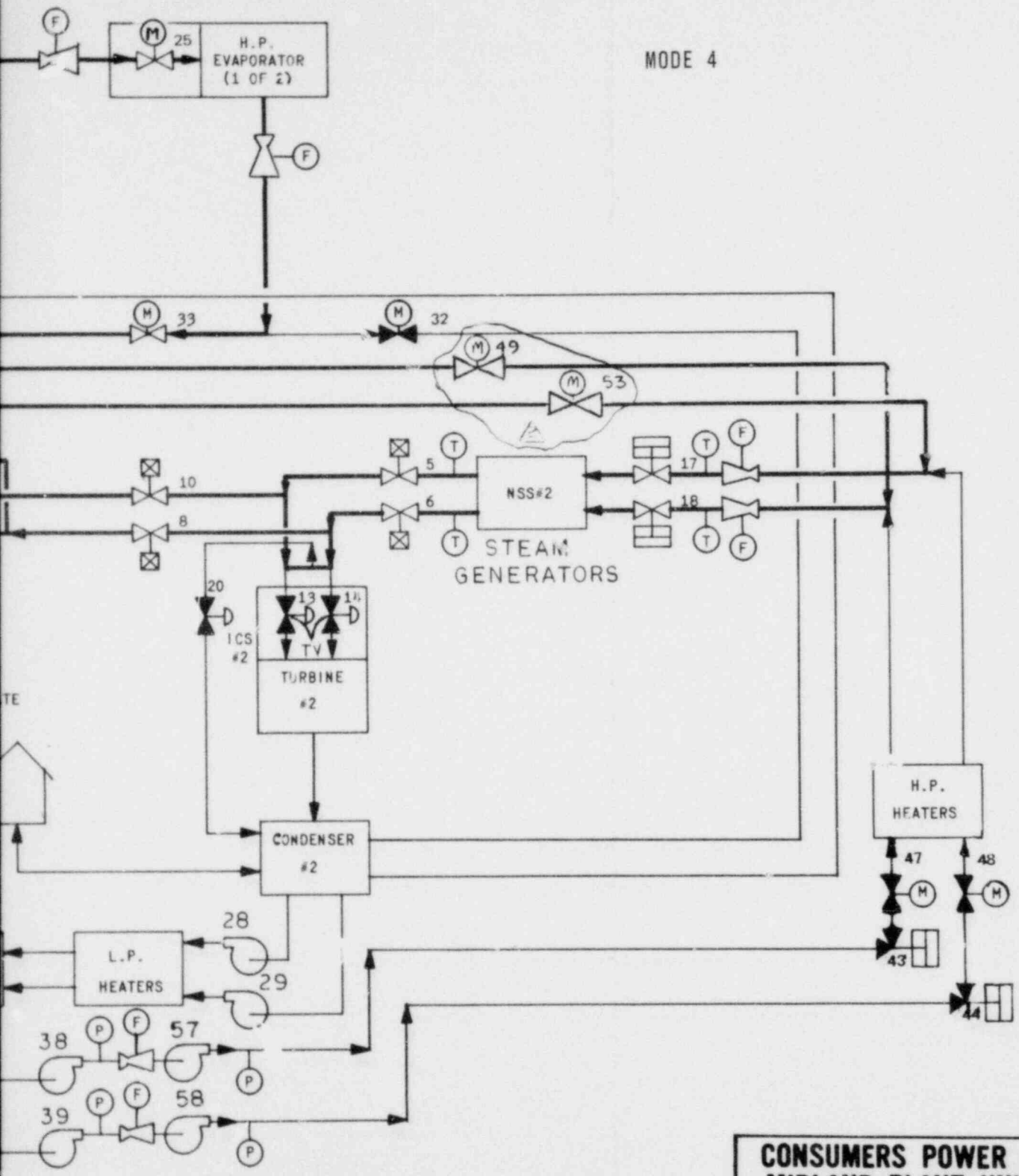
MODE 4



CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Process Steam Transfer System
Mode 4
(J-593 Rev 2)

FSAR Figure 7.7-11

8. ELECTRIC POWER

8.1 INTRODUCTION

8.1.1 UTILITY GRID DESCRIPTION

The Consumers Power Company bulk power grid presently consists of integrated 345kV and 138kV transmission systems. A 765kV system is planned at a future date sometime after the Midland 1 and 2 units are placed in operation. The 345kV system presently consists of approximately 1,650 miles of circuit and thirteen 345kV/138kV substations in an area covering approximately 27,000 square miles in 61 counties of Michigan's lower peninsula. There are approximately 3,400 miles of 138kV circuit in the same area on the Consumers system. Both of these systems are shown in Figure 8.1-1 and are shown schemetically in Figures 8.2-3 and 8.2-4. The Consumers Power Company system is interconnected and is dispatched as a pool with The Detroit Edison Company system. There are four 345kV and five 138kV/120kV interconnections between the two companies. The Consumers Power Company-The Detroit Edison Company grid is interconnected with utilities in other states and Canada by nine 345kV circuits and two 230kV circuits. The grid is designed so that its capacity is sufficient to supply system demands and all reserve requirements under emergency operation within reliability constraints and at the same time provide for all exterior power contracts and inadvertent power flows across the system. Stability and grid reliability are discussed in Subsection 8.2.2. | 2

8.1.2 ONSITE POWER DESCRIPTION

The onsite power system is shown in Figure 8.3-1. Two offsite sources of power provide preferred power through two startup transformers to the onsite power system. The onsite power system is divided into two separate load groups. Power is supplied to auxiliaries at 6.9kV, 4.16kV, and 480V voltage levels. The onsite power system includes the Class 1E electric systems, which provide auxiliary ac and dc power for equipment used to shut down the reactor and limit the release of radioactive material following a design basis event. Class 1E electric systems are defined in IEEE 308. A Class 1E preferred instrument ac system provides four independent sources of 120Vac for the reactor protection system engineered safety features actuation system and safety-related instrumentation. A Class 1E control and instrument ac system provides two independent sources of regulated 120Vac for Class 1E equipment controls and instrumentation. The 120Vac control, instrument, and preferred systems are shown in Figures 8.3-2 and 8.3-3. A Class 1E dc system provides two independent sources of 125Vdc control power for Class 1E switchgear, essential ac power inverters, and other safety-related equipment. The dc power system is shown in Figures 8.3-39 and 8.3-40. | 27

8.1.3 SAFETY-RELATED LOADS

The Class 1E loads supplied by the Class 1E ac system are listed in Table 8.3-1. Class 1E loads supplied by the Class 1E dc system are listed in Table 8.3-6.

8.1.4 DESIGN BASES

8.1.4.1 Offsite Power System

The following principal design bases are applied to the offsite power system:

DESIGN BASIS ONE - Electric power from the offsite power grid to the plant site is supplied by two physically independent circuits designed and located so as to minimize the likelihood of simultaneous failure.

DESIGN BASIS TWO - Two physically independent startup transformers are provided to supply the onsite electrical distribution system.

DESIGN BASIS THREE - The loss of the nuclear unit or the most critical unit on the grid will not result in loss of offsite power to the Class 1E buses.

8.1.4.2 Onsite Power System

The following principal design bases are applied to the onsite power system:

DESIGN BASIS ONE - The onsite power system includes a Class 1E electric power system for each unit.

DESIGN BASIS TWO - The onsite Class 1E electric power system is divided into two independent load groups (defined in IEEE 308), each with its own power supply, buses, transformers, loads, and associated 125Vdc control power. One load group is capable of meeting safe shutdown requirements.

DESIGN BASIS THREE - One independent diesel generator is provided for each Class 1E ac load group.

DESIGN BASIS FOUR - Automatic transfers are not provided between redundant load groups.

DESIGN BASIS FIVE - No portion of the onsite emergency and shutdown ac and dc power systems is shared between units. Sharing of offsite power sources is described in Subsection 8.1.4.3 under a discussion of Section 8 of IEEE 308-1974.

American Iron and Steel Institute (AISI)

National Power Codes by ASME (NPC)

American Society of Mechanical Engineers (ASME)

8.2.2 ANALYSIS

8.2.2.1 Transient Stability

The response of the Midland units to transient network faults was extensively examined, including the design criteria and the investigation of a zero impedance, three-phase fault with one element (breaker, line, bus section, protective relay circuit, etc) out of service or failing during fault clearing. None of these faults would cause the Midland units to lose synchronism with the grid. The swing curves of Midland units, the voltage response, and the frequency response are documented in FSAR Figure 8.2-12. The worst case was a bus fault with failure of the breaker common the strongest network connection, the Tittabawassee-Thetford 345kV line. 19

8.2.2.2 Grid Reliability

As described in Subsection 8.2.1.7, the transmission grid supplying the offsite circuits is integral to the synchronous system of the U.S. and Canada. The portion of the network contiguous to and in the vicinity of the Consumers Power Company grid supplying the offsite circuits has been extensively subjected to simulated testing as detailed in ECAR Document 1 which is included herein as Appendix 8A. These tests included:

a. Sudden dropping of a large load or major load center

b. Sudden outage of all transmission on the same right-of-way

c. Sudden outage of any transmission station, including all generating capacity associated with such stations

This testing demonstrated the ability of the grid to withstand such disturbances without system breakup or uncontrolled cascading.

For the Midland plant, the most severe contingency tested was the sudden loss of the Tittabawassee 345kV substation and associated tripping of the Midland units. In simulated tests, the loads of the offsite supply were adequately carried from the Bullock and Begole substations as shown in Figures 8.2-9 and 8.2-10.

8.2.2.3 System Frequency Excursions

Faults in the vicinity of the Midland plant will result in transient frequency excursions. For the design faults described in Subsection 8.2.2.1, system frequency excursions will not exceed 1.5HZ and system frequency recovery will be within 1 second.

The maximum loss of generation due to contingencies detailed in ECAR Document 1 was found to be less than 3,000MW. Simulated tests show associated frequency excursions to be less than .07Hz and system frequency recovery within 10 to 15 seconds. The associated rate of frequency change has been calculated to be less than .25Hz per second. All of these values are substantially less than those determined to be restrictive in the accident analysis for reactor coolant flow.

8.2.3 STAFF POSITIONS ON VOLTAGE VARIATION, APPENDIX 40-1 (ATTACHMENT TO NRC QUESTION 040.14)

Position 1: Additional Level of Under- or Overvoltage Protection with a Time Delay

The following position is preliminary and reflects the current design. The position is being reevaluated and may be revised by amendment. 27

A second level of voltage protection has been provided as required by Position 1. Based on a system voltage study, nominal voltage and time setpoints for the first and second levels of undervoltage relays have been determined to be as follows: 20 18

a. The first level of undervoltage relays is set at 60% of bus voltage with no time delay (instantaneous). 26 18

b. The second level of undervoltage relays is set at 88% of bus voltage with a time delay of 10 seconds. 26

A two-out-of-two coincidence matrix per bus has been implemented to preclude spurious trips of the offsite power source. The design meets the applicable requirements of IEEE Std 279-1971, Criteria for Protection Systems for Nuclear Power Generating Stations. The logic for each bus is completely independent and separated from the logic for the redundant bus. Refer to Chapter 16 for the limiting conditions for operation, maximum and minimum undervoltage relay dropout setpoints, and time delay setpoints. 20

Position 2: Interaction of Onsite Power Sources with Load Shed Features

Load shedding is blocked during diesel generator load sequencing and is automatically reinstated after all safety loads have been 18

sequenced on the safety buses. Subsection 8.3.1.1.3 provides additional information on load shedding and sequencing. | 18

Position 3: Onsite Power Source Testing

Testing the onsite power sources by simulating loss of offsite power only and by simulating loss of offsite power in conjunction with safety features actuation signals along with methods of verifying proper operation is discussed in revised Technical Specification Subsection 4.8.1.1.2. | 8

Position 4: Optimization of Transformer Tap Settings | 18

A comprehensive voltage regulation study is made upon finalization of the electrical distribution system configuration. Based on the results of the study, the voltage level at the safety-related buses is optimized for full and minimum load conditions that are expected throughout the anticipated range of voltage variations of offsite power source by appropriate adjustment of the voltage tap settings of the intervening transformers. Appropriate tap adjustments are made prior to system energization. | 20 | 18 | 20 | 18 | 20 | 18

To verify the adequacy of the design, actual measurements at the various distribution system voltage levels are made during system functional checkout and correlated with the results obtained from the voltage regulation study. Documentation of this verification will be submitted by amendment to the FSAR prior to initial reactor power operation. | 20 | 18

8.3.1.1.6 Non-Class 1E Instrumentation and Control Power Supplies

Busing arrangements and equipment capacities are shown in Figures 8.3-2A, 8.3-2B and 8.3-3. | 27

NON-CLASS 1E 120Vac PREFERRED POWER SUPPLY - For each unit, two separate non-Class 1E 120Vac preferred power supply systems are provided to supply the computer and other non-Class 1E loads requiring continuous and constant power supply as shown in Figures 8.3-2A, 8.3-2B and 8.3-3. | 27

Each non-Class 1E 120Vac preferred power supply system consists of one static inverter, one static transfer switch, and one distribution panel. Normally, the distribution panel is supplied by the inverter. Inverters are supplied by the non-Class 1E 125Vdc subsystem as described in Subsection 8.3._. If an inverter is inoperable or is to be removed from service for maintenance or testing, backup supply is provided from a non-Class 1E regulating type transformer through a manual switch included in the static transfer switch. If inverter voltage goes outside the ranges 120V [2% or 60Hz [1%, a static transfer switch automatically transfers to the backup supply provided from the non-Class 1E regulating type transformer. Transfer back to inverter supply is manual in either case of manual or automatic transfer to backup supply.

NON-CLASS 1E 120Vac CONTROL AND INSTRUMENT POWER SUPPLY - For each unit the non-Class 1E 120Vac control and instrument power supply consists of four separate transformers and associated distribution panels as shown in Figures 8.3-2A, 8.3-2B, and 8.3-3. There are fifteen common transformers and associated distribution panels. | 27

Non-Class 1E 120Vac control and instrument power supplies are provided to supply non-Class 1E auxiliaries, annunciators, control, and other loads as shown in Figures 8.3-2A, 8.3-2B, and 8.3-3. | 27

8.3.1.1.7 Electric Equipment Layout

Redundant Class 1E switchgear, load centers, and motor control centers are located in separate rooms of the Seismic Category I auxiliary building. These rooms also contain Class 1E distribution centers and panels serving nearby loads. Two separate ventilation systems are provided to service the electrical equipment rooms of both units. Each ventilation system supplies the equipment room of the same load group and is powered from the appropriate load group of either unit. Cooling for each room is provided by separate unit coolers which are powered from the corresponding load group of the equipment being serviced. Refer to Subsection 9.4.1 for further discussion on the cooling and ventilation systems serving the electrical equipment rooms. Class 1E motor control centers are also located in the service water structure and diesel generator building. Redundant Class 1E distribution panels serving remote loads are

located in separate rooms or areas of Seismic Category I structures that are in proximity to the loads being served.

Redundant Class 1E batteries are located in separate rooms of the auxiliary building. As described in Subsection 9.4.1, each room is served by an independent ventilation system designed to control temperature, and preclude the possibility of hydrogen accumulation.

Battery chargers for redundant Class 1E batteries are also located in separate rooms of the auxiliary building. These rooms are separate from those housing the Class 1E batteries.

Two cable spreading rooms are provided, one above and one below the control room. This arrangement enhances redundant cable separation. The ventilation system serving the cable spreading rooms is discussed in Subsection 9.4.1.

Redundant emergency diesel generators are located in separate rooms of the Seismic Category I diesel generator building. Each room is supplied by an independent HVAC system as described in Subsection 9.4.7. The auxiliaries and local controls for redundant emergency generating units are located in the same room as the unit they service. The diesel generator power feeds to the Class 1E buses are routed in reinforced concrete encased duct banks. A separate duct bank is provided to facilitate the feeds from each diesel generator to its respective Class 1E bus.

Power feeds to safety-related equipment located in outlying structures (service water structure, diesel generator fuel oil storage area, borated water storage tank) are also routed in reinforced concrete encased duct bank. The feeds to such equipment are direct routes which preclude the use of manholes.

Electrical equipment layout drawings showing the location of electrical equipment and main cable routes to engineered safety features equipment including the connection of the preferred offsite power system to the onsite Class 1E distribution system are listed in Table 1.7-7. 3

8.3.1.1.8 Design Criteria for Class 1E Equipment

The following design criteria are applied to the Class 1E equipment.

MOTOR SIZE - Motor size (horsepower capability) is equal to or greater than the maximum horsepower required by the driven load under normal running, runout, or discharge valve (or damper) closed condition.

MINIMUM MOTOR ACCELERATING VOLTAGE - The electrical system is designed such that the total voltage decrease on the Class 1E motor circuits is less than 30% of the nominal motor voltage.

8.3.2 DC POWER SYSTEMS

8.3.2.1 Description

Two Class 1E dc power subsystems are provided for each unit. These subsystems are identified as Class 1E in Figures 8.3-39 and 8.3-40. The dc subsystems A and B provide control power for ac load groups 1 and 2 respectively. These subsystems also provide dc power to the four inverters of the Class 1E 120Vac preferred power system. Subsystem A provides dc power to inverters Y10 and Y30 and subsystem B provides dc power to inverters Y20 and Y40. The dc supplies to the inverters of the Class 1E 120Vac preferred power system are shown in Figures 8.3-2A, 8.3-2B and 8.3-3. | 27
Power for valve actuators, and diesel generator field flashing is also supplied by dc subsystems A and B. Each Class 1E dc power subsystem consists of one 125V battery, two battery chargers, one distribution center, and one distribution panel.

Each of the batteries, designated D01 and D02, consists of 60 cells and is of the lead-acid type with lead-calcium grid construction. Each battery is rated 1,500Ah at an 8 hour | 19
discharge rate to a minimum battery terminal voltage of 105Vdc at 77F. This is of sufficient size to meet the duty cycle requirements as shown in Table 8.3-7 without use of either charger and without decreasing the voltage below 1.75 volts per cell.

The 125V battery chargers, designated D15, D17, D25, and D27, are of the current limiting, constant voltage, regulated, and filtered type with silicon thyristors and diodes in a full wave rectified circuit. An input transformer is used to isolate the dc output from the ac input and to ensure proper voltage to the rectifier unit. Each charger is cooled by natural convection and is rated for continuous operation in a 50C ambient environment. The housing is freestanding, ventilated NEMA Type 1 with gasketed doors. The charger is rated 300 amperes with a current limiting capability adjustable from 90 to 115% of rated current. The adjustable float range is from 130 to 135 volts and the equalize voltage is adjustable to a maximum of 140 volts. The charger output voltage is maintained at ±1% from no-load to full-load with a supply voltage variation of ±10% and a frequency variation of ±5%. The chargers operate at 460 volts, 3-phase, 60Hz supplied from Class 1E 460V motor control centers of the load group associated with each respective dc subsystem. Operating requirements of associated dc equipment are specified based on the voltage variations that will exist during the various charger operating modes. In the event of an overvoltage at the charger output, an overvoltage dc relay is provided to alarm the condition. The relay contacts are operated by a dc sensing printed circuit board when the upper threshold voltage has been exceeded. A similar circuit is provided in the event of an undervoltage when the voltage falls below the lower threshold. The charger units also have complete overcurrent protection. A breaker with a short trip is provided at the charger input and a | 10 | 10

thermal-magnetic breaker is provided at the output. Fuses connected between the input transformer and the rectifier elements serve as semiconductor protection. Additional protection is provided upstream at the 460V motor control center where the charger's source of supply is fed through a thermal-magnetic breaker. | 10 | 15

The 125Vdc distribution centers, designated D10 and D20, are comprised of freestanding steel structures of NEMA Type 1 construction with gasketed doors. Included are molded-case circuit breakers and metering and alarm devices as shown in Figures 8.3-39 and 8.3-40. | 15 | 16

The 125Vdc distribution panels, designated D11, D12, D21, and D22, are comprised of wall-mounted steel structures of NEMA Type 1 construction with gasketed doors. The battery fused disconnect switches, designated D13 and D23, are comprised of freestanding steel structures of NEMA Type 1 construction. | 22

A separate non-Class 1E dc power system is provided for each unit to serve plant nonsafety loads. The non-Class 1E dc power system is also shown in Figures 8.3-39 and 8.3-40. Each non-Class 1E dc power system consists of the following:

a. One 250Vdc center-tapped battery, designated D03

b. Three 125Vdc battery chargers, designated D35, D36, and D37

c. One 250Vdc motor control center, designated D30, which includes molded-case circuit breakers and motor controllers

d. Two battery fused disconnect switches, designated D38 and D39

e. Two 125Vdc distribution centers, designated D31 and D32, which include molded-case circuit breakers and metering and alarm devices

f. Five 125Vdc distribution panels, designated D33, D34, D43, D44 and D54. | 22 | 27

The non-Class 1E dc power system provides a reliable source of power for plant nonsafety loads. The center-tapped battery provides dc voltage at 250 and 125V levels.

The 125Vdc buses serve non-Class 1E control, instrumentation, and power loads. Power for dc emergency lighting and non-Class 1E valve actuators is also supplied by these buses. The 250 dc buses serve the following non-Class 1E dc motors and inverters:

a. Reactor coolant pump lube oil pump motors

b. Steam generator feedwater pump lube oil pump motors

c. Turbine-generator emergency lube oil pump motor

d. Emergency hydrogen seal oil pump motor

e. Inverters designated Y50 and Y60 of the non-Class 1E 120Vac preferred power system

The battery chargers operate at 460 volts, 3-phase, 60Hz, and provide rectified 125Vdc for charging the battery and supplying bus loads. Battery chargers D35 and D37 receive their power from Class 1E 460V motor control centers. In accordance with the provisions of Regulatory Guide 1.75, Rev. 1, the breakers serving these chargers are tripped under accident conditions through action initiated by the emergency core cooling actuation system (ECCAS). Power, once disconnected by the ECCAS signal, can be restored to the non-Class 1E battery chargers by manual operator action initiated under administrative control.

In addition to the separate non-Class 1E 125/250Vdc power system supplied for each unit there is a 125Vdc system common to both units that is located in the evaporator building. The 125Vdc power system consists of the following:

a. One 125Vdc battery, designated 0D04

b. Two 125Vdc battery chargers designated 0D70 and 0D74

c. One battery fused disconnect switch, designated 0D71

d. One 125Vdc distribution center, designated 0D72, which includes molded case circuit breakers, metering and alarm devices

e. One 125Vdc distribution panel, designated 0D47

The 125Vdc distribution panel serves non-Class 1E control, instrumentation and power loads located in the evaporator building and nearby outlying buildings.

The battery chargers operate at 460 volts, 3-phase, 60 Hz and provide rectified 125Vdc for charging the battery and supplying bus loads. Battery chargers 0D70 and 0D74 receive their power from non-Class 1E 460V motor control centers 0B72 and 0G70.

27

8.3.2.1.1 Safety-Related DC Loads

Table 8.3-6 identifies loads related to each Class 1E 125Vdc subsystem.

8.3.2.1.2 Class 1E Station Batteries and Battery Chargers

BATTERY CAPACITY - Each Class 1E battery has sufficient capacity to independently supply the required loads as shown in Table 8.3-7 for 2 hours. |19

The initial battery capacity is 25% greater than required. This margin is consistent with the battery replacement criterion of 80% rated capacity given in IEEE Std 450-1975.

BATTERY CHARGER CAPACITY - With the normal lineup of the battery chargers as shown in Figures 8.3-2A, 8.3-2B, 8.3-3, 8.3-39, and 8.3-40, sufficient capacity is provided by the chargers to recharge the battery from the design minimum charge state to the fully charged state while simultaneously supplying the largest combined demand of the various steady-state and transient loads irrespective of the status of the plant during which these demands occur. This can be accomplished within 12 hours. |27

INSPECTION AND TESTING - Testing of the dc power system is performed prior to and during plant operation in accordance with the procedures described in Chapters 14 and 16.

8.3.2.1.3 Separation and Ventilation

The Class 1E batteries, chargers, fused disconnect switch, and dc distribution centers and panels are located within the confines of the Seismic Category I auxiliary building. The batteries are located in separate rooms of the auxiliary building which are ventilated by a system that is designed to preclude the possibility of hydrogen accumulation. Subsection 9.4.1 contains a description of the battery room ventilation system. The chargers, fused disconnect switch, and dc distribution centers and panels are also located in the auxiliary building but in separate rooms from those housing the batteries. Electrical equipment layout drawings showing the location of Class 1E dc system equipment and their main cable routes are listed in Table 1.7-7.

8.3.2.2 Analysis

8.3.2.2.1 Compliance with General Design Criteria, Branch Technical Positions, Regulatory Guides, and Industry Standards

Compliance with General Design Criteria 1, 2, 3, 4, 5, 13, 17, 18, 21, 22, 33, 34, 35, 38, 41, and 44 is discussed in Section 3.1. The following is provided as additional discussion on compliance with General Design Criteria 17 and 18.

GENERAL DESIGN CRITERION 17, ELECTRIC POWER SYSTEMS - Consideration of Criterion 17 leads to the inclusion of the following factors in the design of the dc power system:

a. Separate Class 1E 125Vdc subsystems supply control power for each of the Class 1E ac load groups.

b. The ac power for the battery chargers in each of these dc subsystems is supplied from the same ac load group for which the dc subsystem supplies the control power.

c. The Class 1E dc subsystems, including batteries, chargers, fused disconnect switches, and dc distribution centers and panels are physically separate and independent.

d. Sufficient capacity, capability, independence, redundancy, and testability are provided in the Class 1E dc subsystems, ensuring the performance of safety functions assuming a single failure.

GENERAL DESIGN CRITERION 18, INSPECTION AND TESTING OF ELECTRIC POWER SYSTEMS - Each of the Class 1E 125Vdc subsystems is designed to permit:

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TABLE 8.3-6

CLASS 1E DC SYSTEM LOADS

DC Subsystem	System Load	
A (battery D01 load group 1)	Diesel generator G11 control and field flash	
	Safety-related control board and auxiliary panel supplies associated with load group 1	
	Class 1E switchgear dc supplies of load group 1	
	Inverter Y10 (Channel A)	
	Inverter Y30 (Channel C)	
	Steam generator auxiliary feedwater valve (Channel A)	19
B (battery D02 load group 2)	Diesel generator G12 control and field flash	
	Safety-related control board and auxiliary panel supplies associated with load group 2	
	Class 1E switchgear dc supplies of load group 2	
	Inverter Y20 (Channel B)	
	Inverter Y40 (Channel D)	
	Steam generator auxiliary feedwater valves (Channel B)	19

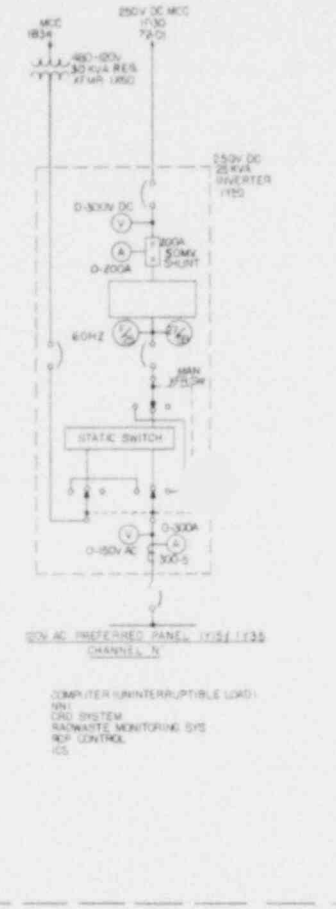
TABLE 8.3-7

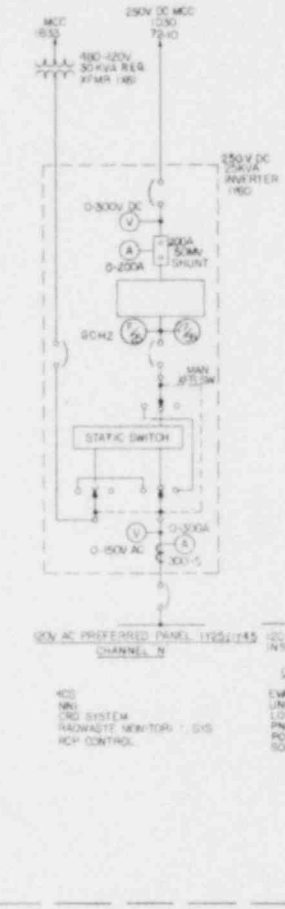
125Vdc CLASS 1E BATTERY LOADING CYCLE
(AMPERES REQUIRED PER TIME INTERVAL PER BATTERY
AFTER LOSS OF AC POWER)

Load Description	0-1 min	1-59 min	59-60 min	60-119 min	119-120 min	Function	
D-G field flashing, Class 1E ac switchgear circuit breaker operation, steam generator auxiliary feedwater valves	224	-	224	-	224	Initial generator excitation, control power, motor operated valves	19
Solenoid valves and Class 1E control and instrumentation	80	80	80	80	80	Control and instrumentation	
Inverters	175	175	175	175	175	Class 1E instrumentation power	19
Total amperes/interval	479	255	479	255	479		27

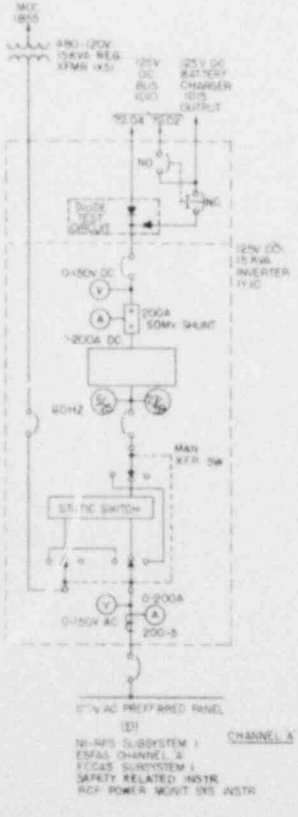
NOTE: Dash means not applicable

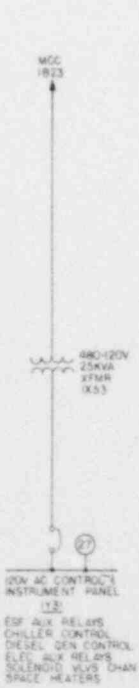
480-120V
25 KVA
XFMR (X65)
440-120 V
25 KVA
XFMR (X67)
120V AC CONTROL AND
INSTRUMENT PANEL
(Y86)
CHANNEL 'B'
SERVICE WTR PUMP
H & V PNL
120 V AC CONTROL
INSTRUMENT PANEL
(Y85)
CHANNEL 'A'
SERVICE WTR PUMP
STRUCTURE DAMPERS
SPACE HEATERS

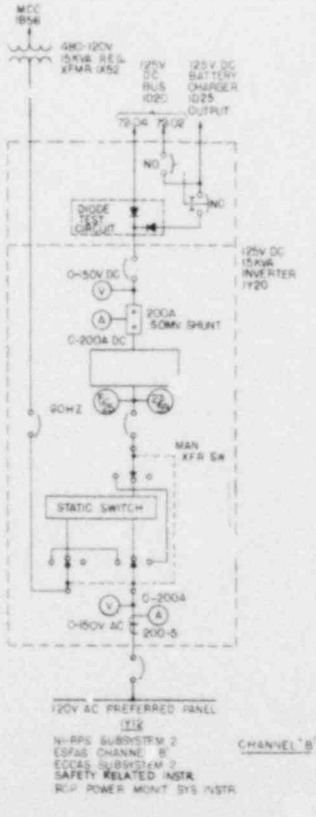

250V DC MCC
(Y30
72-01)
480-120V
30 KVA REG.
XFMR (X60)
250V DC
25 KVA
INVERTER
(Y50)
0-300V DC
300A
50MV
SHUNT
0-200A
60HZ
MAN
XFR SW
STATIC SWITCH
0-300A
0-150V AC
300-5
120V AC PREFERRED PANEL (Y54 / Y35)
CHANNEL 'A'
COMPUTER (UNINTERRUPTIBLE LOAD)
VIM
CRD SYSTEM
RADWASTE MONITORING SYS
RCP CONTROL
ICS

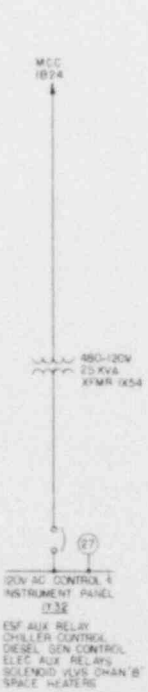

250V DC MCC
(Y30
72-10)
480-120V
30 KVA REG.
XFMR (X61)
250V DC
25 KVA
INVERTER
(Y60)
120V AC PREFERRED PANEL (Y55 / Y45)
CHANNEL 'B'
VIM
CRD SYSTEM
RADWASTE MONITORING SYS
RCP CONTROL

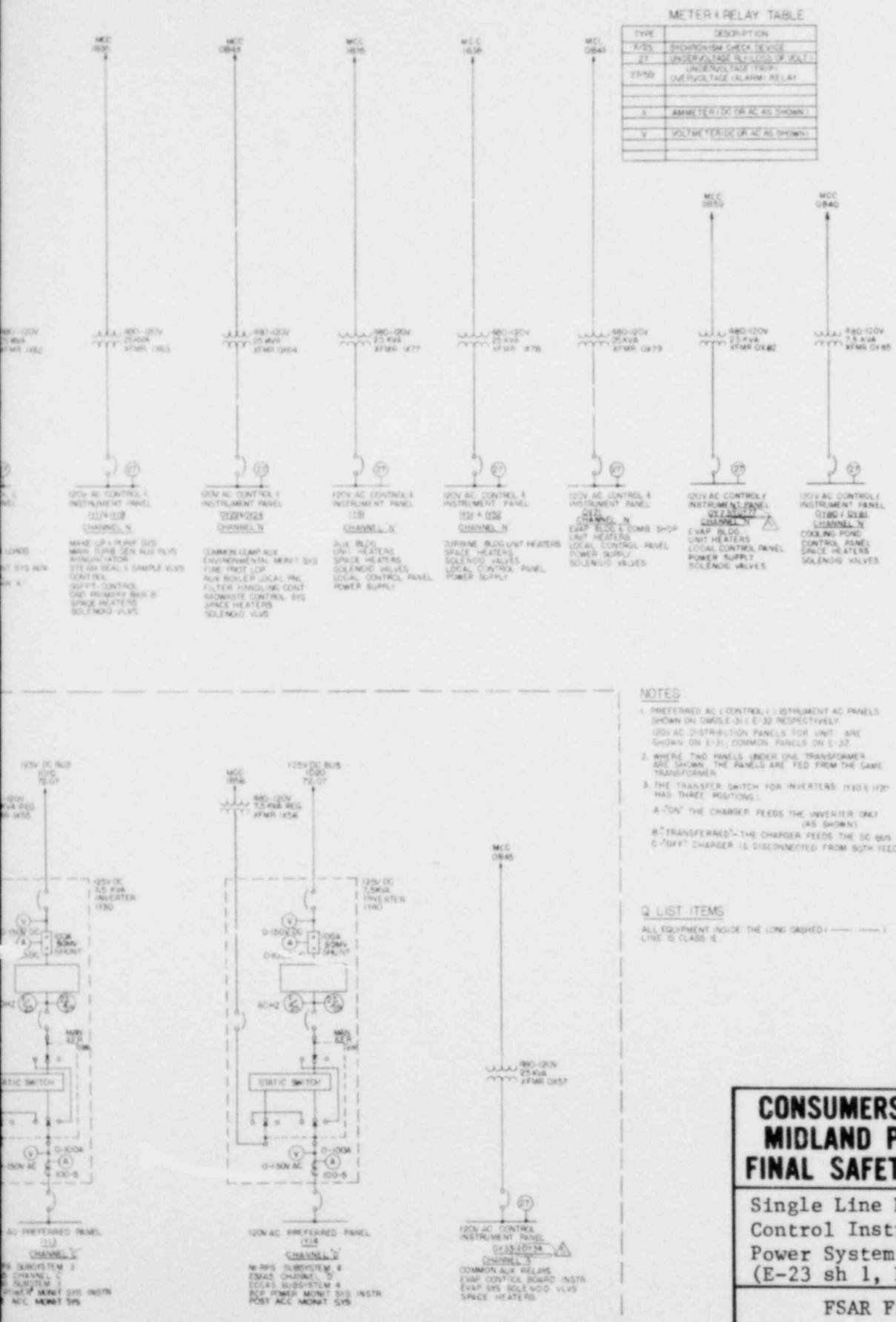
480-120V
25 KVA
XFMR (X64)
120V AC CONTROL
INSTRUMENT PANEL
(Y74 / Y76)
CHANNEL 'A'
EMER BLDG
UNIT HEATERS
LOCAL CONTROL-
PNL
POWER SUPPLY
SOLENOID VLVS


480-120V
15KVA REG.
XFMR (X51)
125V
DC
BUS
(D30)
125 V DC
BATTERY
CHARGER
(D15
OUTPUT)
DIODE
TEST
CIRCUIT
125V DC
15 KVA
INVERTER
(Y40)
0-150V DC
200A
50MV SHUNT
0-200A DC
60HZ
MAN
XFR SW
STATIC SWITCH
0-200A
0-150V AC
200-5
120V AC PREFERRED PANEL
(D1)
CHANNEL 'A'
NI-RFS SUBSYSTEM 1
ESFAS CHANNEL 'A'
ECCAS SUBSYSTEM 1
SAFETY RELATED INSTR
RCP POWER MONIT SYS INSTR


480-120V
25KVA
XFMR
(X53)
120V AC CONTROL
INSTRUMENT PANEL
(Y8)
ESF AUX RELAYS
CHILLER CONTROL
DIESEL GEN CONTROL
ELEC AUX RELAYS
SOLENOID VLVS CHAN 'A'
SPACE HEATERS


480-120V
15KVA REG.
XFMR (X52)
125V
DC
BUS
(D20)
125 V DC
BATTERY
CHARGER
(D25
OUTPUT)
DIODE
TEST
CIRCUIT
125V DC
15 KVA
INVERTER
(Y20)
0-150V DC
200A
50MV SHUNT
0-200A DC
60HZ
MAN
XFR SW
STATIC SWITCH
0-200A
0-150V AC
200-5
120V AC PREFERRED PANEL
(Y14)
CHANNEL 'B'
NI-RFS SUBSYSTEM 2
ESFAS CHANNEL 'B'
ECCAS SUBSYSTEM 2
SAFETY RELATED INSTR
RCP POWER MONIT SYS INSTR


480-120V
25 KVA
XFMR (X54)
120V AC CONTROL
INSTRUMENT PANEL
(Y32)
ESF AUX RELAY
CHILLER CONTROL
DIESEL GEN CONTROL
ELEC AUX RELAYS
SOLENOID VLVS CHAN 'B'
SPACE HEATERS



NOTES

1. PREFERRED AC & CONTROL + INSTRUMENT AC PANELS SHOWN ON DWGS E-31 & E-32 RESPECTIVELY. (120V AC DISTRIBUTION PANELS FOR UNIT 1 ARE SHOWN ON E-31; COMMON PANELS ON E-32.
2. WHERE TWO PANELS UNDER ONE TRANSFORMER ARE SHOWN, THE PANELS ARE FED FROM THE SAME TRANSFORMER.
3. THE TRANSFER SWITCH FOR INVERTERS (Y103 / Y104) HAS THREE POSITIONS:
   A -"ON" THE CHARGER FEEDS THE INVERTER ONLY (AS SHOWN)
   B -"TRANSFERRED" - THE CHARGER FEEDS THE DC BUS
   C -"OFF" CHARGER IS DISCONNECTED FROM BOTH FEEDS.

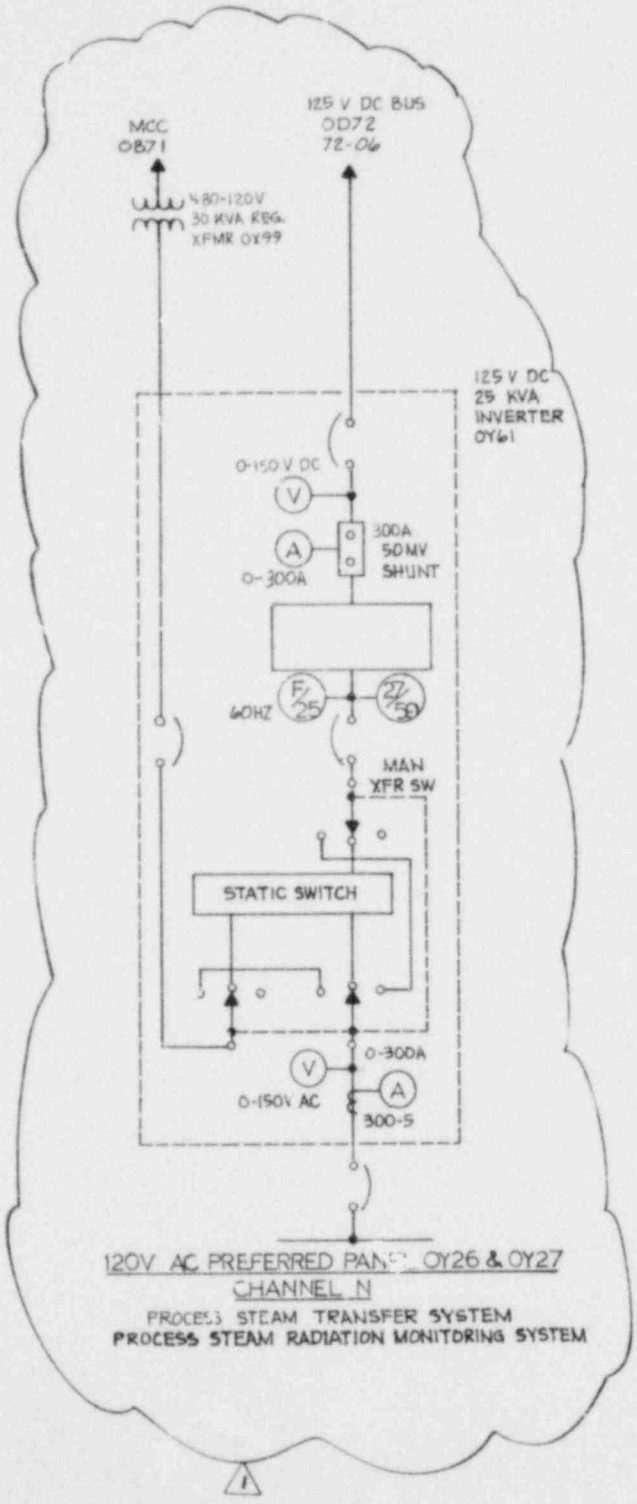
Q LIST ITEMS

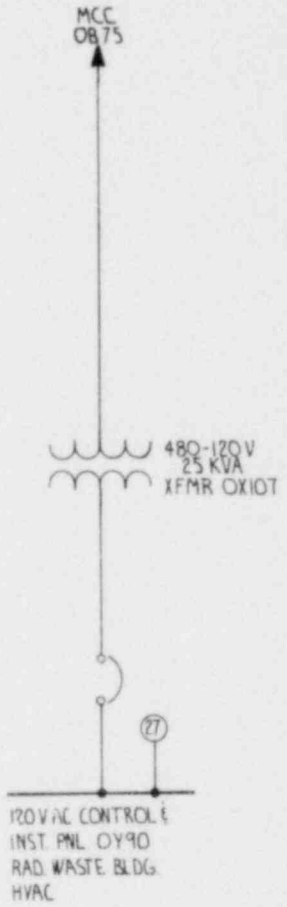
ALL EQUIPMENT INSIDE THE LONG DASHED (— — —) LINE IS CLASS 1E.

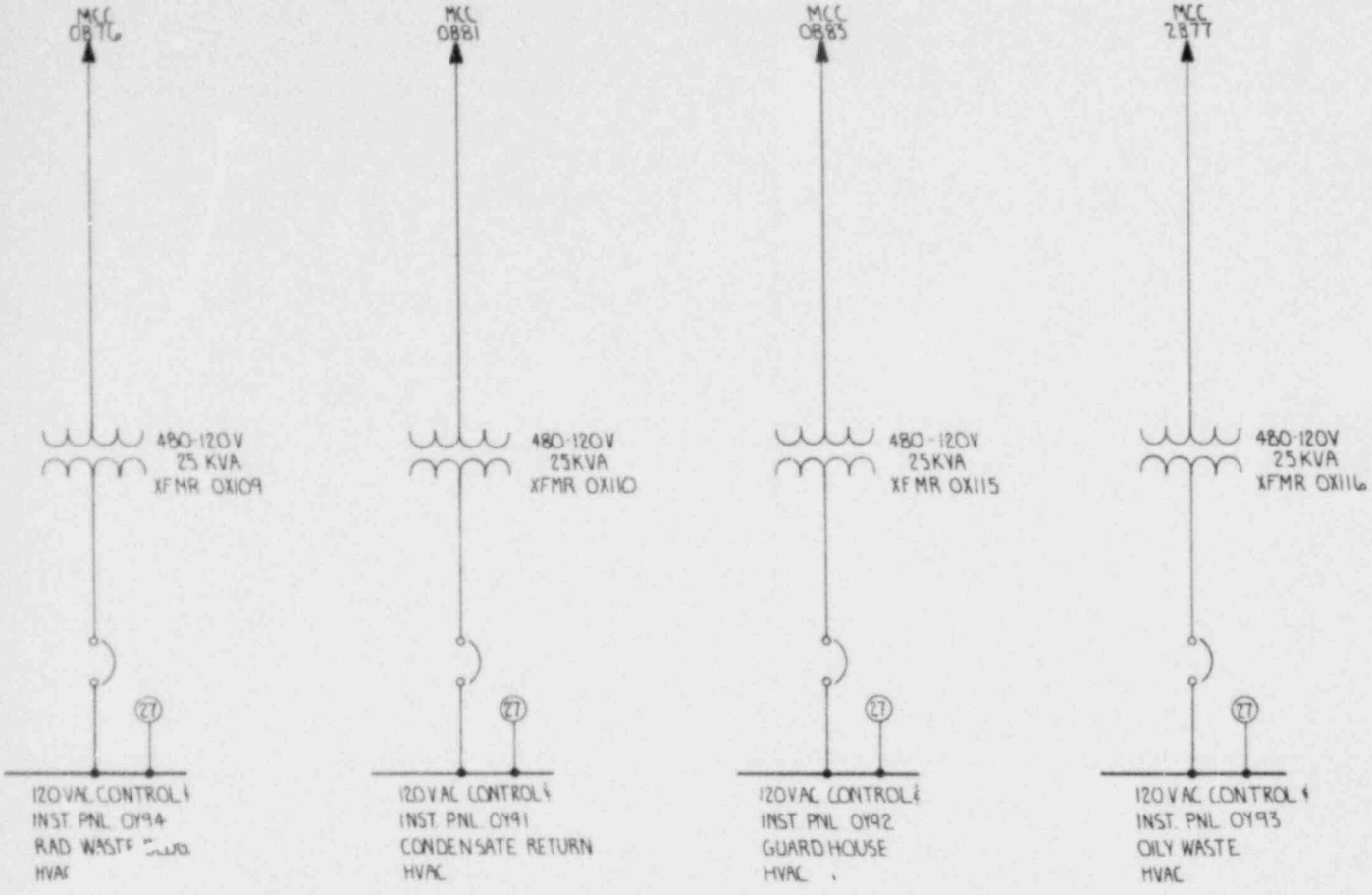
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Single Line Diagram 120 VAC Control Instrument and Preferred Power System Unit 1 and-Common (E-23 sh 1, Rev 5)

FSAR Figure 8.3-2A


MCC
0871
125 V DC BUS
0D72
72-06
480-120V
30 KVA REG.
XFMR 0Y99
125 V DC
25 KVA
INVERTER
0Y61
0-150 V DC
V
A
0-300A
300A
50MV
SHUNT
60HZ
F/25
27/59
MAN
XFR SW
STATIC SWITCH
0-300A
V
0-150V AC
A
300-5
120V AC PREFERRED PANEL 0Y26 & 0Y27
CHANNEL N
PROCESS STEAM TRANSFER SYSTEM
PROCESS STEAM RADIATION MONITORING SYSTEM
1


MCC
0B75
480-120V
25 KVA
XFMR 0X107
27
120V AC CONTROL &
INST. PNL. 0Y90
RAD. WASTE BLDG.
HVAC



NOTES:

1. 120 VAC DISTRIBUTION PANELS FOR UNIT 1 ARE SHOWN ON E-31, UNIT 2 AND COMMON PANELS ARE SHOWN ON E-32.

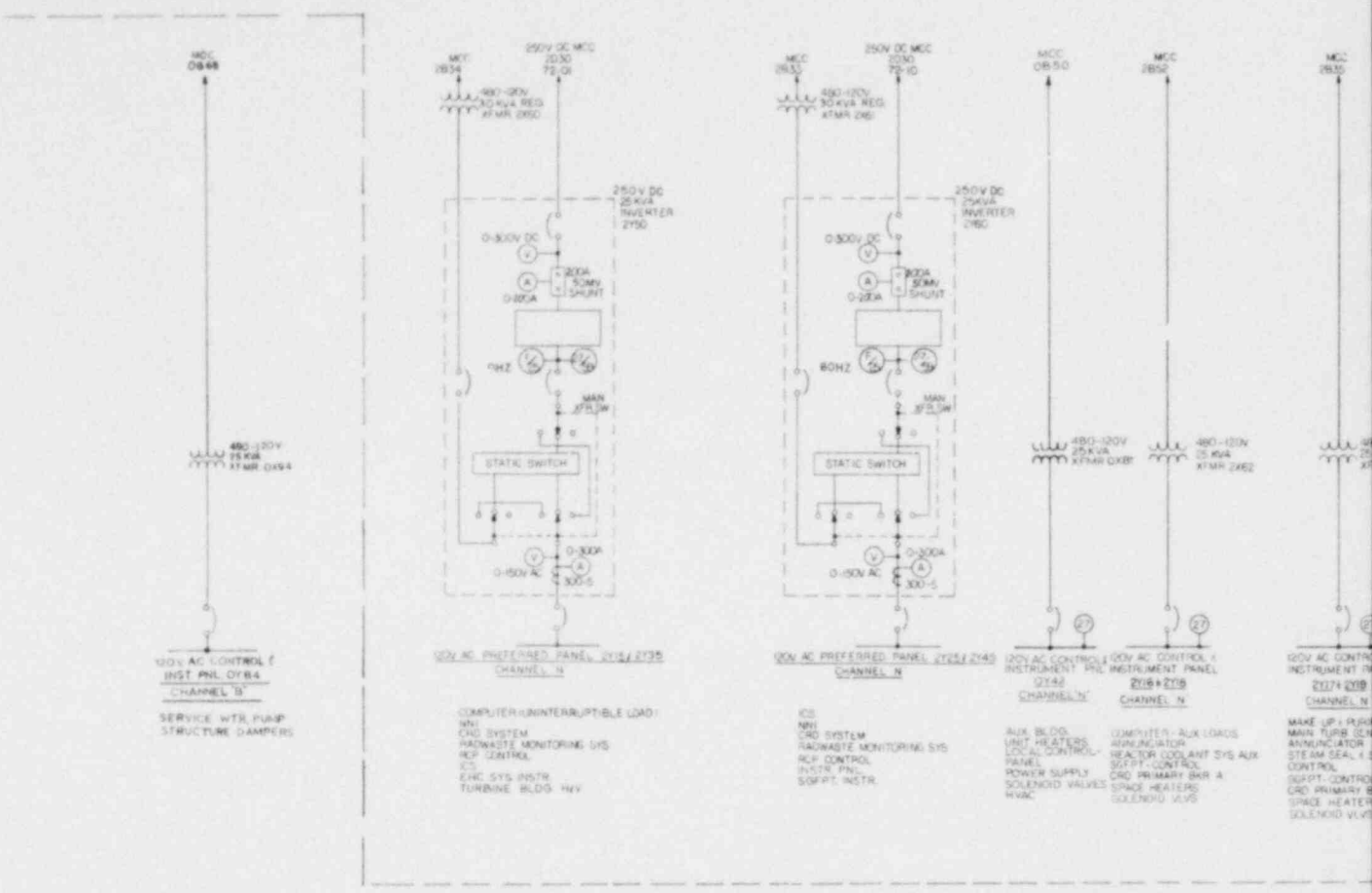
Q LIST ITEMS

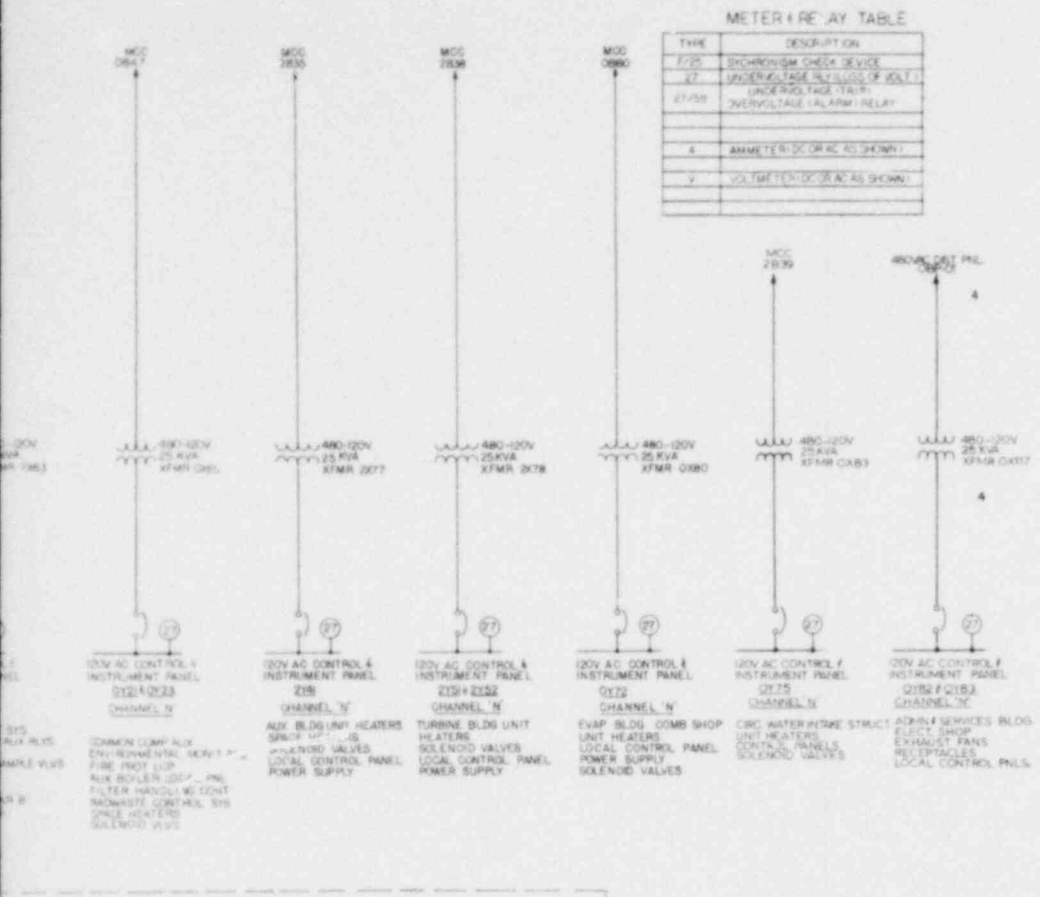
ALL EQUIPMENT INSIDE THE LONG DASHED (— —) LINE IS CLASS 1E.

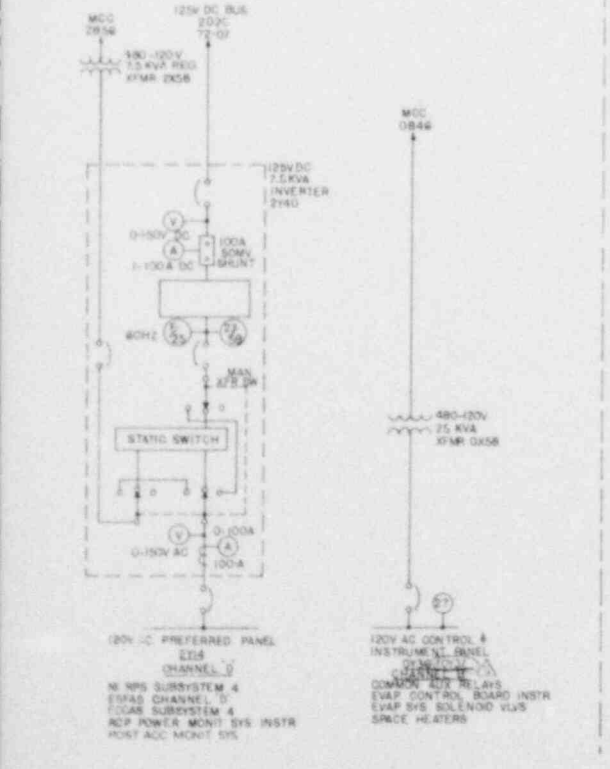
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Single Line Diagram 120 VAC Control Instrument and Preferred Power System Unit 1 and Common (E-23 sh 2, Rev 1)

FSAR Figure 8.3-2B


MCC 0B48
480-120V 15 KVA XFMR 0X84
120V AC CONTROL & INST PNL 0Y84
CHANNEL 'B'
SERVICE WTR PUMP STRUCTURE DAMPERS
MCC 2B34
250V DC MCC 2030 72-01
480-120V 30 KVA REG XFMR 2X50
250 V DC 25 KVA INVERTER 2Y50
0-300V DC
0-200A
200A 50MV SHUNT
0-200A
60HZ
MAIN XFR SW
STATIC SWITCH
0-300A
0-150V AC
300-5
120V AC PREFERRED PANEL 2Y34 / 2Y35
CHANNEL 'A'
COMPUTER-UNINTERRUPTIBLE LOAD
NNI
CRD SYSTEM
RADWASTE MONITORING SYS
RCP CONTROL
ICS
EHC SYS INSTR
TURBINE BLDG HVV
MCC 2B53
250V DC MCC 2030 72-10
480-120V 30 KVA REG XFMR 2X51
250 V DC 25 KVA INVERTER 2Y60
0-300V DC
0-200A
200A 50MV SHUNT
0-200A
60HZ
MAIN XFR SW
STATIC SWITCH
0-200A
0-150V AC
300-5
120V AC PREFERRED PANEL 2Y54 / 2Y45
CHANNEL 'A'
ICS
NNI
CRD SYSTEM
RADWASTE MONITORING SYS
RCP CONTROL
INSTR PNL
SGFPT INSTR
MCC 0B50
480-120V 25 KVA XFMR 0X81
120V AC CONTROL & INSTRUMENT PNL 0Y44
CHANNEL 'A'
AUX BLDG UNIT HEATERS LOCAL CONTROL PANEL POWER SUPPLY SOLENOID VALVES HVAC
MCC 2B52
480-120V 15 KVA XFMR 2X62
120V AC CONTROL & INSTRUMENT PANEL 2Y16 & 2Y19
CHANNEL 'A'
COMPUTER - AUX LOADS ANNUNCIATOR REACTOR COOLANT SYS AUX SGFPT - CONTROL CRD PRIMARY BKR A SPACE HEATERS SOLENOID VLVS
MCC 2B35
480-120V
120V AC CONTR
INSTRUMENT PA
2Y174 2Y19
CHANNEL 'A'
MAKE-UP & PURI
MAIN TURB (EN
ANNUNCIATOR
STEAM SEAL &
CONTROL
SGFPT - CONTRO
CRD PRIMARY B
SPACE HEATER
SOLENOID VLVS
MCC 2B56
480-120V 7.5 KVA REG XFMR 2X51
125V DC BUS 2010
125V DC BATTERY CHARGER 2D15 OUTPUT
72-04 72-02
NO
NC
DIODE TEST CIRCUIT
125V DC 15 KVA INVERTER 2Y10
0-150V DC
200A 50MV SHUNT
0-200A DC
60HZ
MAIN XFR SW
STATIC SWITCH
0-200A
0-150V AC
200-5
120V AC PREFERRED PANEL 2Y11
CHANNEL 'A'
N1 RPS SUBSYSTEM 1
ESFAS CHANNEL A
EDCAS SUBSYSTEM 1
SAFETY RELATED INSTR
RCP POWER MONIT SYS INSTR
MCC 2B23
480-120V 25 KVA XFMR 2X53
120V AC CONTROL & INSTRUMENT PANEL 2Y13
ESF AUX RELAYS
CHILLER CONTROL
DIESEL GEN CONTROL
LEC AUX RELAYS
SOLENOID VLVS CHAN A
SPACE HEATERS
MCC 2B56
480-120V 15 KVA REG XFMR 2X52
125V DC BUS 2020
125V DC BATTERY CHARGER 2D25 OUTPUT
72-04 72-02
NO
NC
DIODE TEST CIRCUIT
125V DC 15 KVA INVERTER 2Y80
0-150V DC
200A 50MV SHUNT
0-200A DC
60HZ
MAIN XFR SW
STATIC SWITCH
0-200A
0-150V AC
200-5
120V AC PREFERRED PANEL 2Y12
CHANNEL 'B'
N1 RPS SUBSYSTEM 2
ESFAS CHANNEL B
EDCAS SUBSYSTEM 2
SAFETY RELATED INSTR
RCP POWER MONIT SYS INSTR
MCC 2B24
480-120V 15 KVA XFMR 2X54
120V AC CONTROL & INSTRUMENT PANEL 2Y33
ESF AUX RELAYS
CHILLER CONTROL
DIESEL GEN CONTROL
ELEC AUX RELAYS
SOLENOID VLVS CHAN B
SPACE HEATERS
MCC 2B55
125V DC BUS 2010 72-07
480-120V 7.5 KVA REG XFMR 2X55
125V DC 7.5 KVA INVERTER 2Y30
0-150V DC
100A 50MV SHUNT
0-100A DC
60HZ
MAIN XFR SW
STATIC SWITCH
0-100A
0-150V AC
100-5
120V AC PREFERRED PANEL 2Y13
CHANNEL 'C'
N1 RPS SUBSYSTEM 3
ESFAS CHANNEL C
EDCAS SUBSYSTEM 3
RCP POWER MONIT SYS INSTR
POST ACC MONIT SYS





NOTES

1. PREFERRED AC & CONTROL & INSTRUMENT AC PANELS SHOWN ON DWG E-31 & E-32 RESPECTIVELY. 120V AC DISTRIBUTION PANELS ARE SHOWN ON E-32.
2. WHERE TWO PANELS UNDER ONE TRANSFORMER ARE SHOWN, THE PANELS ARE FED FROM THE SAME TRANSFORMER.
3. THE TRANSFER SWITCH FOR INVERTERS 2Y10 AND 2Y20 HAS THREE POSITIONS:
   A. "ON"-CHARGER FEEDS THE INVERTER ONLY (AS SHOWN)
   B. "TRANSFERRED"-THE CHARGER FEEDS THE DC BUS
   C. "OFF"-CHARGER IS DISCONNECTED FROM BOTH FEEDS.

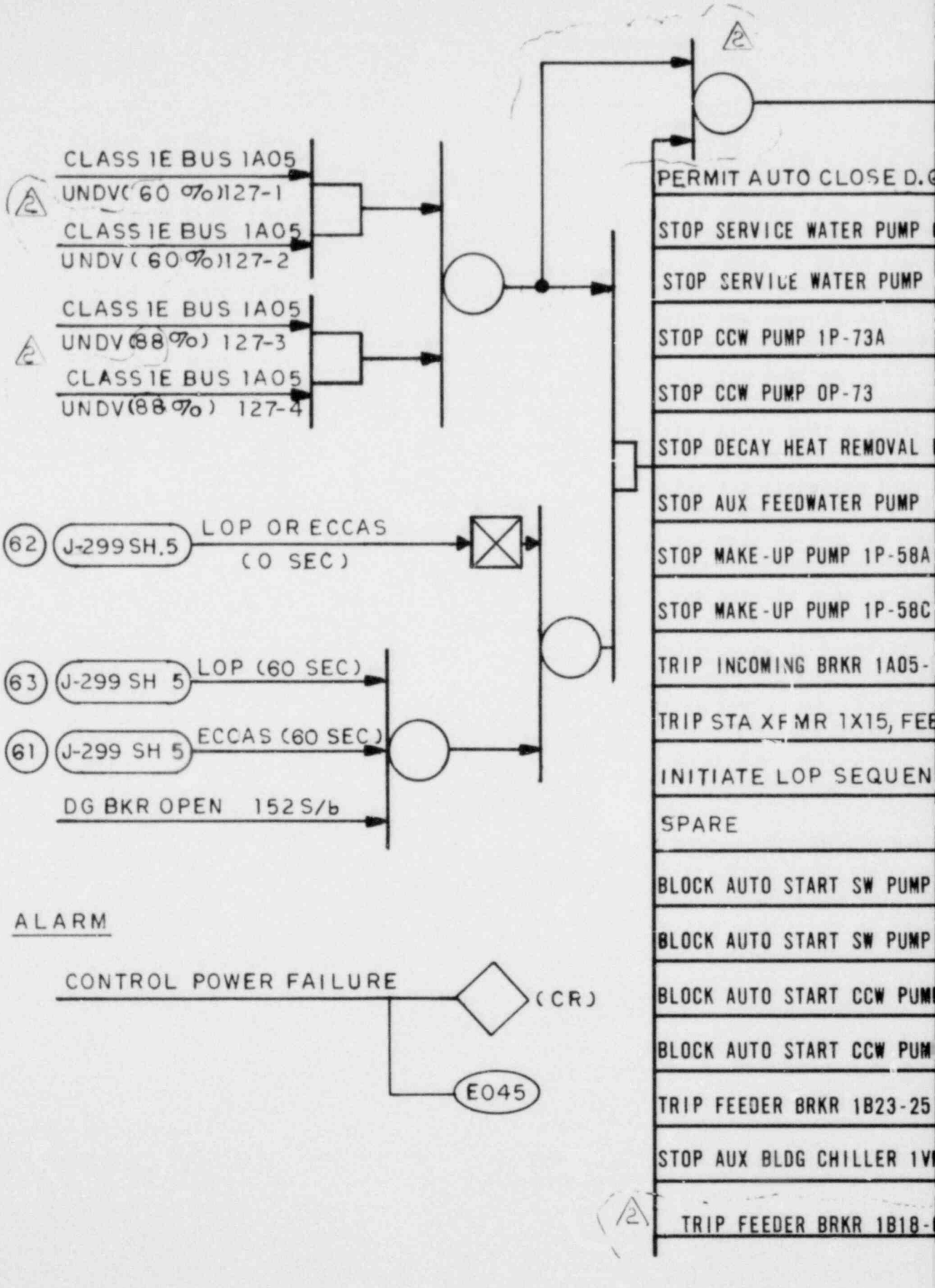
Q LIST ITEMS

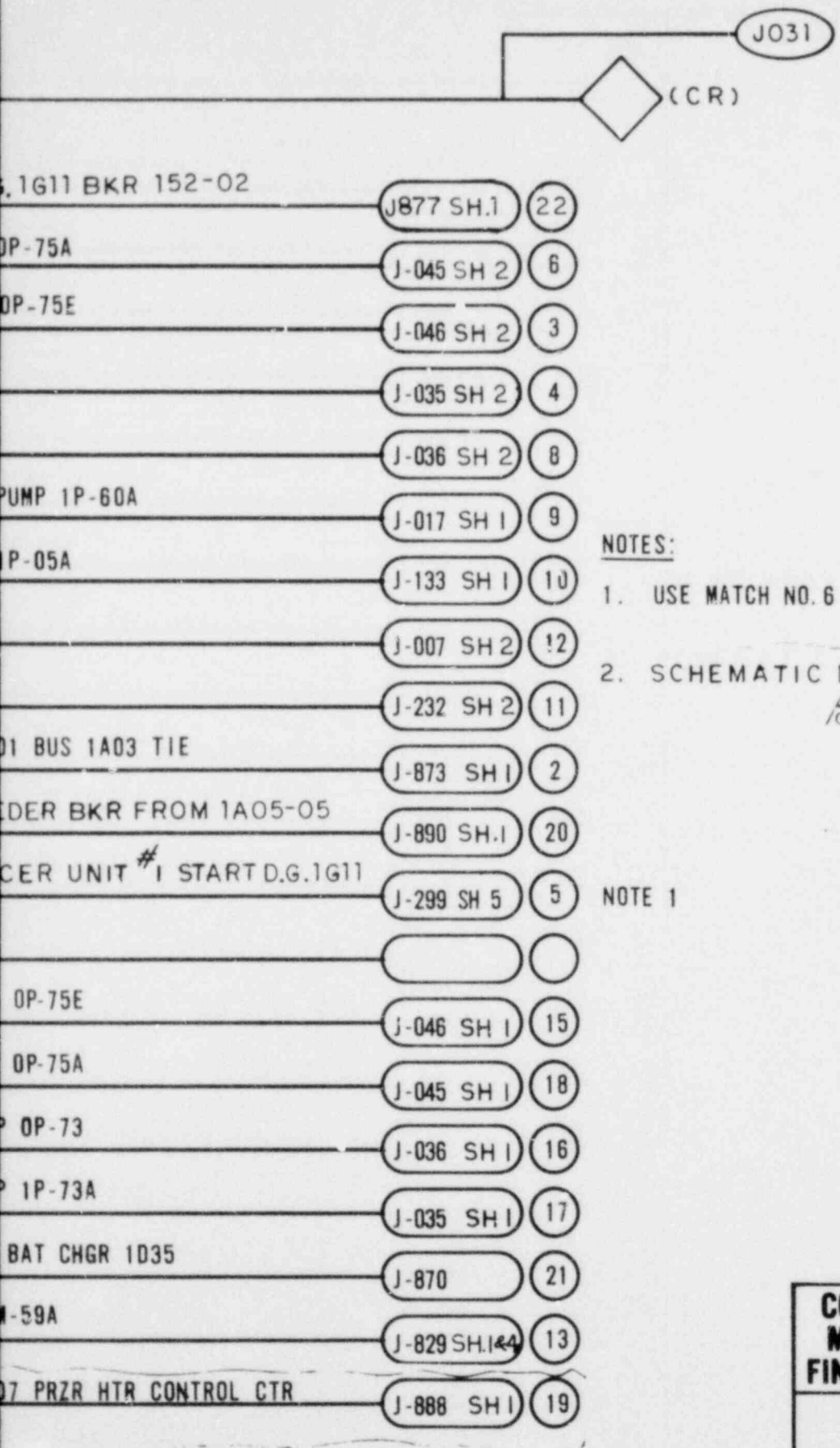
ALL EQUIPMENT INSIDE THE LONG DASHED (—— ——) LINE IS GLASS 'E'.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Single Line Diagram 120 VAC Control Instrument and Preferred Power System Unit 2 and Common (E-24, Rev 5)

FSAR Figure 8.3-3


CLASS 1E BUS 1A05
UNDV(60 %)127-1
CLASS 1E BUS 1A05
UNDV (60 %)127-2
CLASS 1E BUS 1A05
UNDV(88 %) 127-3
CLASS 1E BUS 1A05
UNDV(88 %) 127-4
62 J-299 SH.5 LOP OR ECCAS (0 SEC)
63 J-299 SH 5 LOP (60 SEC)
61 J-299 SH 5 ECCAS (60 SEC)
DG BKR OPEN 152S/b
ALARM
CONTROL POWER FAILURE
(CR)
E045
PERMIT AUTO CLOSE D.G
STOP SERVICE WATER PUMP
STOP SERVICE WATER PUMP
STOP CCW PUMP 1P-73A
STOP CCW PUMP OP-73
STOP DECAY HEAT REMOVAL
STOP AUX FEEDWATER PUMP
STOP MAKE-UP PUMP 1P-58A
STOP MAKE-UP PUMP 1P-58C
TRIP INCOMING BRKR 1A05-
TRIP STA XFMR 1X15, FEE
INITIATE LOP SEQUEN
SPARE
BLOCK AUTO START SW PUMP
BLOCK AUTO START SW PUMP
BLOCK AUTO START CCW PUM
BLOCK AUTO START CCW PUM
TRIP FEEDER BRKR 1B23-25
STOP AUX BLDG CHILLER 1V
TRIP FEEDER BRKR 1B18-



NOTES:

1. USE MATCH NO. 6 FOR CHAN B.
2. SCHEMATIC DIAGRAM E-75, E-83

CONSUMERS POWER COMPANY MIDLAND PLANT UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Logic Diagram 4.16 kV Bus Undervoltage Relays (J-878, sh. 1, Rev 1)
FSAR Figure 8.3-4, sh. 1

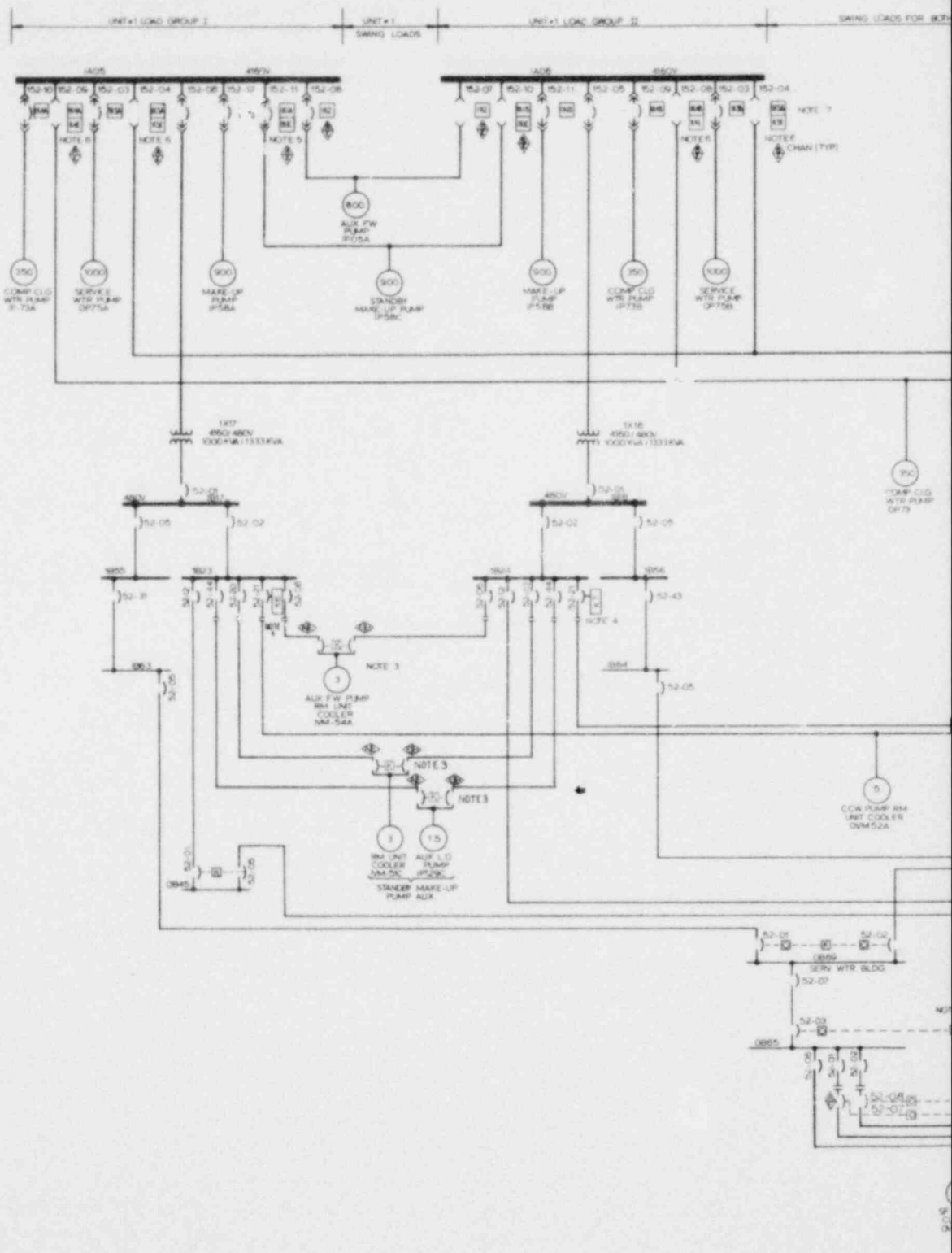
SCHEME	1AA05001		1BA06001	
EQUIPMENT	EQUIP NO	BUS-BRKR	EQUIP NO	BUS-BRK
SERVICE WATER PUMP	0P-75A	1A05-03	0P-75B	1A06-03
	0P-75E	1A05-04	0P-75E	1A06-04
COMP CLG WATER PUMP	1P-73A	1A05-10	1P-73B	1A06-09
	0P-73	1A05-09	0P-73	1A06-08
DECAY HT REMOVAL PMP	1P-60A	1A05-07	1P-60B	1A06-06
AUX FD WATER PMP	1P-05A	1A05-08	1P-05A	1A06-07
MAKEUP PUMP	1P-58A	1A05-12	1P-58B	1A06-11
	1P-58C	1A05-11	1P-58C	1A06-10
BUS INCM BKR	1A03	1A05-01	1A04	1A06-01
DIESEL GENERATOR	1G11	———	1G12	———
STA POWER XFMR FDR	1X15	1A05-05	———	———
PZR HTR CONT CENTER	———	———	1B26	1B18-07
BATTERY CHARGER	1D35	1B23-25	1D37	1B24-25
AUX BLDG CHILLER	1VM-59A	1B17-06	1VM-59B	1B18-06
DIES. GEN. BKR	1G11	1A05-02	1G12	1A06-02
UV COMPUTER PT.	J031	—	J032	—
DC CONT PWR FAIL COMPUTER PT.	E045	—	E046	—
ESFAS ACT. CABINET	1C44	—	1C44	—
		—		—
		—		—
		—		—
J-299 CROSS REFERENCE NUMBER	(62) (61) (63)	———	(64) (66) (65)	———

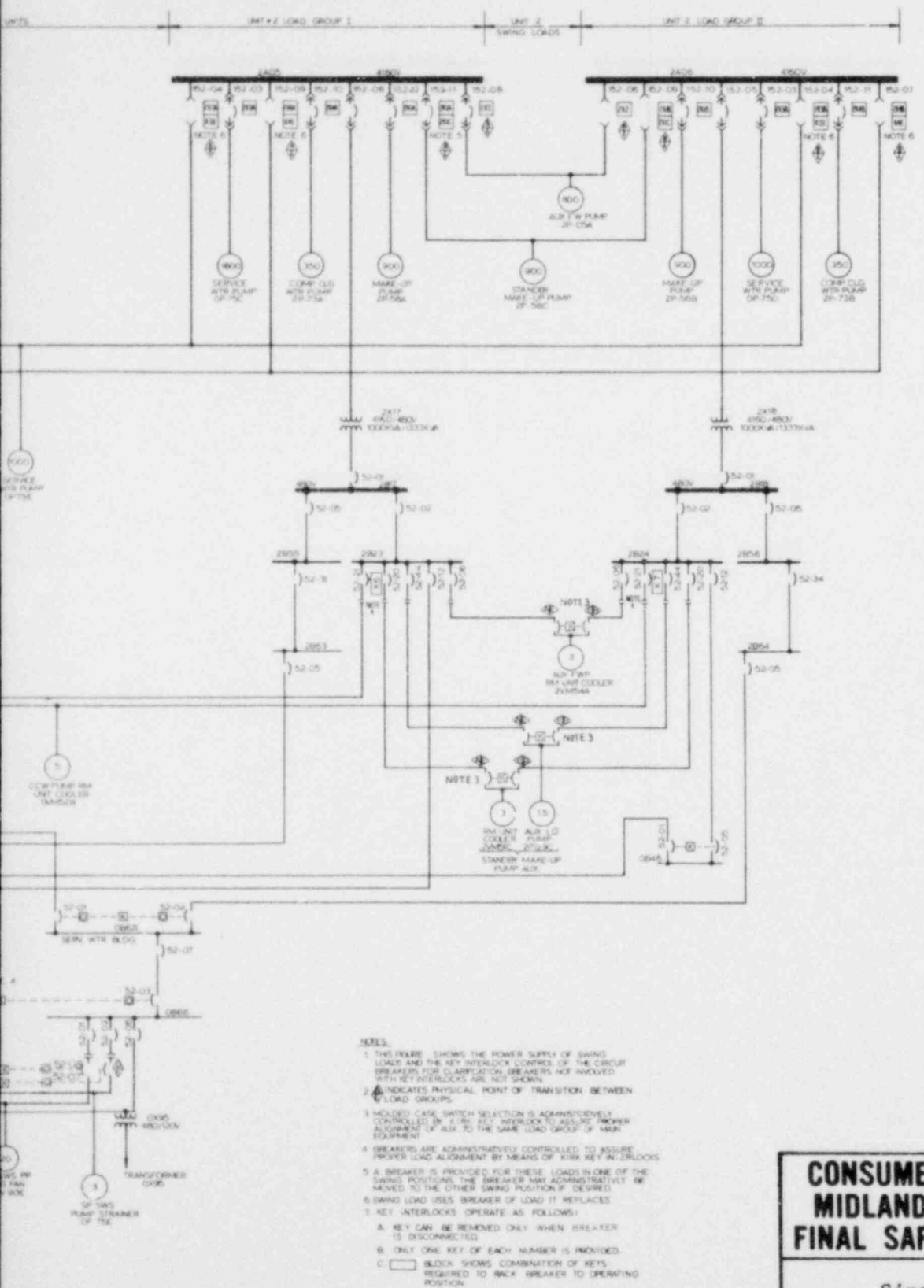
	2AA05001		2BA06001	
R	EQUIP NO	BUS-BRKR	EQUIP NO	BUS-BRKR
	OP-75C	2A05-03	OP-75D	2A06-03
	OP-75E	2A05-04	OP-75E	2A06-04
	2P-73A	2A05-10	2P-73B	2A06-11
	OP-73	2A05-09	OP-73	2A06-07
	2P-60A	2A05-07	2P-60B	2A06-08
	2P-05A	2A05-08	2P-05A	2A06-06
	2P-58A	2A05-12	2P-58B	2A06-10
	2P-58C	2A05-11	2P-58C	2A06-09
	2A03	2A05-01	2A04	2A06-01
	2G11	———	2G12	———
	2X15	2A05-05	———	———
	———	———	2B26	2B18-07
	2D35	2B23-25	2D37	2B24-25
	2VM-59A	2B17-06	2VM-59B	2B18-06
	2G11	2A05-02	2G12	2A06-02
	J031	—	J032	—
	E045	—	E046	—
	2C44	—	2C44	—
		———		———
		———		———
		———		———
	(62) (61) (63)	———	(64) (66) (65)	———

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Logic Diagram 4.16 kV Bus Undervoltage Relays
(J-878 sh 2, Rev 1)

FSAR Figure 8.3-4, sh. 2


UNIT #1 LOAD GROUP 2
UNIT #1 SWING LOADS
UNIT #1 LOAD GROUP 2
SWING LOADS FOR BOTH
1A05
4160V
1A06
4160V
NOTE 5
NOTE 6
NOTE 7
NOTE 8
4 CHAN (TYP)
800
AUX FW PUMP 1P05A
350
COMP CLG WTR PUMP 1P73A
1000
SERVICE WTR PUMP OP75A
900
MAKE-UP PUMP 1P58A
900
STANDBY MAKE-UP PUMP 1P58C
900
MAKE-UP PUMP 1P58B
350
COMP CLG WTR PUMP 1P73B
1000
SERVICE WTR PUMP OP75B
1X17
4160/480V
1000 KVA / 1333 KVA
1X18
4160/480V
1000 KVA / 1333 KVA
350
COMP CLG WTR PUMP OP73
480V
480V
52-05
52-02
52-02
52-05
1B55
1B23
1B24
1B56
52-31
52-43
NOTE 4
NOTE 3
1
AUX FW PUMP RM UNIT COOLER VAM-54A
1B63
1B64
52-05
NOTE 3
NOTE 3
5
CCA PUMP RM UNIT COOLER 0VM52A
1
RM UNIT COOLER VAM-56C
1.5
AUX L.O PUMP 1P52C
STANDBY MAKE-UP PUMP AUX
0B45
52-07
52-02
1B59
SERV WTR BLDG
52-07
52-03
0B65
52-08
52-07



NOTES:

1. THIS FIGURE SHOWS THE POWER SUPPLY OF SWING LOADS AND THE KEY INTERLOCK CONTROL OF THE CIRCUIT BREAKERS FOR CLARIFICATION, BREAKERS NOT INVOLVED WITH KEY INTERLOCKS ARE NOT SHOWN.
2. INDICATES PHYSICAL POINT OF TRANSITION BETWEEN LOAD GROUPS.
3. MOLDED CASE SWITCH SELECTION IS ADMINISTRATIVELY CONTROLLED OR 3 WAY KEY INTERLOCK TO ASSURE PROPER ALIGNMENT OF AUX. TO THE SAME LOAD GROUP OF MAIN EQUIPMENT.
4. BREAKERS ARE ADMINISTRATIVELY CONTROLLED TO INSURE PROPER LOAD ALIGNMENT BY MEANS OF KIRK KEY INTERLOCKS.
5. A BREAKER IS PROVIDED FOR THESE LOADS IN ONE OF THE SWING POSITIONS. THE BREAKER MAY ADMINISTRATIVELY BE MOVED TO THE OTHER SWING POSITION IF DESIRED.
6. SWING LOAD USES BREAKER OF LOAD IT REPLACES.
7. KEY INTERLOCKS OPERATE AS FOLLOWS:
   - A. KEY CAN BE REMOVED ONLY WHEN BREAKER IS DISCONNECTED.
   - B. ONLY ONE KEY OF EACH NUMBER IS PROVIDED.
   - C. ▭ BLOCK SHOWS COMBINATION OF KEYS REQUIRED TO RACK BREAKER TO OPERATING POSITION.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Single Line Diagram
Separation Group E

FSAR Figure 8.3-54

CHAPTER 9
AUXILIARY SYSTEMS

FIGURES

Section and Number	Title	2
Section 9.1		
9.1-1	Fuel Pool Cooling and Purification	26
9.1-2	New Fuel Handling Tool	
9.1-3	RV Closure Head Handling	
9.1-4	Reactor Internals (Plenum) Handling	
9.1-5	Fuel Handling Bridge	
9.1-6	Fuel Transfer System	
9.1-7	New Fuel Elevator	
9.1-8	Rod Handling Container Assembly	
9.1-9	Rod Assembly Handling Tool	
9.1-10	Typical Double Yoke Concept Cask Lifting Rig	
9.1-11	Deleted	17
9.1-12	Deleted	
9.1-13	Deleted	
9.1-14	Fuel Pool Liner Plate Attachments	14
9.1-15	Spent Fuel Pool Storage Racks Plan Arrangement	19
9.1-16	Spent Fuel Pool Storage Rack Assembly	
Section 9.2		
9.2-1	Schematic Diagram Service Water System	
9.2-2	Service Water Cooling Tower and Pump Structure Units 1 & 2	26
9.2-3	Service Water Reactor and Auxiliary Building Units 1 & 2	27

Figures (continued)

Section and Number	Title	
9.2-4	Service Water Turbine Building Unit 2	27
9.2-5	Service Water Turbine Building Units 1 & 2	
9.2-6	Service Water Pump Impeller Elevation	
9.2-7	Component Cooling Water Unit 1	
9.2-8	Component Cooling Water Unit 1	
9.2-9	Component Cooling Water Unit 2	26
9.2-10	Component Cooling Water Unit 2	
9.2-11	Makeup Demineralizer	
9.2-12	Domestic Water	12
9.2-13	Analytical Model of the Emergency Cooling Pond	26
9.2-14	Residual Decay Heat Release	
9.2-15	Heat Rates vs Time for Ultimate Heat Sink Analysis	15
9.2-16	UHS Outlet Temperature After Accident and Safe Shutdown	
9.2-17	Pond Volume and Elevation After Accident and Safe Shutdown	
9.2-18	Plant Water Storage and Transfer	26
9.2-19	Plant Water Storage and Transfer	
9.2-20	Chilled Water Auxiliary Building	
9.2-21	Chilled Water Turbine Building Unit 1	
9.2-22	Chilled Water Turbine Building Unit 2	
9.2-23	Chilled Water Office and Service Buildings	26
9.2-24	Chilled Water Safeguard Equipment Unit 1	
9.2-25	Chilled Water Safeguard Equipment Unit 2	

Figures (continued)

Section and Number	Title	
9.2-26	Integrated Heat vs Time for Ultimate Heat Sink Analysis	3
Section 9.3		
9.3-1	Instrument and Service Air	
9.3-2	Instrument and Service Air	
9.3-3	Reactor Plant Sample System	
9.3-4	Reactor Plant Sample System	
9.3-5	Reactor Plant Sample System	
9.3-6	Reactor Plant Sample System	
9.3-7	Steam Plant Sample System Unit 1	
9.3-8	Steam Plant Sample System Unit 1	
9.3-9	Steam Plant Sample System Unit 1	
9.3-10	Steam Plant Sample System Unit 1	14
9.3-11	Steam Plant Sample System Unit 2	
9.3-12	Steam Plant Sample System Unit 2	
9.3-13	Steam Plant Sample System Unit 2	
9.3-14	Steam Plant Sample System Unit 2	
9.3-15	Evaporator Plant Sample System	
9.3-16	Evaporator Plant Sample System	
9.3-17	Evaporator Plant Sample System	27
9.3-18	Boron Recovery Units 1 & 2 Riser Diagram	
9.3-19	Boron Recovery Units 1 & 2 Riser Diagram	
9.3-20	Auxiliary Building DRW	

Figures (continued)

Section and Number	Title	
9.3-21	Auxiliary Building DRW Process Drainage	
9.3-22	Auxiliary Building DRW Process Drainage	
9.3-23	Auxiliary Building DRW Process Drainage	
9.3-24	Auxiliary Building DRW Process Drainage	
9.3-25	Auxiliary Building DRW Process Drainage	
9.3-26	Auxiliary Building DRW Process Drainage	
9.3-27	Auxiliary Building DTRW Process Drainage	
9.3-28	Auxiliary Building CHW Process Drainage	
9.3-29	Auxiliary and Turbine Building Plumbing	
9.3-30	Turbine Building Plumbing	25
9.3-31	Makeup and Purification Unit 1	
9.3-32	Makeup and Purification Unit 1	26
9.3-33	Makeup and Purification Unit 2	
9.3-34	Makeup and Purification Unit 2	
9.3-35	Boron Recovery Units 1 & 2	
9.3-36	Boron Recovery Units 1 & 2	
9.3-37	Boron Recovery Units 1 & 2	
9.3-38	Boron Recovery Units 1 & 2	
9.3-39	Boric Acid Evaporator	
9.3-40	Chemical Addition System	26
9.3-41	Miscellaneous Gas System Hydrogen Supply	
9.3-42	Miscellaneous Gas System Nitrogen Supply	
9.3-43	Miscellaneous Gas System Carbon Dioxide Supply	

Figures (continued)

Section and Number	Title	
9.3-44	Makeup Pump Characteristics	
9.3-45	Boron Recovery Degasifier, Sheet 1	26
9.3-45	Boron Recovery Degasifier, Sheet 2	
Section 9.4		
9.4-1	HVAC-Control Room-Battery Room-Switchgear and Cable Spreading Room	
9.4-2	HVAC Control Room Battery Room, Switchgear, and Cable Spreading Room	14
9.4-3	HVAC Auxiliary Building Units 1 & 2	
9.4-4	HVAC Auxiliary Building Units 1 & 2	
9.4-5	HVAC Auxiliary Building Units 1 & 2	
9.4-6	HVAC Auxiliary Building Units 1 & 2	
9.4-7	HVAC Auxiliary Building Units 1 & 2	
9.4-8	HVAC Turbine Building Unit 1	
9.4-9	HVAC Turbine Building Unit 2	
9.4-10	HVAC Reactor Building Unit 1	
9.4-10A	HVAC Reactor Building Unit 2	12
9.4-11	HVAC Diesel Generator Puilding and Service Water Pump Structure	
9.4-12	HVAC Access Control and Computer Area	
9.4-13	Plant Heating Turbine Building	26
9.4-14	Plant Heating Auxiliary and Reactor Buildings	
9.4-15	Plant Heating Office and Service Buildings	26
9.4-16	Plant Heating Miscellaneous Structures	
9.4-17	HVAC Office and Service Buildings	

Figures (continued)

Section and Number	Title	
9.4-18	HVAC Office and Service Buildings	27
9.4-19	Miscellaneous Building HVAC System (Evaporator and Auxiliary Boiler Building)	11
9.4-20	Miscellaneous Structures HVAC	
9.4-21	Miscellaneous Structures HVAC (Guardhouse)	16
9.4-22	Miscellaneous Structures HVAC	
9.4-23	Location of SFPAVS Radiation Detectors	18
Section 9.5		
9.5-1	Single Line Diagram Public Address System	
9.5-2	Single Line Diagram Public Address System	
9.5-3	Single Line Diagram Public Telephone System	
9.5-4	Single Line Diagram Intercommunication and Sound Powered Telephone System	
9.5-5	Single Line Diagram Intercommunication and Sound Powered Telephone System	
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9.5-12	Deleted	
9.5-13	Deleted	

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9.5-20	Deleted	
9.5-21	Deleted	
9.5-22	Deleted	
9.5-23	Deleted	
9.5-24	Single Line Diagram Lighting Distribution	27
9.5-25	Emergency Diesel Engine Oil Storage and Transfer System	
9.5-26	Emergency Diesel Generator Cooling Water System	
9.5-27	Emergency Diesel Generator Starting System	
9.5-28	Emergency Diesel Generator Lubrication System	
9.5-29	Chemical and Oily Waste System	
9.5-30	Chemical and Oily Waste System - Sheet A	
9.5-31	Emergency Diesel Engine Fuel Oil Piping Schematic	
9.5-32	Emergency Diesel Fuel Oil Piping from Storage Tanks to and from Day Tanks	

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9.1.1.1.3 Codes and Standards

Codes and standards applicable to the new fuel storage area are listed in Table 3.2-1.

The new fuel storage racks are designed in accordance with NRC Standard Review Plan 9.1-1 and ANSI N18.2a-1975 to ensure that the effective multiplication factor, K_{eff}, remains within the limits specified in the applicable codes and standards. 15

9.1.1.2 New Fuel Storage Area Description

The location of the new fuel storage area is illustrated in the auxiliary building equipment location drawings, Figures 1.2-7 and 1.2-8.

The new fuel storage area is made up of two separate pits containing fuel storage racks, enclosed on four sides by a reinforced concrete structure and by a steel checker plate above. The two separate new fuel storage areas provide for dry storage of new fuel with a total capacity of 132 fuel assemblies. The assemblies are stored in a lattice array having a square pitch center-to-center distance of 21.0 inches. Each storage pit contains an array of fuel assemblies arranged so that periodic visual inspection of each cell is possible. The new fuel storage racks are supported by the floor and walls in a manner which will not permit a critical reduction in separation space during and after the safe shutdown earthquake, in accordance with Seismic Category I criteria. Each pit is provided with a separate drainage connection. 23 15

The bottom plates of the racks supporting the fuel bundles are raised from the floor level. Lateral support is provided for the fuel assembly at its lower and upper end fittings. 15

Construction of the cans and structural components for the new fuel racks utilize stainless steel material conforming to the requirements of ASTM Specification A-240, Type 304. 27

During the core fueling, more new fuel assemblies may be delivered to the unit than can be contained within the new storage area. The assemblies not stored in the new fuel storage racks can be stored in spent fuel storage racks in the spent fuel pool. The spent fuel storage racks and the spent fuel pool are described in Subsection 9.1.2.

9.1.1.3 Safety Evaluation

The safety evaluations are numbered to correspond to the safety design bases.

SAFETY EVALUATION ONE - The spacing between fuel assemblies in the storage racks is sufficient to maintain the array, when fully

loaded and flooded with unborated water, in a subcritical condition; i.e. k_{eff} is less than 0.95. Furthermore, the design of the new fuel storage racks is such that the k_{eff} will not exceed 0.98, assuming optimum moderation by partial-density water. For detailed information regarding the criticality of the new fuel storage racks, see the criticality analysis for the Midland nuclear plant fuel storage racks, Q&R Appendix 4A. | 19

SAFETY EVALUATION TWO - The new fuel storage area is located in the auxiliary building which is within the protected area. Access to the protected area is allowed only to authorized personnel in accordance with the security plan as described in Chapter 13.

SAFETY EVALUATION THREE - The new fuel storage pit and fuel racks are designed in accordance with Seismic Category I requirements as specified in Section 3.7. The components (and supporting structures) of any system, equipment, or structure which is not Seismic Category I and whose collapse could result in loss of a required function of the new fuel storage area through either impact or flooding are checked to determine that they will not collapse when subjected to seismic loading resulting from the safe shutdown earthquake.

SAFETY EVALUATION FOUR - Storage of more than one new fuel assembly at a specific location or insertion of an assembly in other than the prescribed orientation is precluded by the geometry of the fuel storage channels. The design of the new fuel storage racks provides maximum cross-sectional dimensions of 9.06 inches square for the insertion of the 8.536 inch square fuel assemblies. | 15

SAFETY EVALUATION FIVE - The new fuel storage racks, loaded with fuel, are designed to minimize distortion or buckling of rack arrangements for all anticipated loadings, including dropping or side swinging of a fuel bundle on the rack, in an accidental event. This condition ensures no increase in k_{eff} ; i.e., k_{eff} remains less than 0.95, as confirmed by the new fuel rack criticality analysis. | 15

The new fuel storage equipment is designed to meet Seismic Category I requirements as discussed above. The racks are not designed to meet maximum uplift forces of the auxiliary building crane because all hookups to the new fuel assemblies are done manually and under administrative controls. The new fuel storage racks are designed to withstand a maximum uplift force of 3,000 pounds. | 15

Protective devices restricting movement of equipment over the new fuel storage pit are discussed in Subsection 9.1.4.

SAFETY EVALUATION SIX - The sharing of the new fuel storage facility between Units 1 and 2 does not result in any added potential for increasing k_{eff} of the storage array.

9.1.2.2.2 Component Description

SPENT FUEL POOL - The spent fuel pool is a reinforced concrete structure with a stainless steel liner. The pool volume is approximately 47,000 cubic feet. The spent fuel pool is filled with borated water with a boric acid concentration maintained at 2,257.5 ppm boron or greater.

The primary functions of the fuel pool liner plate are to provide leak tightness and an easy means of decontaminating the fuel pool area. The liner plate is not designed to carry any imposed load.

The liner plate is secured by continuous seam welds along all the edges to Seismic Category I carbon steel embeds located in the fuel pool concrete. The capacity of these welds exceeds any possible loading of the liner plate during a seismic event. In addition, panels larger than 2' x 2' are secured to Seismic Category I embeds by plug welds at intermediate points, as shown in Figure 9.1-14. 14 17

All the seam and plug welds are tested by the liquid penetrant method. In addition, vacuum box or helium mass spectrometer methods are used at all locations unless space limitations do not permit these tests. After completion of the work, the pool is hydrotested for 48 hours.

The welding conforms to the ASME Code, Section III, Division 2. Welders and welding procedures are qualified in accordance with the ASME Code, Section IX. Liquid penetrant testing is performed in accordance with the ASME Code, Section V. 14

CPCo project management organization, with the assistance of CPCo quality assurance, is conducting periodic surveillances on the erecting subcontractor to determine compliance with the specifications, the erecting subcontractors written procedures, and the referenced codes. These surveillances are documented and action is taken to close out any discrepancies found.

The computed stresses induced in the liner plate welds during an SSE event are 248 psi, compared to the 21,000 psi allowable stress. Because of this low stress level and the reasons noted above, complete or partial separation of a liner panel from its supporting embeds is not a credible event. 16

However, for leakage analysis purposes, it has been conservatively assumed that one large liner plate panel, with 32 square feet of surface area, has cracked, exposing the entire concrete surface behind this panel to the maximum fuel pool water pressure. Under these assumptions, the calculated leakage rate is 25×10^{-10} ft^3/sec. 14

However, this postulated leakage would not have any detrimental effects on any safety-related equipment or result in uncontrolled release of radioactive fluid to the environment.

The postulated leakage fluid would seep through the concrete fuel pool structure and be collected in the floor drains located in the immediate area. This seepage would be contained and processed by the auxiliary building liquid radwaste system, the capacity of which is much larger than any postulated leakage flowrates. For information regarding the auxiliary building liquid radwaste system, see FSAR Section 11.2. 14

SPENT FUEL STORAGE RACKS - Spent fuel assemblies are stored under water in the spent fuel storage racks in the spent fuel pool. The spent fuel storage racks are designed to provide interim storage for 1,049 fuel assemblies (approximately 5-2/3 reactor cores) on a maximum center-to-center spacing of 10.98 inches. Figures 9.1-15 and 9.1-16 show the dimensional details of the fuel racks. 15 27 19

The storage racks for the spent fuel consist of vertical elongated canned storage cells arranged in an array such that the storage locations form rows parallel and perpendicular to the sides of the spent fuel pool. Construction of the cans and structural components of the spent fuel racks utilize stainless steel material conforming to the requirements of ASTM Specification A-240, Type 304. Neutron absorbing material is also used as an integral part of the stainless steel rack structures. The neutron absorbing material is not used for structural support and is sandwiched between stainless steel plates. The rack design provides for removeability of neutron absorbing material. The storage racks are laterally braced to the spent fuel pool walls as required to meet seismic design criteria. 15 27 15

The spent fuel storage rack structure is designed to withstand the impact resulting from a falling fuel assembly under all loading and unloading conditions. The structural arrangement is such that under this impact force, no significant lateral displacement of the fuel occurs. The rack structure also prevents the dropped assembly from entering the spaces between adjacent stored fuel. Therefore, subcritical spacing is maintained.

Fuel assemblies are stored in storage racks in a lattice array having a square pitch maximum center-to-center distance of 10.98 inches in both horizontal directions. The design of the spent fuel storage racks is such that it is impossible to insert more than one fuel assembly in any one storage location. 15 27 15

REACTOR BUILDING TEMPORARY STORAGE RACKS - The reactor building temporary storage racks are provided for temporary storage of spent or new fuel in the refueling canal during refueling operations. These racks are subjected to the same design criteria as the spent fuel storage racks. However, it is not necessary to use a neutron absorbing material integral with the temporary racks because of an 18 inch center-to-center spacing. Each temporary storage rack has the capacity for 6 fuel assemblies. |27

FUEL TRANSFER CANAL - The fuel transfer canal is connected to the refueling pool (inside containment) by the fuel transfer tube. A leaktight gate is provided to separate the spent fuel pool and the fuel transfer canal. The fuel transfer canal has an approximate volume of 6,000 cubic feet, and is utilized to transfer fuel assemblies between the spent fuel pool and the refueling pool via the transfer mechanism.

SHIPPING CASK LOADING PIT - The shipping cask loading pit is designed for loading the spent fuel assemblies from the spent fuel pool into the shipping casks. This transfer is accomplished via a gate joining the spent fuel pool. This gate allows for drainage of the loading pit while retaining normal water level in the spent fuel pool. |17

WASHDOWN PIT - The washdown pit is used for decontamination of the spent fuel shipping cask. Decontamination of the cask is required following immersion in the loading pit and prior to offsite shipment. A gate separates the washdown pit from the loading pit.

9.1.2.2.3 Facility Operation

Fuel racks are provided for at least 5-2/3 cores of spent fuel assemblies in the spent fuel pool. Control rod assemblies requiring removal from the reactor are stored in their designated locations in the spent fuel assemblies or placed in a rod assembly handling container and stored in a vacant rack location. Locations for two failed fuel containers are also provided in the spent fuel pool. |15 |15

During the core fueling, more new fuel assemblies may be delivered to the unit than can be contained within the new fuel storage racks. The assemblies not stored in the new fuel storage racks are stored in designated spent fuel storage racks in the spent fuel pool.

Adequate shielding is provided for station personnel by the 6 foot thick concrete floor, the 5 foot 9 inch thick concrete wall around three sides of the pool, a 3 foot 6 inch thick concrete wall on the pool side adjacent to the fuel transfer canal, a 1/4

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inch steel liner on the spent fuel pool floor and walls, and the pool water. The pool water is maintained at a level sufficient to ensure that the top of a fuel assembly is adequately submerged when the assembly is being transported under water by the fuel handling equipment. Shielding considerations are discussed in Subsection 12.3.2.2.

The spent fuel handling area ventilation system is described in Subsection 9.4.2.

Spent fuel pool area radiation monitoring is provided for personnel protection and general surveillance of the spent fuel pool area. The fuel pool exhaust to the auxiliary building stack is monitored for gaseous and particulate activity. Indication, recording, and high radiation level annunciation are provided in the control room in addition to local audible and visual indicators. This monitoring is further described in Subsection 12.3.4.

9.1.2.2.4 Control and Instrumentation Drawings

Applicable control and instrumentation drawings are listed below and in Tables 1.7-9, 1.7-11, and 1.7-15.

a. Logic - not applicable

b. Control boards - J-735

c. Schematics - not applicable

9.1.2.3 Safety Evaluation

Safety evaluations are numbered to correspond to the safety design bases.

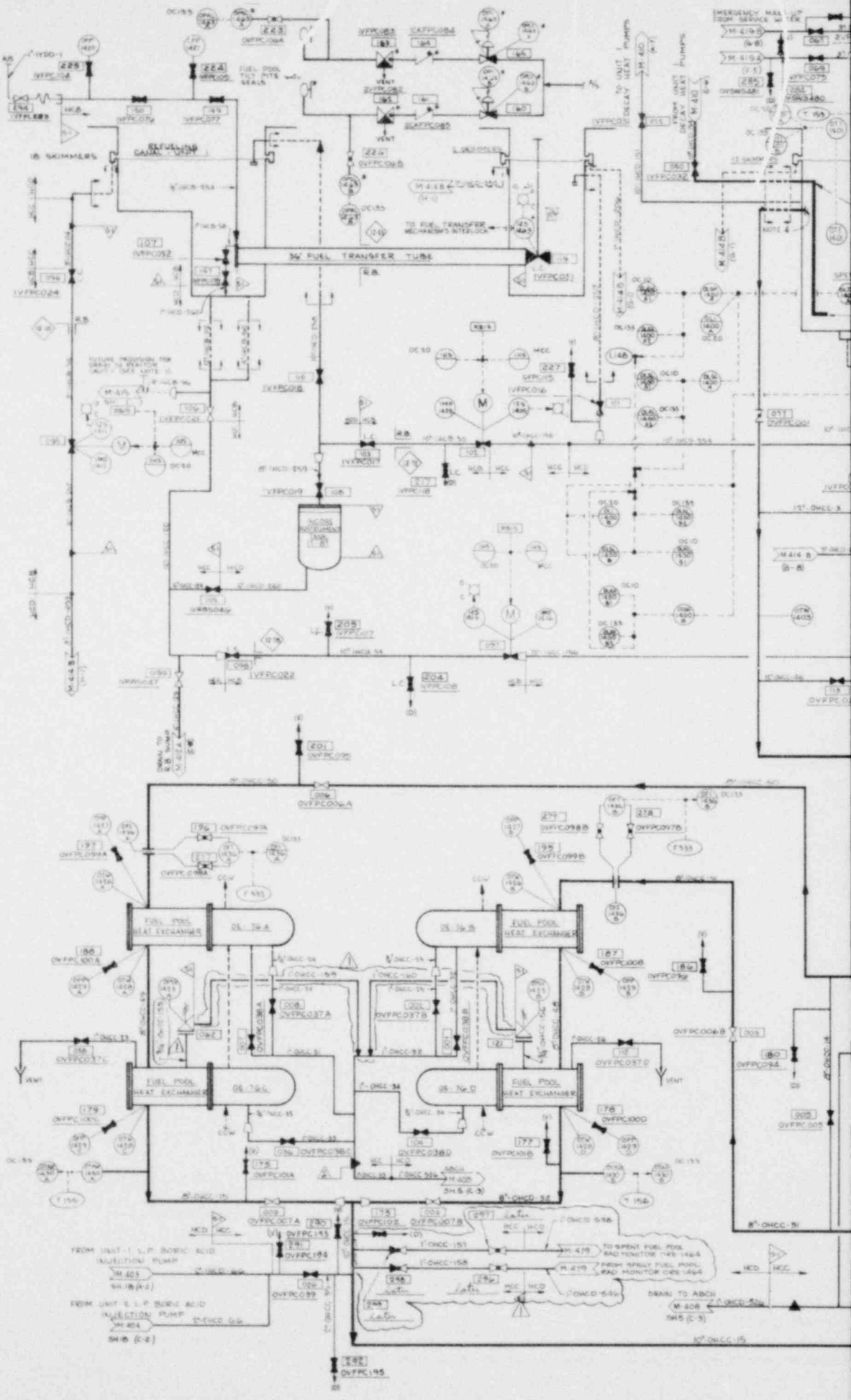
SAFETY EVALUATION ONE - In accordance with General Design Criterion 62 of 10 CFR 50 Appendix A, the poisoned design of the spent fuel storage racks ensures the existence of subcriticality (k_{eff} less than .95) with all racks filled and the pool filled with unborated water. For detailed information regarding the criticality of the new fuel storage racks, see the criticality analysis for the Midland nuclear plant fuel storage racks, Q&R Appendix 4A. 19

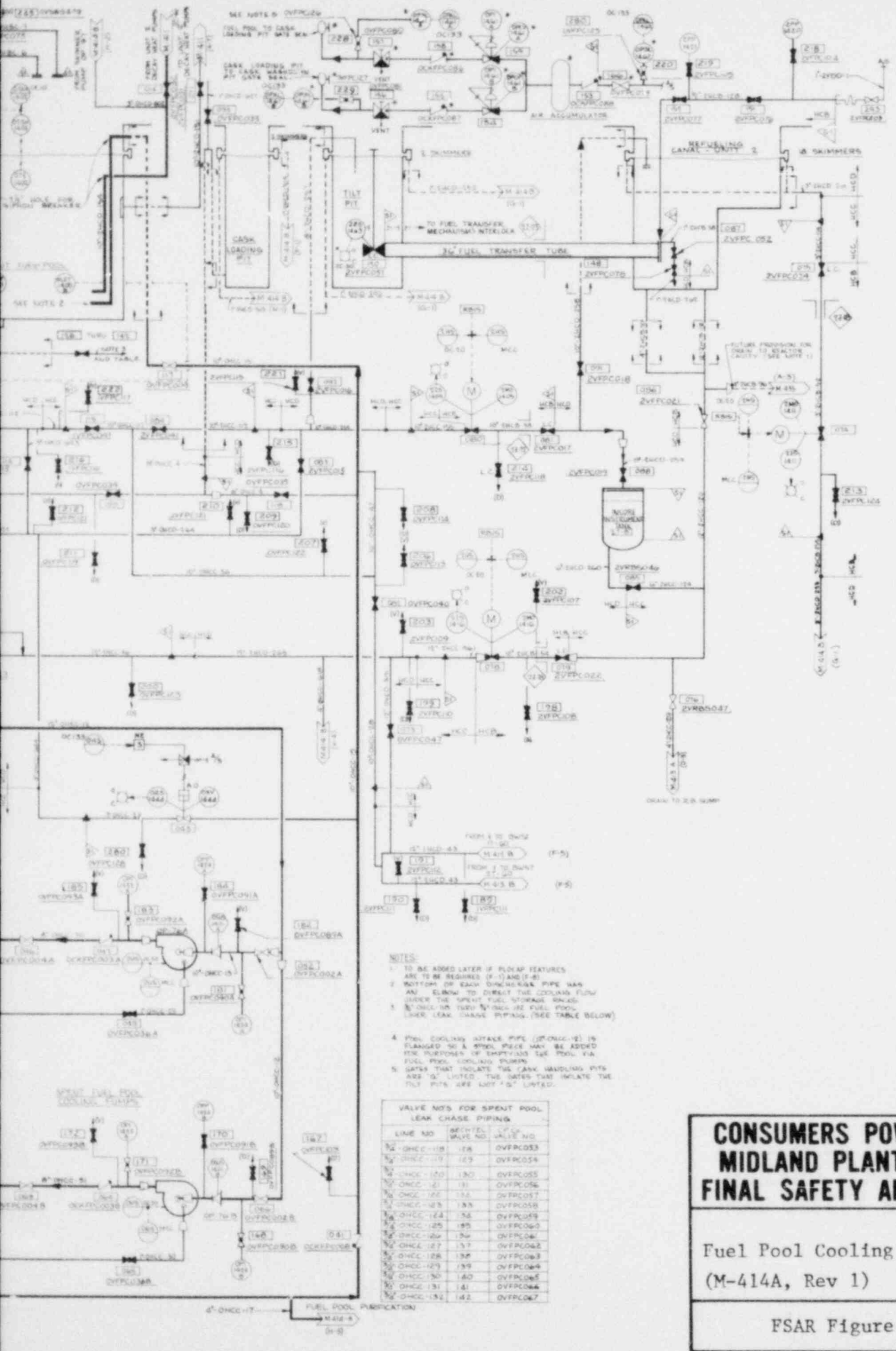
SAFETY EVALUATION TWO - Loss of water from the spent fuel pool could cause damage to spent fuel assemblies stored therein and also increase the radiation level in the vicinity of the pool.

To ensure that the spent fuel pool water level is not lowered by a malfunction of the fuel pool cooling and cleanup system, the cooling system takes suction from the pool near the normal water level. To preclude the possibility of siphoning the pool, a siphon breaker is provided in the cooling system discharge line near the normal water level.

In the event of abnormal water loss from the spent fuel pool, emergency makeup supply is available via connections to the two redundant trains of the Seismic Category I service water system. Sizing of the water supply source for the essential service water system includes provision for water used in this manner.

SAFETY EVALUATION THREE - The spent fuel storage facility is designed in accordance with Seismic Category I requirements as specified in Section 3.7. The components (and supporting


36" FUEL TRANSFER TUBE
FUEL POOL HEAT EXCHANGER
FUEL POOL HEAT EXCHANGER
FUEL POOL HEAT EXCHANGER
FUEL POOL HEAT EXCHANGER
TO SPENT FUEL POOL RAD MONITOR 1HB-1464
FROM SPENT FUEL POOL RAD MONITOR ORE-1464
DRAIN TO ABCH
FROM UNIT 1 L.P. BORIC ACID INJECTION PUMP
FROM UNIT 2 L.P. BORIC ACID INJECTION PUMP



NOTES:

1. TO BE ADDED LATER IF FLOCAP FEATURES ARE TO BE REQUIRED. (F-1) AND (F-8).
2. BOTTOM OF EACH DISCHARGE PIPE HAS AN ELBOW TO DIRECT THE COOLING FLOW UNDER THE SPENT FUEL STORAGE RACKS.
3. [illegible] FUEL POOL LINER LEAK CHASE PIPING. (SEE TABLE BELOW)
4. FUEL COOLING INTAKE PIPE (2"-DNCC-12) IS FLANGED SO A SPOOL PIECE MAY BE ADDED FOR PURPOSES OF EMPTYING THE POOL VIA FUEL POOL COOLING PUMPS.
5. GATES THAT ISOLATE THE CASK HANDLING PITS ARE "D" LISTED. THE GATES THAT ISOLATE THE TILT PITS ARE NOT "D" LISTED.

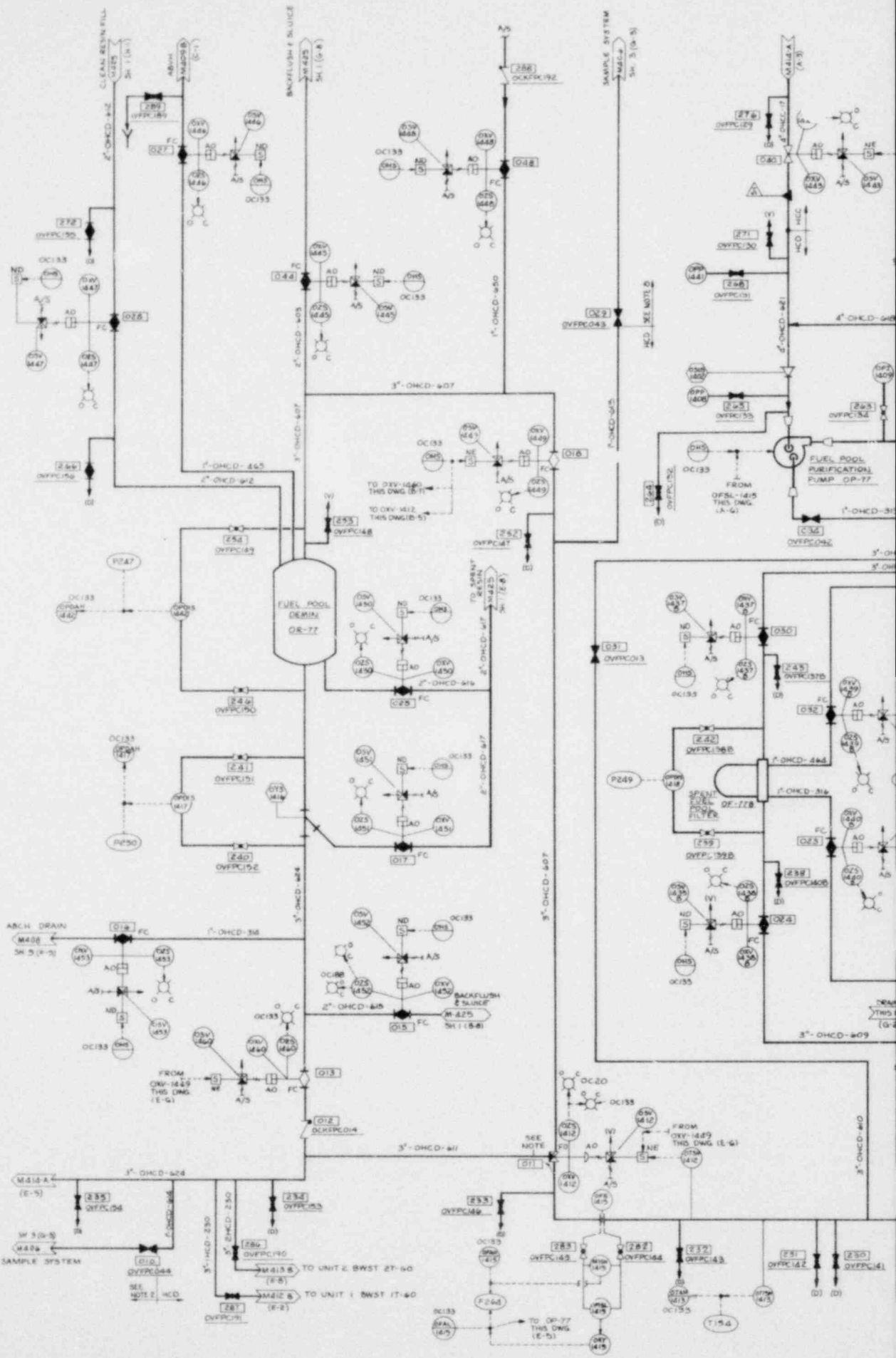
VALVE NO'S FOR SPENT POOL LEAK CHASE PIPING

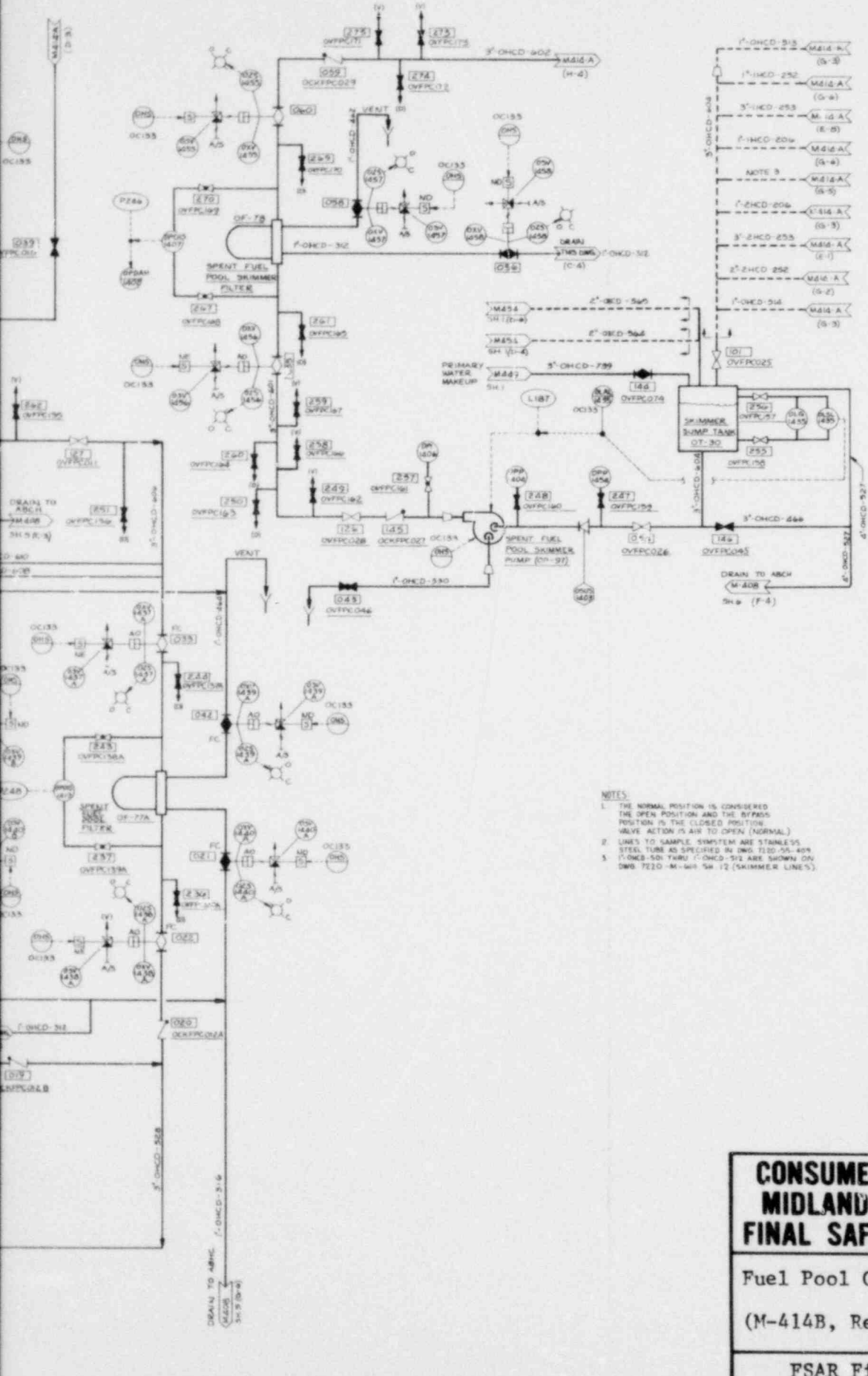
LINE NO	RECHTEL VALVE NO.	J.C.P. NO.
3/4"-DNCC-118	118	OVFPC053
3/4"-DNCC-119	119	OVFPC054
3/4"-DNCC-120	120	OVFPC055
3/4"-DNCC-121	121	OVFPC056
3/4"-DNCC-122	122	OVFPC057
3/4"-DNCC-123	123	OVFPC058
3/4"-DNCC-124	124	OVFPC059
3/4"-DNCC-125	125	OVFPC060
3/4"-DNCC-126	126	OVFPC061
3/4"-DNCC-127	127	OVFPC062
3/4"-DNCC-128	128	OVFPC063
3/4"-DNCC-129	129	OVFPC064
3/4"-DNCC-130	130	OVFPC065
3/4"-DNCC-131	131	OVFPC066
3/4"-DNCC-132	132	OVFPC067

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Fuel Pool Cooling & Purification
(M-414A, Rev 1)

FSAR Figure 9.1-1, sh. 1


FUEL POOL DEMIN OR-77
FUEL POOL PURIFICATION PUMP OP-77
SPENT RESIN STORAGE TANK OT-77B
SAMPLE SYSTEM
ABCH DRAIN
CLEAN RESIN FILL
BACKFLUSH & SLUICE
TO UNIT 2 BWST 2T-60
TO UNIT 1 BWST 1T-60
TO OP-77 THIS DWG (E-5)
FROM OFSL-1415 THIS DWG. (A-6)
FROM OXV-1449 THIS DWG. (E-6)
SEE NOTE 2 HCD
SEE NOTE HCD



CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Fuel Pool Cooling and Purification

(M-414B, Rev 0)

FSAR Figure 9.1-1, sh. 2

service water system without reducing flows to other components below their design levels.

SAFETY EVALUATION FIVE - Each of the systems served by the essential service water system is composed of two 100% capacity trains. The essential service water trains are similarly sized and configured. One train of the service water system provides cooling water flow to the heat exchangers of one train of the containment air cooler system, the safeguards chiller condenser and the component cooling water system; the redundant essential service water train provides cooling water to the redundant heat exchangers. The diesel generator is supplied by its associated safety-related portions of the turbine building service water trains. Each essential service water train also provides an emergency makeup supply to the spent fuel pool and the auxiliary feedwater system. This arrangement assures the full heat removal capacity to permit the required generation of diesel generator power, prevent overpressurization of the containment, prevent thermal damage to the stored fuel or core, and provide the cooling required for necessary engineered safety features systems operation in the event that one essential service water train becomes unavailable or fails to operate, or after the failure of any single component. Effects of single failure are listed in Table 9.2-4.

SAFETY EVALUATION SIX - The essential service water train and the safety-related portion of the turbine building service water trains are designed in accordance with Seismic Category I requirements as specified in Section 3.2. The components (and supporting structures) of any system, equipment, or structure which are not Seismic Category I and whose collapse could result in loss of a required function of the essential service water train through either impact or flooding are analytically checked to determine that they will not collapse when subjected to seismic loading.

SAFETY EVALUATION SEVEN - The service water system operates continuously during normal plant power generation and shutdown conditions at pressures and flowrates that roughly approximate accident conditions. Provisions are incorporated in the design to allow periodic verification of the required flowpath at pressures approximating the accident conditions. These operations demonstrate the operability, performance, and structural and leaktight integrity of all cooling water system components.

During unit shutdown the service water system is designed to include the capability for testing through the full operational sequence which brings the system into operation for reactor shutdown and for loss-of-coolant accidents, including operation of applicable portions of the protection system.

The important components of the service water system (i.e., pumps, valves, heat exchangers, and piping -- to the extent

practicable) are designed and located to facilitate periodic inspection.

Tests and inspections are further discussed in Subsection 9.2.1.4.

9.2.1.4 Tests and Inspections

All system components shall be hydrostatically tested prior to plant startup. Preoperational testing performed on the service water system is described in Chapter 14. Periodic testing of the service water system is performed as described in Chapter 16. Inservice inspection of service water components is described in Section 6.6. 27

9.2.1.5 Instrumentation Applications

The service water system instrumentation is designed to facilitate automatic operation, remote control, and continuous indication of system parameters.

Local instrumentation is provided in the service water pumphouse and at the heat exchangers for maintenance, testing, and performance evaluation. Hand switches for the service water pumps and for all electric motor operated valves associated with the engineered safety features operation of the service water system are located in the main control room. Service water trains are equipped with pressure switches which sound an alarm in the main control room on low discharge pressure. A time delay is included in the pump trip circuitry to permit the pumps to start and bring the system to normal operating pressure. Temperature detectors and flow measuring devices located in major headers provide the means to detect abnormal flow which could accompany major leaks. High level alarms of the drain pans located below the containment recirculating air cooling units will indicate any leakage from these units.

Since the component cooling water serves as an intermediate buffer between potentially radioactive fluid systems and the service water, no radioactive fluid is expected to leak into the service water system. Nonetheless, two radiation detectors, one in the return line of each service water train, are installed. These are further discussed in Section 11.5.

9.2.2 COOLING SYSTEM FOR REACTOR AUXILIARIES (COMPONENT COOLING WATER SYSTEM)

The component cooling water (CCW) system provides cooling water to selected nuclear auxiliary components during normal plant operation and provides cooling water to engineered safety features systems during a loss-of-coolant accident (LOCA). This system is a closed loop system which serves as an intermediate

conditioning units, are provided with three-way mixing valves in order to control chilled water flow through the cooling coils. All other cooling units have a constant flow of chilled water through the coils.

Chilled water is also provided to the compressor oil cooler to maintain required lubrication oil temperature.

9.2.9.3 Safety Evaluation

Inasmuch as the CWS has no safety design basis, no safety evaluation is provided.

9.2.9.4 Tests and Inspections

The chilled water piping circuits are hydrostatically tested and balanced to provide design flowrates and temperatures.

9.2.9.5 Instrumentation Applications

Chillers are provided with variable inlet guide vanes in front of both stages of compression. Guide vanes are controlled between fully open and fully closed positions as required by the refrigeration load imposed on the compressor.

Chillers are capable of operating from full load down to 10% of full load without hot gas bypass. Chillers also have a hot gas bypass and can operate at no load mode. Local pressure, temperature, and flow indicators are used to facilitate manual operation and to verify flow conditions. Chiller water pumps are controlled locally from the chiller room and at the motor control centers.

9.2.10 SAFEGUARDS CHILLED WATER SYSTEM

The safeguards chilled water system (SCWS) described in this subsection provides chilled water to various safety-related air conditioning systems in the auxiliary building.

9.2.10.1 Design Bases

Criteria for the selection of design bases are stated in Subsection 1.1.2.2. Protection of the SCWS from wind and tornado effects is discussed in Section 3.3. Flood design is discussed in Section 3.4. Missile protection is discussed in Section 3.5. Protection against dynamic effects associated with postulated rupture of piping is discussed in Section 3.6. Environmental design is discussed in Section 3.11.

9.2.10.1.1 Safety Design Bases

SAFETY DESIGN BASIS ONE - The safeguards chilled water system is designed so that a single failure of any active component, assuming loss of offsite power, cannot result in loss of ESF switchgear, or the ability to operate at least one of the redundnat ESF chilled water trains.

SAFETY DESIGN BASIS TWO - The SCWS is designed to remain functional during and after a safe shutdown earthquake.

SAFETY DESIGN BASIS THREE - The SCWS is designed to maintain air temperature of the control room, switchgear rooms, battery rooms, and engineered safety features (ESF) equipment rooms below the room design ambient air temperature during operation under accident conditions. | 27

9.2.10.1.2 Power Generation Design Bases

POWER GENERATION DESIGN BASIS ONE - The SCWS provides chilled water to the safety-related unit coolers and control room air handling units during normal and plant shutdown operations.

9.2.10.1.3 Codes and Standards

Codes and standards applicable to the SCWS are listed in Table 3.2-1. All pressure retaining parts of the safeguards chilled water system are constructed in accordance with the ASME B&PV Code, Section III, Class 3 requirements, as applicable.

9.2.10.2 System Description

9.2.10.2.1 General System Description

The SCWS is shown schematically in Figures 9.2-24 and 9.2-25. The SCWS consists of two chilled water trains for each unit, each of which is independent of the other. The individual train consists of a chiller and two 100% capacity pumps, piping, valves, expansion tank, air separator, chemical addition pot feeder, instrumentation, and controls. Except for the manually controlled chemical addition subsystem, the chilled water system described in this subsection is safety-related.

9.2.10.2.2 Component Description

Design data for major components of the SCWS are listed in Table 9.2-26.

CHILLER - The compressor is of high performance two stage design using a readily available halogenated hydrocarbon refrigerant.

conditioning units, are provided with three-way mixing valves in order to control chilled water flow through the cooling coils. All other cooling units have a constant flow of chilled water through the coils.

Chilled water is also provided to the compressor oil cooler to maintain required lubrication oil temperature.

9.2.9.3 Safety Evaluation

Inasmuch as the CWS has no safety design basis, no safety evaluation is provided.

9.2.9.4 Tests and Inspections

The chilled water piping circuits are hydrostatically tested and balanced to provide design flowrates and temperatures.

9.2.9.5 Instrumentation Applications

Chillers are provided with variable inlet guide vanes in front of both stages of compression. Guide vanes are controlled between fully open and fully closed positions as required by the refrigeration load imposed on the compressor.

Chillers are capable of operating from full load down to 10% of full load without hot gas bypass. Chillers also have a hot gas bypass and can operate at no load mode. Local pressure, temperature, and flow indicators are used to facilitate manual operation and to verify flow conditions. Chiller water pumps are controlled locally from the chiller room and at the motor control centers.

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9.2.10.1.1 Safety Design Bases

SAFETY DESIGN BASIS ONE - The safeguards chilled water system is designed so that a single failure of any active component, assuming loss of offsite power, cannot result in loss of ESF switchgear, or the ability to operate at least one of the redundnat ESF chilled water trains.

SAFETY DESIGN BASIS TWO - The SCWS is designed to remain functional during and after a safe shutdown earthquake.

SAFETY DESIGN BASIS THREE - The SCWS is designed to maintain air temperature of the control room, switchgear rooms, battery rooms, and engineered safety features (ESF) equipment rooms below the room design ambient air temperature during operation under accident conditions. | 27

9.2.10.1.2 Power Generation Design Bases

POWER GENERATION DESIGN BASIS ONE - The SCWS provides chilled water to the safety-related unit coolers and control room air handling units during normal and plant shutdown operations.

9.2.10.1.3 Codes and Standards

Codes and standards applicable to the SCWS are listed in Table 3.2-1. All pressure retaining parts of the safeguards chilled water system are constructed in accordance with the ASME B&PV Code, Section III, Class 3 requirements, as applicable.

9.2.10.2 System Description

9.2.10.2.1 General System Description

The SCWS is shown schematically in Figures 9.2-24 and 9.2-25. The SCWS consists of two chilled water trains for each unit, each of which is independent of the other. The individual train consists of a chiller and two 100% capacity pumps, piping, valves, expansion tank, air separator, chemical addition pot feeder, instrumentation, and controls. Except for the manually controlled chemical addition subsystem, the chilled water system described in this subsection is safety-related.

9.2.10.2.2 Component Description

Design data for major components of the SCWS are listed in Table 9.2-26.

CHILLER - The compressor is of high performance two stage design using a readily available halogenated hydrocarbon refrigerant.

The compressor is housed in a close grained cast iron housing, using gaskets between all casing joints. The evaporator is of the horizontal, flooded, shell and tube type. The condenser of the chiller is of the horizontal shell and tube type. The evaporator section of the chiller provides a constant flow of approximately 45F chilled water to the coils of various cooling units associated with the SCWS in the auxiliary building.

AIR SEPARATOR, EXPANSION TANK, AND CHEMICAL ADDITION SUBSYSTEM - An air separator and expansion tank are provided to accommodate trapped air and expansion and concentration in the system due to temperature fluctuations and minor leakage. The chemical subsystem provides chemical treatment control against corrosion. Feed of chemicals, determined as proper to fulfill specific system requirements, is manually initiated.

9.2.10.2.3 System Operation

NORMAL OPERATION - The safeguards chilled water system forms a link between the heat receiver of the safeguard unit coolers and air handling units in the auxiliary building and the heat sink of the essential service water system. Heat absorbed by the chilled water cooling coils is transferred to the chilled water. The warmed water is piped past the chemical addition subsystem feed input point and the air separator to the suction of the chilled water pump. The pump discharge is to the chiller evaporator section. Chilled by the refrigeration circuit, the water leaves the evaporator at approximately 45F to return to the coils. | 27

The condenser of the chiller is cooled by the essential service water system described in Subsection 9.2.1. Required condenser flowrate is maintained by a meter-modulated valve controlled by the condenser pressure. Demineralized water is the normal supply for the evaporator side of the chillers for makeup. | 3 | 24 | 27

Air handling units, serving the control room, are provided with three-way mixing valves in order to control chilled water flow through the cooling coils. All other cooling units have a constant flow of chilled water through the coils. Chilled water is also provided to the compressor oil cooler to maintain required lubricant oil temperature.

Only one of the two redundant trains operates during normal operation.

POST-ACCIDENT OPERATION - During the post-accident mode of operation, only the safeguard chillers are required to operate. Power to these chillers and chiller pumps is supplied by the Class 1E ac power system. The post-accident mode of the operation is automatically initiated by an emergency core cooling actuation signal (ECCAS) or auxiliary feedwater actuation signal (AFWAS) and RBSAS, which are subsystems of the engineered safety | 27

features actuation system (ESFAS) described in Section 7.3. The emergency mode of operation can also be manually initiated from the control room for all of the listed subsystems. 3

9.2.10.2.4 Control and Instrumentation Drawings

Applicable control and instrumentation drawings are listed below and in Tables 1.7-9, 1.7-11, and 1.7-15. 2

a. Logic - J-299, 824, 829

b. Control boards - J-722, 723, 730, 734, 739, 743

c. Schematics - E-375, 478, 480

9.2.10.3 Safety Evaluation

Safety evaluations are numbered to correspond to the safety design bases.

SAFETY EVALUATION ONE - Redundant ESF chilled water trains are provided such that no single active failure, assuming loss of offsite power, can prevent the system from performing its design requirements following a LOCA or initiation of auxiliary feedwater system. Components of the train, including piping, instrumentation, and power supplies, are physically separated and protected from the components of the other train such that no single credible accident causing failure of one ESF chilled water train could simultaneously cause failure of the other ESF train. A system failure modes and effects analysis is presented in Table 9.2-27.

SAFETY EVALUATION TWO - All the safety-related portions of the chilled water system are designed and constructed in accordance with Seismic Category I requirements as specified in Section 3.2. The components (and supporting structures) of any system, equipment, or structure which are not Seismic Category I and whose collapse could result in a loss of a required function of the SCWS through either impact or flooding are analytically checked to determine that they will not collapse when subjected to seismic loading.

SAFETY EVALUATION THREE - The SCWS capacity is selected and tested to provide adequate heat transfer to allow the coils to maintain design ambient air temperature in the control room area ventilation system and the ESF ventilation system as discussed in Subsections 9.4.1 and 9.4.5 respectively.

9.2.10.4 Tests and Inspections

The chillers and all materials used in construction of the chillers are subject to tests required by applicable codes. Automatic controls are tested for actuation at the proper setpoints and the system is balanced and tested initially with regard to flow capacity and mechanical operability.

9.2.10.5 Instrumentation Applications

Chillers are provided with variable inlet guide vanes in front of both stages of compression. Guide vanes are controlled between fully open and fully closed positions as required by the refrigeration load imposed on the compressor. Chillers are capable of operating from full load down to 10% of full load, without hot gas bypass. Chillers also have a hot gas bypass and can operate at no load mode. Local pressure, temperature, and flow indicators are used to facilitate manual operation and to verify flow conditions. | 27

REFERENCES

1. D. K. Brady, W. L. Graves, and J. C. Geyer, Surface Exchange at Power Plant Cooling Lakes, No. 69-901 (1971), Edison Electric Institute, New York

2. P.J. Ryan and D.R.F. Harleman, An Analytical and Experimental Study of Transient Cooling Pond Behavior, Ralph M. Parsons Laboratory for Water Resources and Hydrodynamics, Report 161 (January 1973), MIT

3. Vanderbilt University, Effect of Geographical Location on Cooling Pond Requirements and Performance, EPA Water Quality Office, Project No. 16130FDQ (March 1971)

4. J.E. Edinger, et al, Generic Emergency Cooling Pond Analysis, Contract No. AT(11-1)-2224 (May 1972 - October 1972), Pennsylvania USAEC

TABLE 9.2-25 (continued)

Name and Equipment No.	Flow (gpm)	Pressure Drop (ft)	Heat Transferred (Btu/hr x 10^3)
Office and Service Bldg			
1 A/H unit office building 0VM-06	300	17.0	1,800.0
Turbine Bldg Unit 1			
5 unit coolers 1VM-63A-E	58.1 ea	11.7	770
4 unit coolers 1VM-64A-D	87.0 ea	16.5	1,125.7
5 unit coolers 1VM-65A-E	87.0 ea	16.5	1,125.7
Battery room air handling unit 1VM-75	7.2		90.9
Lube oil room air handling unit 1VM-77	10.9	0.2	123.2
Turbine Bldg Unit 2			
6 unit coolers 2VM-63A-F	58.1 ea	11.7	770
4 unit coolers 2VM-64A-D	99.0 ea	14	1,294
5 unit coolers 2VM-65A-E	87 ea	16.5	1,125.7
Battery room 2VM-75	7.2	0.7	90.9
Lube oil room 2VM-77	10.9	0.2	123.2

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TABLE 9.2-26

SCWS DESIGN DATA

Chillers

System	Quantity	Capacity (tons)
Safety-related equipment (SRE) Unit 1 (trains A and B) 1VM-59 A and B	2	180
SRE (trains A and B) Unit 2 2VM-59 A and B	2	180

Pumps

System	Quantity	gpm	head (ft)	
SRE train A (Unit 1)	2	297	87	
SRE train B (Unit 1)	2	291	92.8	27
SRE train A (Unit 2)	2	297	92	
SRE train B (Unit 2)	2	304	88	

Expansion Tanks

System	Quantity	Capacity (gallons)	
SRE Unit 1 train A	1	40	27
Unit 1 train B	1	40	
SRE Unit 2 train A	1	47	
Unit 2 train B	1	47	

TABLE 9.2-26 (continued)

Areas Served	Equipment Number	Flow (gpm)	Pressure drop (ft)	Heat Transferred MBH
		Unit 1		
Control room A/H 1 unit	OVM-01A	125	17.6	813.3
Switchgear rooms 2 units	IVM-05A IVM-05B	20	1.5	201.5
Battery room 2 units	IVM-40A IVM-40B	6.0	17.5	59.8
Decay heat removal heat exchanger room 2 units	IVM-50A IVM-50B	6.0	9.7	61.3
Makeup pump room 3 units	IVM-51A IVM-51B IVM-51C	21.5	1.3	230.0
CCW pump room 1 unit	OVM-52A	8.0	1.2	87.0
CCW heat exchanger area 2 units	IVM-52A IVM-52B	12 14	0.7 0.6	120.0 145.5
Aux feedwater pump (elect. and steam) 2 units	IVM-54A IVM-54B	23.0 5.0	0.7 8.6	244.3 46.5
Reactor building spray and decay heat removal pump	IVM-55A IVM-55B	22.0	1.4	233.2
		Unit 2		
Control room A/H 1 unit	OVM-01B	125	17.6	813.3
Switchgear rooms 2 units	2VM-05A 2VM-05B	20	1.5	201.5

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TABLE 9.2-26 (continued)

Areas Served	Equipment Number	Flow (gpm)	Pressure drop (ft)	Heat Transferred MBH
Battery room 2 units	2VM-40A 2VM-40B	6.0	17.5	59.8
Decay heat removal heat exchanger room 2 units	2VM-50A 2VM-50B	6.0	9.7	61.3
Makeup pump room 3 units	2VM-51A 2VM-51B 2VM-51C	21.5	1.3	230.0
Component cooling water room 1 unit	OVM-52B	8.0	1.2	87.0
CCW heat x area 2 units	2VM-52A 2VM-52B	12 14	0.7 0.6	120.0 145.5
Aux feedwater pump (elect. and steam) 2 units	2VM-54A 2VM-54B	23.0 5.0	0.7 8.6	244.3 46.5
Reactor building spray and decay heat removal pump rooms 2 units	2VM-55A 2VM-55B	22.0	1.4	233.2

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TABLE 9.2-27

SCWS FAILURE MODES AND EFFECTS ANALYSIS

Component	Failure Modes	Effects
Chiller	Chiller, train A, mz functions	The train B chiller goes into operation providing 100% minimum requirement under all operating conditions.
Chiller pump	Both chiller pumps malfunction	The train B chiller goes into operation providing 100% minimum requirements under all operating conditions.
System pressure boundary	Single failure in Seismic Category I pressure boundary	Trains A and B are independent so that a single failure in one train will not affect the other train.
Piping	Pipe rupture	The second train will provide 100% of minimum requirements under all operating conditions.
Power supplies	Failure of normal power source	All system components will automatically switch to operation from preferred power.
	Failure of both normal and preferred (offsite power sources)	All system components will automatically switch to operation from power supplied by emergency diesel generators.
	Failure of power supply to one train	Other train is supplied from an independent and physically separate power supply.

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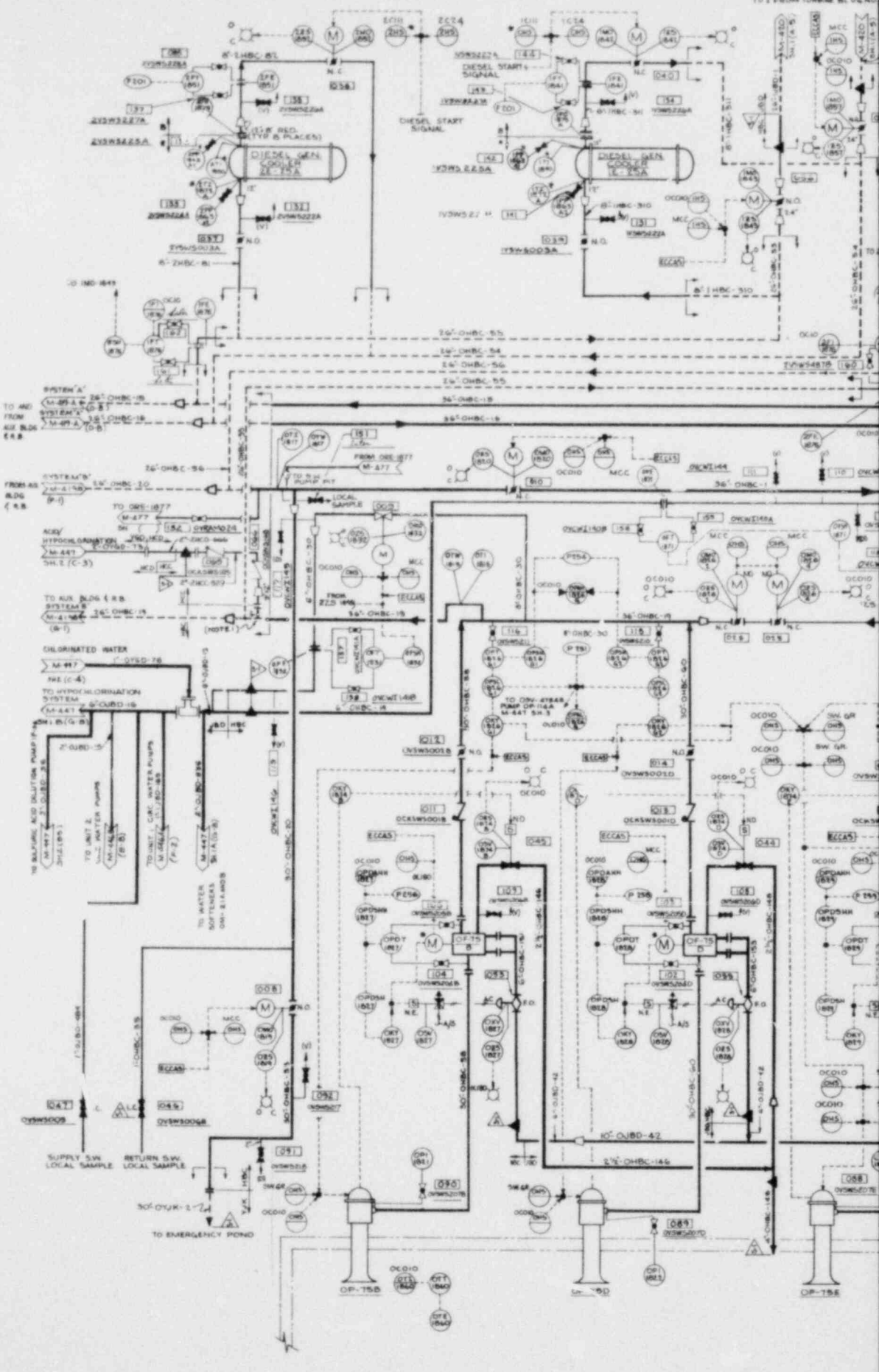
TABLE 9.2-28

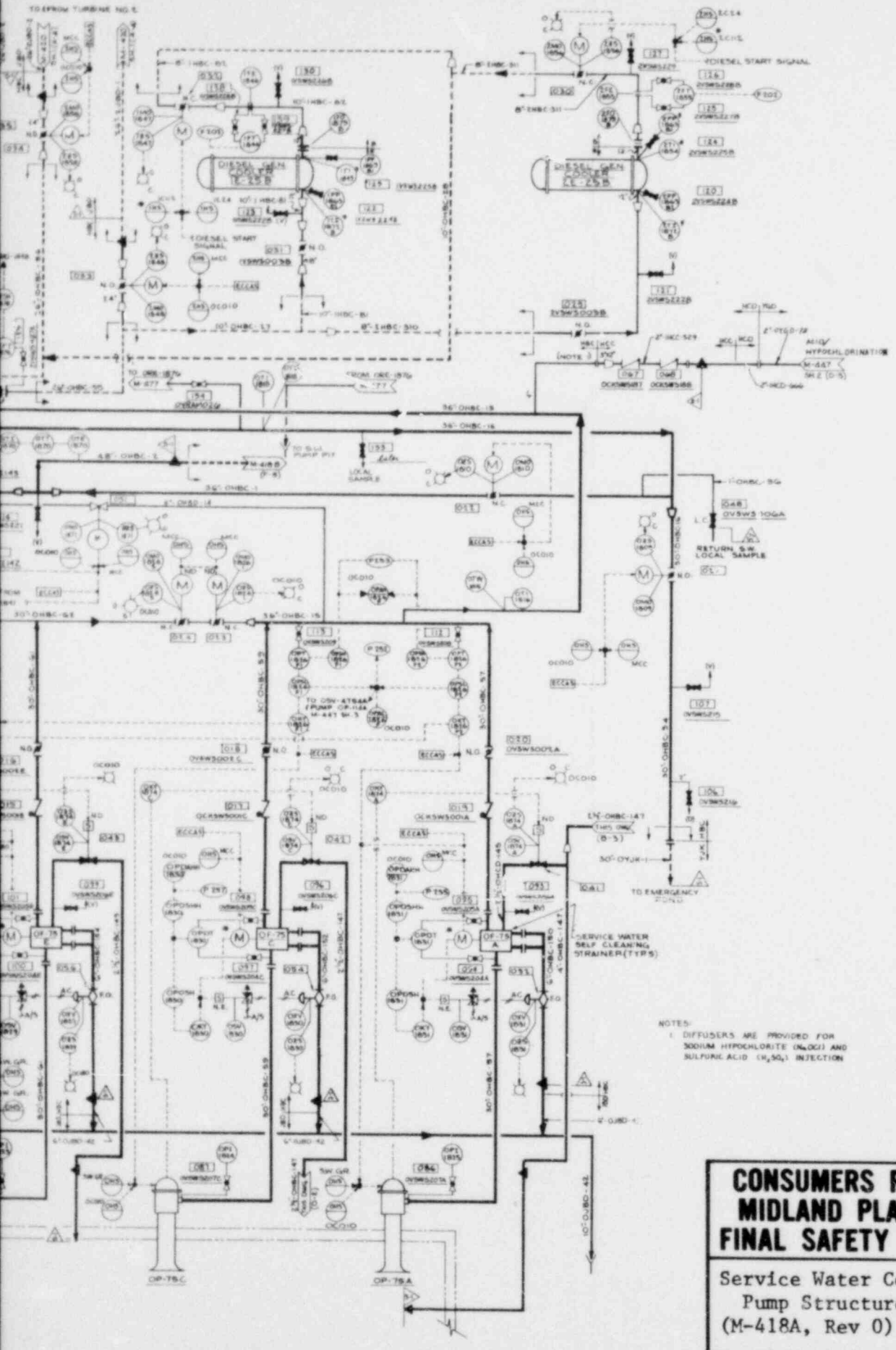
REACTOR GENERATED DECAY HEAT

Time After Shutdown (s)	Total Decay Heat Rate (Btu/hr)	Total Integrated Decay Heat (Btu)
1.000000-01[1]	7.472+08	2.075+04
5.000000-01	7.123+08	1.018+05
1.000000+00	6.827+08	1.987+05
5.000000+00	5.928+08	9.073+05
1.000000+01	5.489+08	1.700+06
5.000000+01	4.272+08	7.123+06
9.999999+01	3.789+08	1.272+07
5.000000+02	2.555+08	4.797+07
9.999999+02	2.226+08	8.117+07
5.000000+03	1.282+08	2.760+08
9.999999+03	1.064+08	4.389+08
5.000000+04	6.669+07	1.400+09
9.999999+04	5.541+07	2.248+09
5.000000+05	3.301+07	7.160+09
9.999999+05	2.622+07	1.127+10
5.000000+06	1.476+07	3.404+10
9.999999+06	1.143+07	5.223+10
5.000000+07	5.676+06	1.472+11
9.999999+07	4.795+06	2.200+11

3

[1] 1.000000-01 denotes 1.000000×10^{-1}

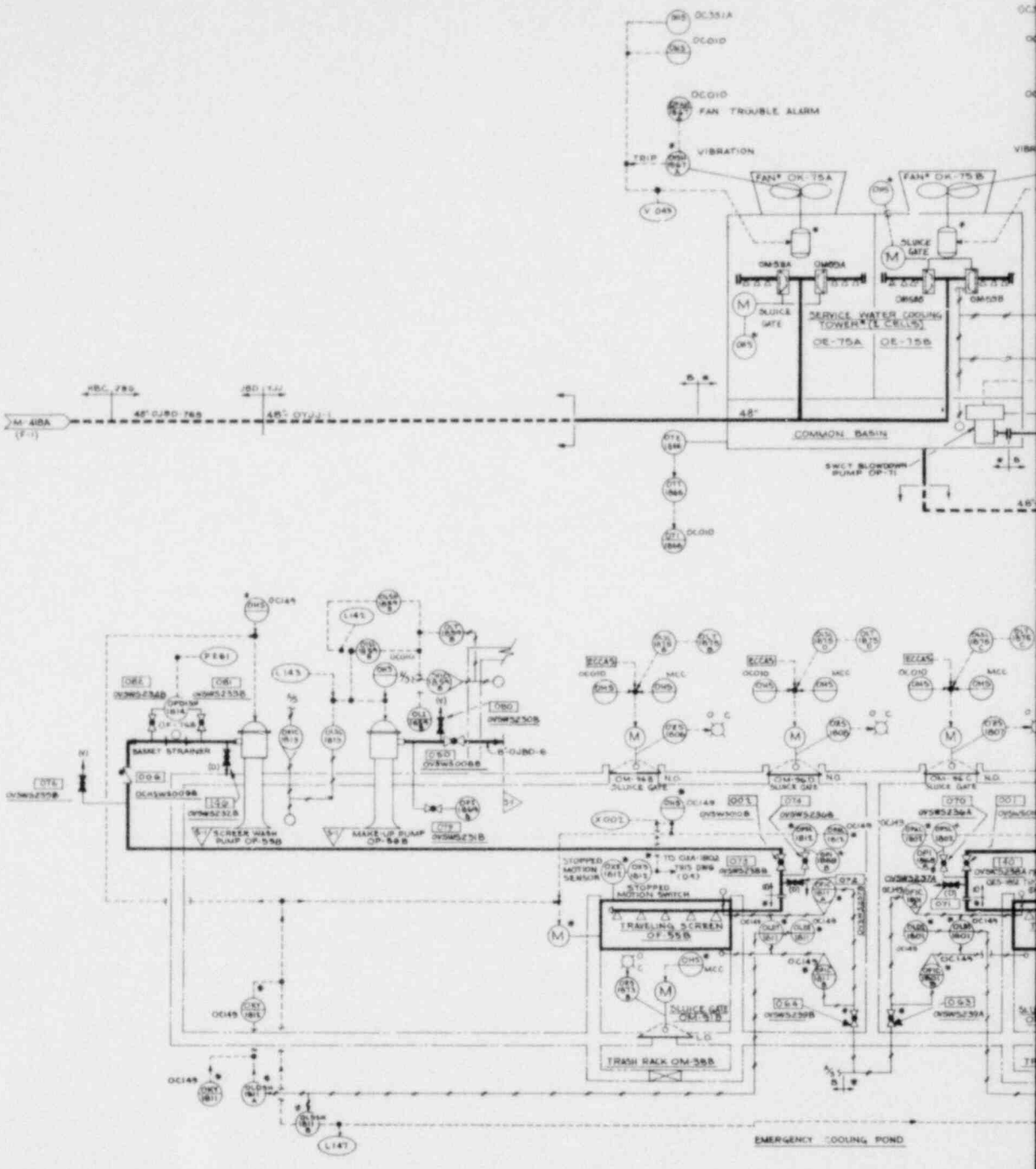

DIESEL GEN. COOLER 2E-79A
DIESEL GEN. COOLER 1E-79A
DIESEL START SIGNAL
SYSTEM 'A'
SYSTEM 'B'
TO AND FROM AUX BLDG (I.B.
FROM AUX BLDG (I.B.
TO AUX BLDG (I.B.
SYSTEM 'B'
ACID/ HYPOCHLORINATION
CHLORINATED WATER
TO HYPOCHLORINATION SYSTEM
TO SULFURIC ACID DILUTION PUMP
TO UNIT 2 CIRC. WATER PUMPS
TO UNIT 1 CIRC. WATER PUMPS
TO WATER SOFTENERS
LOCAL SAMPLE
FROM ORE-1877
TO ORE-1877
FROM FZS-1416
TO ENERGENCY POND
SUPPLY S.W. LOCAL SAMPLE
RETURN S.W. LOCAL SAMPLE
OP-75B
OP-75A
OP-75C
10"-OJBD-42
2½"-OHBC-146

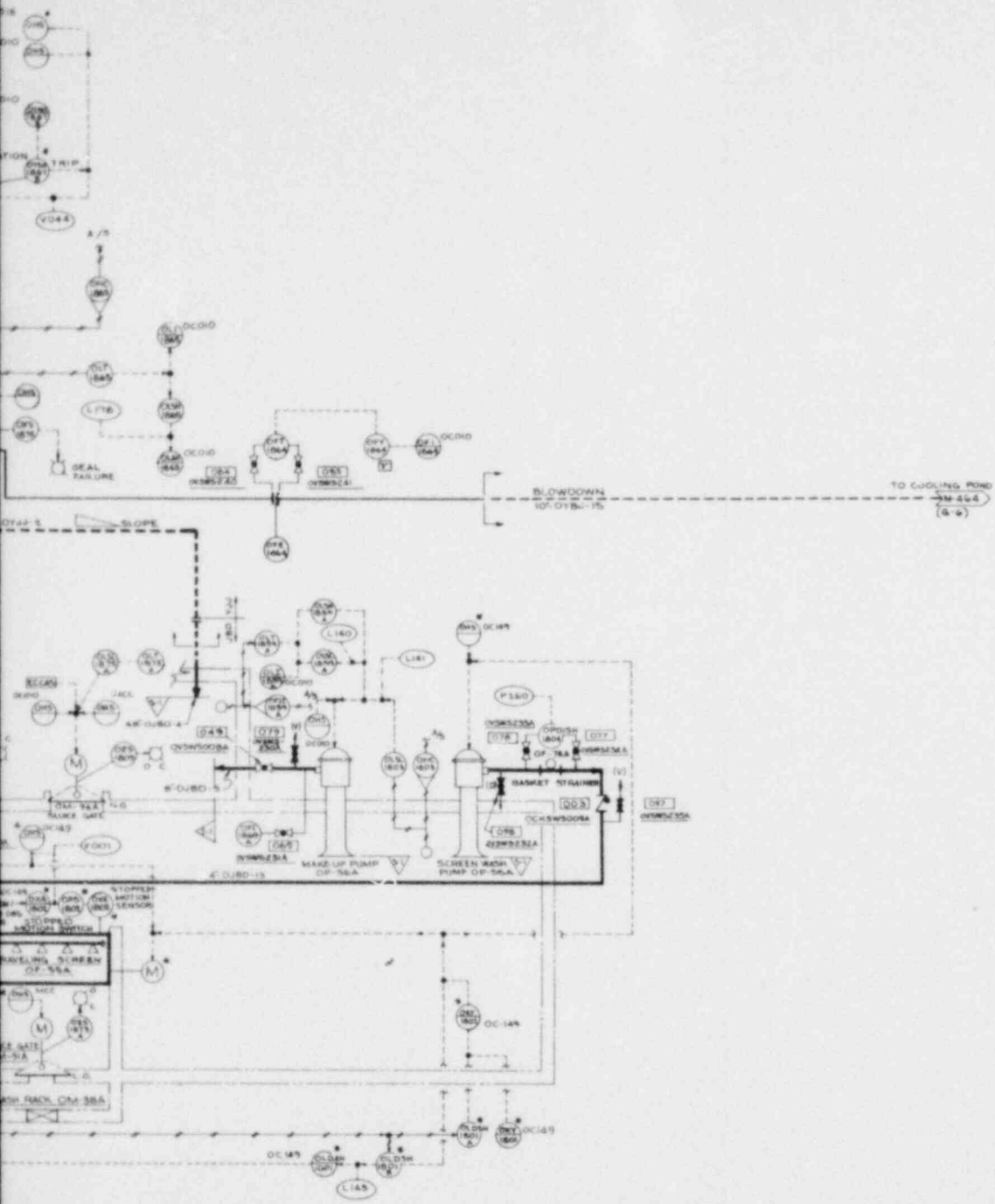


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Service Water Cooling Tower and Pump Structure Units 1 & 2
(M-418A, Rev 0)

FSAR Figure 9.2-2, sh. 1

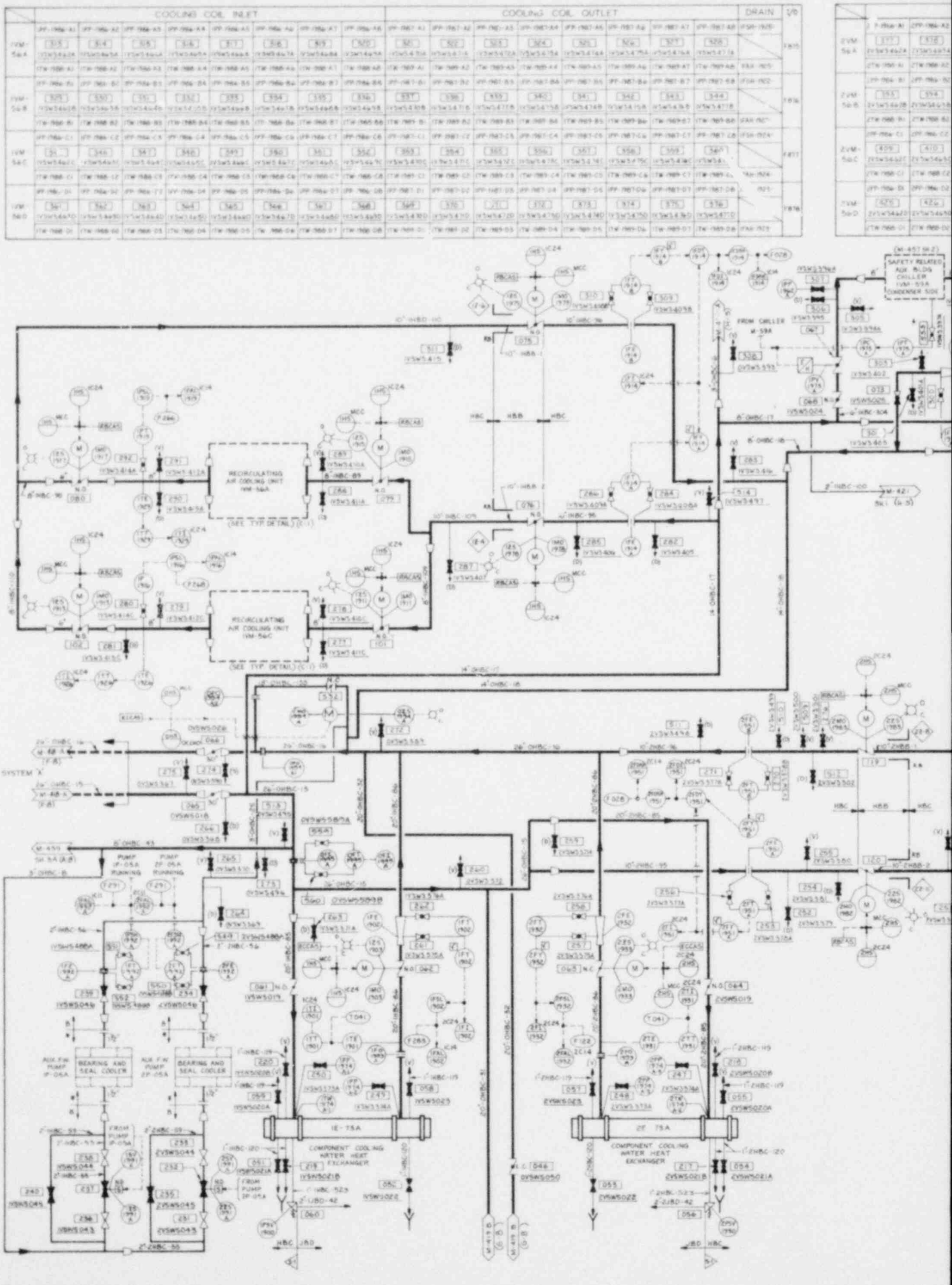

FAN TROUBLE ALARM
VIBRATION
TRIP
FAN OK-75A
FAN OK-75B
SLUICE GATE
SERVICE WATER COOLING TOWER (2 CELLS)
OE-75A
OE-75B
COMMON BASIN
SWCT BLOWDOWN PUMP OP-71
48"
M-48A
(F-1)
BASKET STRAINER
SCREEN WASH PUMP OP-55B
MAKE-UP PUMP OP-56B
STOPPED MOTION SENSOR
STOPPED MOTION SWITCH
TRAVELING SCREEN OF-55B
SLUICE GATE OM-55B
TRASH RACK OM-56B
EMERGENCY COOLING POND

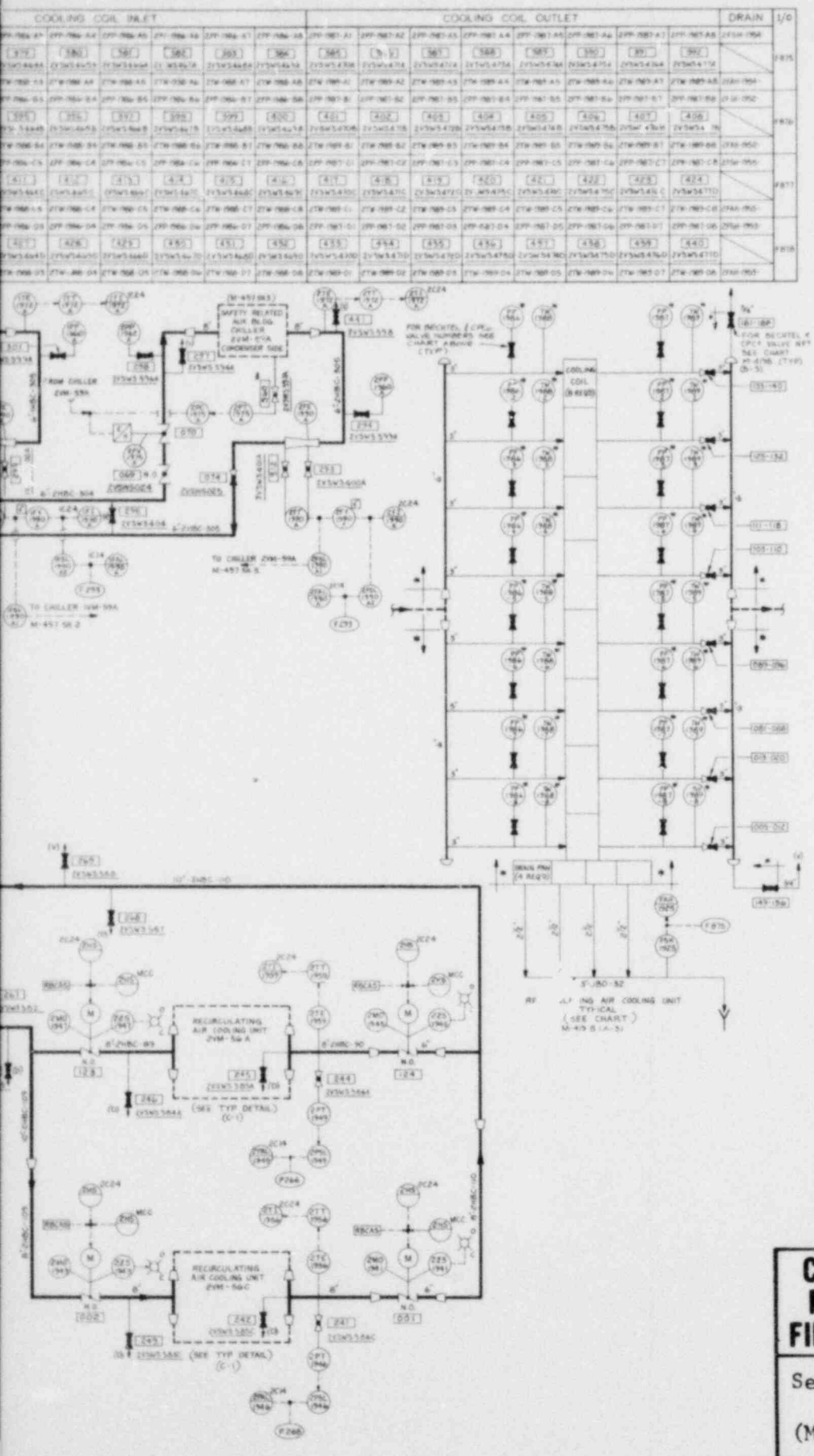


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Service Water Cooling Tower and Pump Structure Units 1 & 2 (M-418B, Rev 0)

FSAR Figure 9.2-2, sh. 2

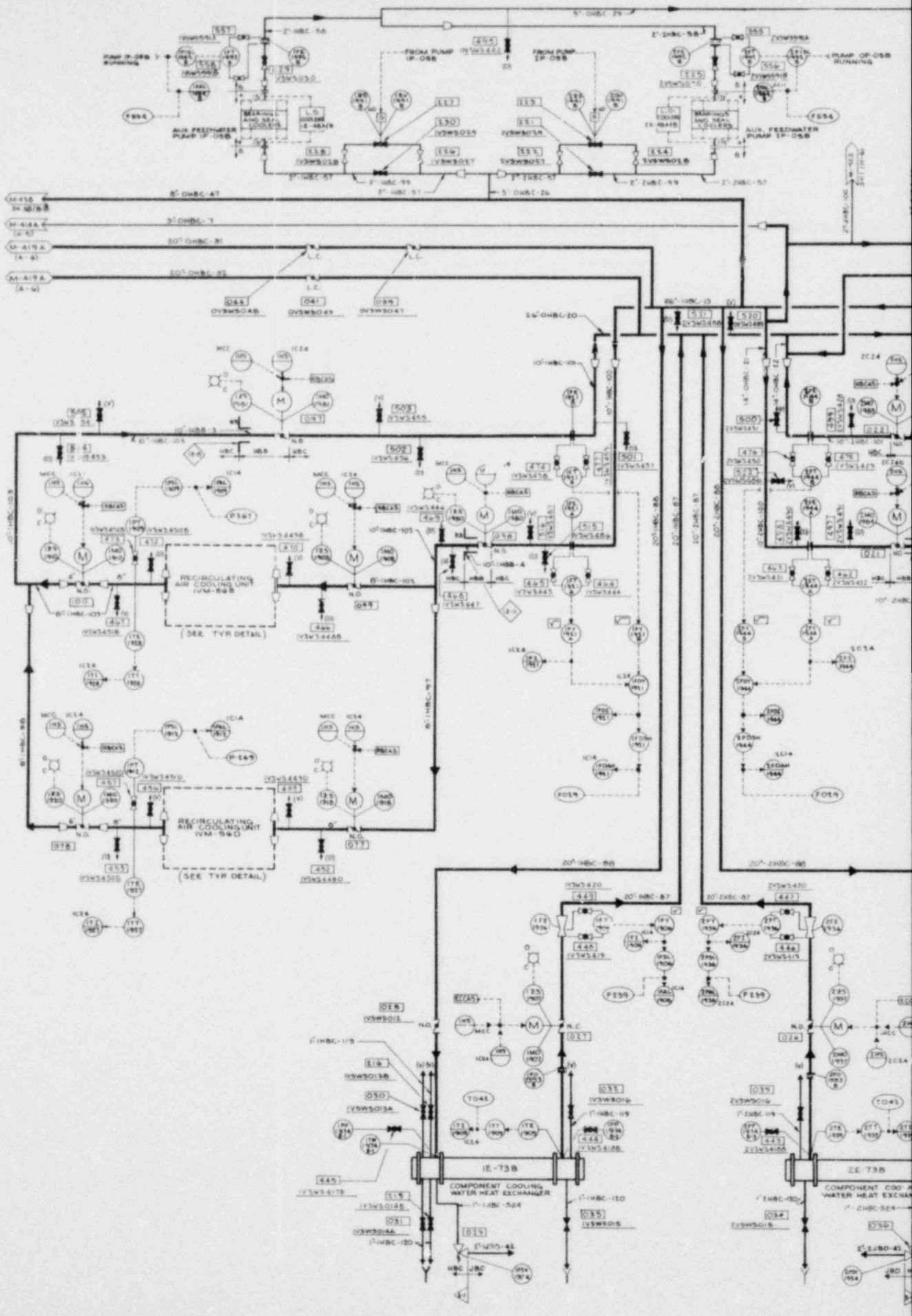

COOLING COIL INLET
COOLING COIL OUTLET
DRAIN
I/O
VM-56A
VM-56B
VM-56C
VM-56D
RECIRCULATING AIR COOLING UNIT VM-56A
RECIRCULATING AIR COOLING UNIT VM-56C
(SEE TYP. DETAIL) (C-1)
FROM CHILLER M-59A
SAFETY RELATED AUX. BLDG. CHILLER VM-59A CONDENSER SIDE
SYSTEM 'A'
PUMP 2P-05A RUNNING
PUMP 1P-05A RUNNING
AUX. F.W. PUMP 1P-05A
AUX. F.W. PUMP 2P-05A
BEARING AND SEAL COOLER
1E-75A
2E-75A
COMPONENT COOLING WATER HEAT EXCHANGER
FROM PUMP 2P-05A
FROM PUMP 1P-05A
M-457 (B-2)
M-459 (A-8)
M-42 (A-5)

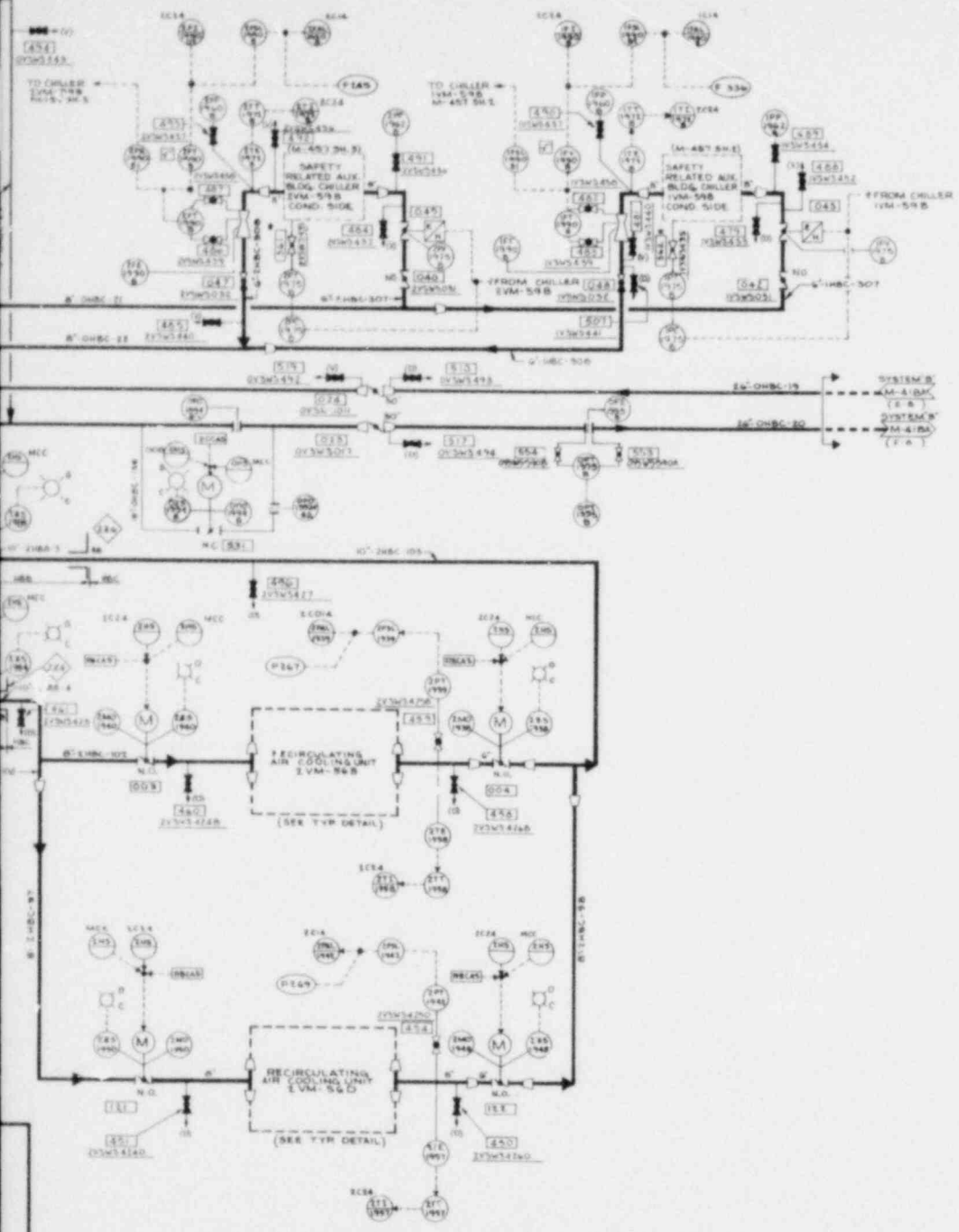


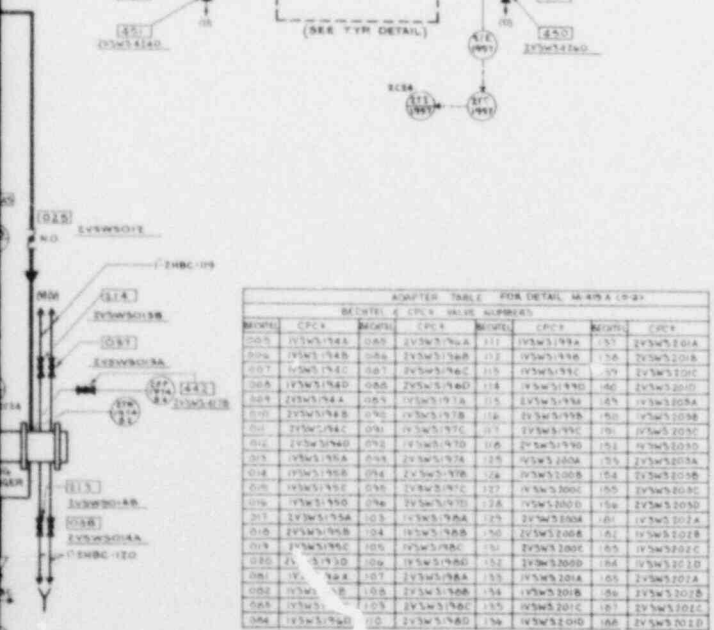
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Service Water Reactor and Auxiliary Building Units 1 & 2
(M-419A, Rev 0)

FSAR Figure 9.2-3, sh. 1


FROM PUMP 1P-058
FROM PUMP 1P-058
PUMP 1P-058 RUNNING
PUMP 0P-058 RUNNING
AUX. FRESHWATER PUMP 1P-058
AUX. FRESHWATER PUMP 1P-058
RECIRCULATING AIR COOLING UNIT 1VM-88
(SEE TYP. DETAIL)
RECIRCULATING AIR COOLING UNIT 1VM-90
(SEE TYP. DETAIL)
1E-73B
COMPONENT COOLING WATER HEAT EXCHANGER
2E-73B
COMPONENT COOLING WATER HEAT EXCHANGER



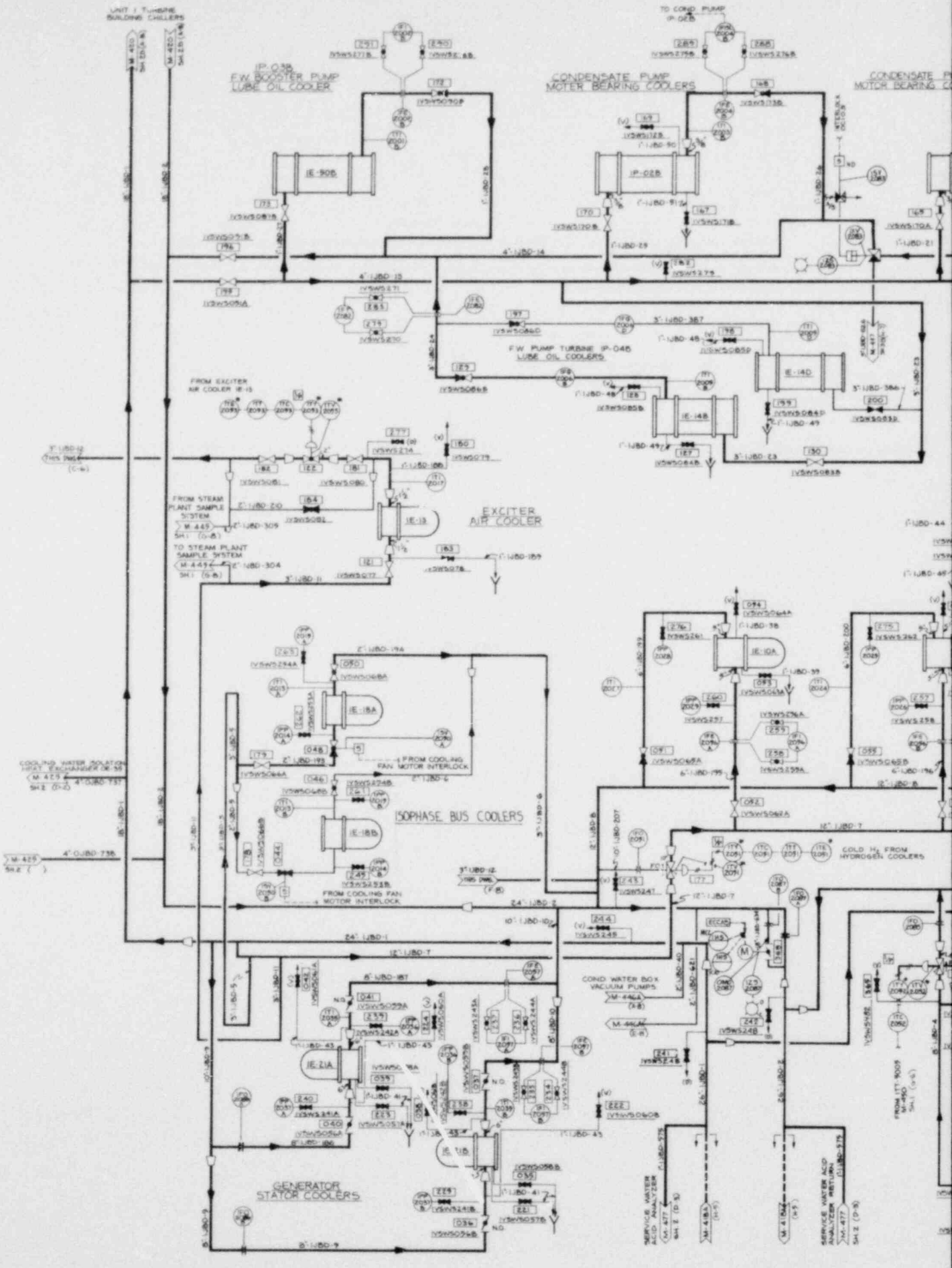


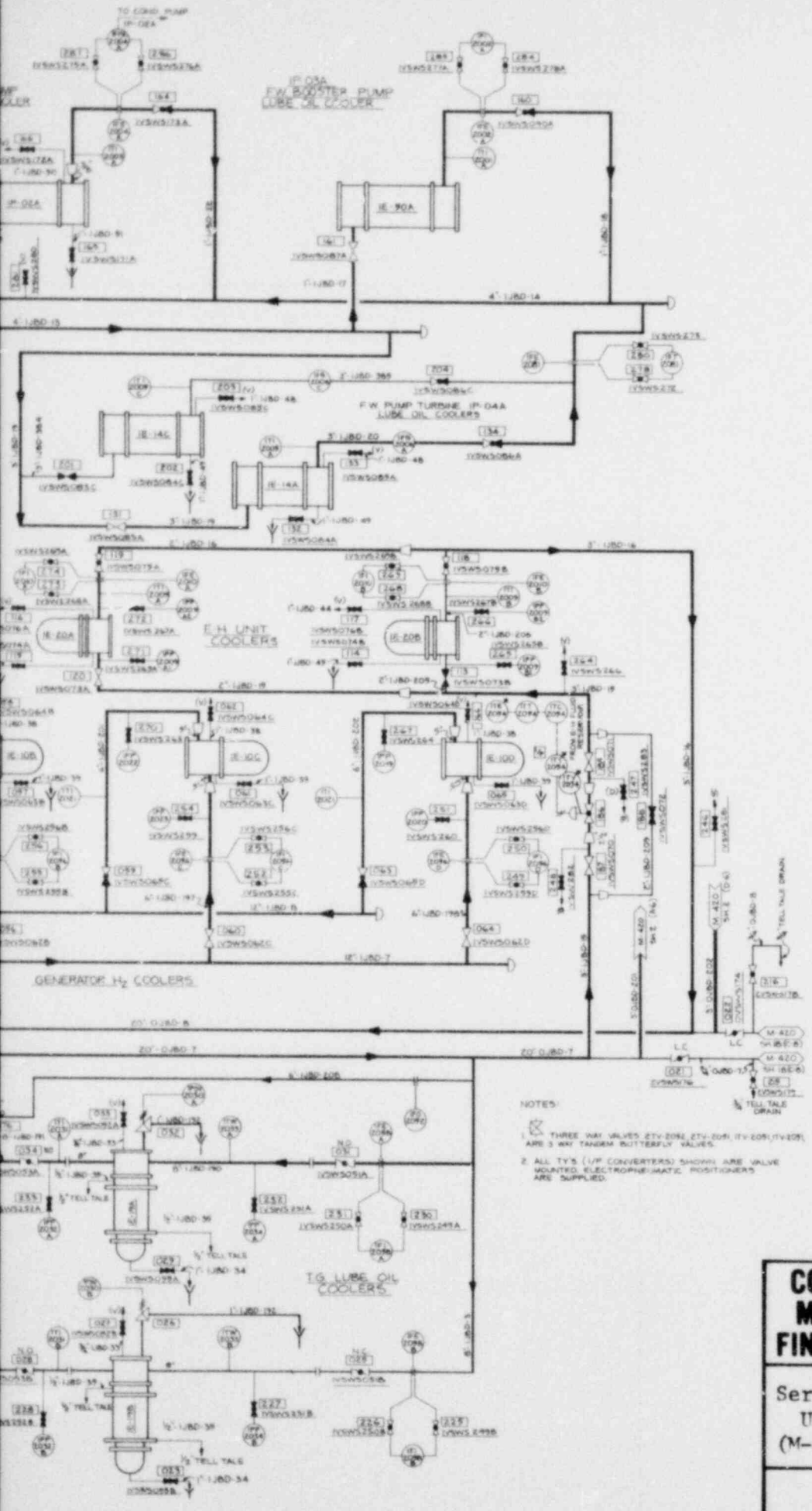
ADAPTER TABLE FOR DETAIL M-419A (SH 2)							
RECIRC & CPC'S VALVE NUMBERS							
RECIRC	CPC'S	RECIRC	CPC'S	RECIRC	CPC'S	RECIRC	CPC'S
005	2VSW51948A	065	2VSW51960A	111	2VSW51998A	157	2VSW52018A
006	2VSW51948B	066	2VSW51960B	112	2VSW51998B	158	2VSW52018B
007	2VSW51948C	067	2VSW51960C	113	2VSW51998C	159	2VSW52018C
008	2VSW51948D	068	2VSW51960D	114	2VSW51998D	160	2VSW52018D
009	2VSW51949A	069	2VSW51970A	115	2VSW52000A	161	2VSW52028A
010	2VSW51949B	070	2VSW51970B	116	2VSW52000B	162	2VSW52028B
011	2VSW51949C	071	2VSW51970C	117	2VSW52000C	163	2VSW52028C
012	2VSW51949D	072	2VSW51970D	118	2VSW52000D	164	2VSW52028D
013	2VSW51958A	073	2VSW51978A	125	2VSW52008A	155	2VSW52038A
014	2VSW51958B	074	2VSW51978B	126	2VSW52008B	156	2VSW52038B
015	2VSW51958C	075	2VSW51978C	127	2VSW52008C	165	2VSW52038C
016	2VSW51958D	076	2VSW51978D	128	2VSW52008D	166	2VSW52038D
017	2VSW51958A	103	2VSW51988A	149	2VSW52004A	101	2VSW52024A
018	2VSW51958B	104	2VSW51988B	150	2VSW52004B	102	2VSW52024B
019	2VSW51958C	105	2VSW51988C	151	2VSW52004C	103	2VSW52024C
020	2VSW51958D	106	2VSW51988D	152	2VSW52004D	104	2VSW52024D
021	2VSW51968A	107	2VSW51988A	153	2VSW52014A	105	2VSW52034A
022	2VSW51968B	108	2VSW51988B	154	2VSW52014B	106	2VSW52034B
023	2VSW51968C	109	2VSW51988C	155	2VSW52014C	107	2VSW52034C
024	2VSW51968D	110	2VSW51988D	156	2VSW52014D	108	2VSW52034D

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Service Water Reactor and Auxiliary Buildings Units 1 & 2
(M-419B, Rev 0)

FSAR Figure 9.2-3, sh. 2

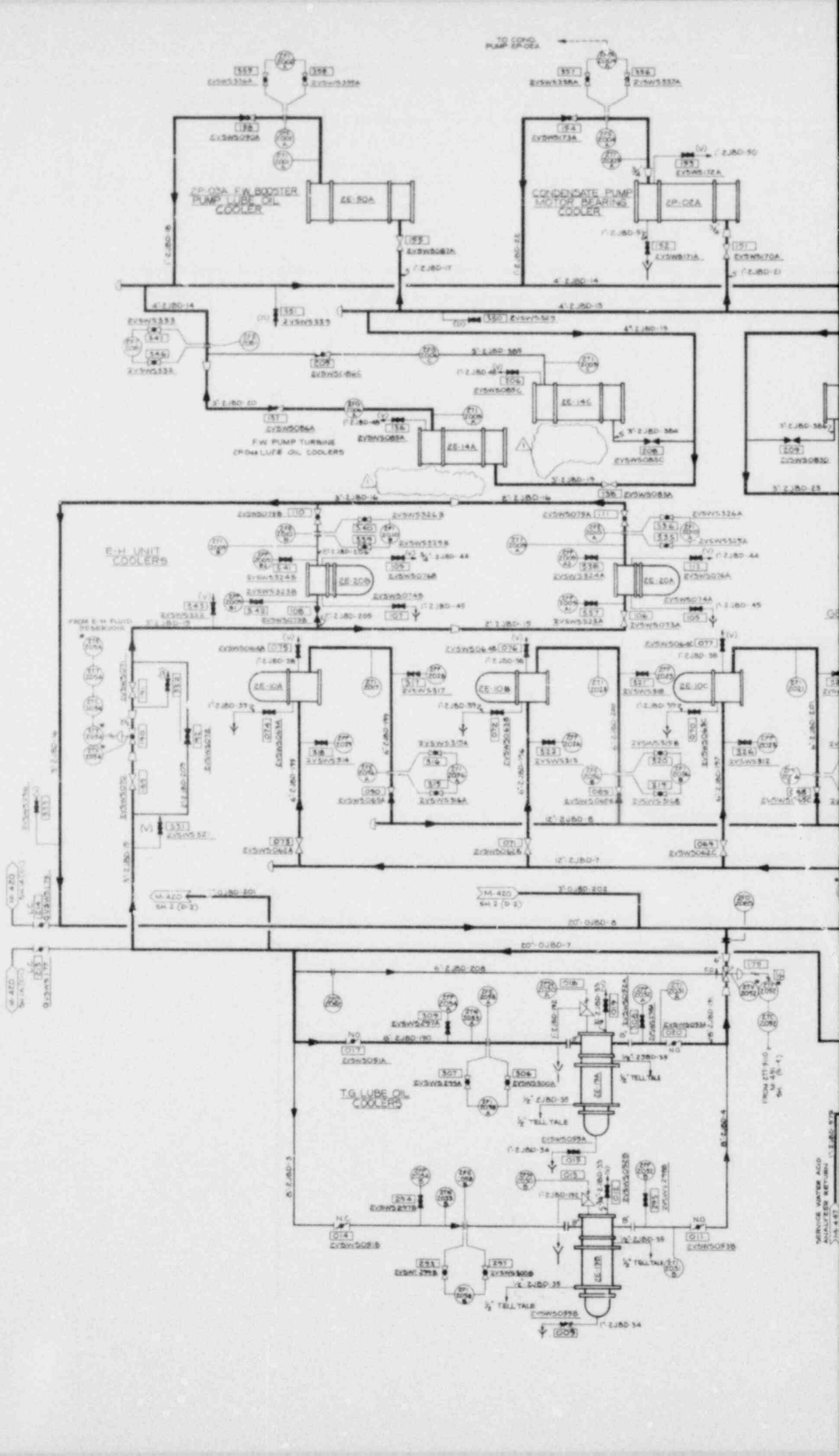

UNIT 1 TURBINE BUILDING CHILLERS
IP-038 F.W. BOOSTER PUMP LUBE OIL COOLER
IE-90B
CONDENSATE PUMP MOTOR BEARING COOLERS
TO COND. PUMP IP-028
IP-028
IE-14D
IE-14B
F.W. PUMP TURBINE IP-048 LUBE OIL COOLERS
FROM EXCITER AIR COOLER IE-13
FROM STEAM PLANT SAMPLE SYSTEM
TO STEAM PLANT SAMPLE SYSTEM
IE-13
EXCITER AIR COOLER
IE-10A
IE-18A
IE-18B
FROM COOLING FAN MOTOR INTERLOCK
ISOPHASE BUS COOLERS
COLD H2 FROM HYDROGEN COOLERS
COND WATER BOX VACUUM PUMPS
IE-21A
IE-11B
GENERATOR STATOR COOLERS
SERVICE WATER ACID ANALYZER
SERVICE WATER ACID ANALYZER RETURN

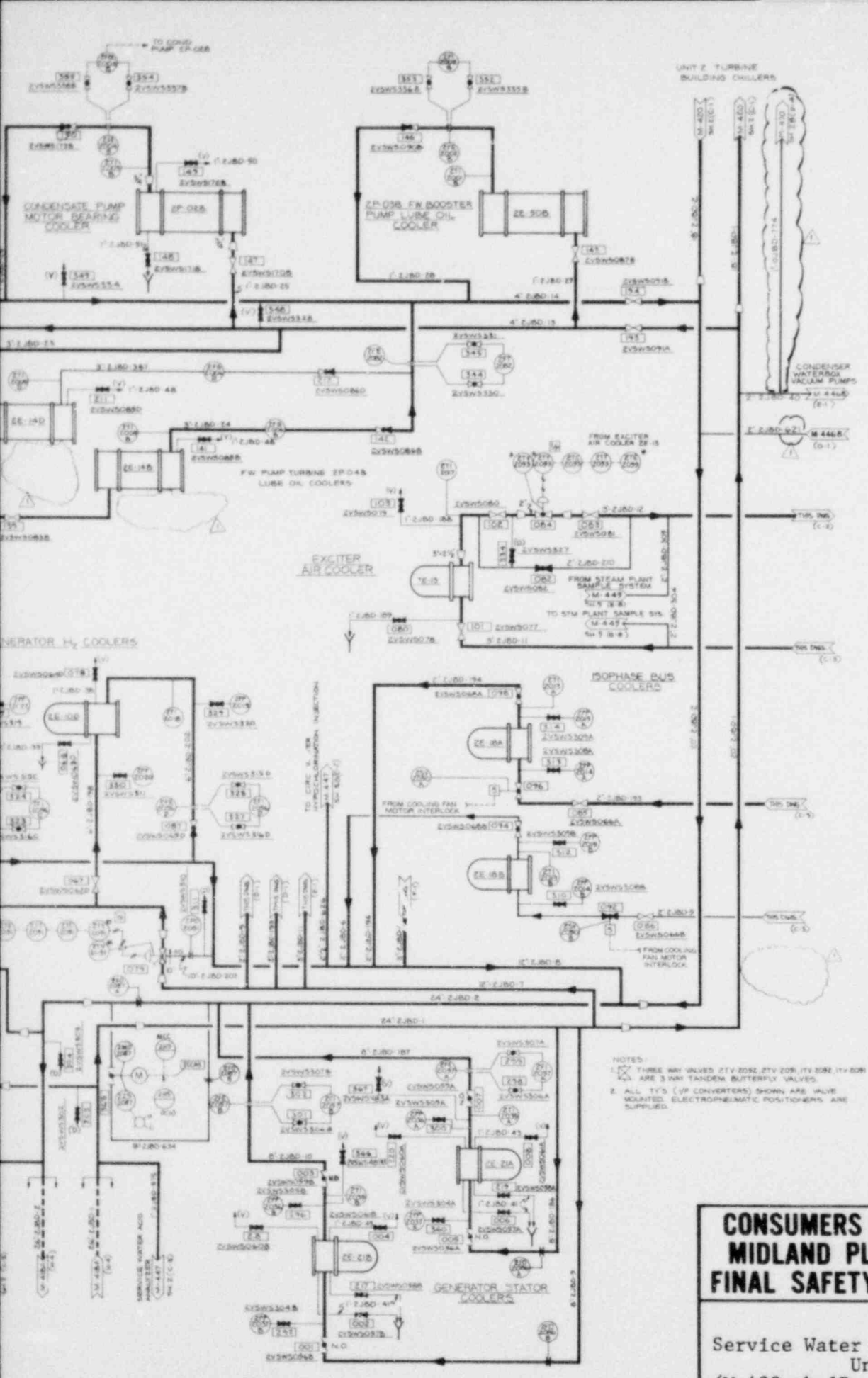


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Service Water Turbine Building
Unit 1
(M-420 sh 1A, Rev 0)

FSAR Figure 9.2-4, sh. 1

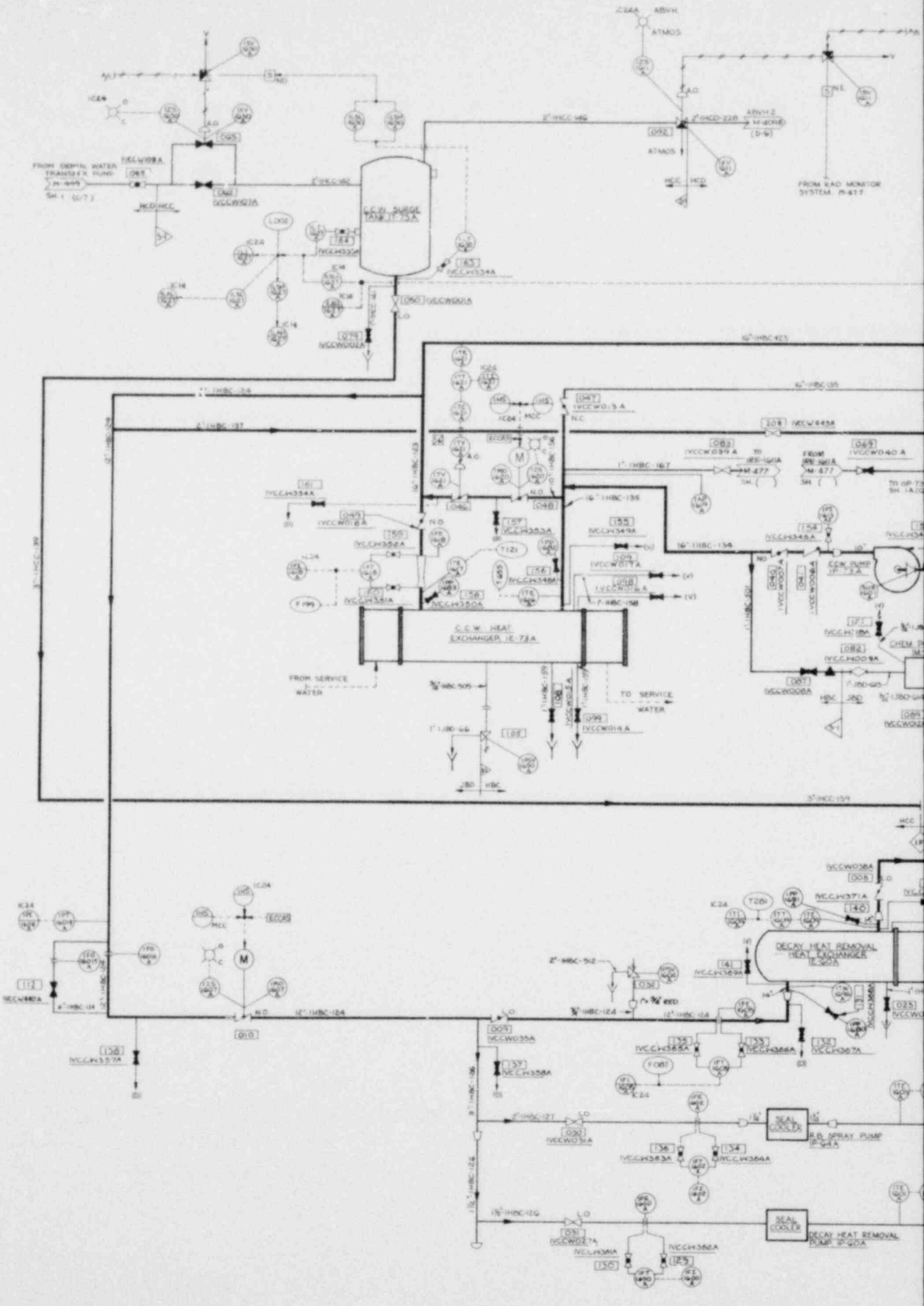

TO COND. PUMP 2P-02A
2P-03A F.W. BOOSTER PUMP LUBE OIL COOLER
2E-50A
CONDENSATE PUMP MOTOR BEARING COOLER
2P-02A
F.W. PUMP TURBINE 2P-04A LUBE OIL COOLERS
2E-14A
2E-14C
E.H. UNIT COOLERS
2E-20B
2E-20A
2E-10A
2E-10B
2E-10C
T.G. LUBE OIL COOLERS
2E-13A
2E-13B
SERVICE WATER ACID ANALYZER RETURN

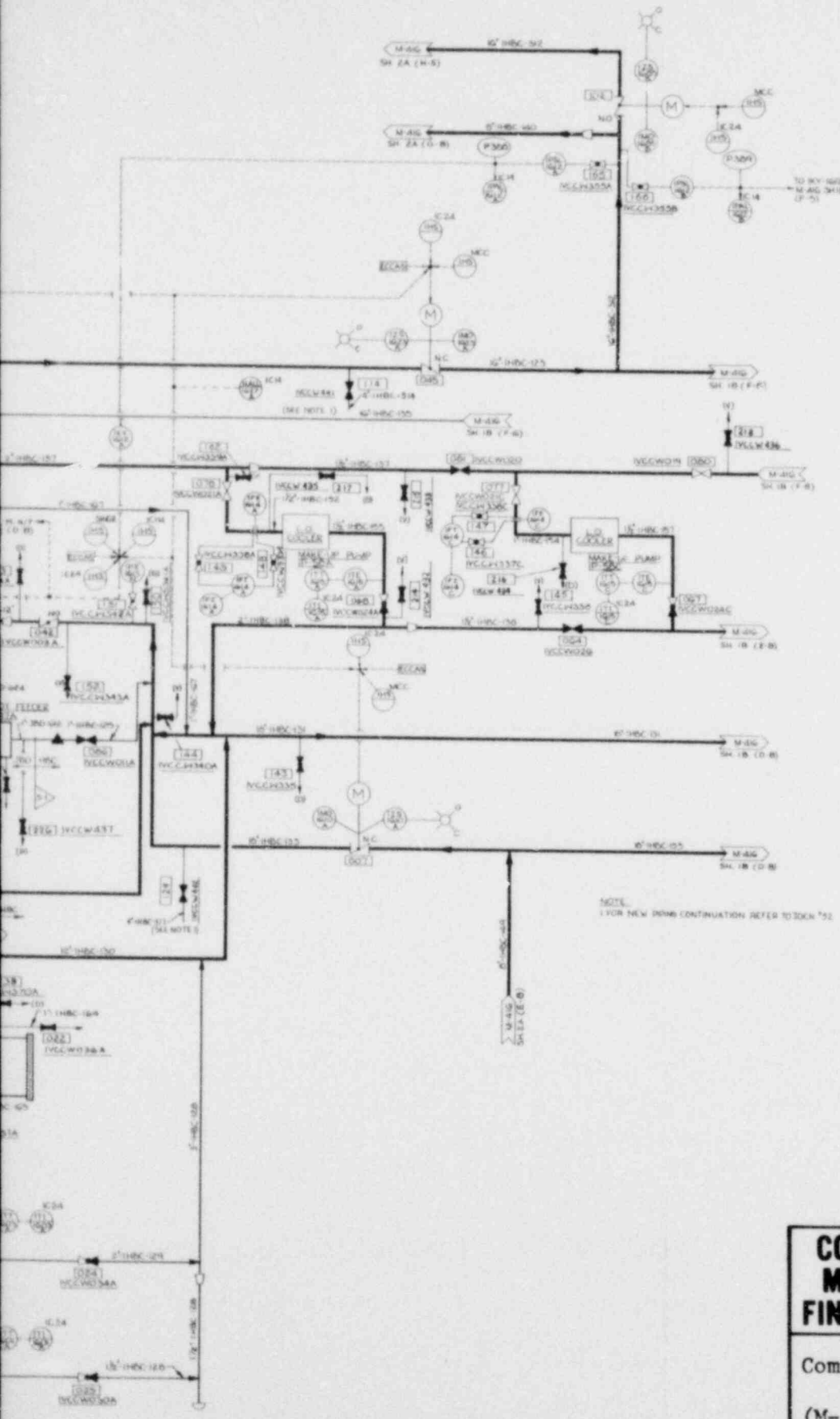


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Service Water Turbine Building
Unit 2
(M-420 sh 1B, Rev 1)

FSAR Figure 9.2-4, sh. 2


C.C.W. SURGE TANK IT-75A
C.C.W. HEAT EXCHANGER IE-73A
DECAY HEAT REMOVAL HEAT EXCHANGER IE-90A
SEAL COOLER
R.B. SPRAY PUMP IP-94A
DECAY HEAT REMOVAL PUMP IP-90A
CCW PUMP IP-73A
FROM DEMIN. WATER TRANSFER PUMP
FROM SERVICE WATER
TO SERVICE WATER
ATMOS
FROM RAD MONITOR SYSTEM
TO
FROM

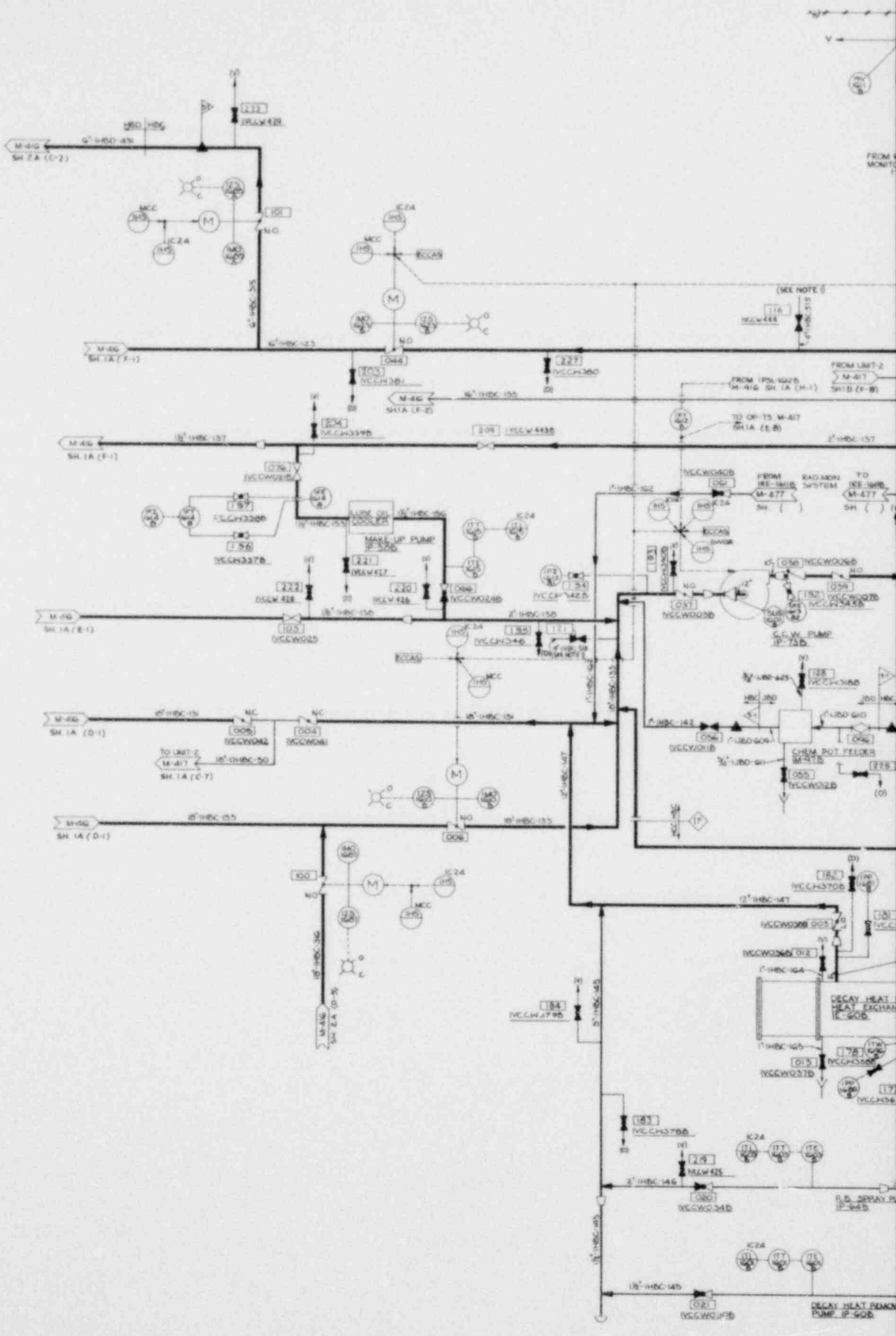


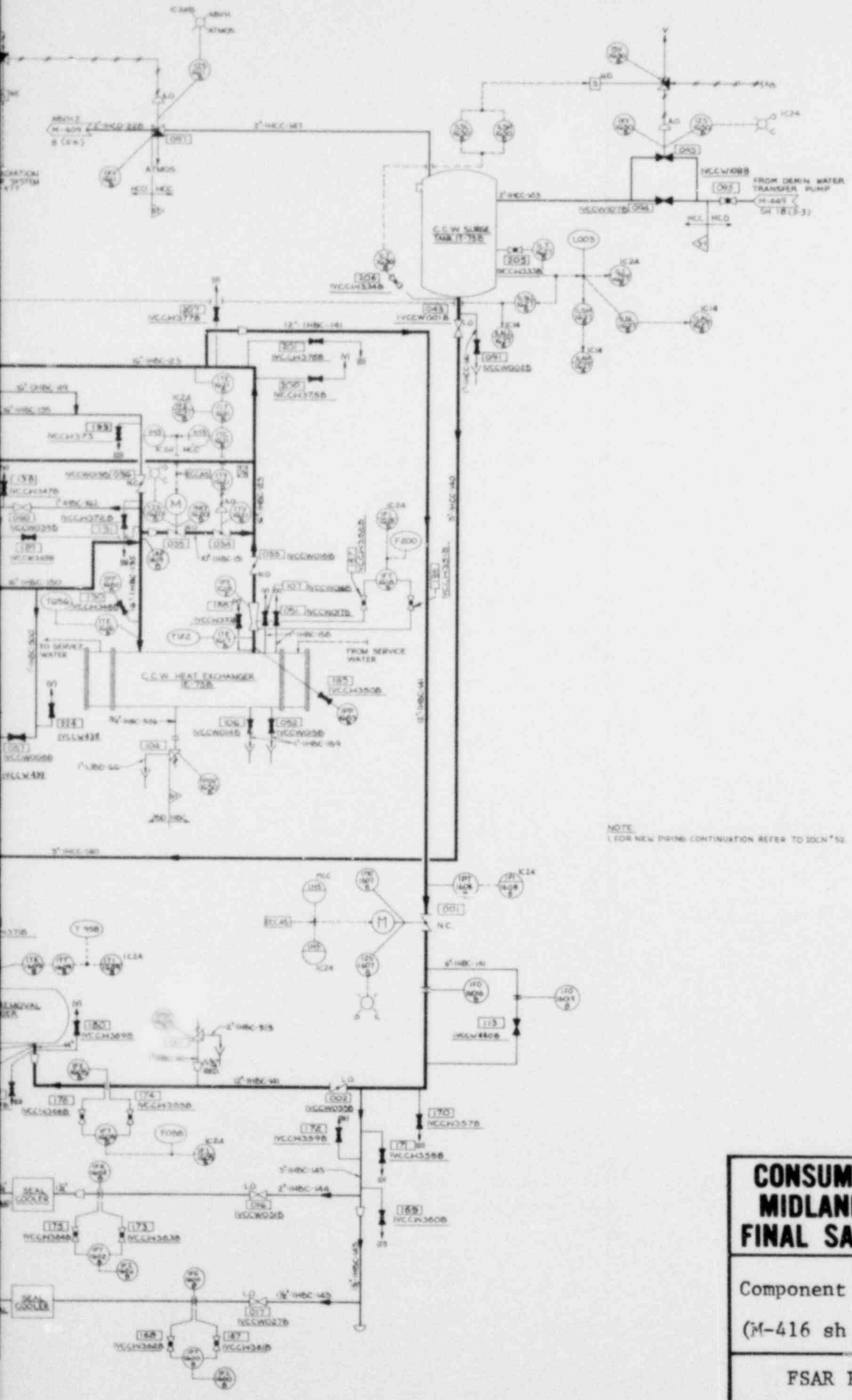
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Component Cooling Water - Unit 1

(M-416 sh 1A, Rev 0)

FSAR Figure 9.2-7, sh. 1


M-416
SH 2A (C-2)
6"-HBD-85
233
HRLW428
MCC
LC 2A
101
N.O.
6"-HBC-135
M-416
SH 1A (F-1)
16"-HBC-123
044
227
VCCH360
VCCH3381
M-416
SH 1A (F-2)
16"-HBC-136
234
VCCH3396
209
VCCW4436
16"-HBC-137
M-416
SH. 1A (F-1)
036
VCCW0216
SURGE TK COOLER
16"-HBC-156
MAKE UP PUMP
IP-93B
221
HRLW427
222
HRLW 428
220
HRLW 426
046
VCCW0248
M-416
SH. 1A (E-1)
16"-HBC-136
105
VCCW025
2"-HBC-156
RCCAS
MCC
M-416
SH. 1A (D-1)
18"-HBC-134
NC
006
VCCW0142
NC
004
VCCW0141
TO UNIT-2
M-417
SH. 1A (C-7)
18"-HBC-150
18"-HBC-135
M-416
SH. 1A (D-1)
18"-HBC-133
006
100
M-416
SH 2A (D-5)
18"-HBC-145
FROM UNIT-2
M-417
SH 1B (F-8)
FROM IPSL-1025
M-416 SH. 1A (H-1)
TO OP-T5 M-417
SH 1A (E-8)
2"-HBC-157
VCCW0460B
061
FROM
RE-1618
M-477
SH. ( )
RADIATION
SYSTEM
TO
RE-1618
M-477
SH. ( )
RCCAS
SWGR
056
VCCW0026B
054
VCCW0027B
VCCH3458
037
VCCW0036
S.C.W. PUMP
IP-73B
228
VCCH3368
1"-LBD-625
2"-HBC-150
2"-HBC-142
1"-LBD-609
1"-LBD-610
056
VCCW0010B
046
CHEM POT FEEDER
M-478
1"-LBD-611
055
VCCW0012B
225
(D)
18"
VCCH3708
12"-HBC-147
VCCW0368
005
VCCW0360
012
2"-HBC-164
DECAY HEAT
HEAT EXCHAN
P-90B
2"-HBC-165
78
VCCH0588
015
VCCW0037B
184
VCCW3796
3"-HBC-163
183
VCCH3788
29
HRLW425
2"-HBC-146
020
VCCW0348
R.B. SPRAY P
IP-94B
18"-HBC-145
021
VCCW0398
DECAY HEAT REMOV
PUMP IP-90B

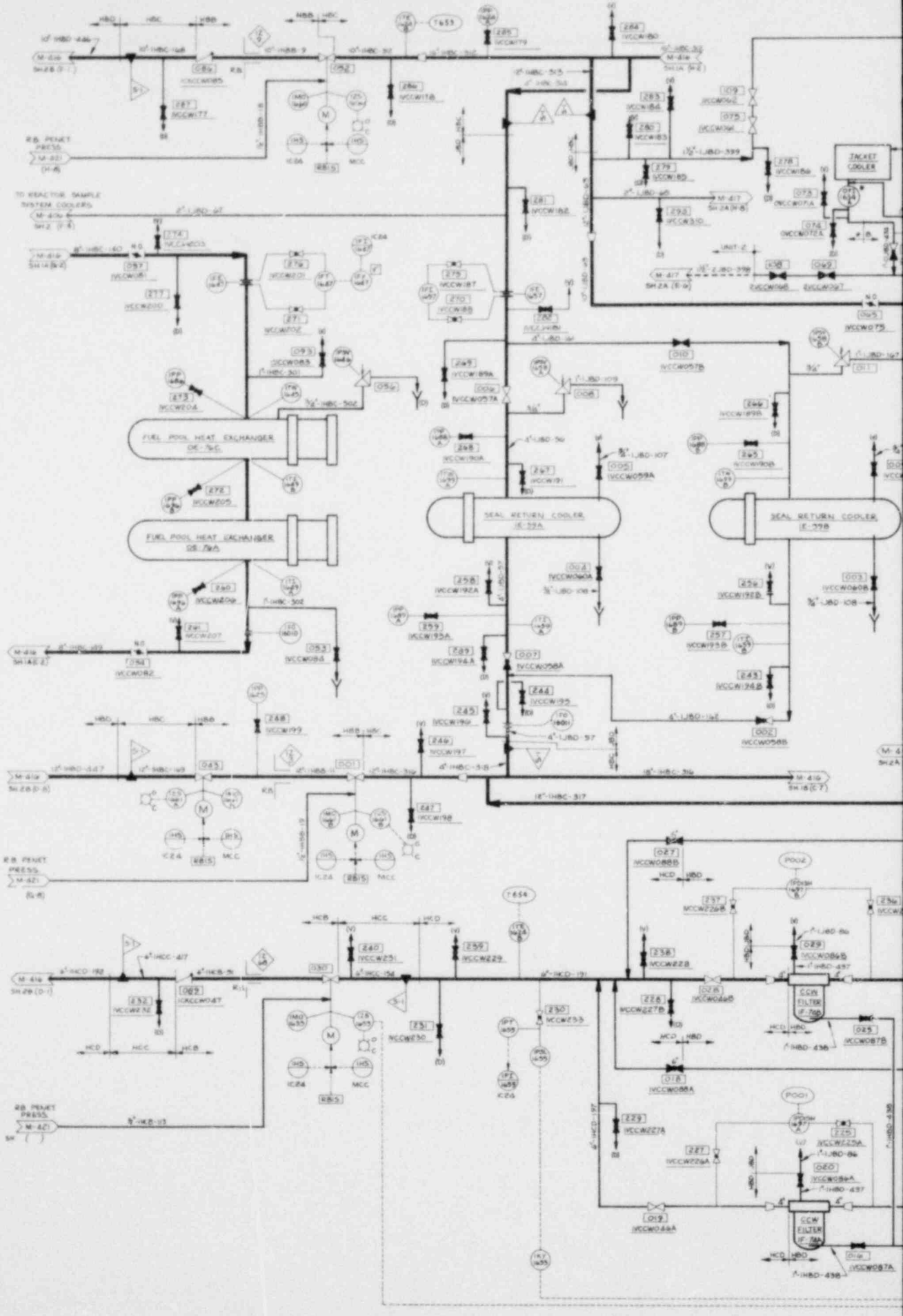


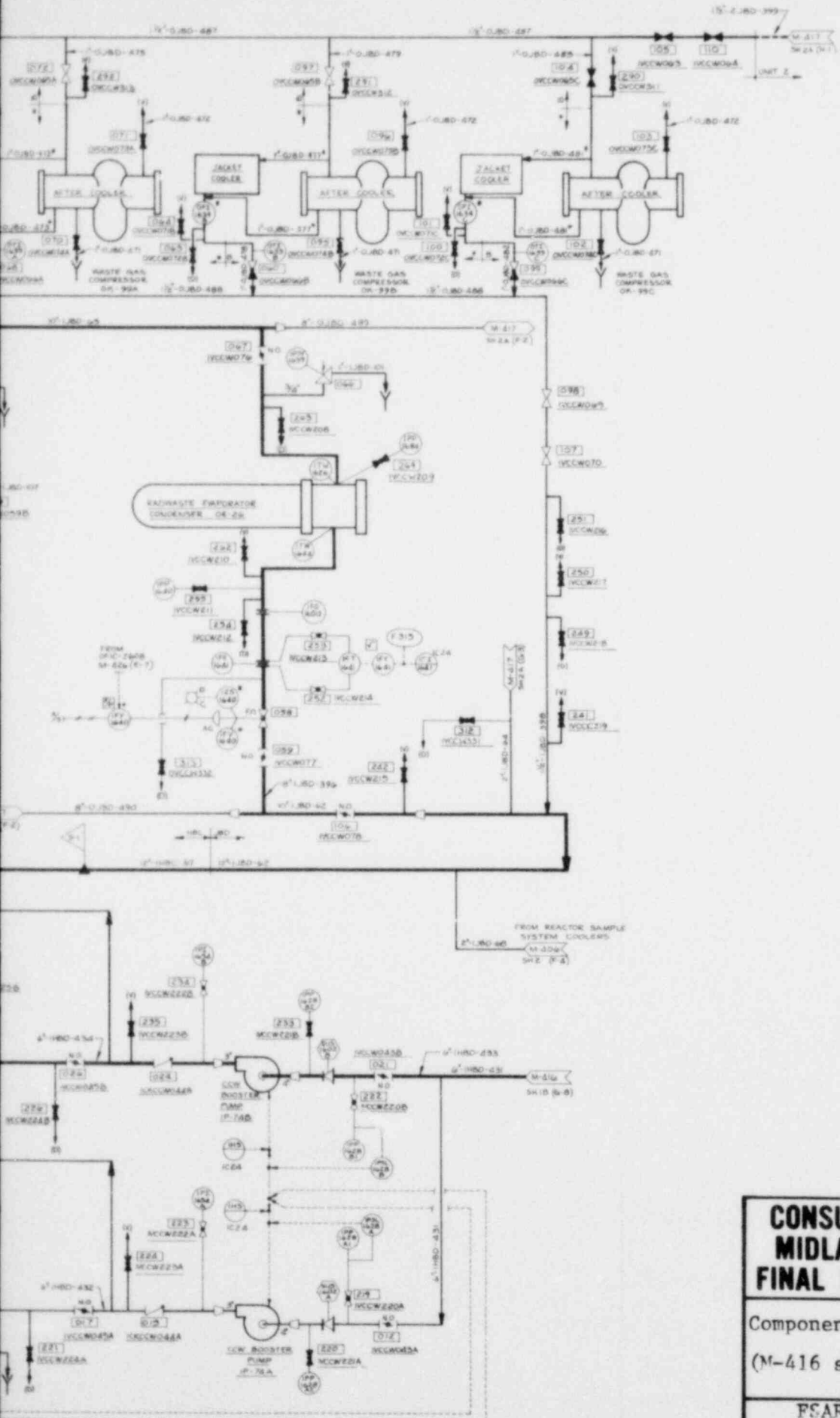
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Component Cooling Water - Unit 1

(M-416 sh 1B, Rev 0)

FSAR Figure 9.2-7, sh. 2


FUEL POOL HEAT EXCHANGER
SEAL RETURN COOLER
SEAL RETURN COOLER
JACKET COOLER
CCW FILTER
CCW FILTER
RB PENET PRESS
TO REACTOR SAMPLE SYSTEM COOLERS
UNIT-2
MCC
MCC
MCC

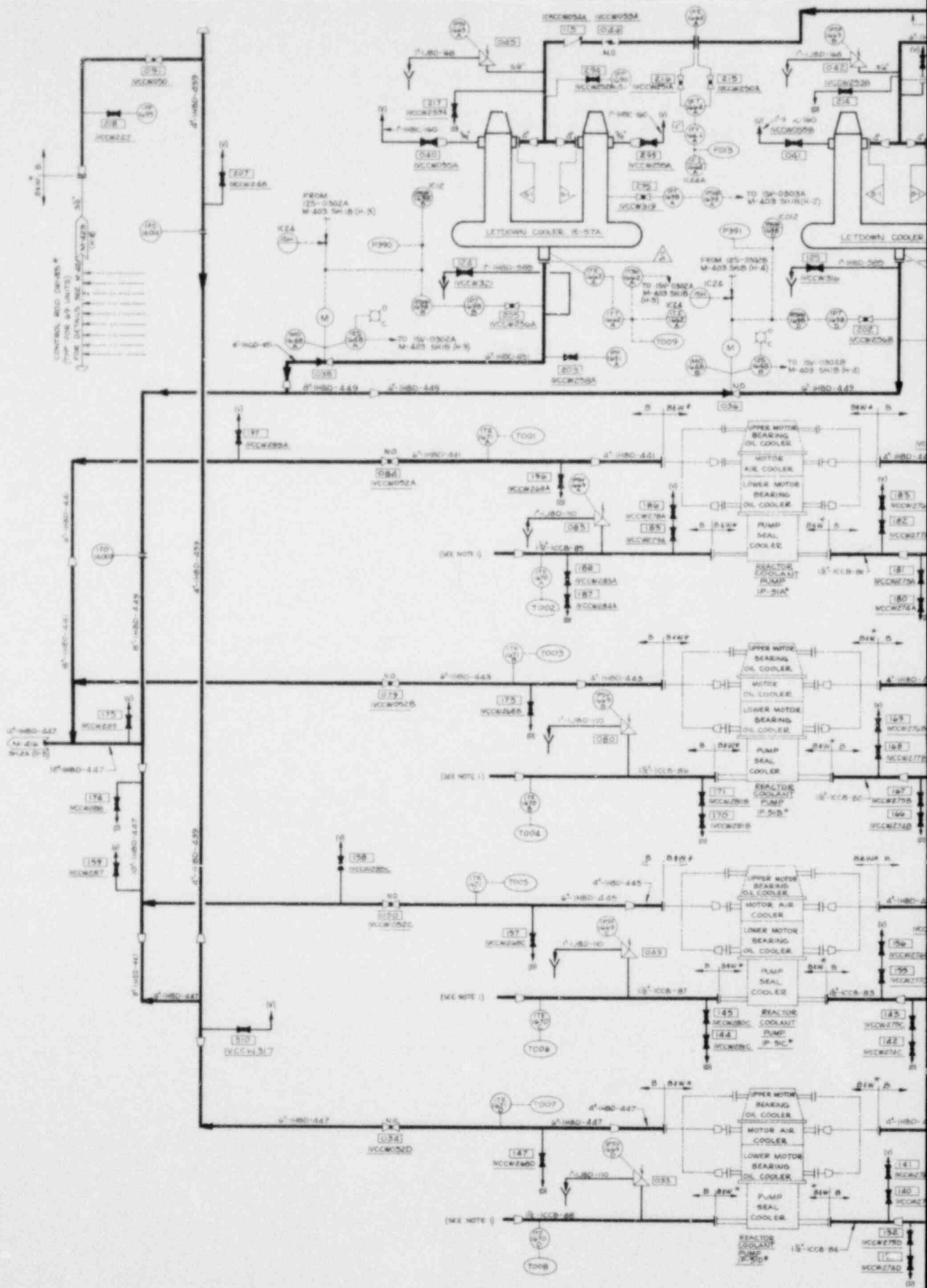


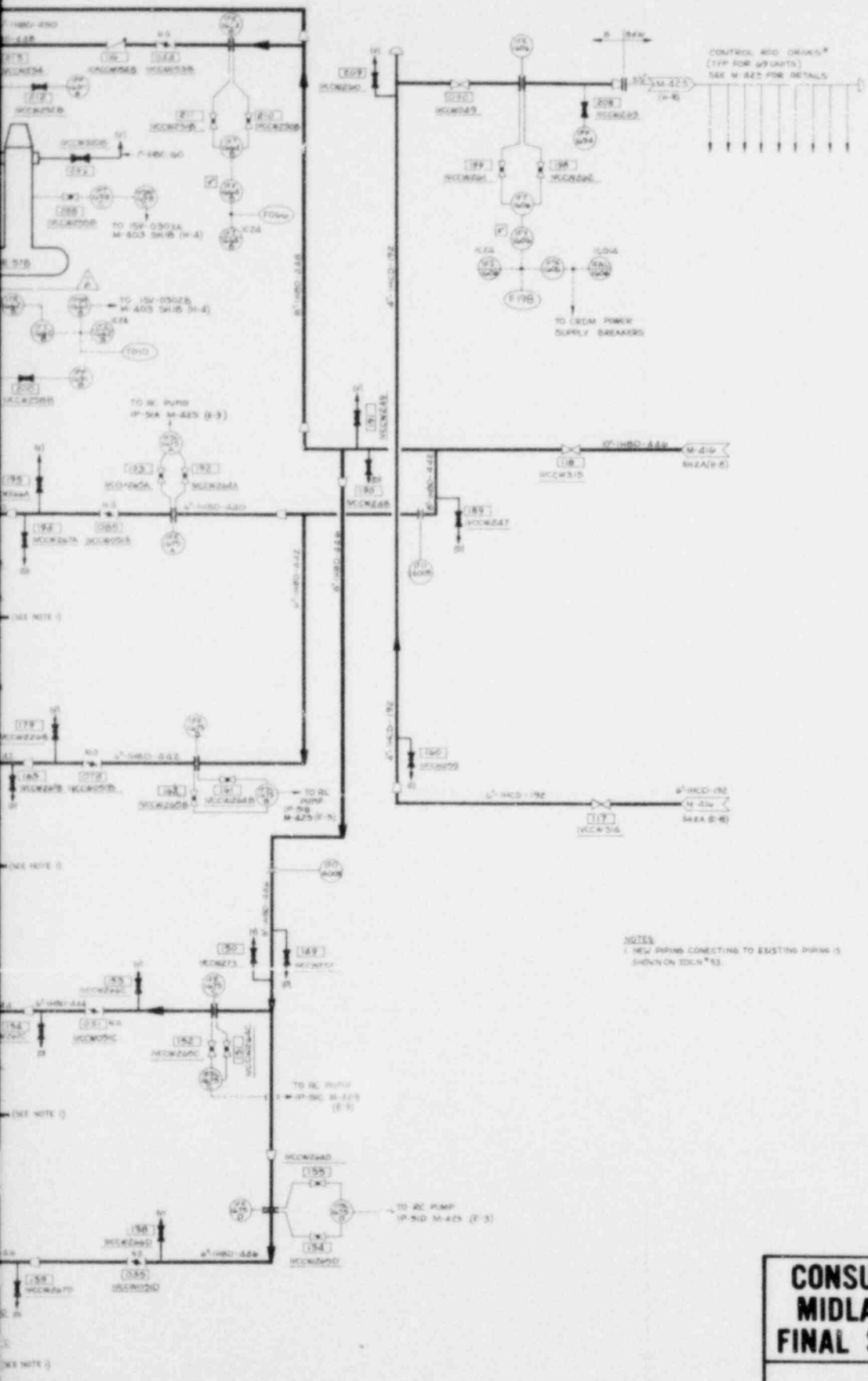
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Component Cooling Water - Unit 1

(M-416 sh 2A, R - 0)

FSAR Figure 9.2-8, sh. 1


LETDOWN COOLER 1B-57A
LETDOWN COOLER
UPPER MOTOR BEARING OIL COOLER
MOTOR AIR COOLER
LOWER MOTOR BEARING OIL COOLER
PUMP SEAL COOLER
REACTOR COOLANT PUMP 1P-51A*
REACTOR COOLANT PUMP 1P-51B*
REACTOR COOLANT PUMP 1P-51C*
REACTOR COOLANT PUMP 1P-51D*
MOTOR OIL COOLER
FROM 1SI-0502A M-403 SH.1B (H-5)
TO 1SI-0502A M-403 SH.1B (H-5)
FROM 1SI-0502B M-403 SH.1B (H-4)
TO 1SI-0502B M-403 SH.1B (H-4)
TO 1SI-0503A M-403 SH.1B (H-1)
CONTROL ROD DRIVES (TYP. FOR #9 UNITS) FOR DETAILS SEE M-402
(SEE NOTE 1)

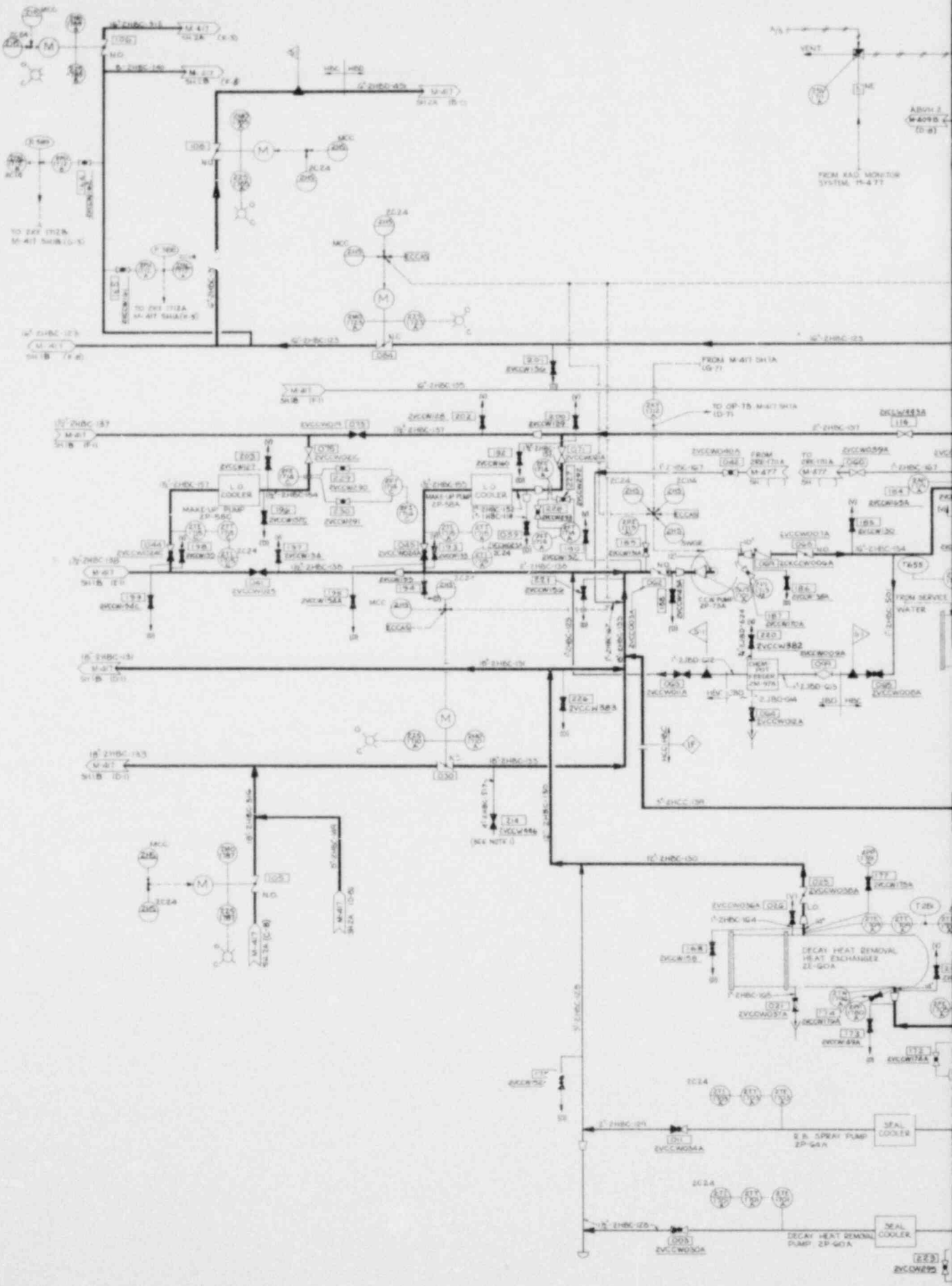


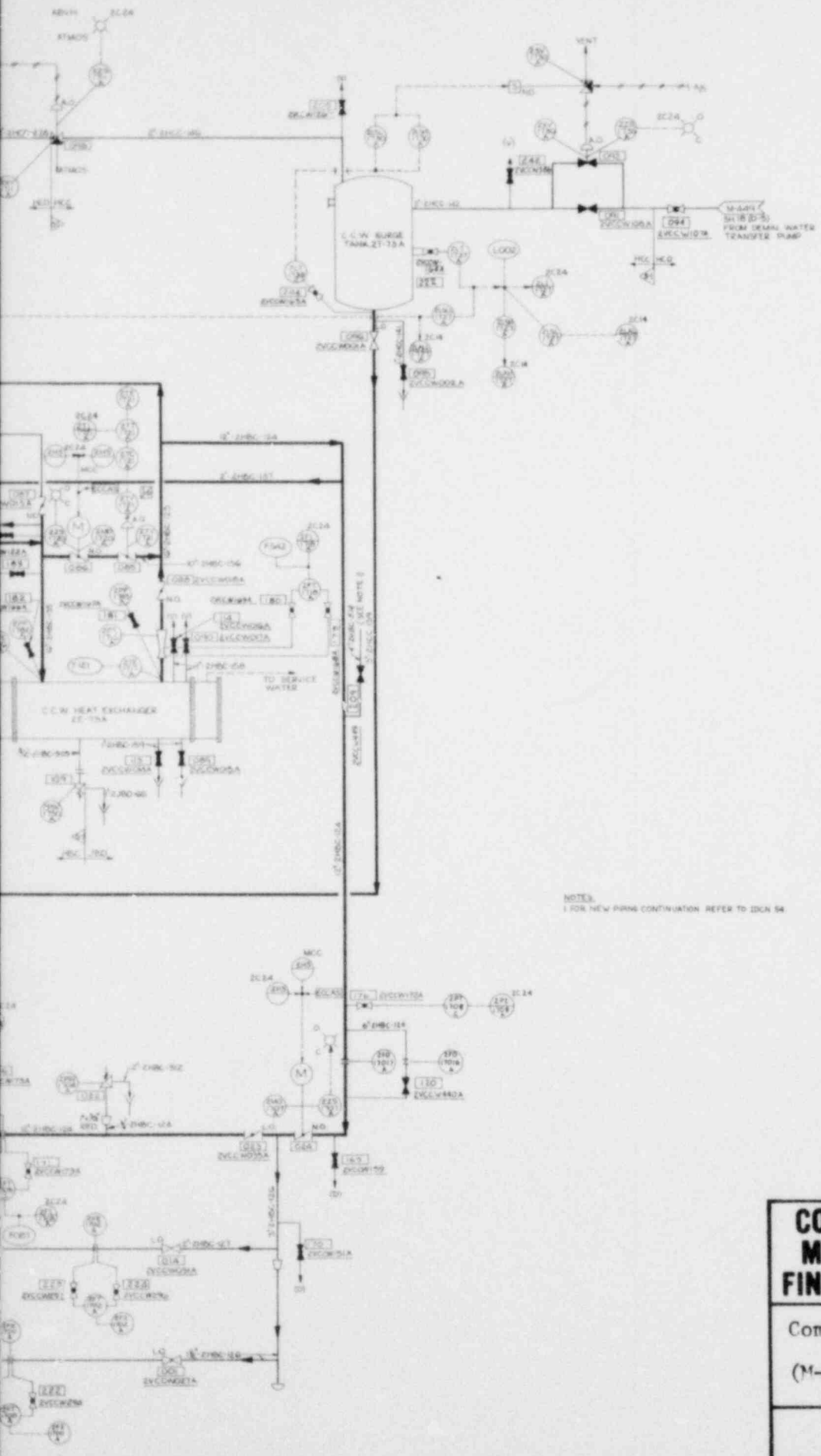
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Component Cooling Water - Unit 1

(M-416 sh 2B, Rev 0)

FSAR Figure 9.2-8, sh. 2


LO COOLER
MAKE-UP PUMP ZP-58A
DECAY HEAT REMOVAL HEAT EXCHANGER ZE-60A
SEAL COOLER
RB SPRAY PUMP ZP-64A
DECAY HEAT REMOVAL PUMP ZP-60A
FROM RADIATION MONITOR SYSTEM, M-477
FROM SERVICE WATER
TO OP-TR M-417 SH 1A
FROM M-417 SH 1A

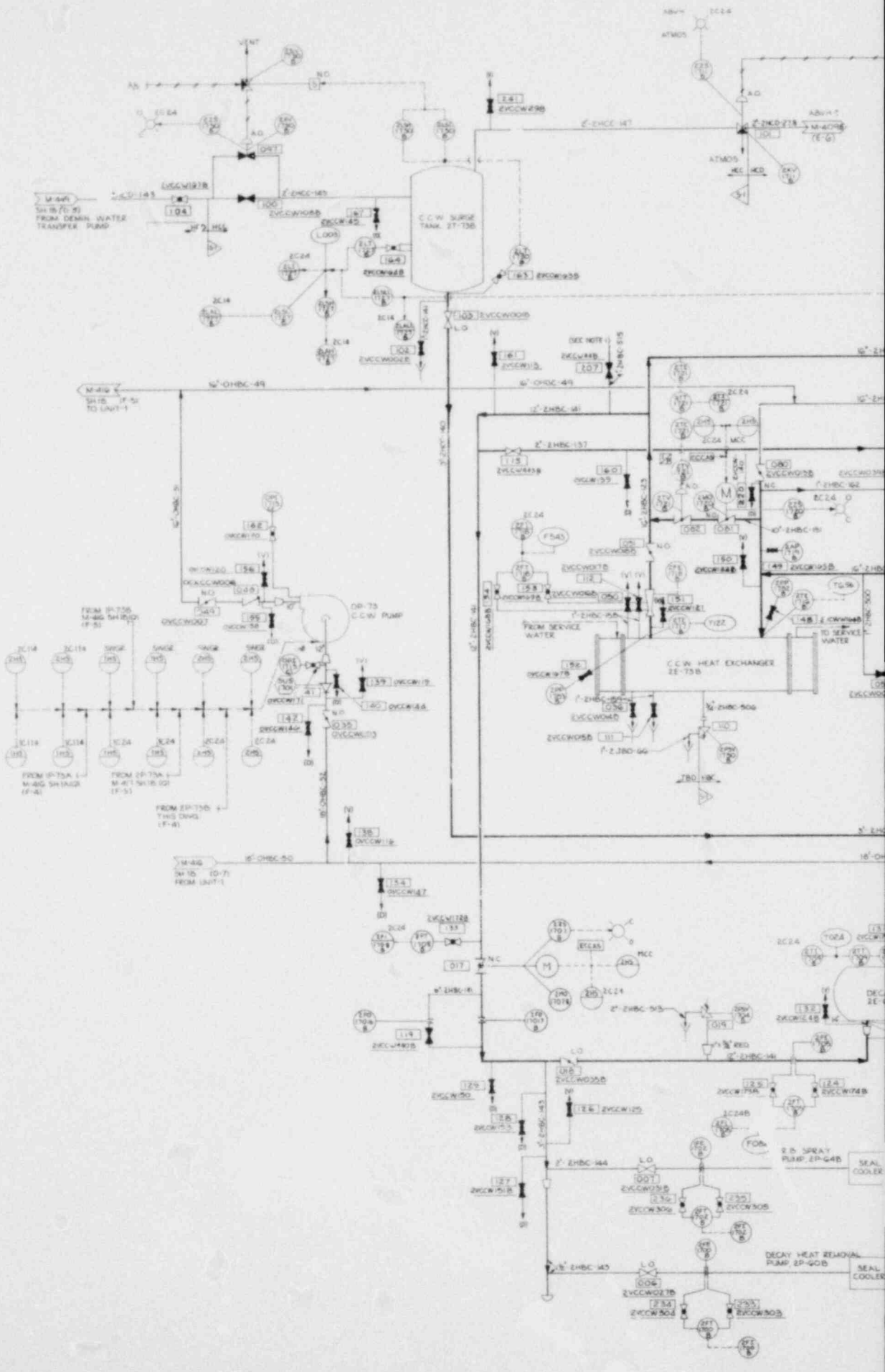


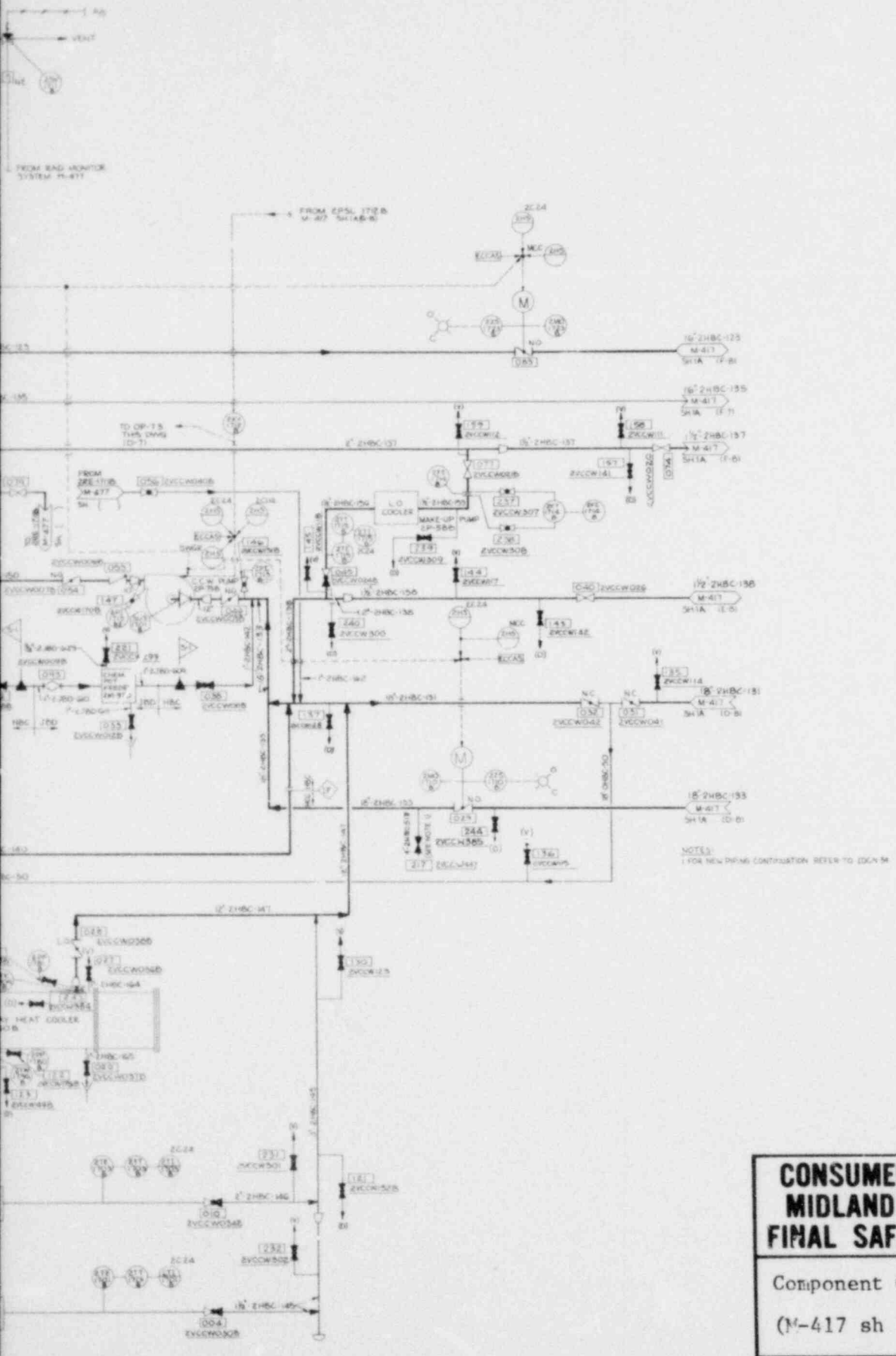
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Component Cooling Water - Unit 2

(M-417 sh 1A, Rev 0)

FSAR Figure 9.2-9, sh. 1


C.C.W. SURGE TANK 2T-73B
FROM DEMIN. WATER TRANSFER PUMP
M-44A SH 18 (D-5)
2WCCW-145
2WCCW108B
2WCCW-140
2WCCW-142
2WCCW-141
2WCCW-144
2WCCW-143
2WCCW-139
2WCCW-138
2WCCW-137
2WCCW-136
2WCCW-135
2WCCW-134
2WCCW-133
2WCCW-132
2WCCW-131
2WCCW-130
2WCCW-129
2WCCW-128
2WCCW-127
2WCCW-126
2WCCW-125
2WCCW-124
2WCCW-123
2WCCW-122
2WCCW-121
2WCCW-120
2WCCW-119
2WCCW-118
2WCCW-117
2WCCW-116
2WCCW-115
2WCCW-114
2WCCW-113
2WCCW-112
2WCCW-111
2WCCW-110
2WCCW-109
2WCCW-108
2WCCW-107
2WCCW-106
2WCCW-105
2WCCW-104
2WCCW-103
2WCCW-102
2WCCW-101
2WCCW-100

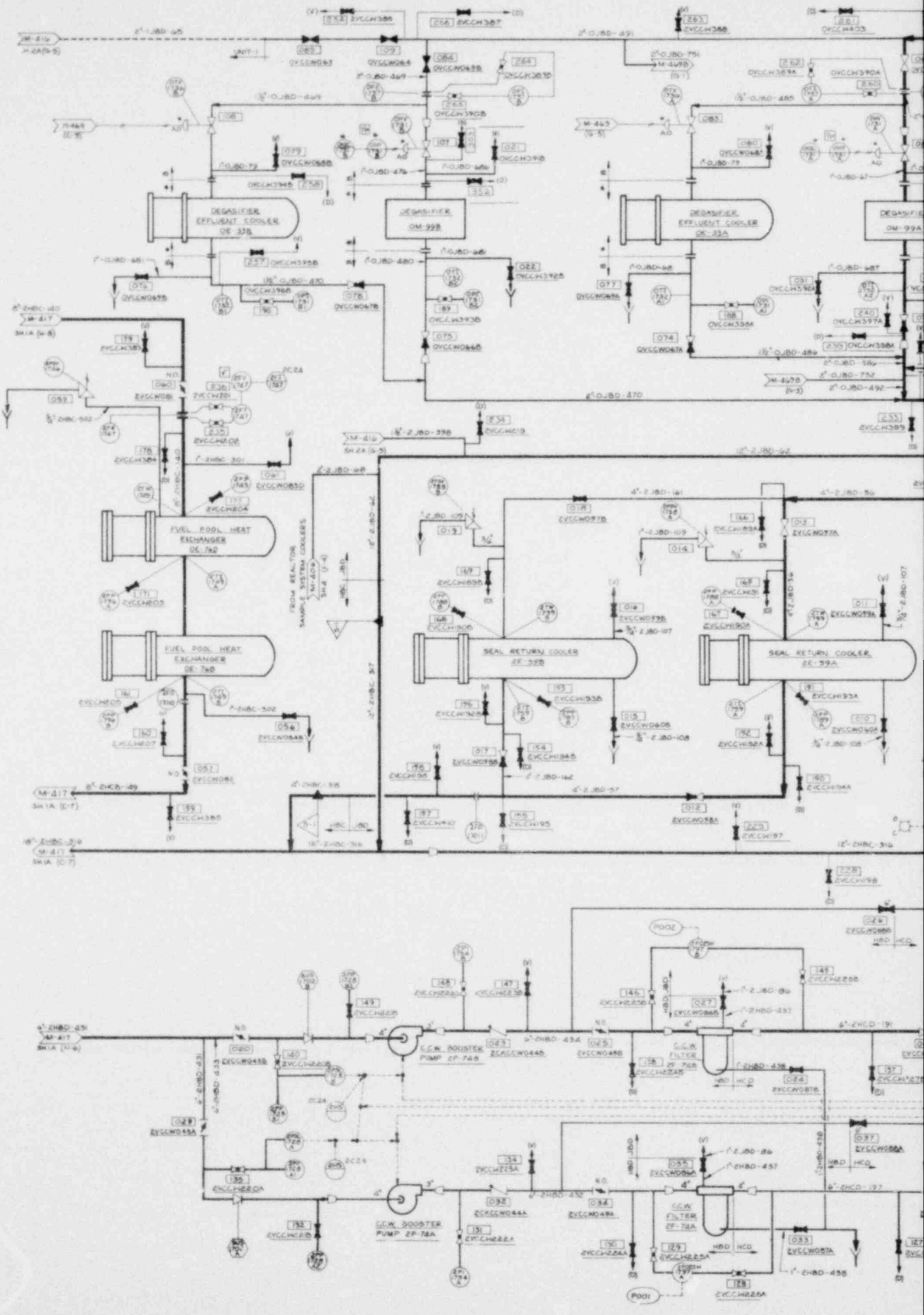


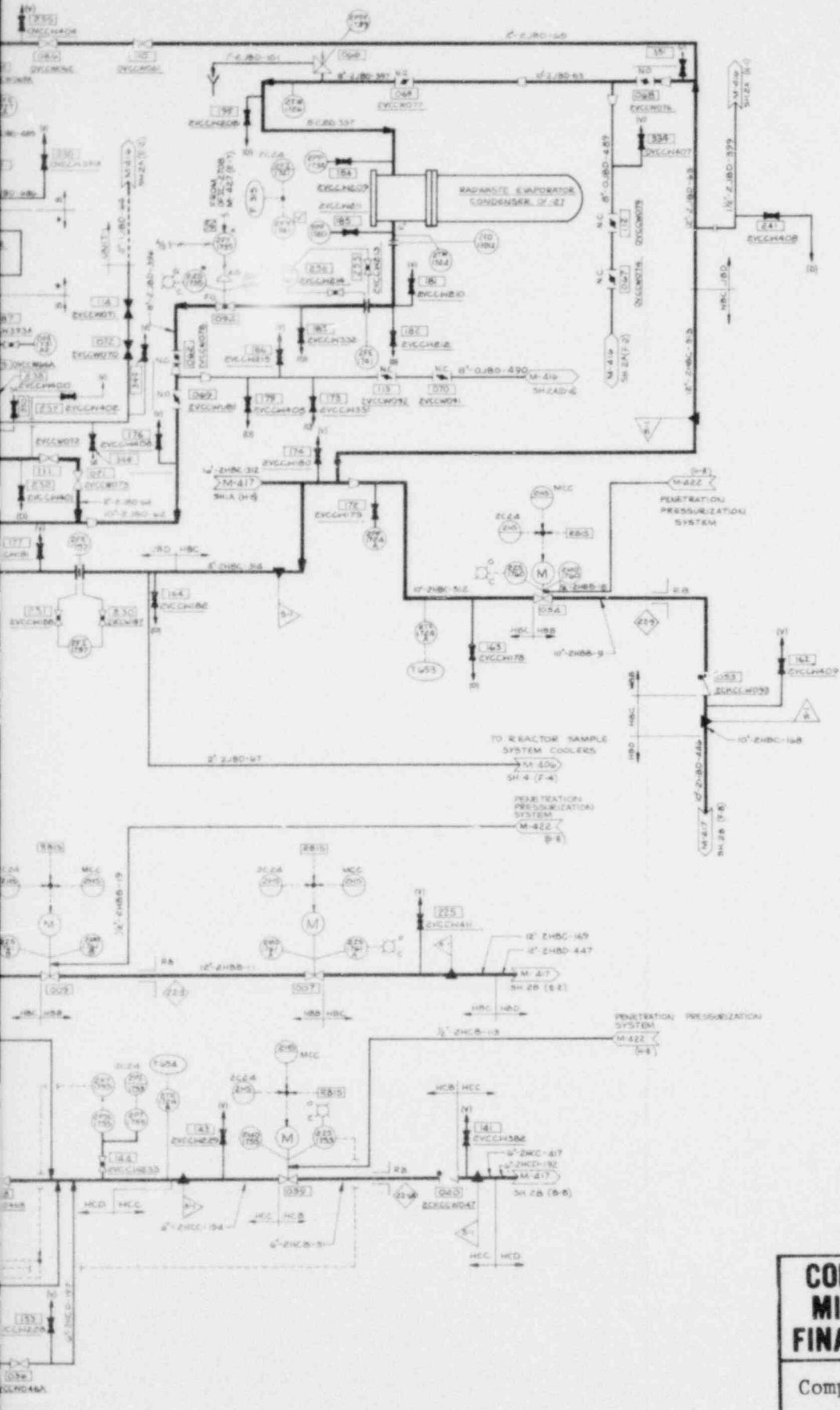
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Component Cooling Water - Unit 2

(M-417 sh 1B, Rev 0)

FSAR Figure 9.2-9, sh. 2


DEGASIFIER EFFLUENT COOLER ZE-33B
DEGASIFIER ZM-99B
DEGASIFIER EFFLUENT COOLER ZE-33A
FUEL POOL HEAT EXCHANGER ZE-76B
FUEL POOL HEAT EXCHANGER ZE-76B
SEAL RETURN COOLER ZE-39B
SEAL RETURN COOLER ZE-39A
C.C.W. BOOSTER PUMP ZP-76B
C.C.W. FILTER ZF-76B
C.C.W. BOOSTER PUMP ZP-76A
C.C.W. FILTER ZF-76A
FROM REACTOR SAMPLE SYSTEM COOLERS
P002
P001

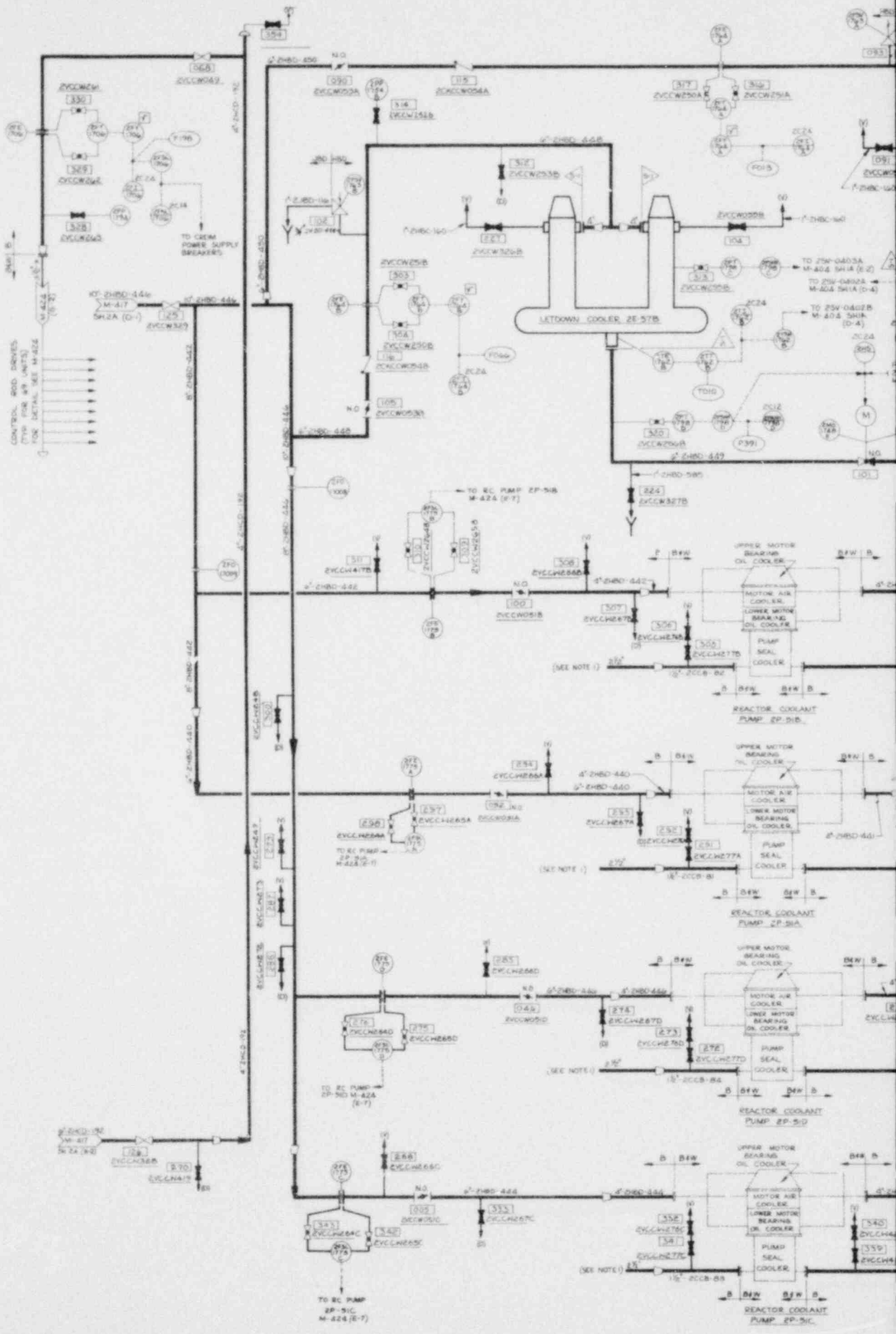


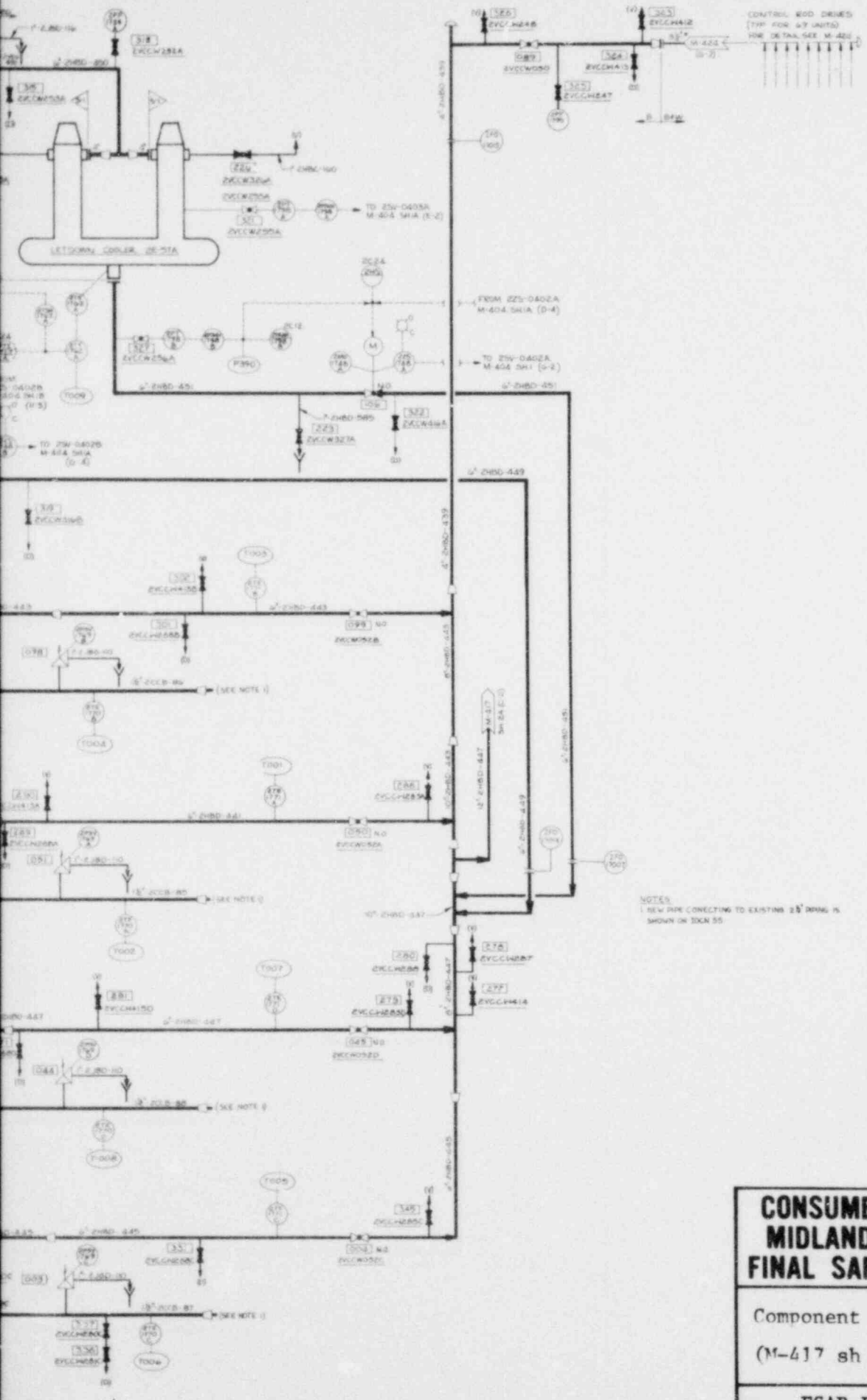
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Component Cooling Water - Unit 2

(M-417 sh 2A, Rev 0)

FSAR Figure 9.2-10, sh. 1


LETDOWN COOLER 2E-57B
REACTOR COOLANT PUMP 2P-51B
REACTOR COOLANT PUMP 2P-51A
REACTOR COOLANT PUMP 2P-51D
REACTOR COOLANT PUMP 2P-51C
UPPER MOTOR BEARING OIL COOLER
MOTOR AIR COOLER
LOWER MOTOR BEARING OIL COOLER
PUMP SEAL COOLER
CONTROL ROD DRIVES (TYP FOR 69 UNITS) FOR DETAIL SEE M-424
TO CREM POWER SUPPLY BREAKERS
TO RC PUMP 2P-51B M-424 (F-7)
TO RC PUMP 2P-51A M-424 (E-1)
TO RC PUMP 2P-51D M-424 (E-7)
TO RC PUMP 2P-51C M-424 (E-7)
TO 2SV-0403A M-404 SH1A (E-2)
TO 2SV-0402A M-404 SH1A (D-4)
TO 2SV-0402B M-404 SH1A (D-4)
(SEE NOTE 1)

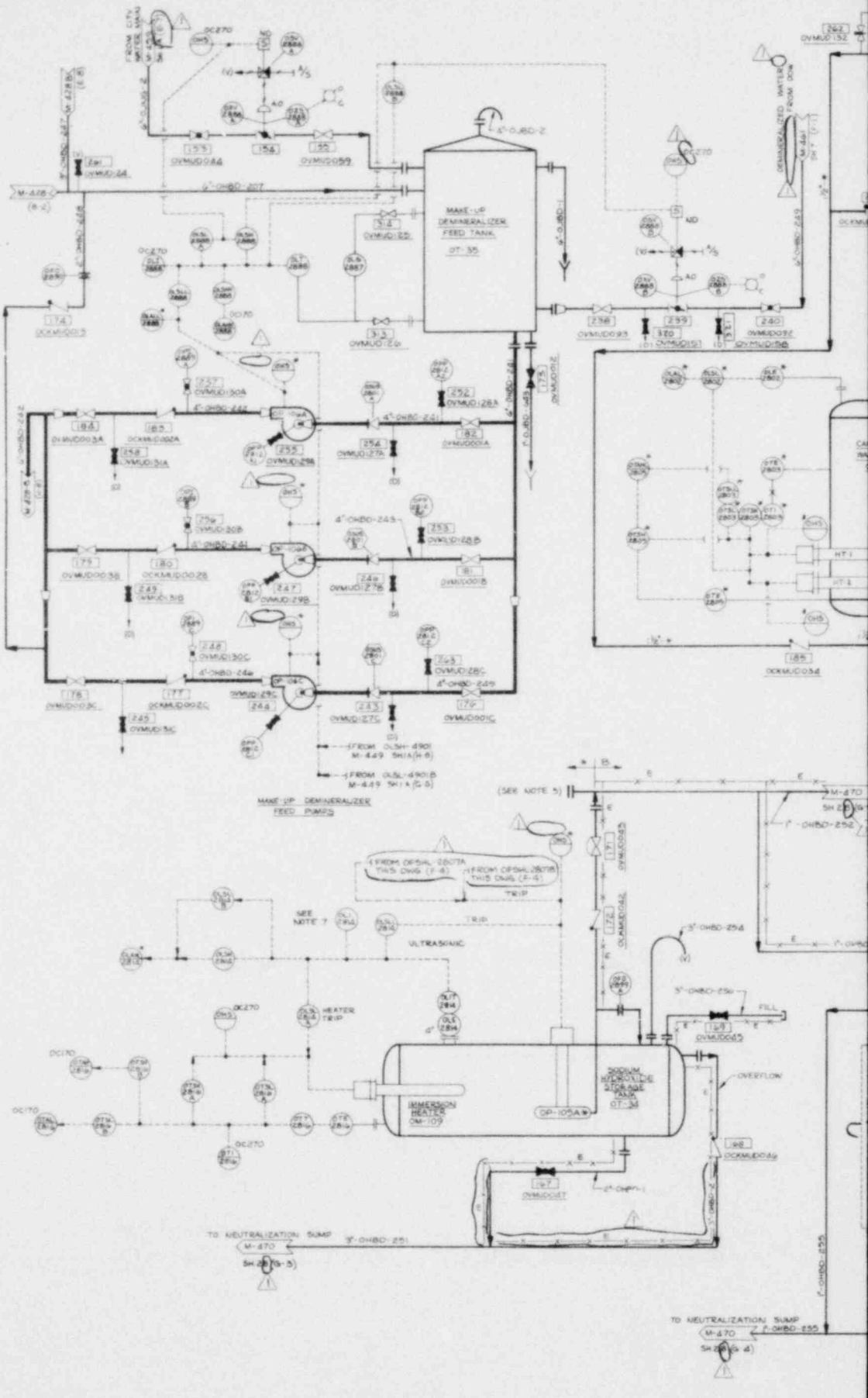


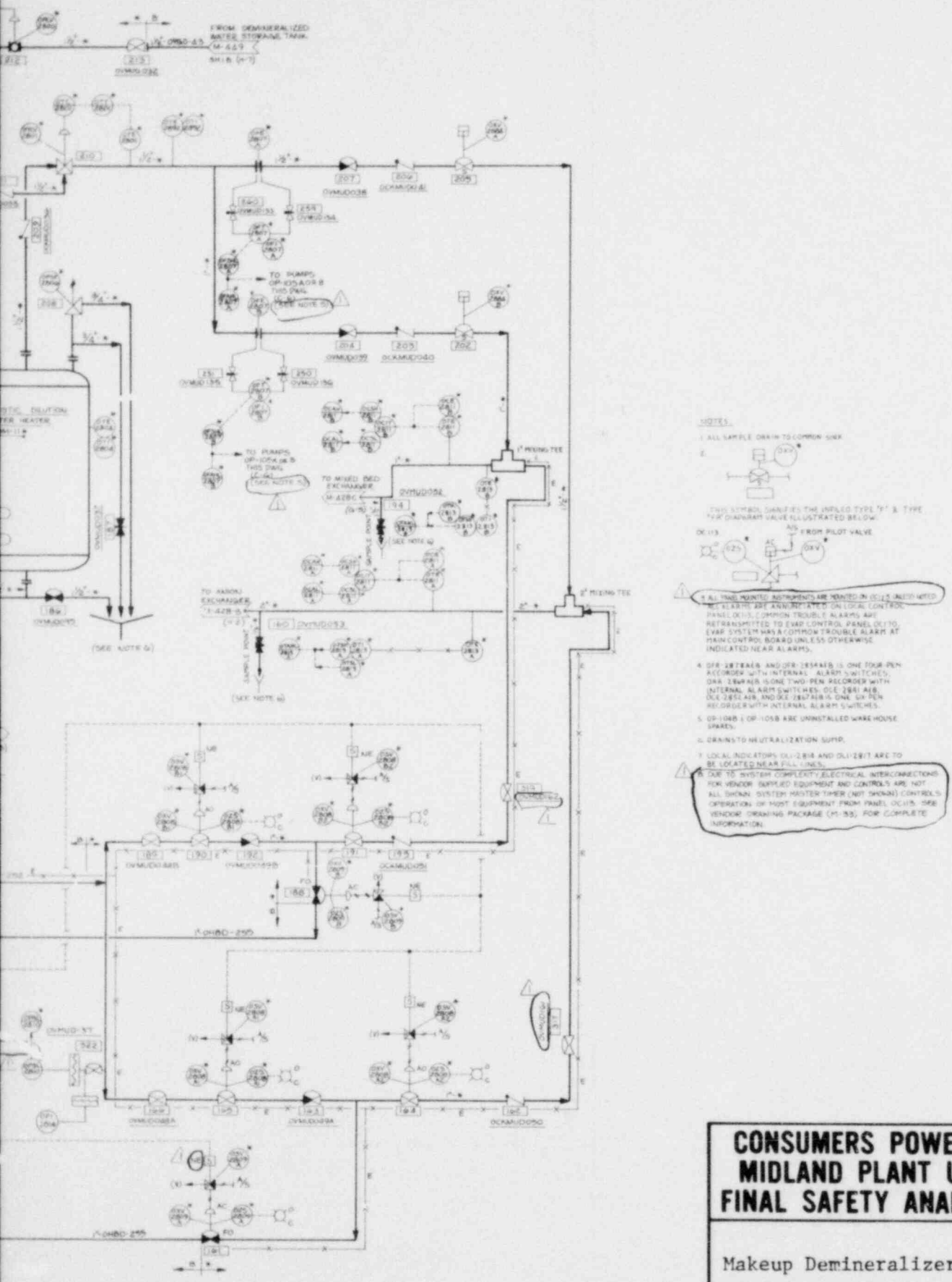
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Component Cooling Water - Unit 2

(M-417 sh 2B, Rev 0)

FSAR Figure 9.2-10, sh. 2

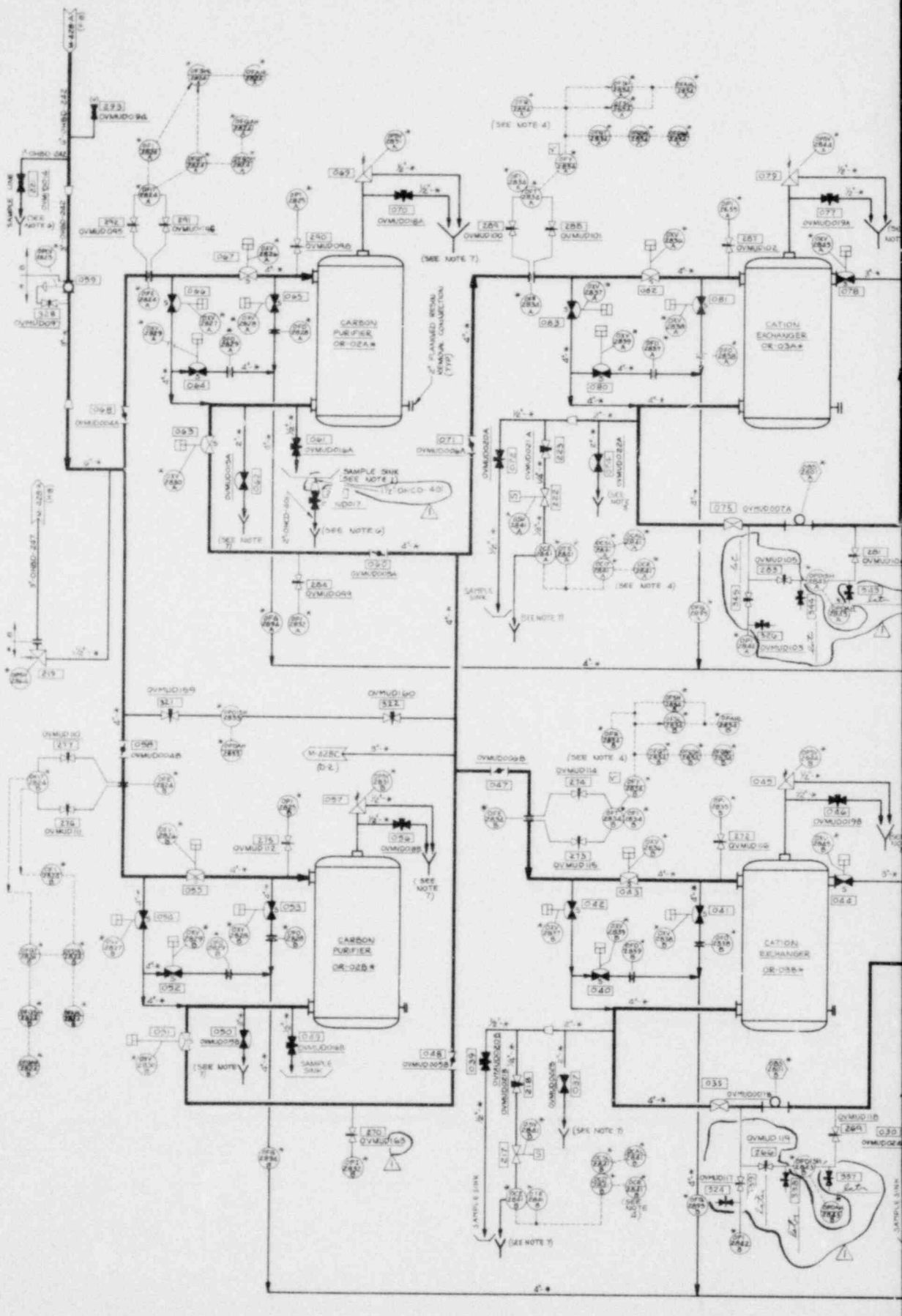

MAKE-UP DEMINERALIZER FEED TANK DT-35
DEMINERALIZED WATER FROM DCW
MAKE UP DEMINERALIZER FEED PUMPS
FROM OFSAL-28077A THIS DWG (F-8)
FROM OFSAL-28078 THIS DWG (F-4)
TRIP
SEE NOTE 7
ULTRASONIC
HEATER TRIP
IMMERSION HEATER 0M-109
SODIUM HYDROXIDE STORAGE TANK DT-34
OP-105A
OVERFLOW
FILL
TO NEUTRALIZATION SUMP
M-670
(SEE NOTE 5)
FROM OLSH-4901 M-449 SH1A (H-8)
FROM OLSL-4901B M-449 SH1A (G-8)

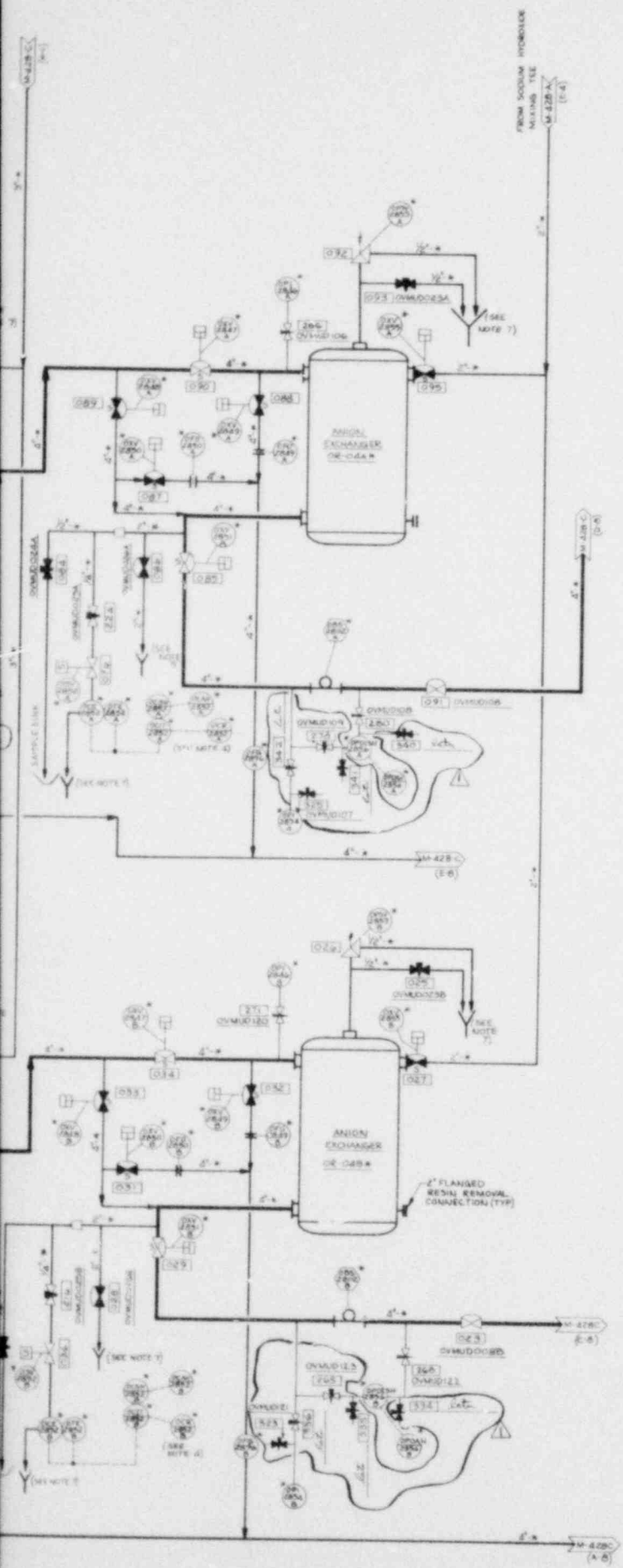


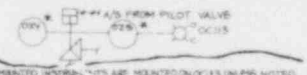
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Makeup Demineralizer
(M-428A, Rev 1)

FSAR Figure 9.2-11, sh. 1


CARBON PURIFIER OR-02A*
CATION EXCHANGER OR-03A*
CARBON PURIFIER OR-02B*
CATION EXCHANGER OR-03B*
SAMPLE SINK
(SEE NOTE 4)
(SEE NOTE 7)



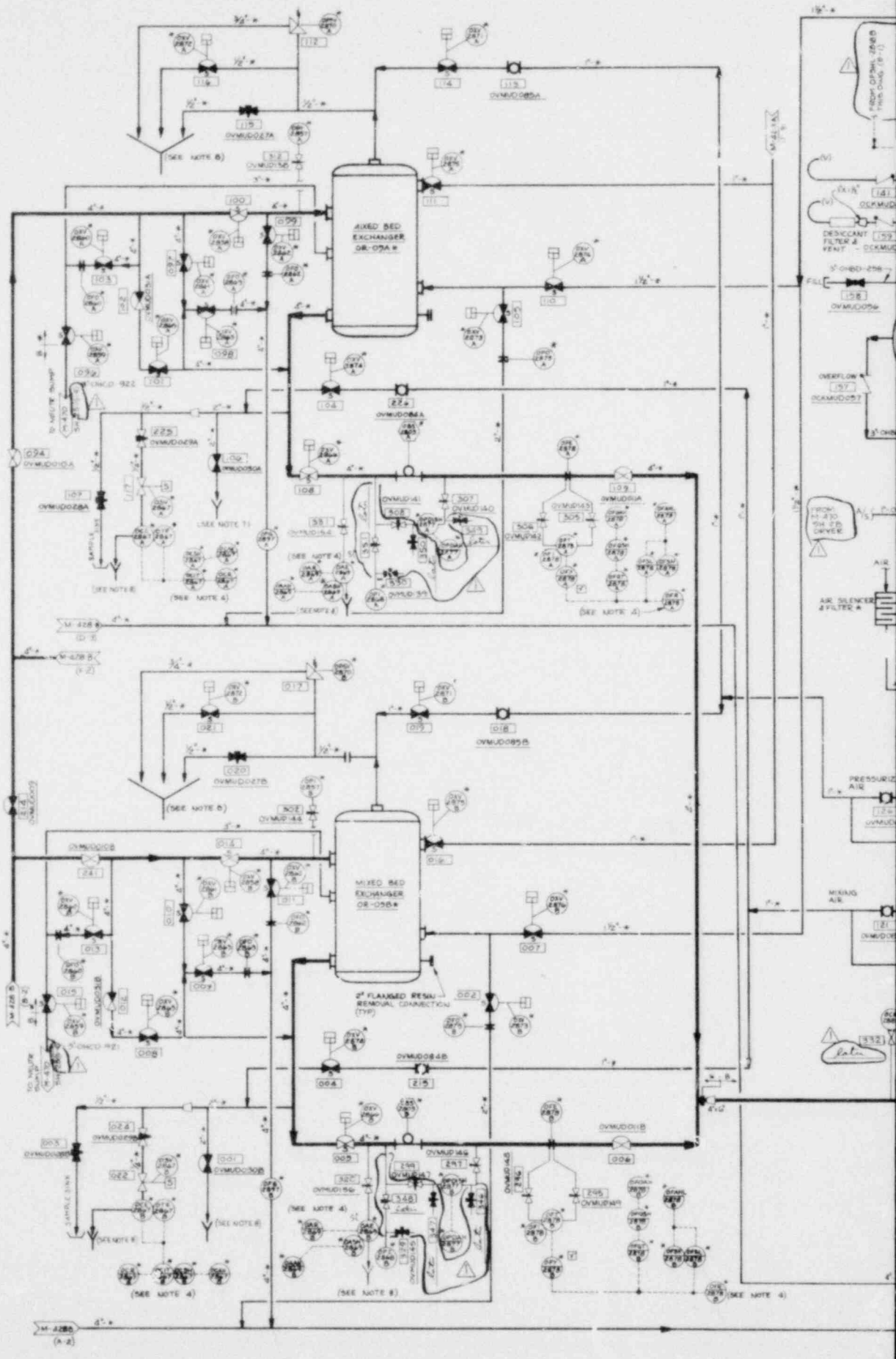
NOTES:
1. ALL SAMPLE LINES DRAIN TO COMMON SINK.
2.
THIS SYMBOL SIGNIFIES THE INFILCO TYPE 'P' & TYPE 'PX' DIAPHRAGM VALVE ILLUSTRATED BELOW.


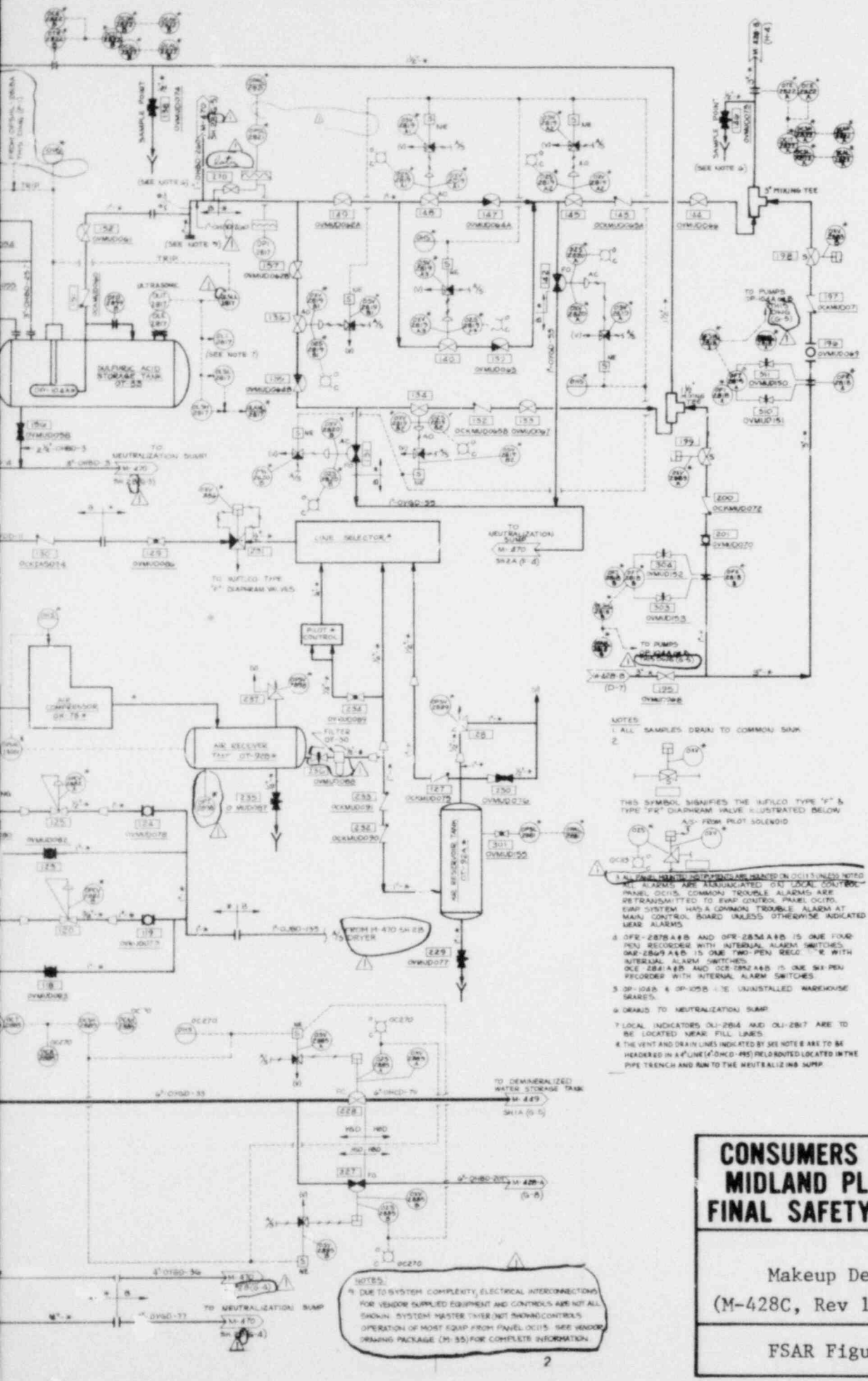
3. ALL PANEL MOUNTED INSTRUMENTS ARE MOUNTED ON OC13 UNLESS NOTED. ALL ALARMS ARE ANNUNCIATED ON LOCAL CONTROL PANEL OC13. COMMON TROUBLE ALARMS ARE RETRANSMITTED TO EVAP CONTROL PANEL OC17D. EVAP SYSTEM HAS A COMMON TROUBLE ALARM AT MAIN CONTROL BOARD UNLESS OTHERWISE INDICATED NEAR ALARMS.
4. QFR-1878A & B AND QFR-2834A & B IS ONE FOUR-PEN RECORDER WITH INTERNAL ALARM SWITCHES. QAR-2869 A & B IS ONE TWO PEN RECORDER WITH INTERNAL ALARM SWITCHES.
5. DP-1048 & DP-1058 ARE UNINSTALLED WAREHOUSE SPARES.
6. DRAINS TO NEUTRALIZATION SUMP.
7. THE VENT AND DRAIN LINES INDICATED BY SEE NOTE 7 ARE TO BE HEADERED IN A 4" LINE (4"-DHCD-495) FIELD ROUTED LOCATED IN THE TRENCH AND RUN TO THE NEUTRALIZING SUMP. THE SAMPLE SINK DRAIN LINE 2"-DHCD-401 WILL CONNECT TO 4"-DHCD-495 HEADER.
8. DUE TO SYSTEM COMPLEXITY, ELECTRICAL INTERCONNECTIONS FOR VENDOR SUPPLIED EQUIPMENT AND CONTROLS ARE NOT ALL SHOWN. SYSTEM MASTER TIMER (NOT SHOWN) CONTROLS OPERATION OF MOST EQUIPMENT FROM PANEL OC13. SEE VENDOR DRAWING PACKAGE (M-35) FOR COMPLETE INFORMATION.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Makeup Demineralizer
(M-428B, Rev 1)

FSAR Figure 9.2-11, sh. 2

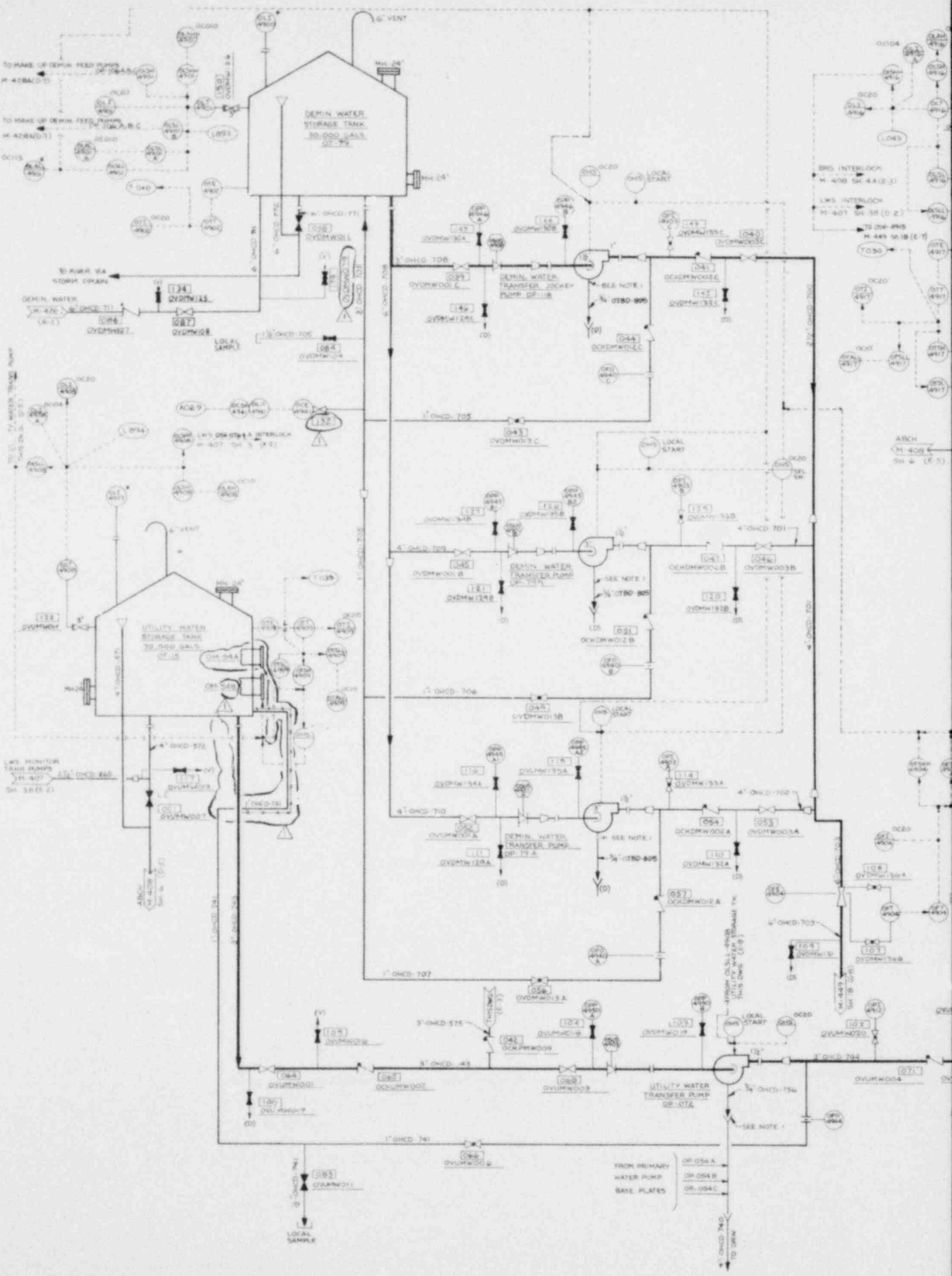

MIXED BED EXCHANGER OR-058A
MIXED BED EXCHANGER OR-058B
2" FLANGED RESIN REMOVAL CONNECTION (TYP)
(SEE NOTE 4)
(SEE NOTE 5)
(SEE NOTE 6)
(SEE NOTE 8)
TO WASTE PUMP
SAMPLE SINK
AIR SILENCER & FILTER A
PRESSURIZING AIR
MIXING AIR

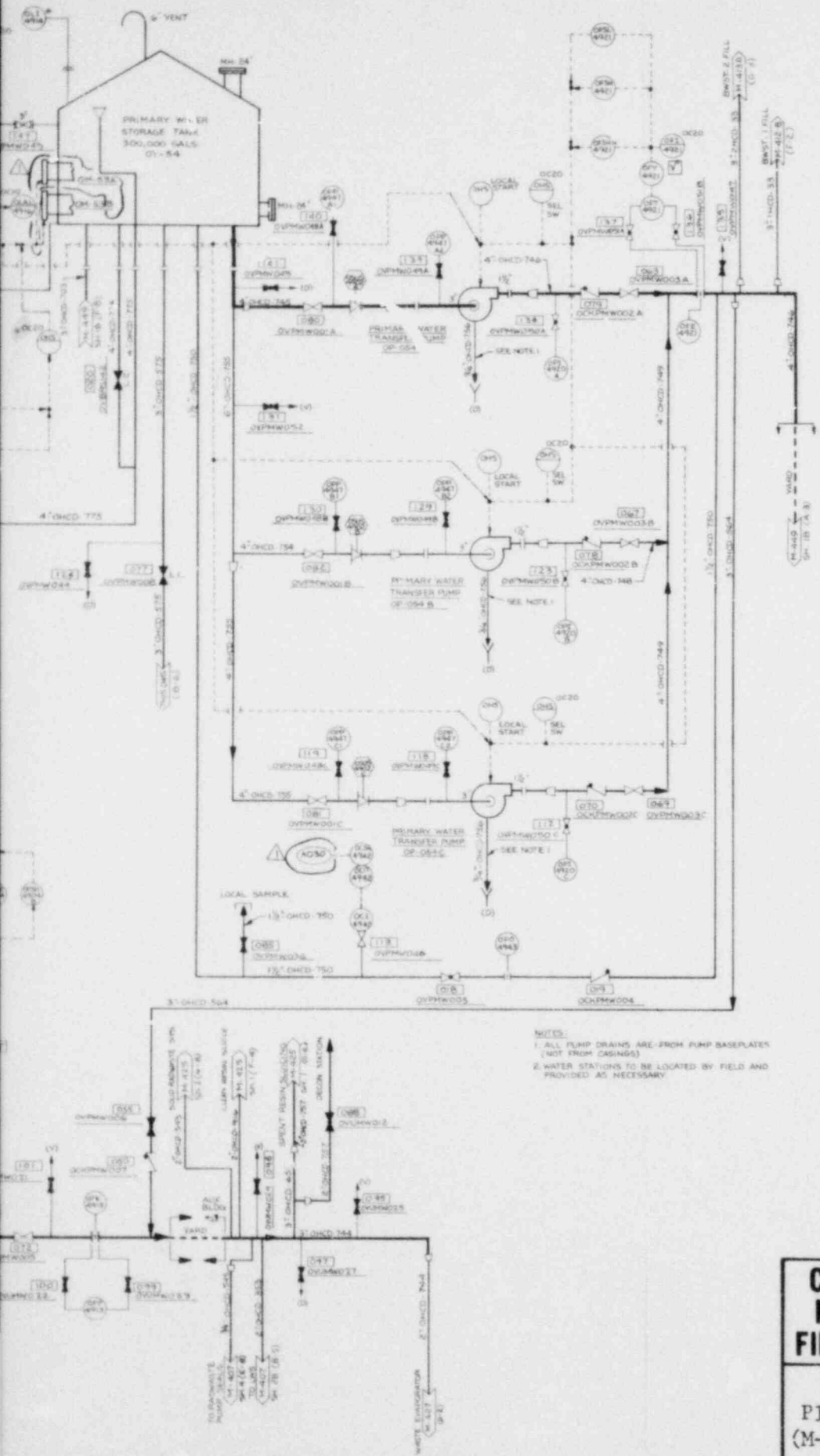


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Makeup Demineralizer
(M-428C, Rev 1)

FSAR Figure 9.2-11, sh. 3

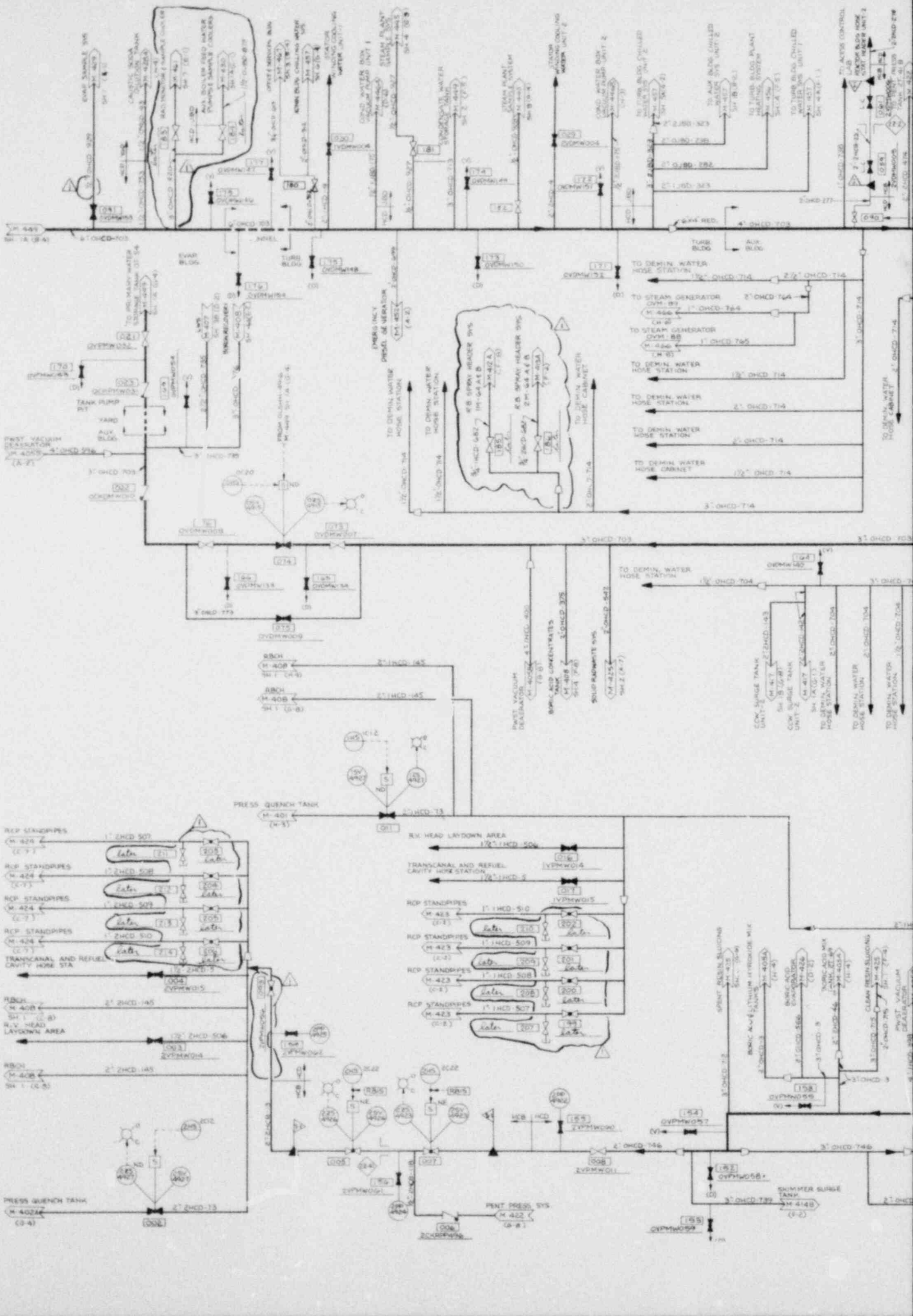

DEMIN. WATER STORAGE TANK 30,000 GALS OP-19
UTILITY WATER STORAGE TANK 70,000 GALS OP-15
DEMIN. WATER TRANSFER JOCKEY PUMP OP-18
DEMIN. WATER TRANSFER PUMP OP-19A
DEMIN. WATER TRANSFER PUMP OP-19B
UTILITY WATER TRANSFER PUMP OP-17A
6" VENT
TO RIVER VIA STORM DRAIN
LOCAL SAMPLE
TO DRW
FROM PRIMARY WATER PUMP BASE PLATES OP-054A OP-054B OP-054C
SEE NOTE 1
LOCAL START

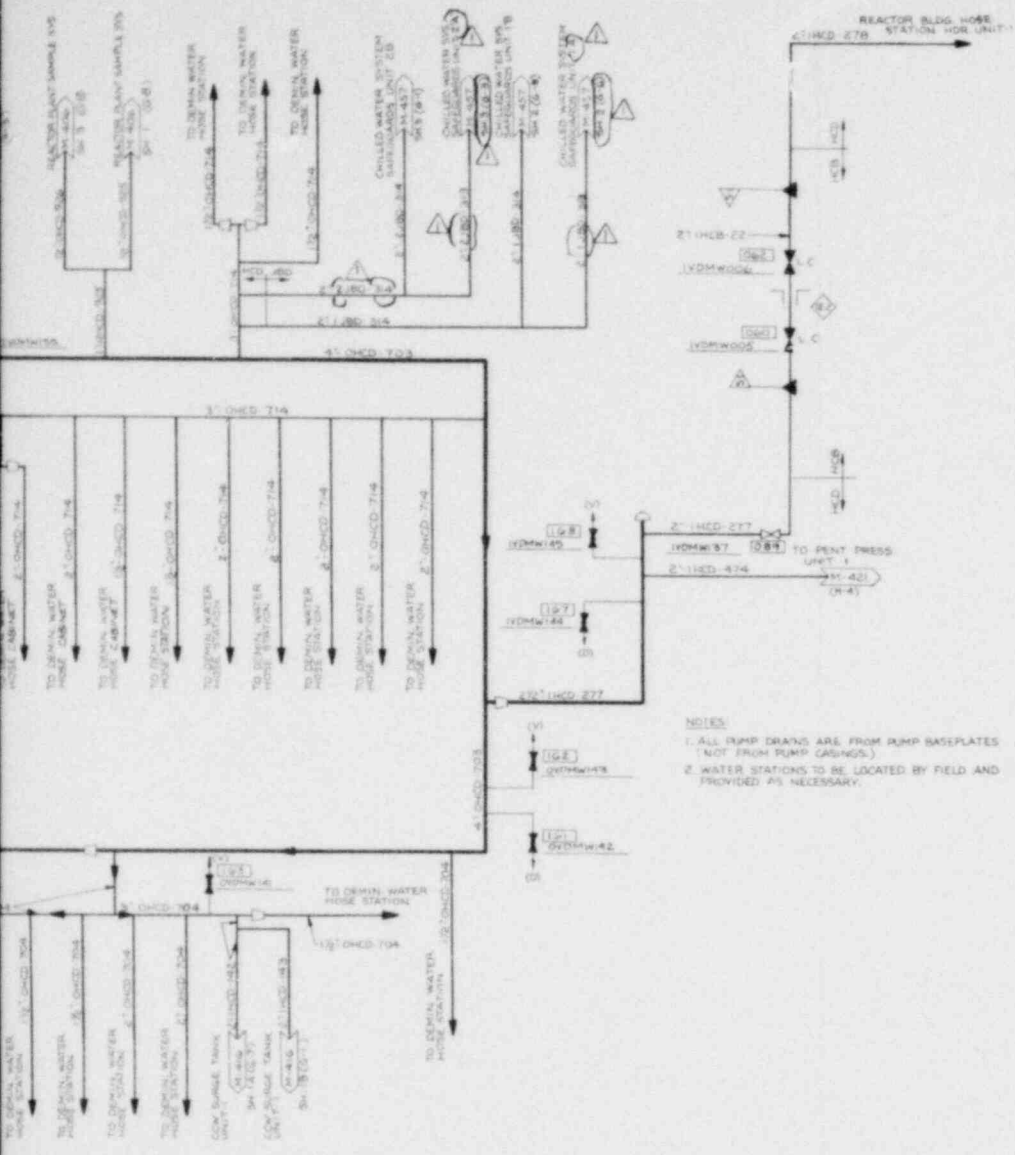


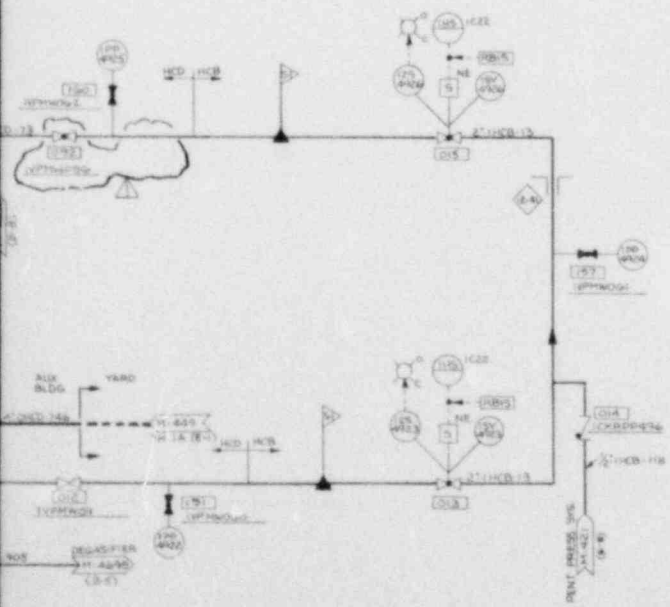
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Plant Water Storage & Transfer
(M-449 sh 1A, Rev 1)

FSAR Figure 9.2-18, sh. 1


TO DEMIN. WATER HOSE STATION
TO STEAM GENERATOR
TO DEMIN. WATER HOSE CABINET
TANK PUMP PIT
YARD
AUX. BLDG.
PRESS. QUENCH TANK
RCP STANDPIPES
R.V. HEAD LAYDOWN AREA
TRANSCANAL AND REFUEL. CAVITY HOSE STA.
PENT. PRESS. SYS.
SKIMMER SURGE TANK

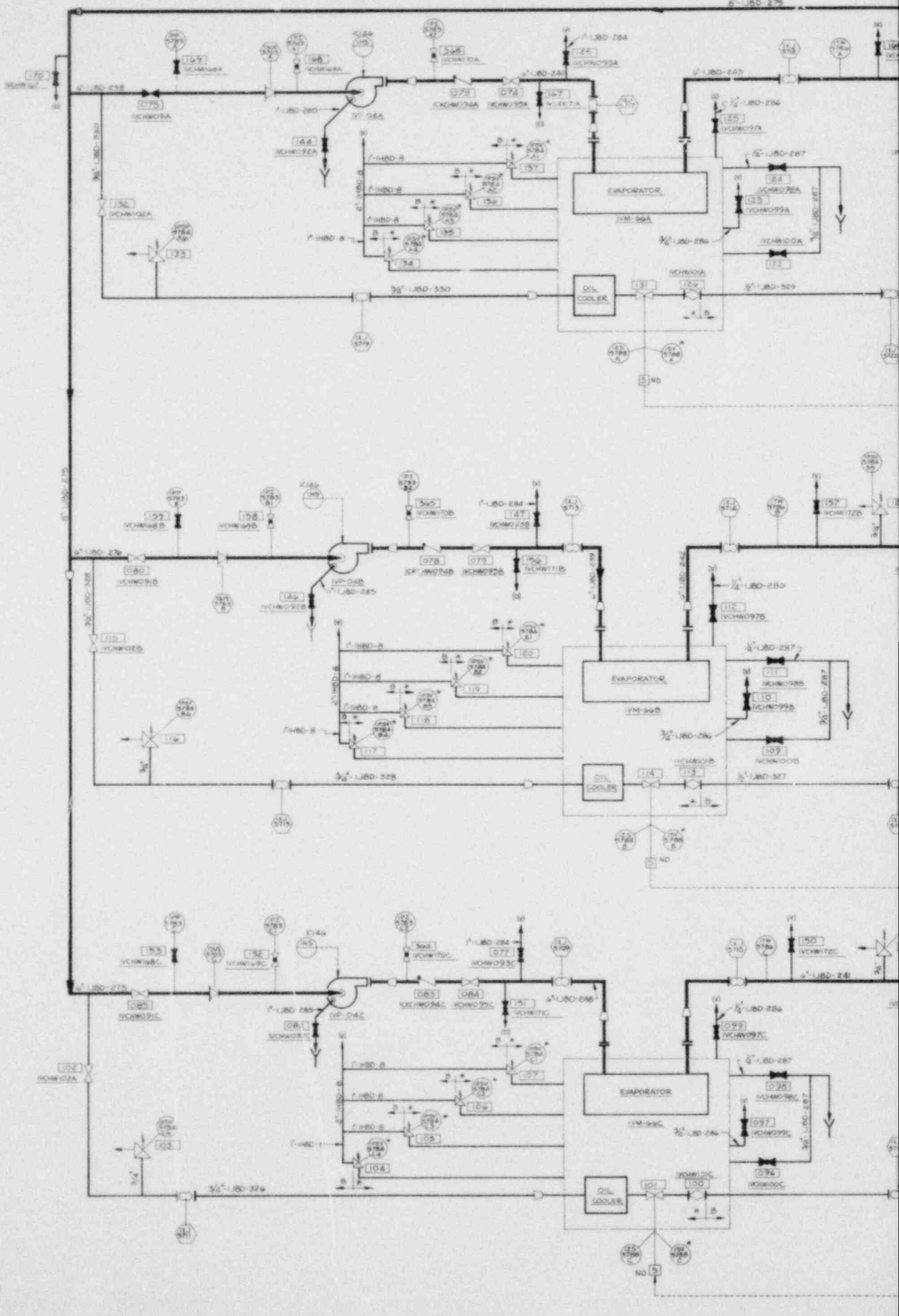


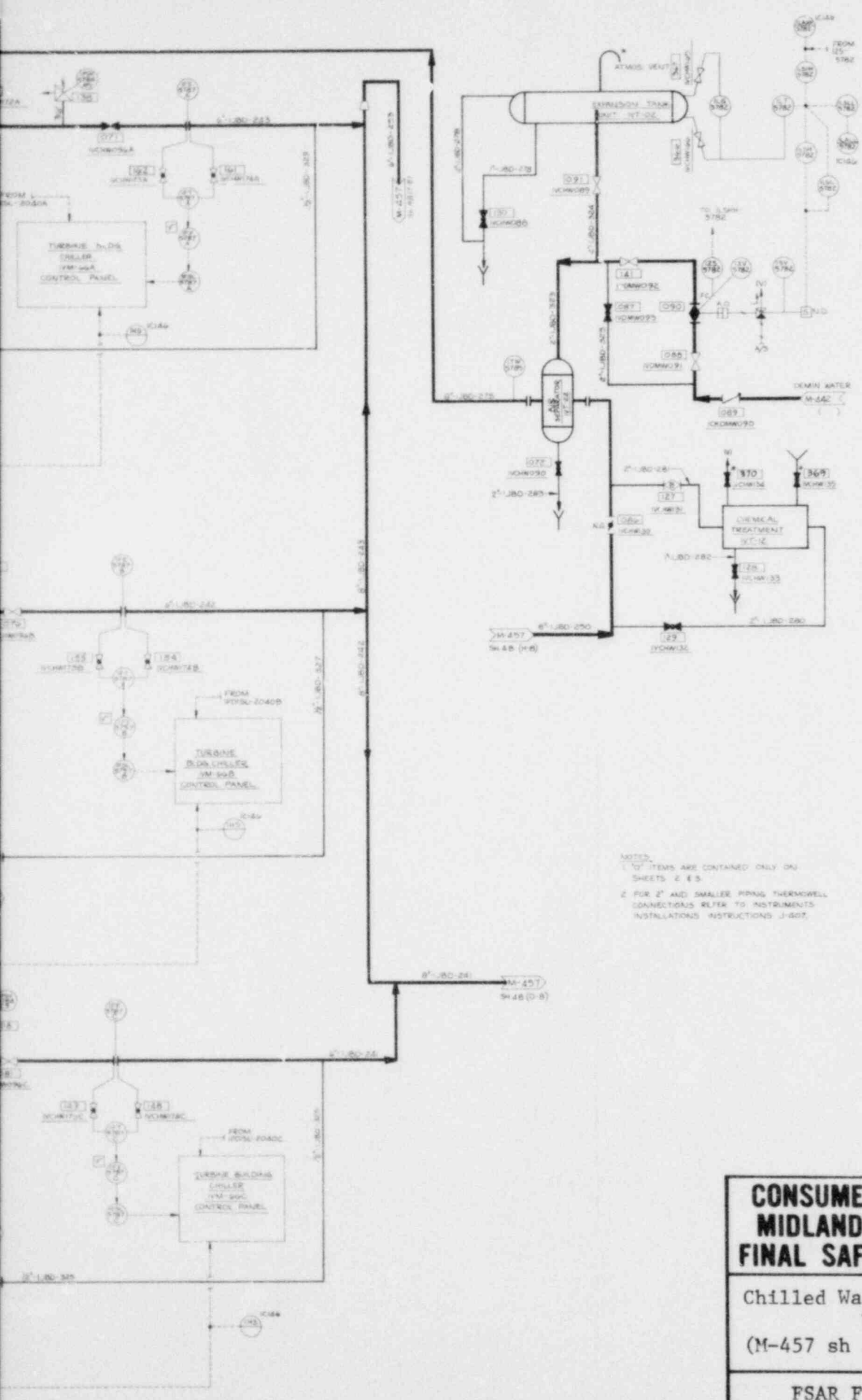


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Plant Water Storage & Transfer
(M-449 sh 1B, Rev 1)

FSAR Figure 9.2-18, sh. 2

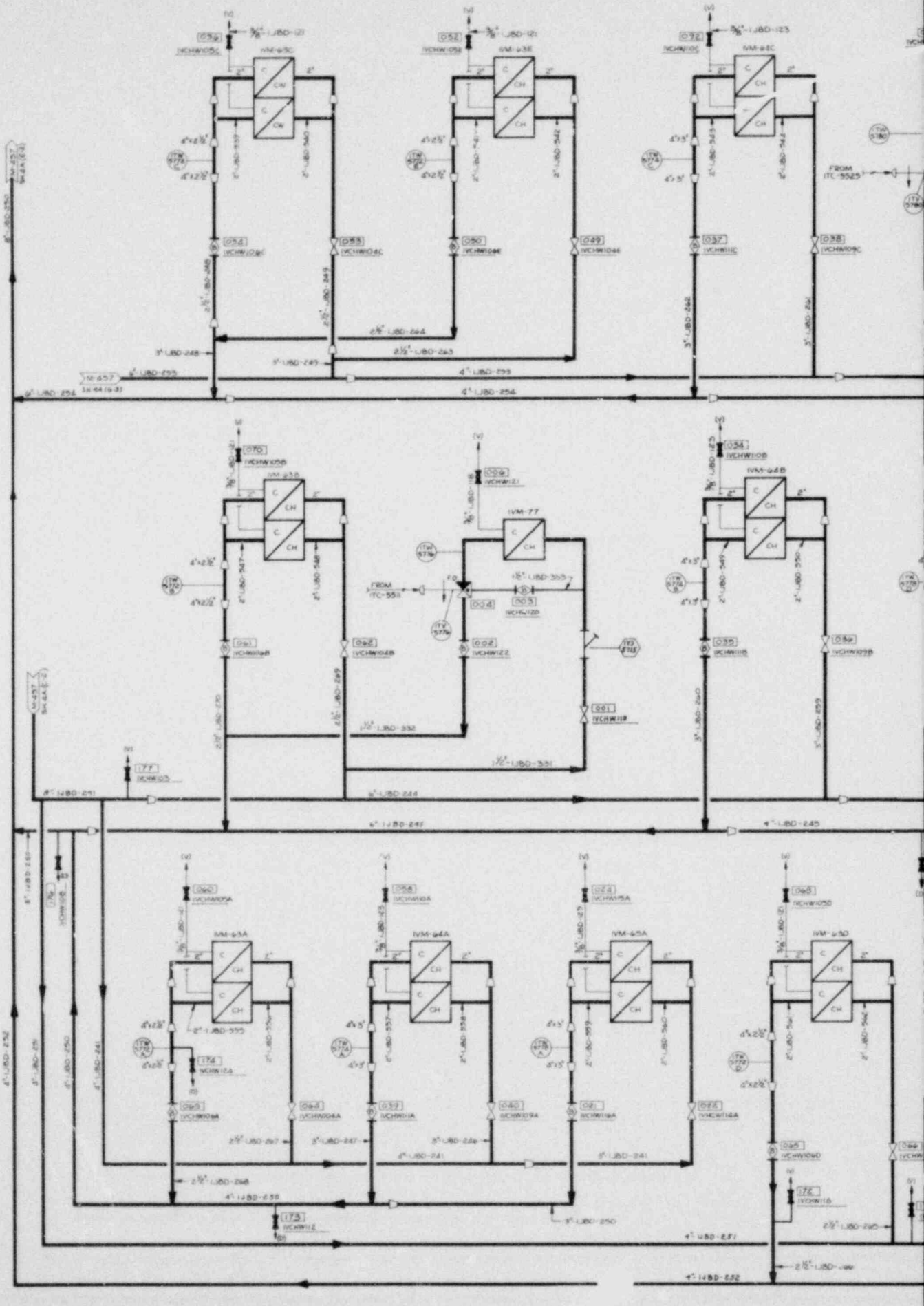

EVAPORATOR
OIL COOLER
EVAPORATOR
OIL COOLER
EVAPORATOR
OIL COOLER

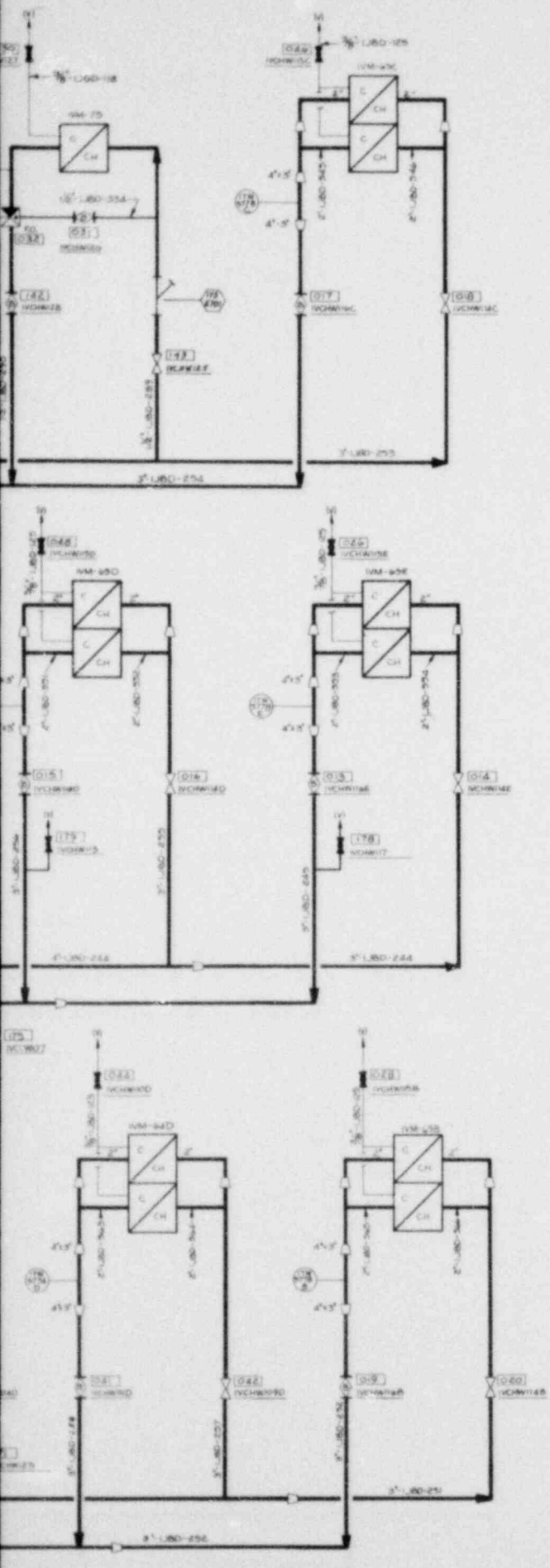


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Chilled Water Turbine Building
Unit 1
(M-457 sh 4A, Rev 0)

FSAR Figure 9.2-21, sh. 1


IVM-63C
IVM-63E
IVM-63C
IVM-63A
IVM-77
IVM-64B
IVM-63A
IVM-64A
IVM-65A
IVM-63D
FROM ITC-5525
FROM ITC-5511
FROM ITC-5512
FROM ITC-5513
FROM ITC-5514
FROM ITC-5515
FROM ITC-5516
FROM ITC-5517
FROM ITC-5518
FROM ITC-5519
FROM ITC-5520
FROM ITC-5521
FROM ITC-5522
FROM ITC-5523
FROM ITC-5524
FROM ITC-5526
FROM ITC-5527
FROM ITC-5528
FROM ITC-5529
FROM ITC-5530
FROM ITC-5531
FROM ITC-5532
FROM ITC-5533
FROM ITC-5534
FROM ITC-5535
FROM ITC-5536
FROM ITC-5537
FROM ITC-5538
FROM ITC-5539
FROM ITC-5540
FROM ITC-5541
FROM ITC-5542
FROM ITC-5543
FROM ITC-5544
FROM ITC-5545
FROM



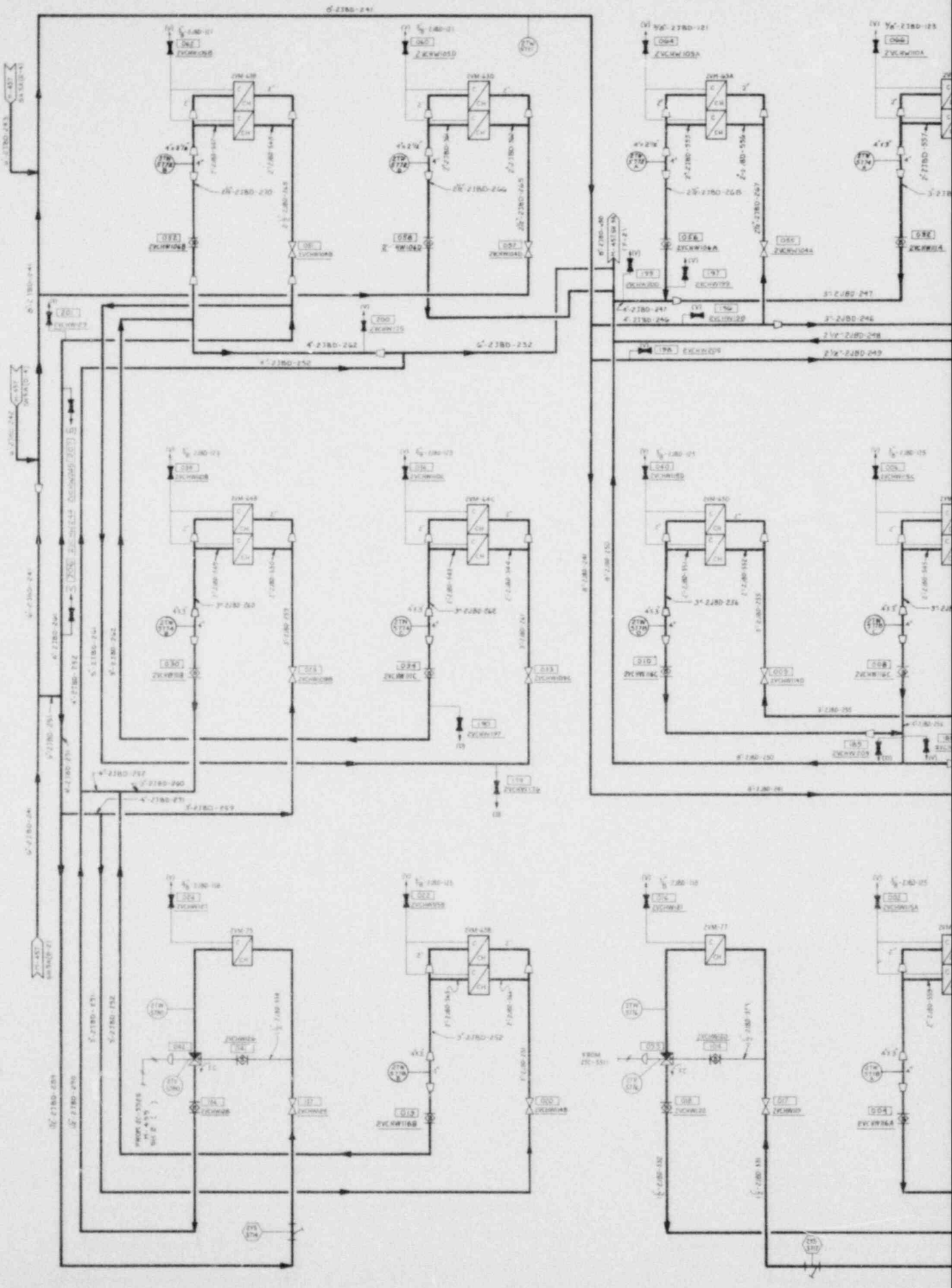
NOTES:

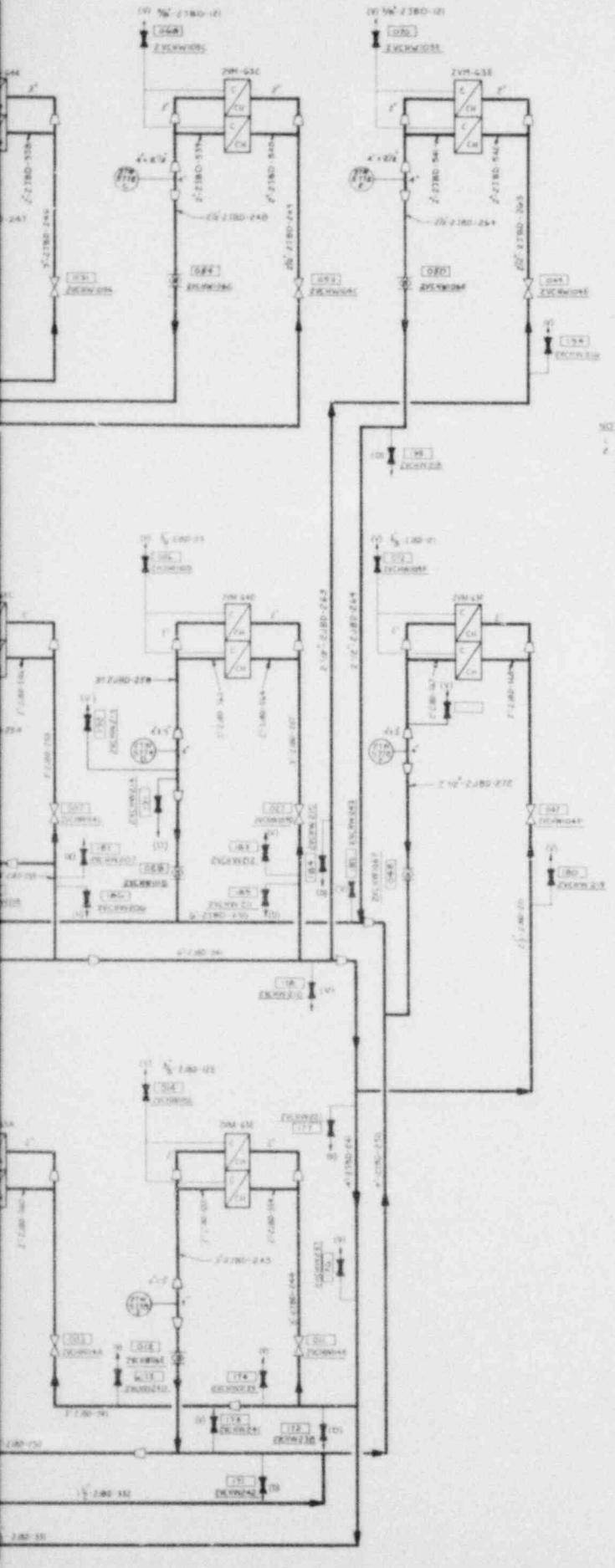
1. ALL "Q" ITEMS ARE CONTAINED ONLY ON SHEETS 2 & 3.
2. FOR 2" AND SMALLER PIPING THERMOWELL CONNECTIONS REFER TO INSTRUMENTS INSTALLATIONS INSTRUCTIONS J-407.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Chilled Water Turbine Building
Unit 1
(M-457 sh 4B, Rev 0)

FSAR Figure 9.2-21, sh. 2



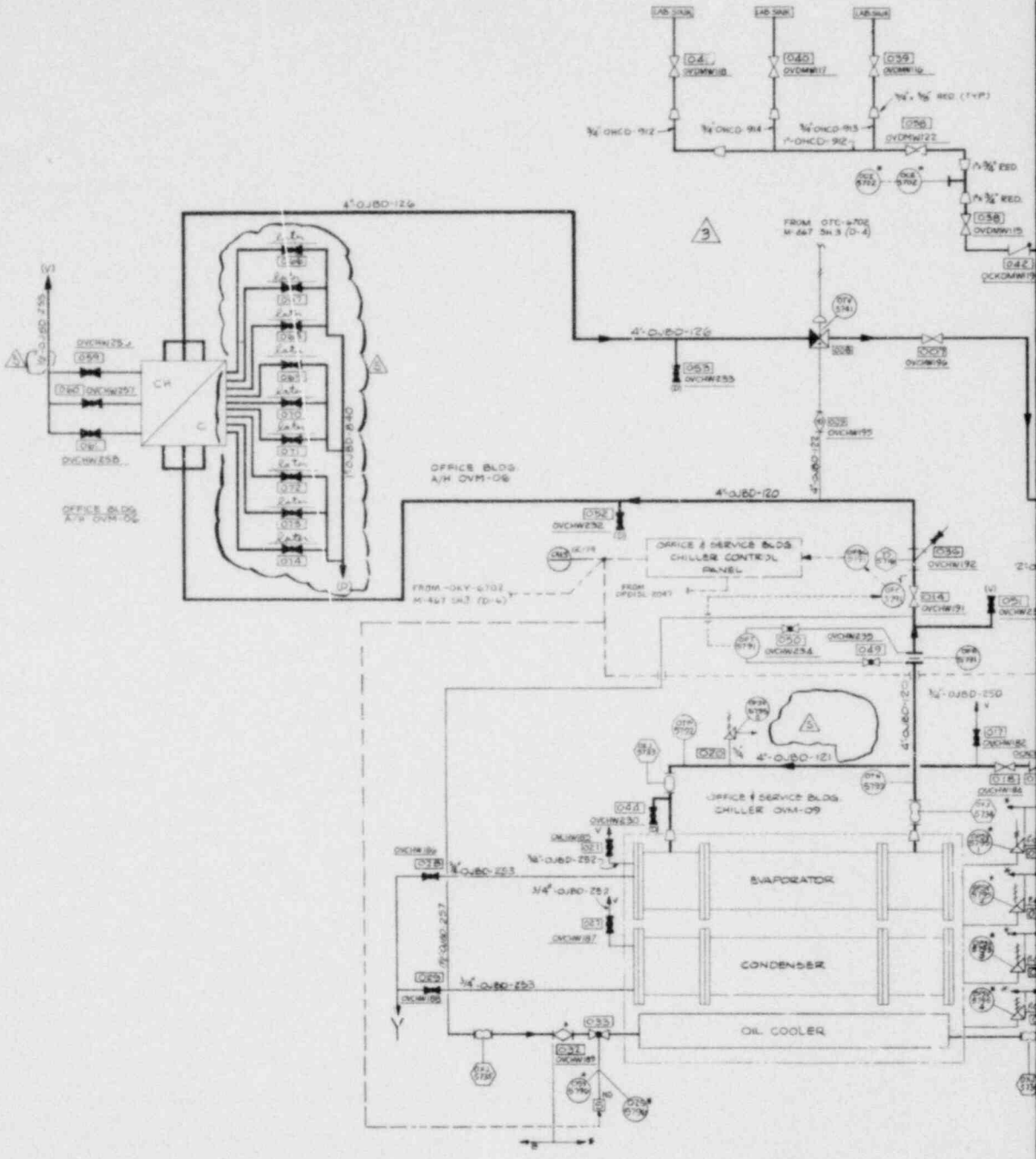


NOTES:
1. "Q" ITEMS ARE CONTAINED ONLY ON SK[illegible]
2. FOR 2" AND SMALLER PIPING THERMOWELL CONNECTIONS REFER TO INSTRUMENTS INSTALLATION INSTRUCTIONS J-407

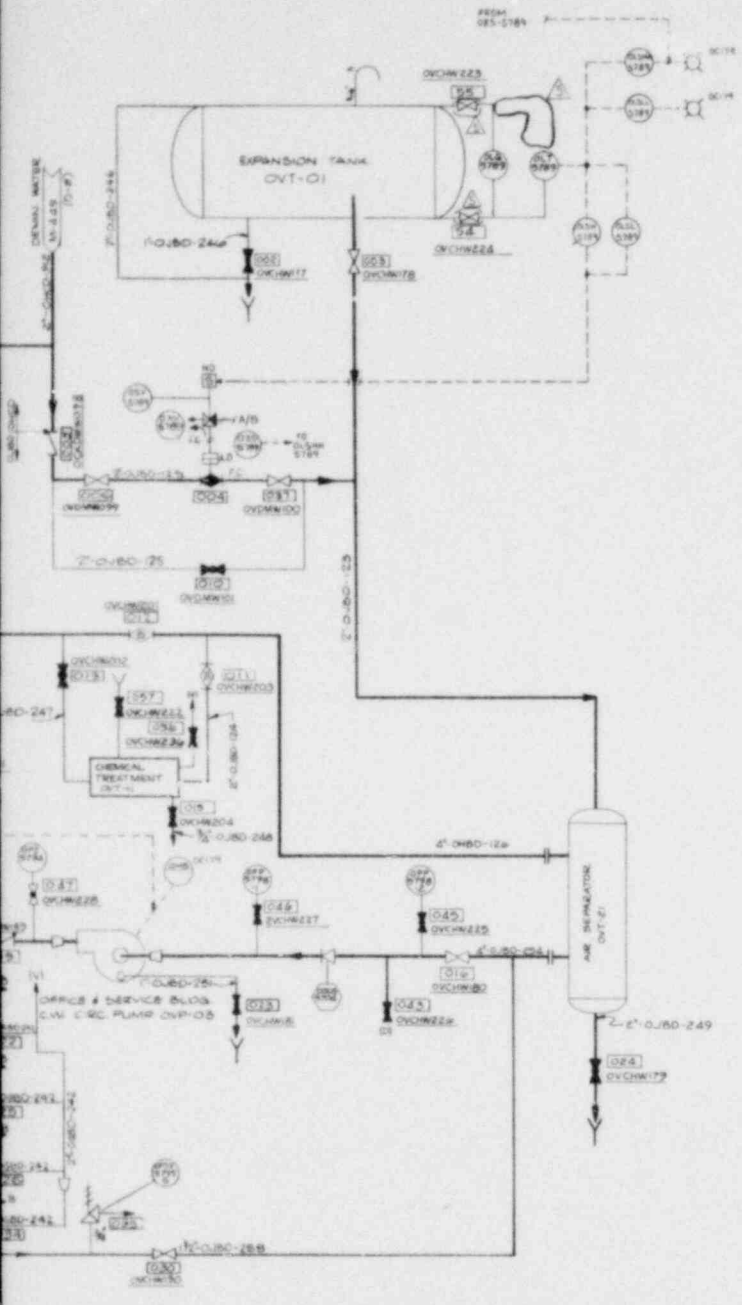
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Chilled Water Turbine Building
Unit 2
(M-457 sh 5B, Rev 0)

FSAR Figure 9.2-22, sh. 2



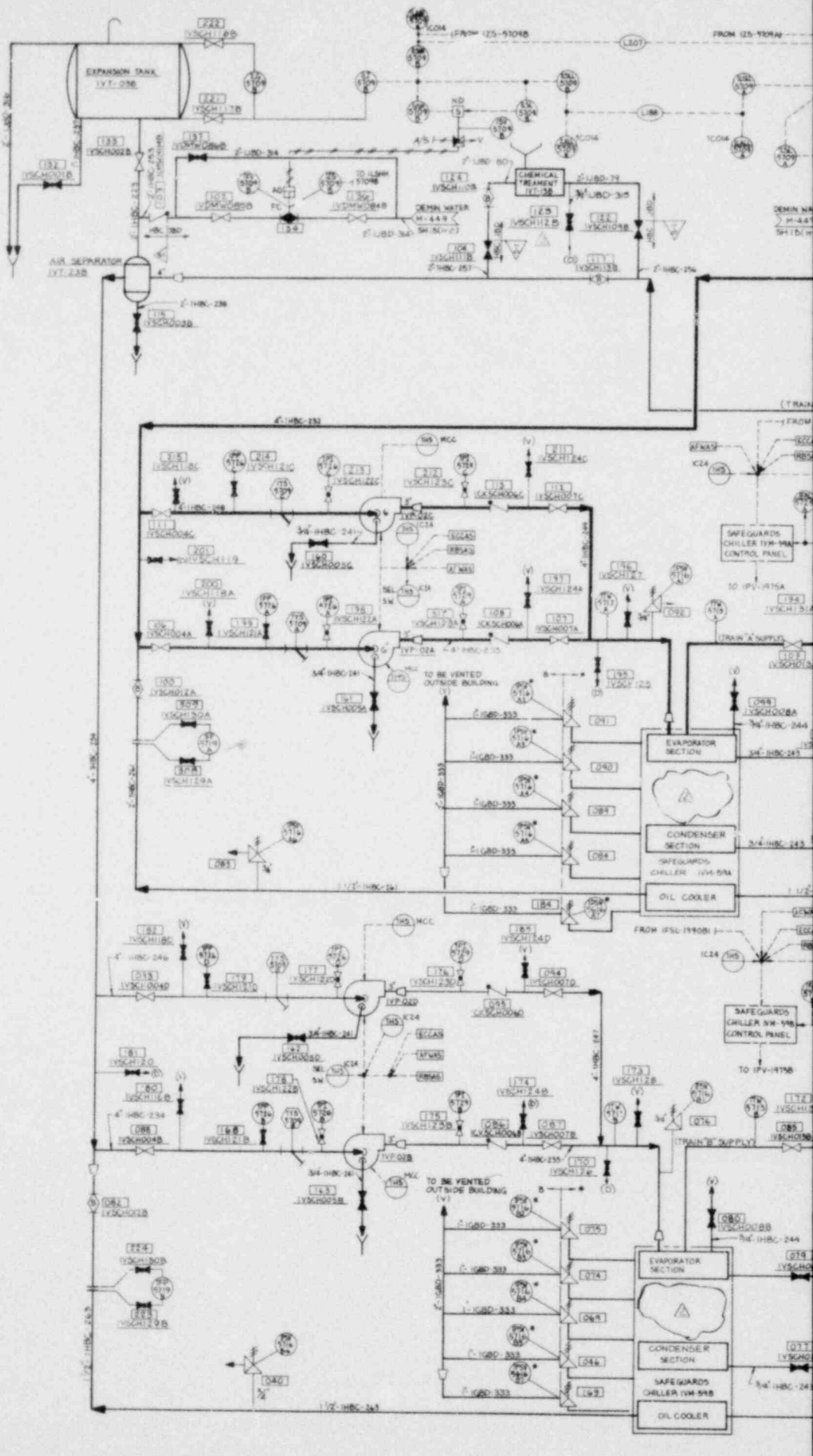
OFFICE AND SERVICE BUILDING
CHILLED WATER SYSTEM

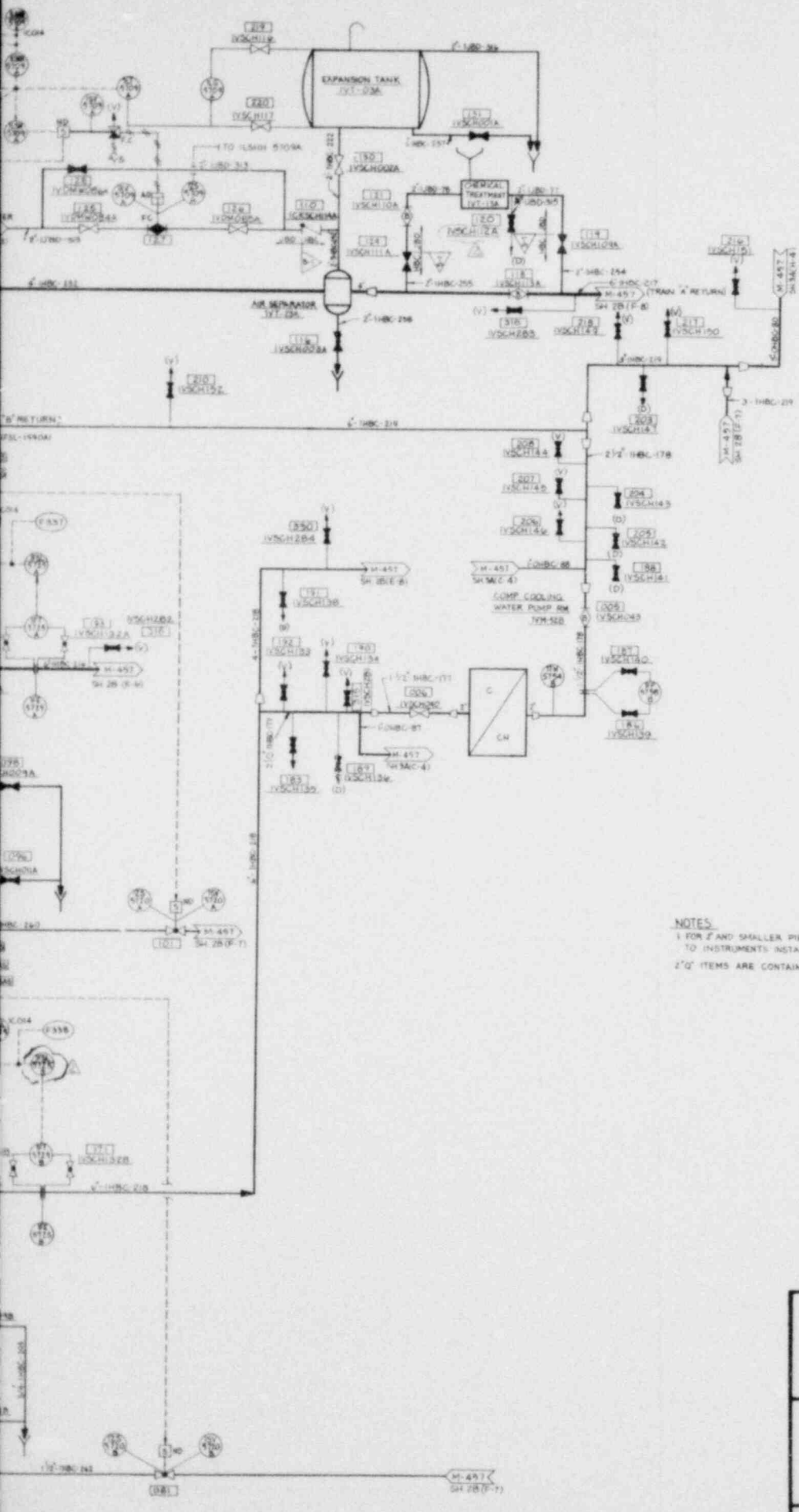


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Chilled Water - Office and Service Building
(M-457 sh 6, Rev 5)

FSAR Figure 9.2-23

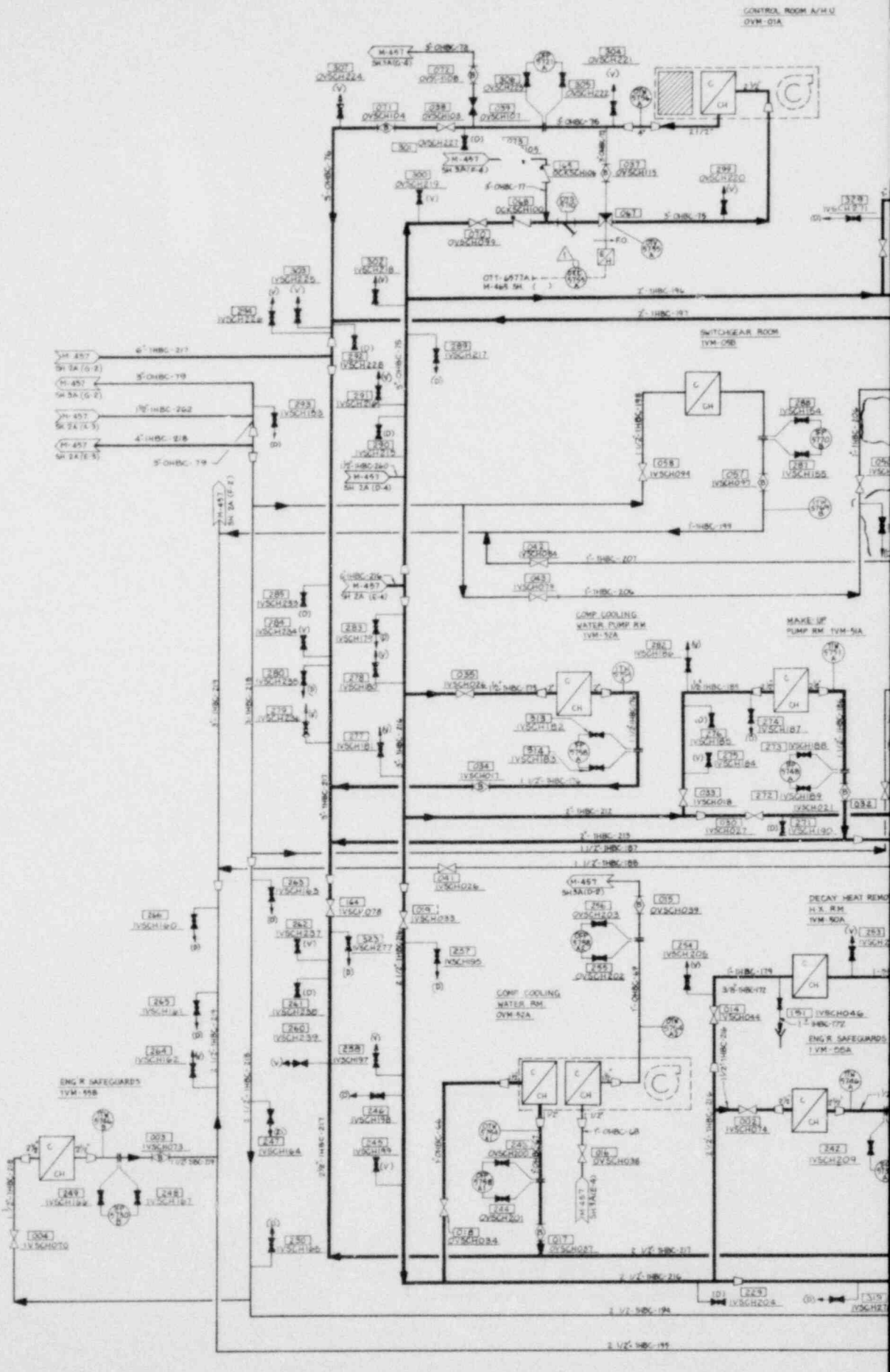

EXPANSION TANK
IVT-036
AIR SEPARATOR
IVT-238
CHEMICAL TREATMENT
IVT-32
DEMIN WATER
M-449
SH 15 (H-23)
TO ULDRN
SYSTEM
FROM IZS-93048
FROM IZS-93048A
MCC
EVAPORATOR SECTION
CONDENSER SECTION
OIL COOLER
SAFEGUARDS CHILLER IVM-598
SAFEGUARDS CHILLER IVM-598A
CONTROL PANEL
TO IPV-19758
TO IPV-19758A
TO BE VENTED OUTSIDE BUILDING
(TRAIN "A" SUPPLY)
(TRAIN "B" SUPPLY)
FROM IFSL-19908
IVP-02A
IVP-02B
IVP-02C
IVP-02D

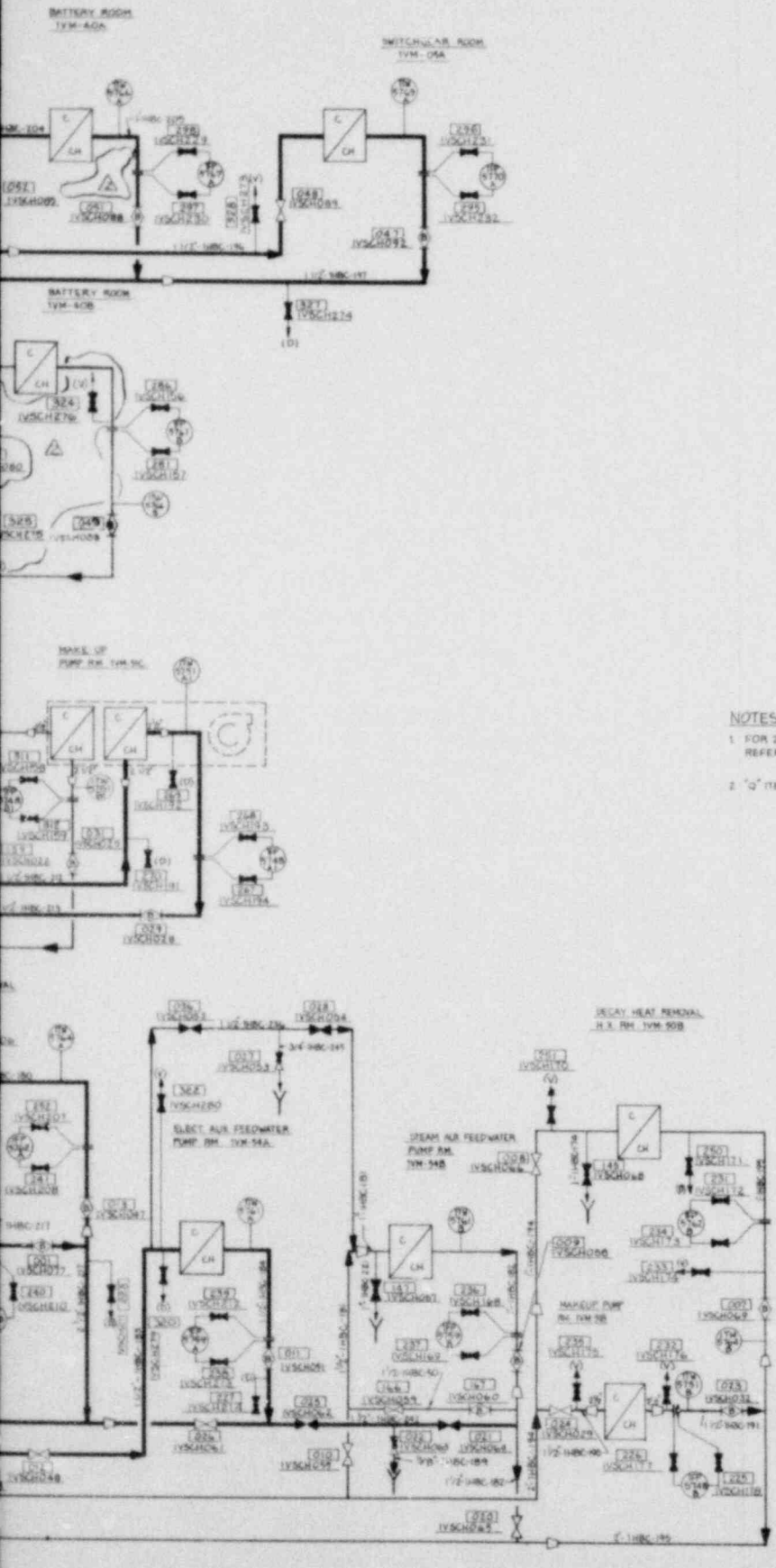


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Chilled Water - Safeguards Equip.
Unit 1
(M-457 sh 2A, Rev 2)

FSAR Figure 9.2-24, sh. 1

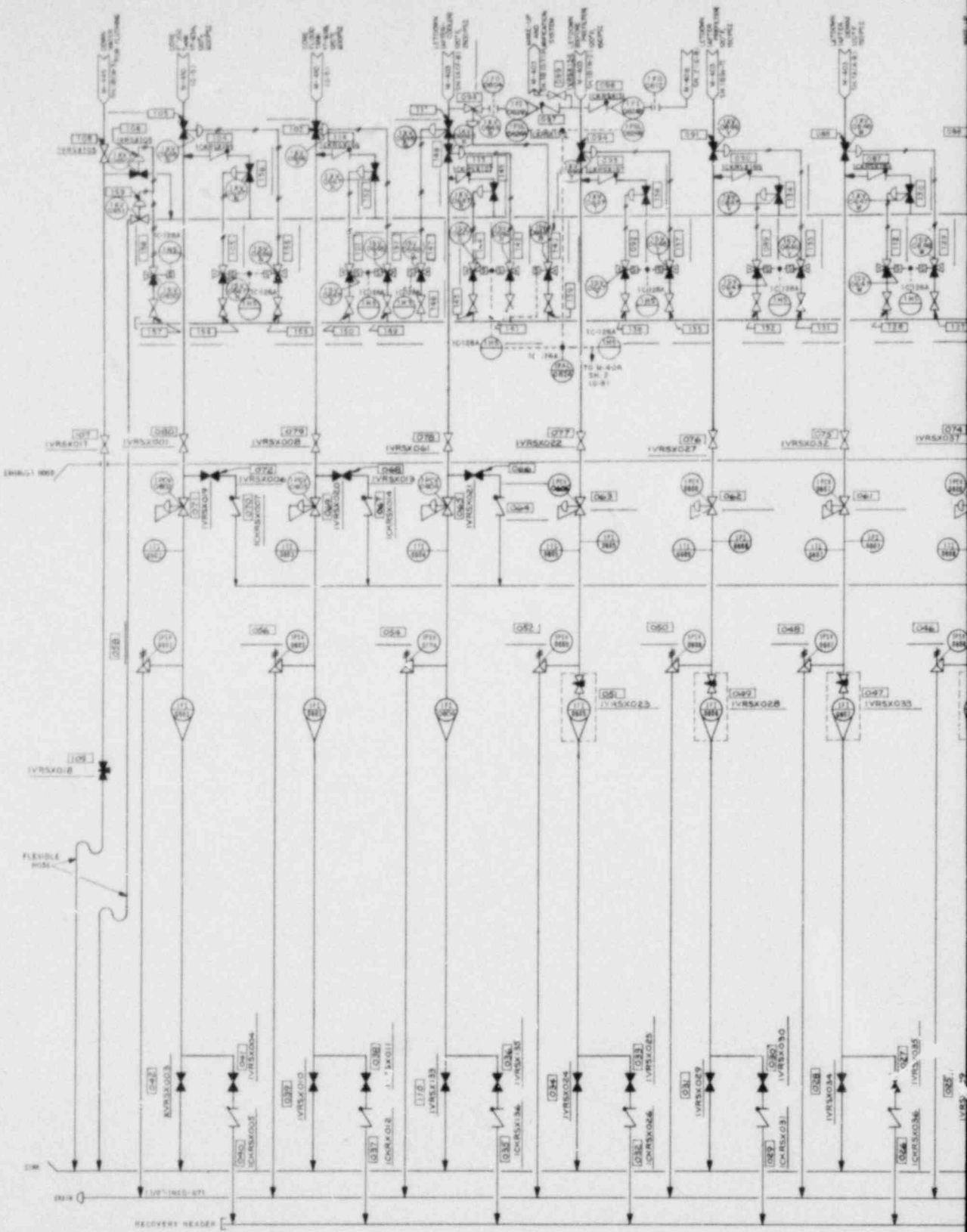

CONTROL ROOM A/H.U
0VM-01A
SWITCHGEAR ROOM
1VM-09B
COMP. COOLING WATER PUMP RM 1VM-52A
MAKE-UP PUMP RM. 1VM-54A
COMP. COOLING WATER RM 0VM-52A
DECAY HEAT REMO
H.X. RM.
1VM-50A
ENG'R SAFEGUARDS 1VM-55B
ENG'R SAFEGUARDS
1VM-55A
FO
FC
FH
2 1/2"-1HBC-194
2 1/2"-1HBC-195
2 1/2"-1HBC-197
2 1/2"-1HBC-207
2 1/2"-1HBC-206
2 1/2"-1HBC-203
2 1/2"-1HBC-187
2 1/2"-1HBC-188
2 1/2"-1HBC-216
2 1/2"-1HBC-217

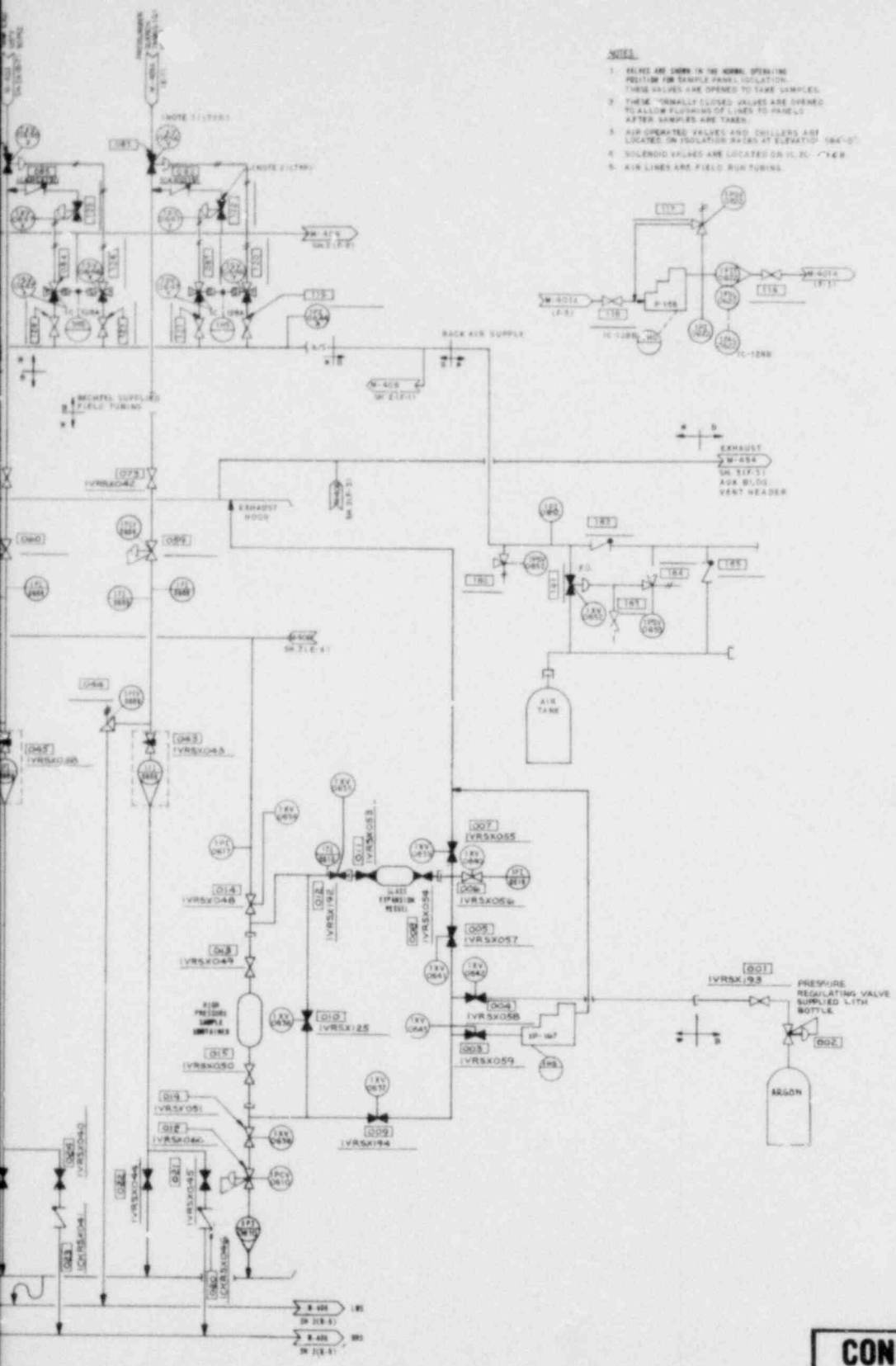


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

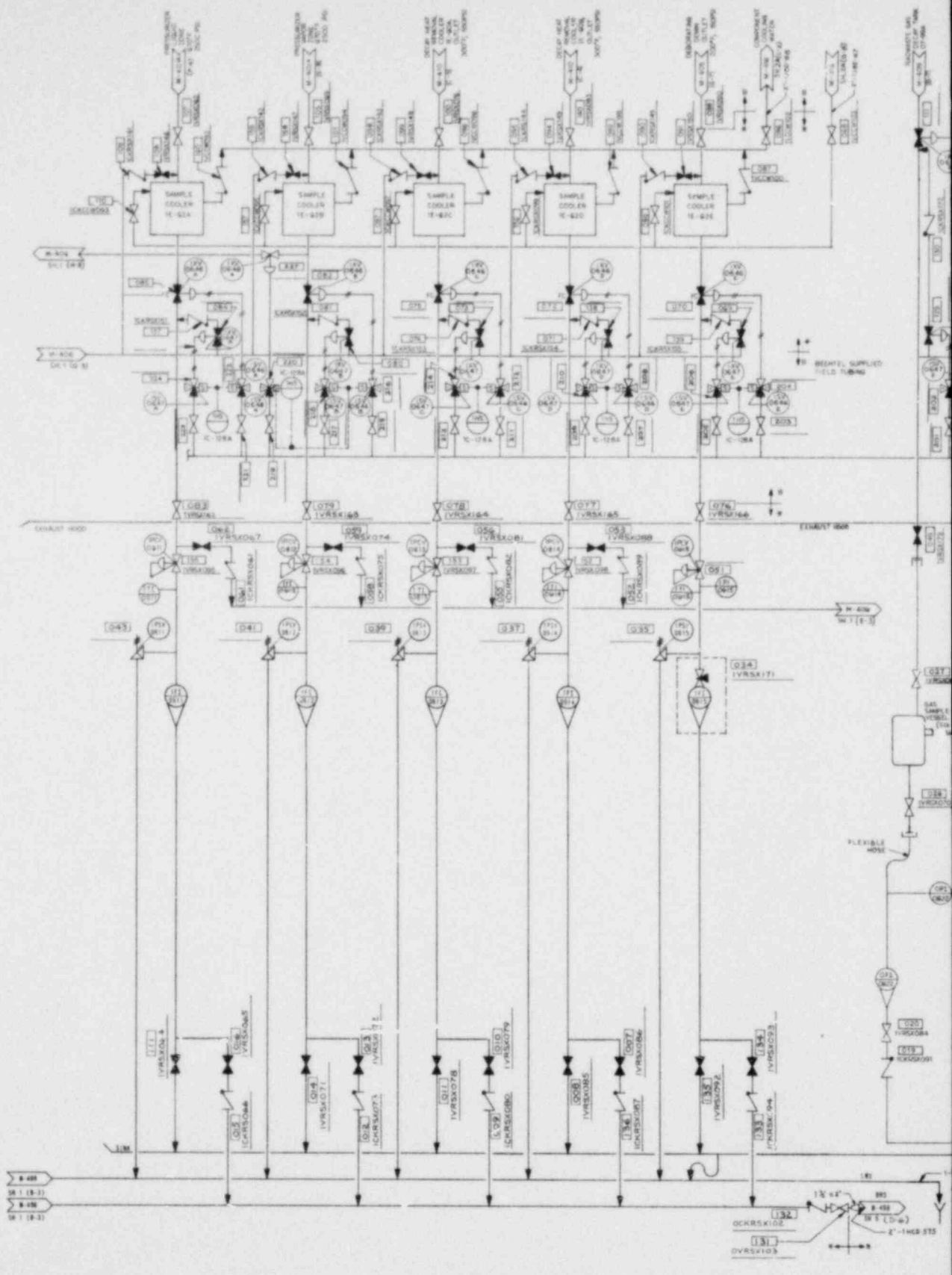
Chilled Water - Safeguards Equip.
Unit 1
(M-457 sh 2B, Rev 2)

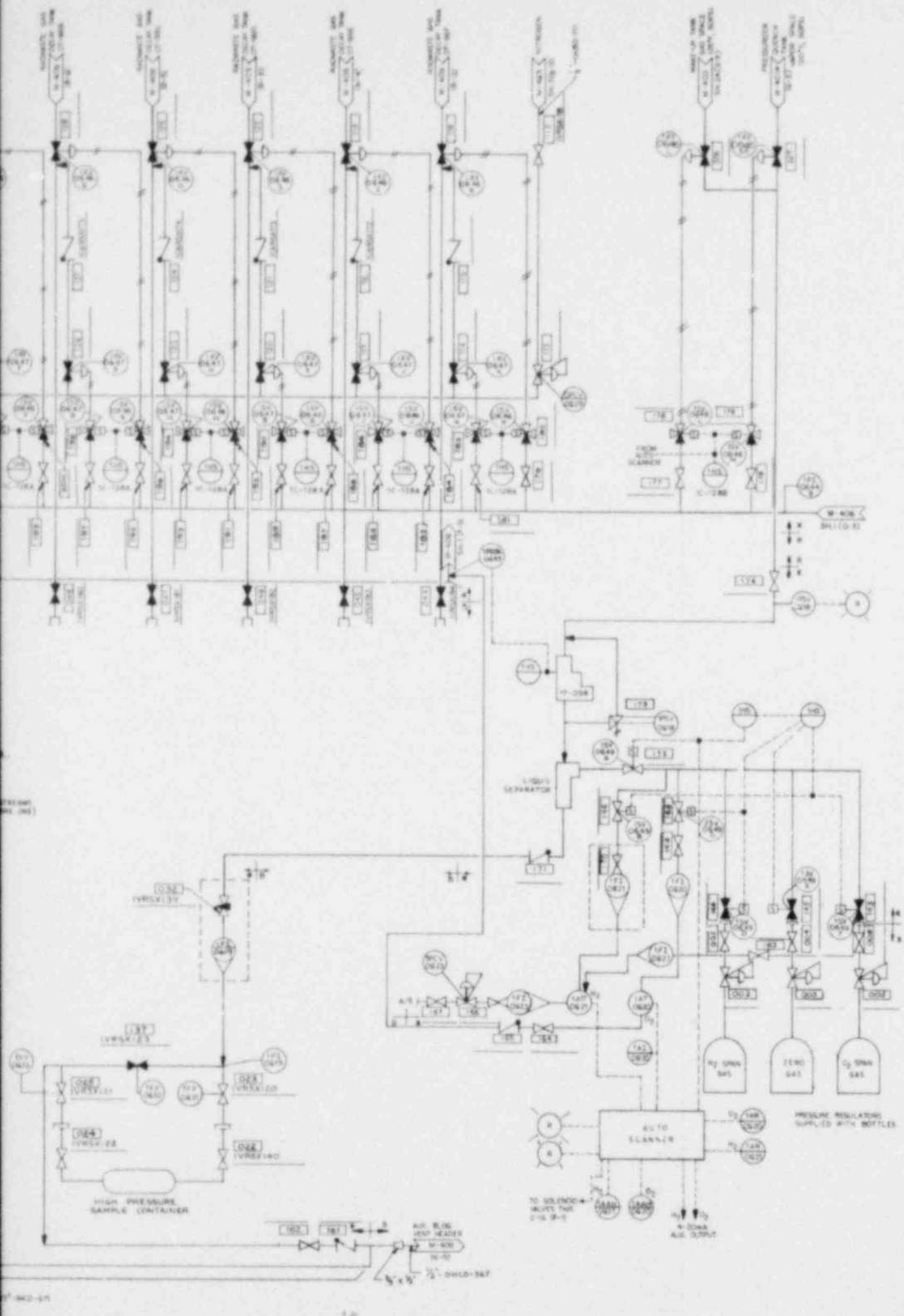
FSAR Figure 9.2-24, sh. 2


FLEXIBLE HOSE
RECOVERY HEADER



CONSUMERS POWER COMPANY MIDLAND PLANT UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Reactor Plant Sample System Unit - 1 (M-406 Sh 1 Rev 4)
FSAR Figure 9.3-3

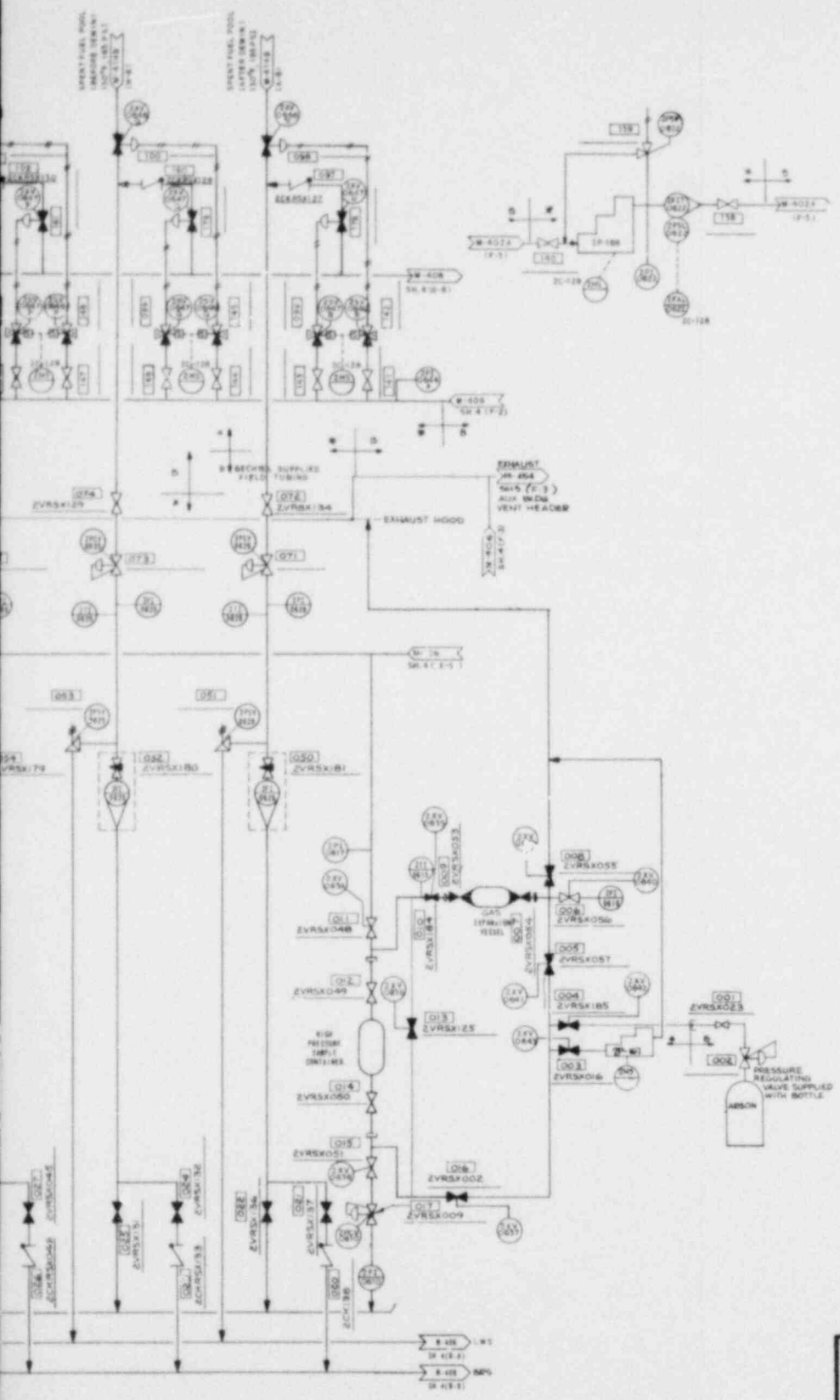




CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Reactor Plant Sample System
Unit-1
(M-406 Sh 2 Rev 4)

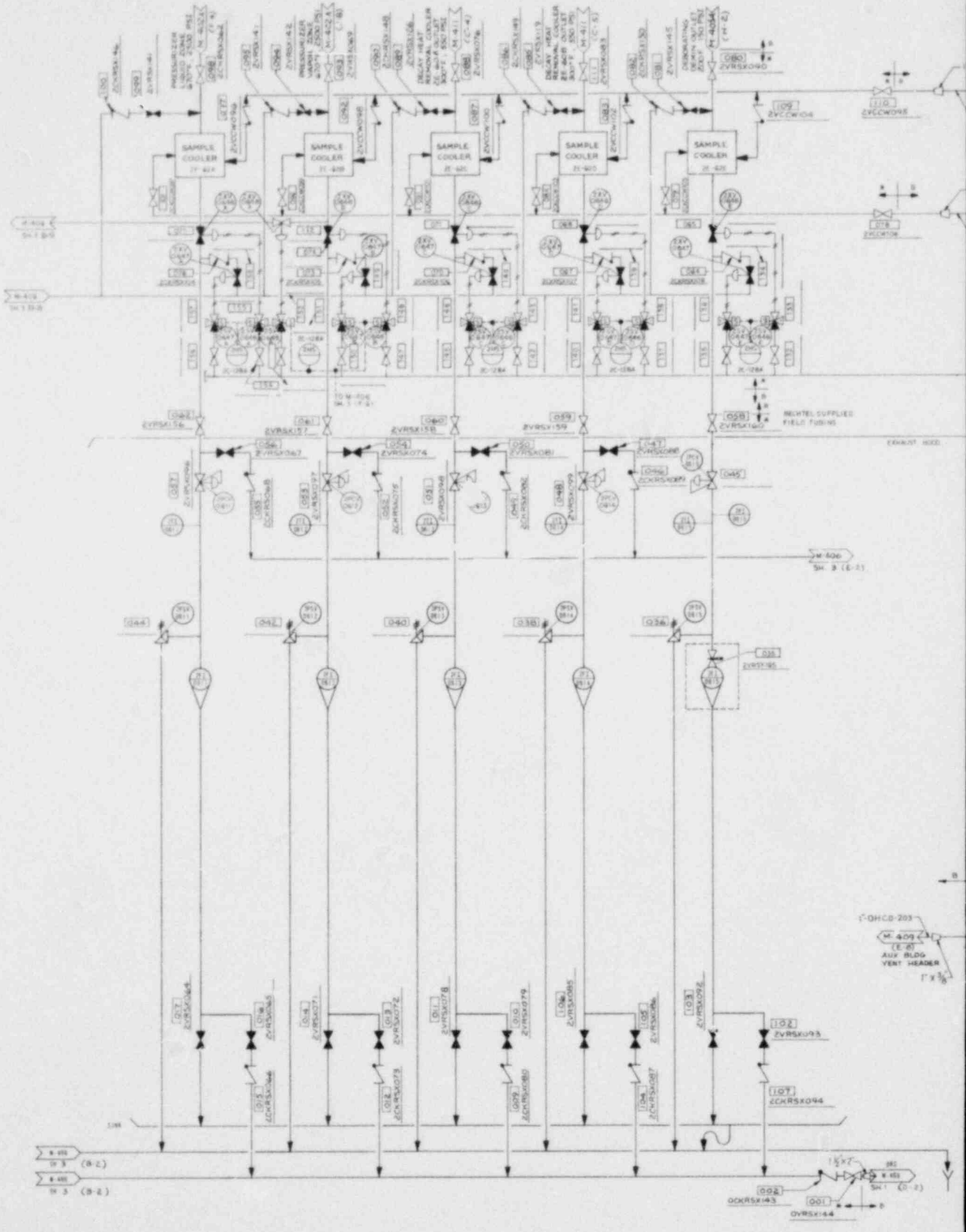
FSAR Figure 9.3-4



CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Reactor Plant Sample System
Unit 2
(M-406 Sh 3, Rev 4)

FSAR Figure 9.3-5


SAMPLE COOLER
SAMPLE COOLER
SAMPLE COOLER
SAMPLE COOLER
SAMPLE COOLER
ZVCCW095
ZVCCW096
ZVCCW097
ZVCCW098
ZVCCW099
ZVCCW100
ZVCCW101
ZVCCW102
ZVCCW103
ZVCCW104
ZVCCW105
ZVCCW106
ZVRSX156
ZVRSX157
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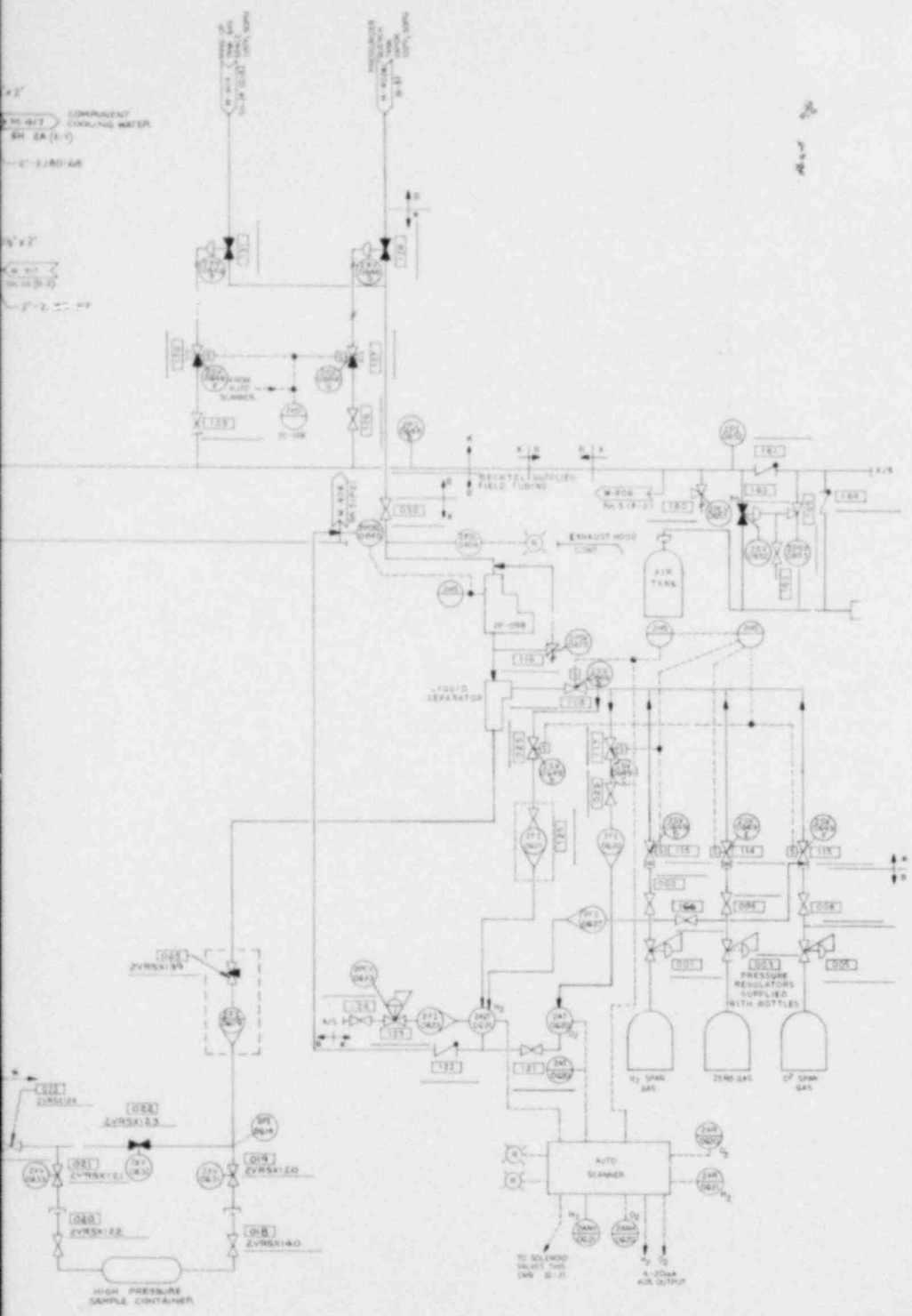
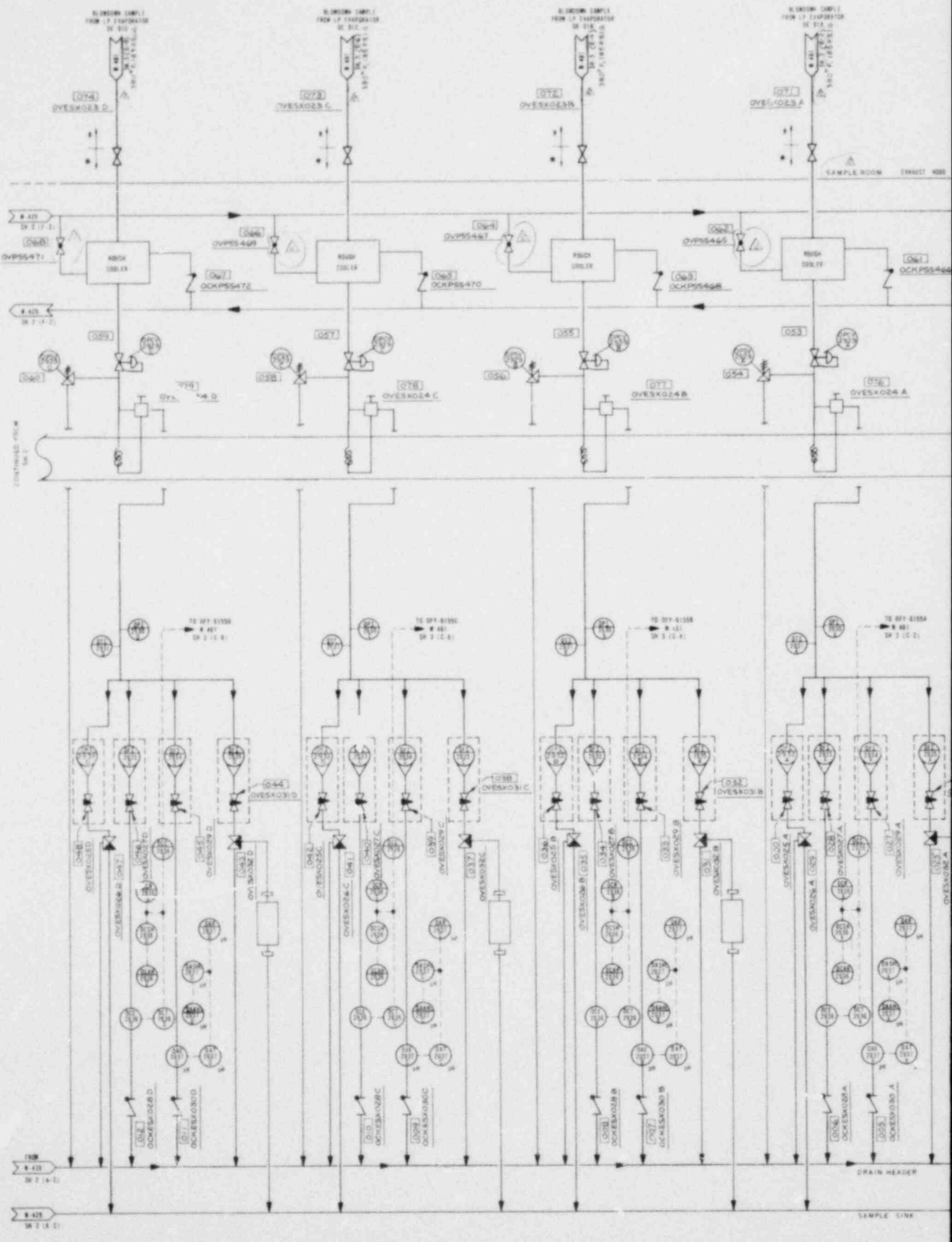
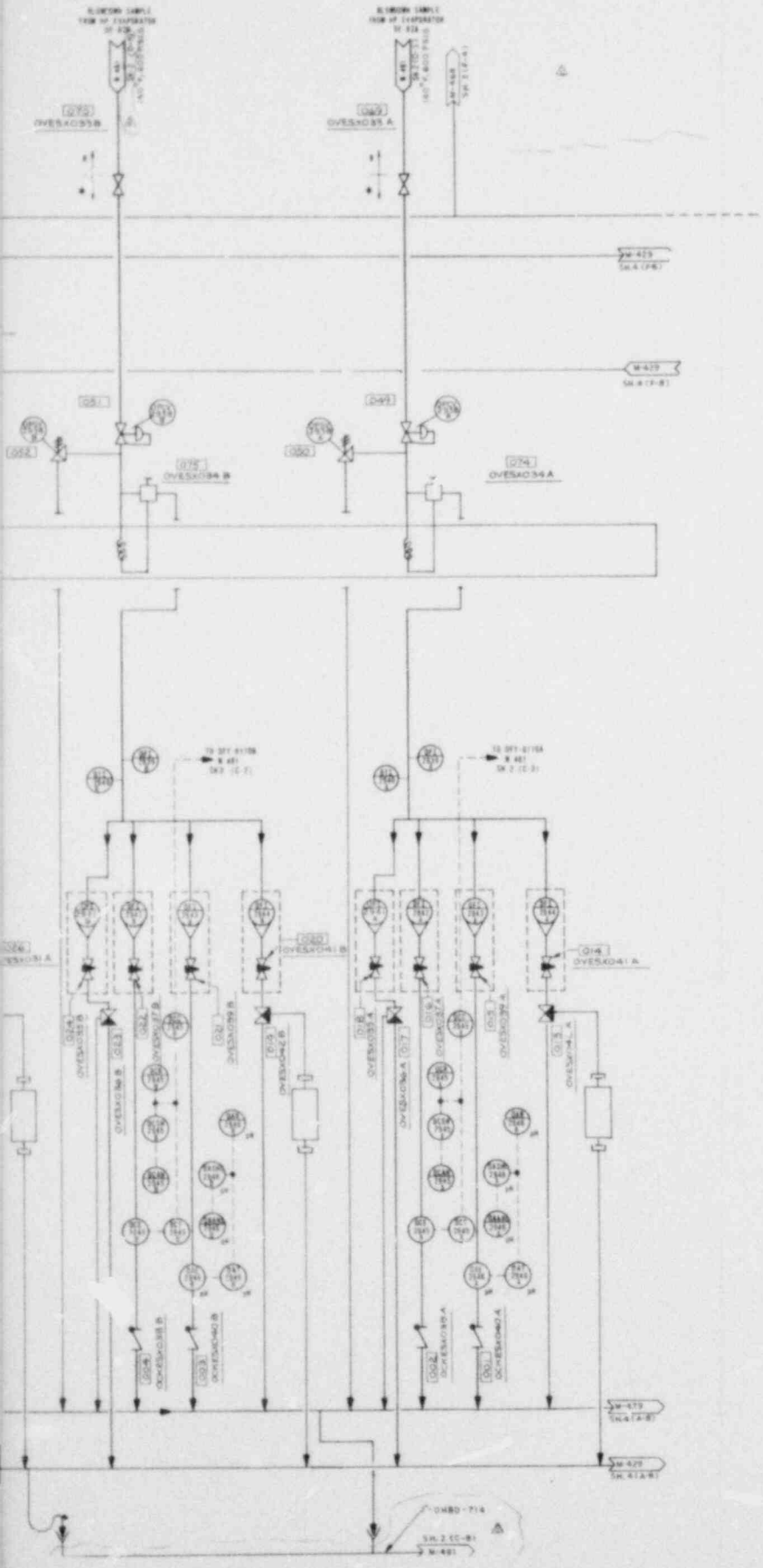


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Reactor Plant Sample System
Unit 2
(M-406 Sh 4 Rev 4)

FSAR Figure 9.3-6


SAMPLE ROOM
DRAIN HEADER
SAMPLE SINK

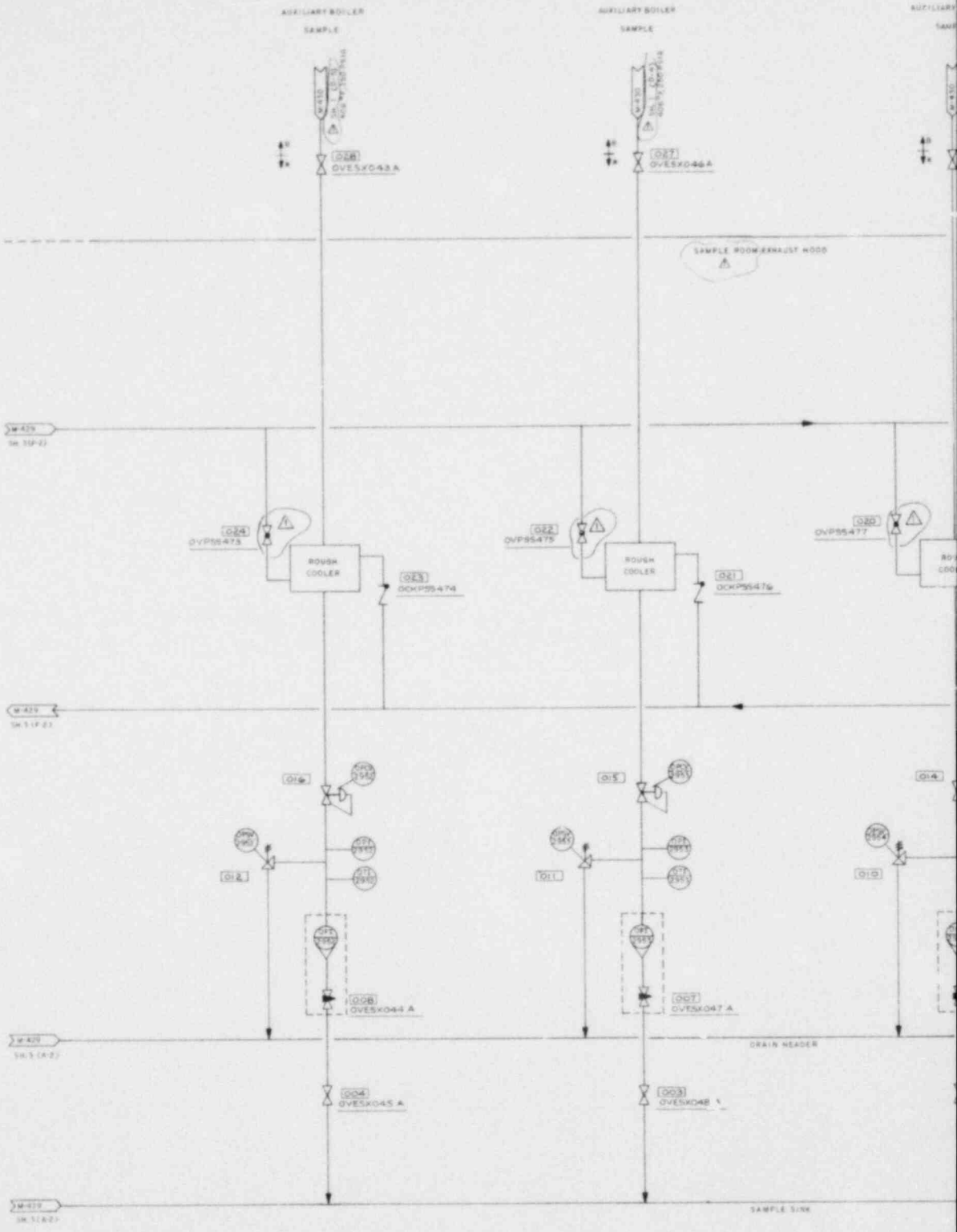


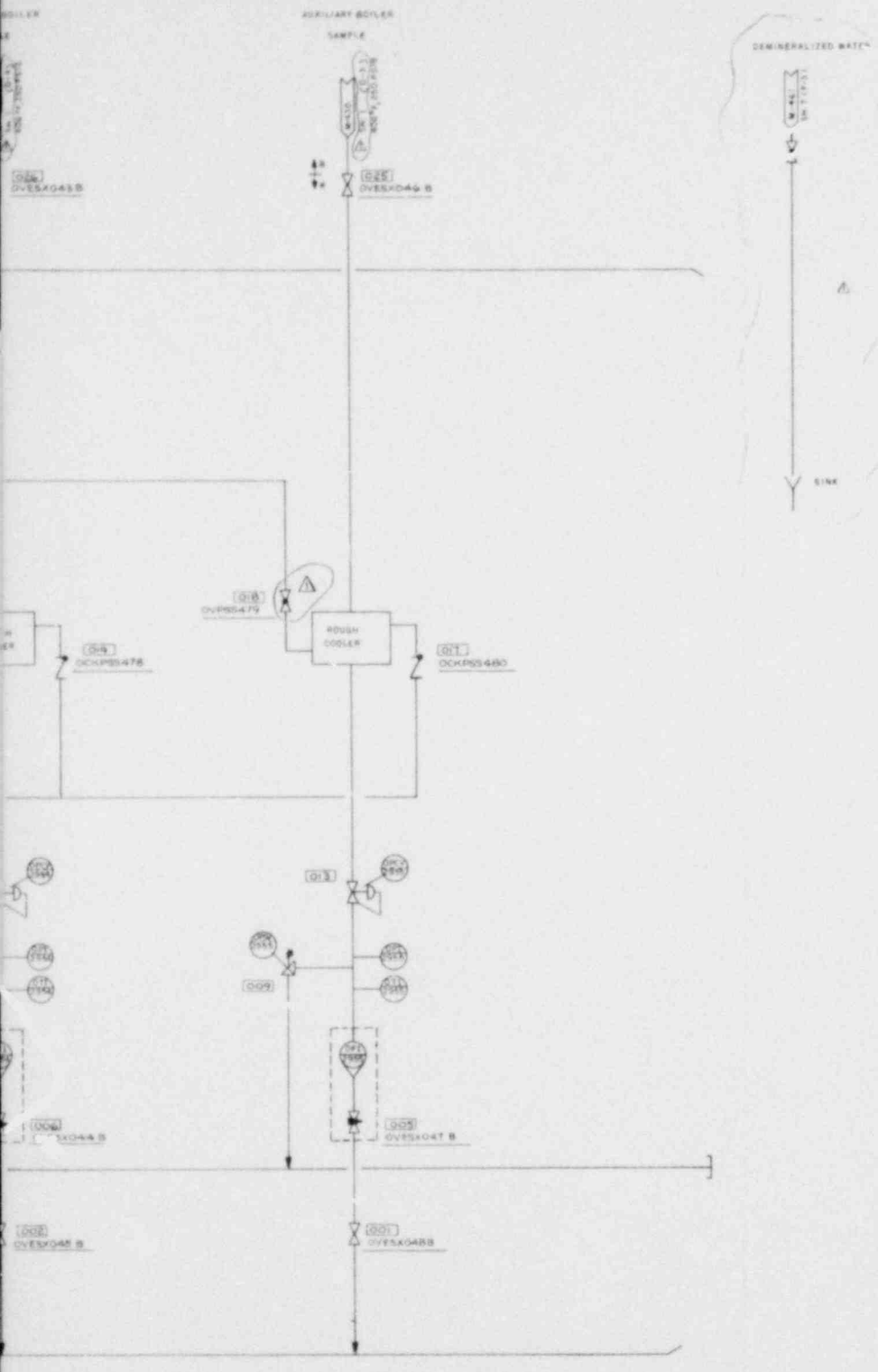
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Evaporator Plant Sample System

(M-429 sh 3, Rev 2)

FSAR Figure 9.3-17, sh. 1


AUXILIARY BOILER
SAMPLE
AUXILIARY BOILER
SAMPLE
028
OVESX043 A
027
OVESX046 A
SAMPLE ROOM EXHAUST HOOD
W-429
SH. 3 (F-2)
024
OVPS5473
ROUGH
COOLER
023
OCKPS5474
022
OVPS5475
ROUGH
COOLER
021
OCKPS5476
020
OVPS5477
W-429
SH. 3 (F-2)
016
015
014
012
011
010
008
OVESX044 A
007
OVESX047 A
W-420
SH. 3 (A-2)
DRAIN HEADER
004
OVESX045 A
003
OVESX048
W-429
SH. 3 (A-2)
SAMPLE SINK

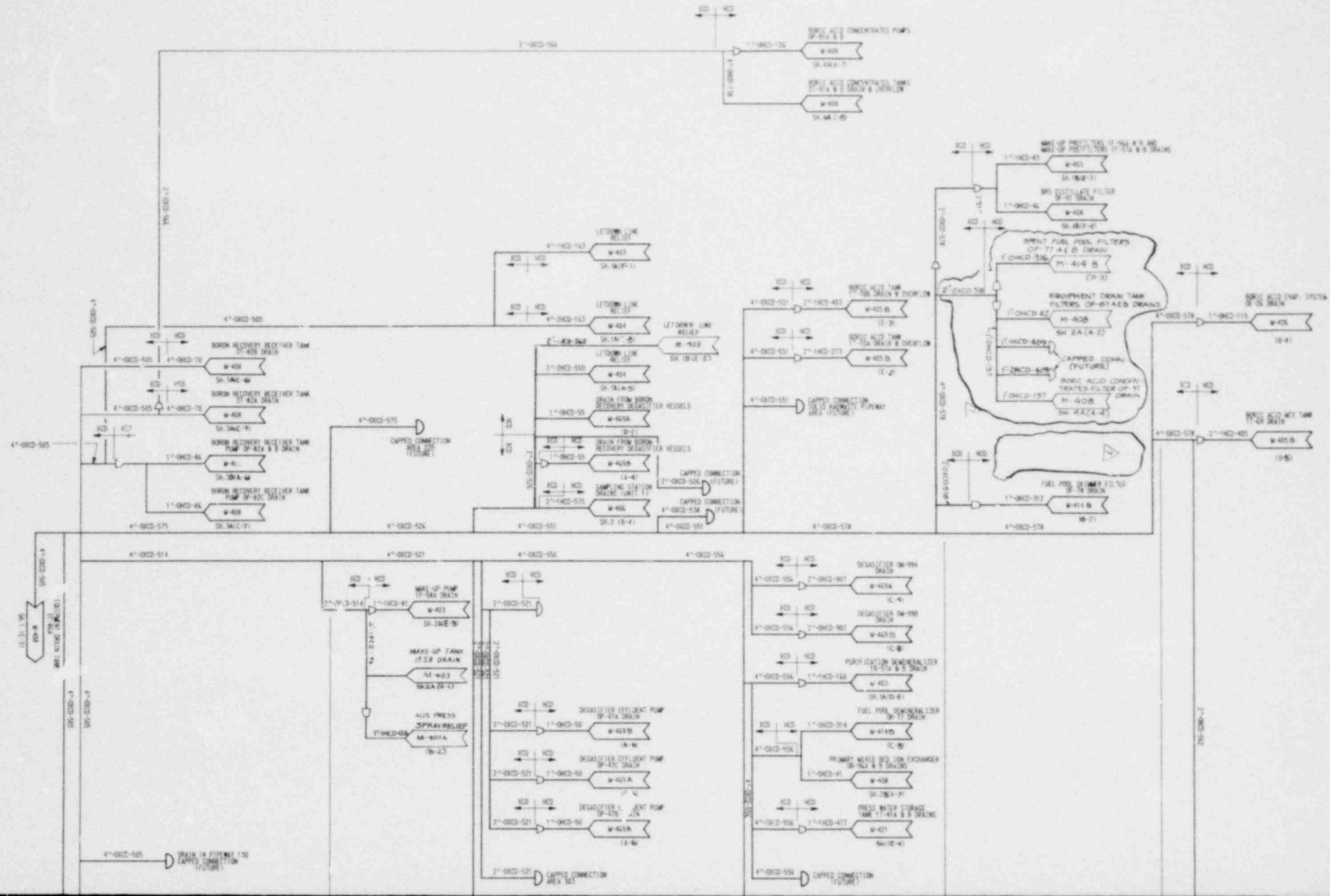


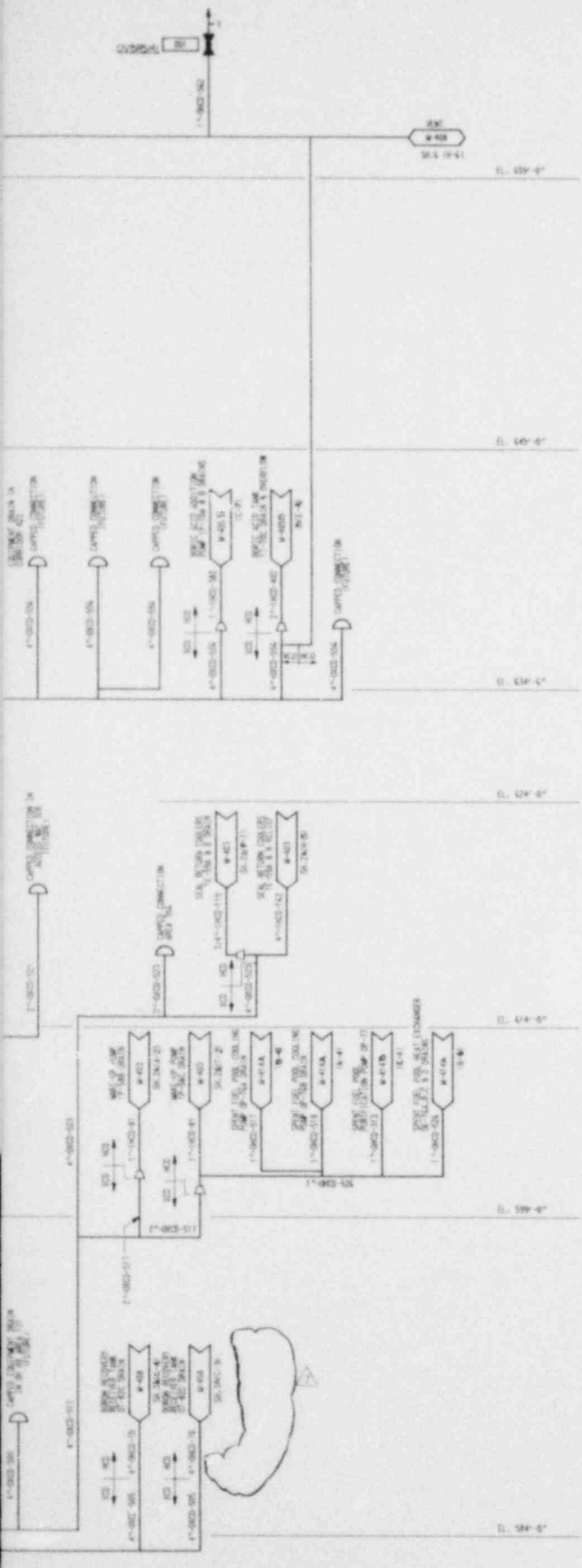
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Evaporator Plant Sample System

(M-429 sh 4, Rev 1)

FSAR Figure 9.3-17, sh. 2


BORIC ACID CONCENTRATES PUMPS DP-67A & B
BORIC ACID CONCENTRATES TANKS TT-67A & B DRAIN & OVERFLOW
LETDOWN LINE RELIEF
BORON RECOVERY DEGASIFIER TANK DP-62A DRAIN
BORON RECOVERY DEGASIFIER TANK PUMP DP-62A & B DRAIN
BORON RECOVERY DEGASIFIER TANK PUMP DP-62C DRAIN
DRAIN FROM BORON RECOVERY DEGASIFIER VESSELS
CAPPED CONNECTION AREA 100 (FUTURE)
CAPPED CONNECTION (FUTURE)
SAMPLING STATION SAMPLING TANK TT
BORIC ACID TANK TA DRAIN & OVERFLOW
CAPPED CONNECTION (FUTURE) SPARE PIPEWAY AREA (FUTURE)
MAKE-UP PIPING TT-56A & B AND MAKE-UP PIPING TT-57A & B DRAINS
BRS DISTILLATE FILTER DP-67 DRAIN
SPENT FUEL PIXEL FILTERS DP-77 A & B DRAIN
EQUIPMENT DRAIN TANK FILTERS DP-67 A & B DRAINS
BORIC ACID CONCENTRATES FILTER DP-67 DRAIN
FUEL POOL DEMINERALIZER FILTER DP-78 DRAIN
BORIC ACID EVAP. SYSTEM DP-65 DRAIN
BORIC ACID MIX TANK TT-69 DRAIN
MAKE-UP PUMP TP-56A DRAIN
MAKE-UP TANK TT-58 DRAIN
AUX PRESS SPRAY RELIEF
DEGASIFIER EFFLUENT PUMP DP-47A DRAIN
DEGASIFIER EFFLUENT PUMP DP-47C DRAIN
DEGASIFIER EFFLUENT PUMP DP-47B DRAIN
DEGASIFIER SW-99A DRAIN
DEGASIFIER SW-99B DRAIN
PURIFICATION DEMINERALIZER TK-57A & B DRAIN
FUEL POOL DEMINERALIZER DP-77 DRAIN
PRIMARY MIXED BED ION EXCHANGER SK-76A & B DRAINS
PRESS WATER STORAGE TANK TT-47A & B DRAINS
DRAIN IN PIPEWAY 132 CAPPED CONNECTION (FUTURE)
CAPPED CONNECTION AREA 107
CAPPED CONNECTION (FUTURE)

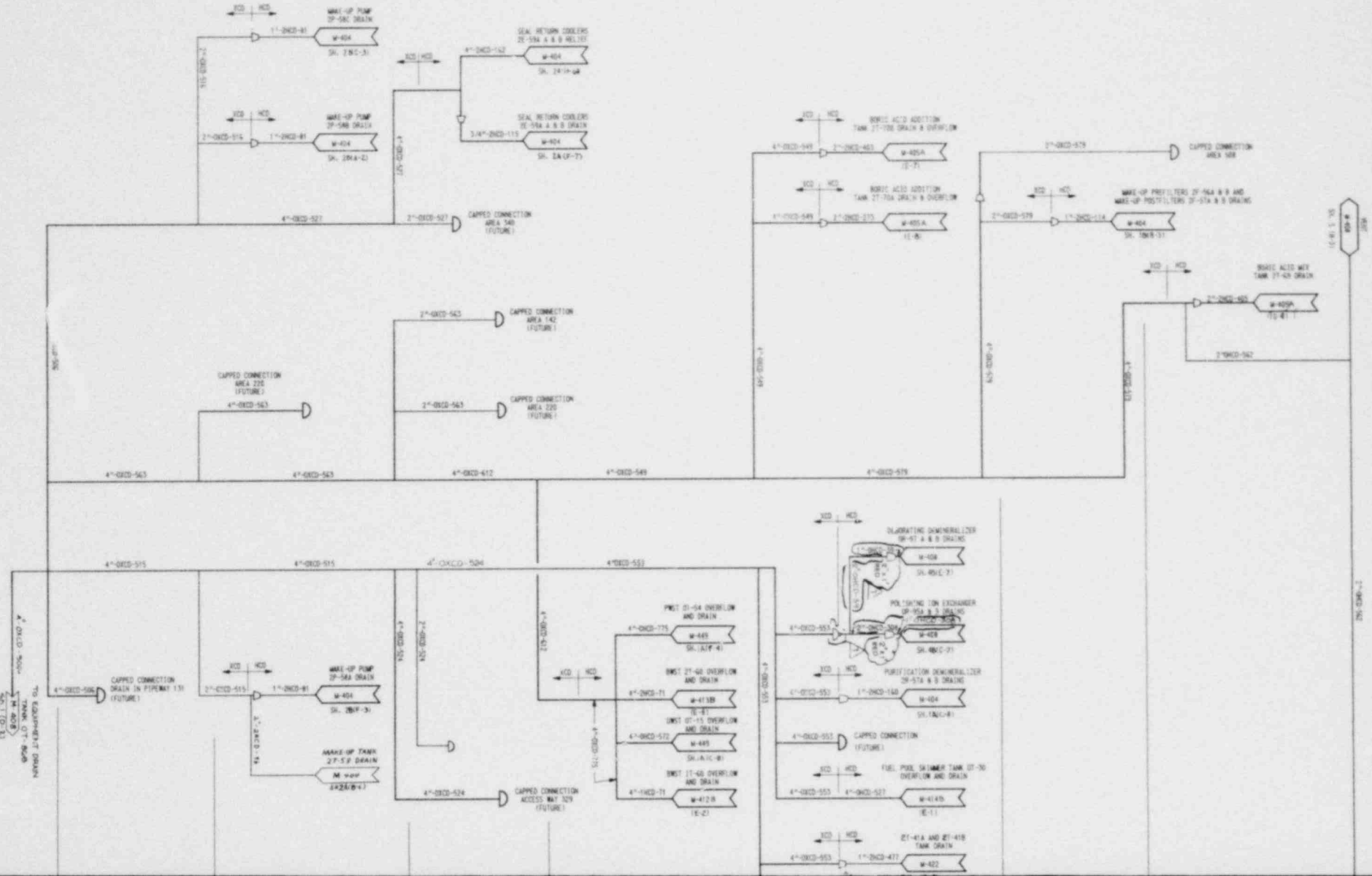


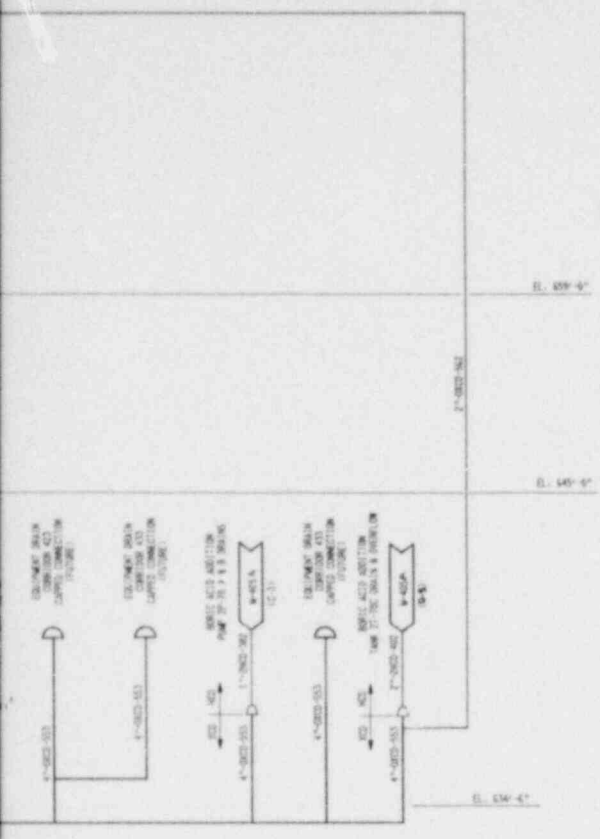
NOTE :
1. THE ORDER OF PIPING CONNECTIONS TO EMBEDDED PIPING IS SHOWN AS A SCHEMATIC REPRESENTATION ONLY. ACTUAL CONSTRUCTION ORDER OF PIPING CONNECTIONS IS NOT CRITICAL.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Boron Recovery - Units 1 & 2
(M-408 sh 5, Rev 7)

FSAR Figure 9.3-18


MAKE-UP PUMP 2P-58C DRAIN
W-404
SEAL RETURN COOLERS 2E-59A A & B DRAIN
MAKE-UP PUMP 2P-58B DRAIN
SEAL RETURN COOLERS 2E-59A A & B DRAIN
BORIC ACID ADDITION TANK 2T-70A DRAIN & OVERFLOW
W-405A
BORIC ACID ADDITION TANK 2T-70A DRAIN & OVERFLOW
CAPPED CONNECTION AREA 548
MAKE-UP PREFILTERS 2F-56A & B AND MAKE-UP POSTFILTERS 2F-57A & B DRAINS
BORIC ACID MIX TANK 2T-69 DRAIN
W-405A
CAPPED CONNECTION AREA 142 (FUTURE)
CAPPED CONNECTION AREA 548 (FUTURE)
CAPPED CONNECTION AREA 220 (FUTURE)
DEMINERALIZER 2F-97 A & B DRAINS
POLISHING ION EXCHANGER 2F-95A & B DRAINS
PURIFICATION DEMINERALIZER 2F-57A & B DRAINS
CAPPED CONNECTION
FUEL POOL SKIMMER TANK 2T-50 OVERFLOW AND DRAIN
CAPPED CONNECTION DRAIN IN PIPEWAY 131 (FUTURE)
MAKE-UP PUMP 2P-58A DRAIN
MAKE-UP TANK 2T-59 DRAIN
PRDT 2T-64 OVERFLOW AND DRAIN
DRDT 2T-40 OVERFLOW AND DRAIN
DRDT 2T-15 OVERFLOW AND DRAIN
DRDT 2T-40 OVERFLOW AND DRAIN
CAPPED CONNECTION ACCESS WAY 329 (FUTURE)
2T-41A AND 2T-41B TANK DRAIN
TO EQUIPMENT DRAIN TANK 2T-40
W-408
W-422
W-445
W-4139
W-4128
W-4145
W-404
W-409
W-410
W-411



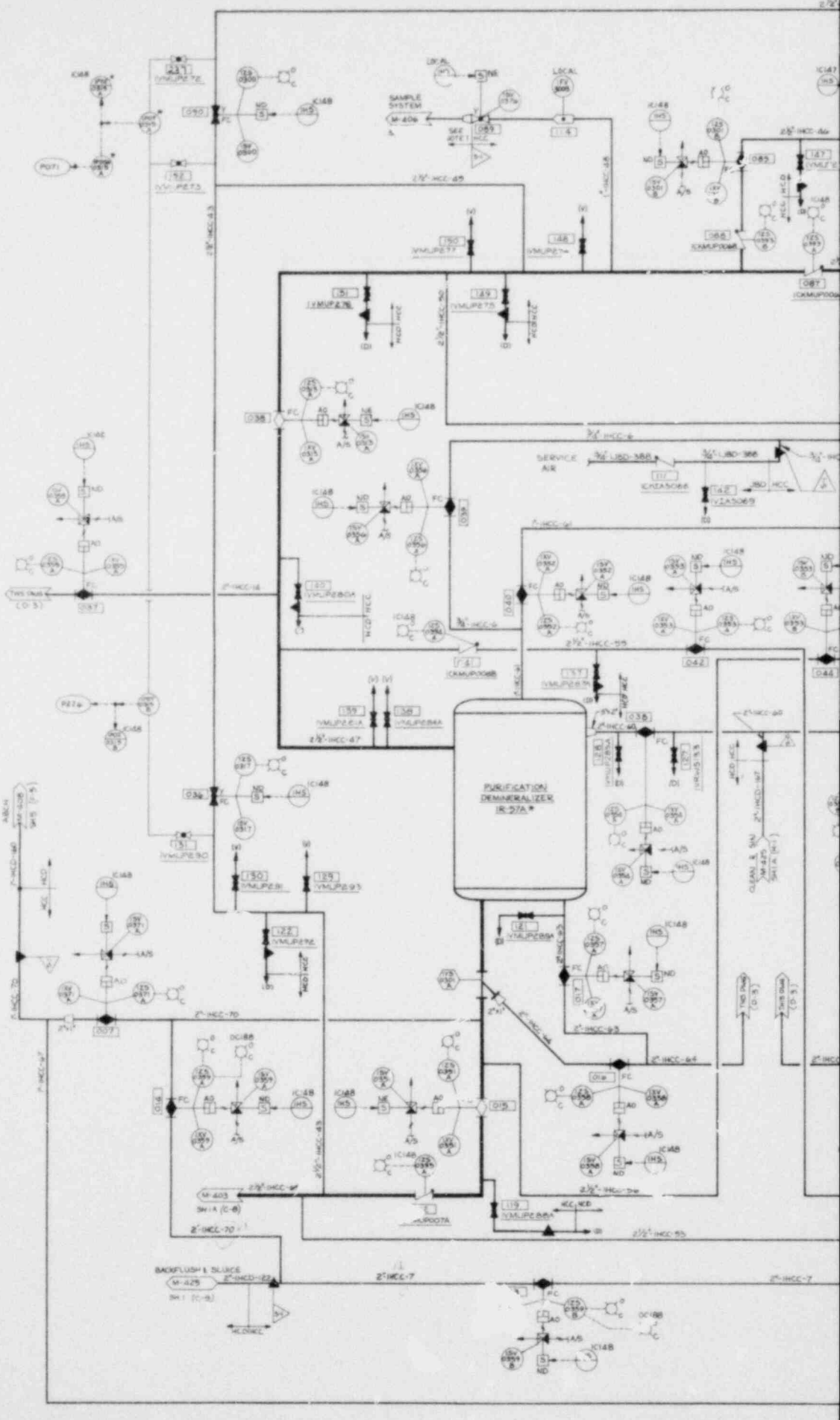
NOTE :

1. THE ORDER OF PIPING CONNECTIONS TO EMBEDDED PIPING IS SHOWN AS A SCHEMATIC REPRESENTATION ONLY. ACTUAL CONSTRUCTION ORDER OF PIPING CONNECTIONS IS NOT CRITICAL.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Boron Recovery - Units 1 & 2
(M-408 sh 6, Rev 7)

FSAR Figure 9.3-19


PURIFICATION DEMINERALIZER IR-57A*
SERVICE AIR
SAMPLE SYSTEM
BACKFLUSH & SLUICE
LOCAL
REMOTE
2"-HCC-70
2"-HCC-7
2"-HCC-69
2"-HCC-68
2"-HCC-67
2"-HCC-66
2"-HCC-65
2"-HCC-64
2"-HCC-63
2"-HCC-62
2"-HCC-61
2"-HCC-60
2"-HCC-59
2"-HCC-58
2"-HCC-57
2"-HCC-56
2"-HCC-55
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2"-HCC-48
2"-HCC-47
2"-HCC-46
2"-HCC-45
2"-HCC-44
2"-HCC-43
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2"-HCC-41
2"-HCC-40
2"-HCC-39
2"-HCC-38
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2"-HCC-19
2"-HCC-18
2"-HCC-17
2"-HCC-16
2"-HCC-15
2"-HCC-14
2"-HCC-13
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2"-HCC-7
2"-HCC-6
2"-HCC-5
2"-HCC-4
2"-HCC-3
2"-HCC-2
2"-HCC-1
3/4"-HCC-6
3/4"-HCC-5
3/4"-HCC-4
3/4"-HCC-3
3/4"-HCC-2
3/4"-HCC-1
3/4"-LBD-388
3/4"-LBD-386
3/4"-HCC-7
3/4"-HCC-8
3/4"-HCC-9
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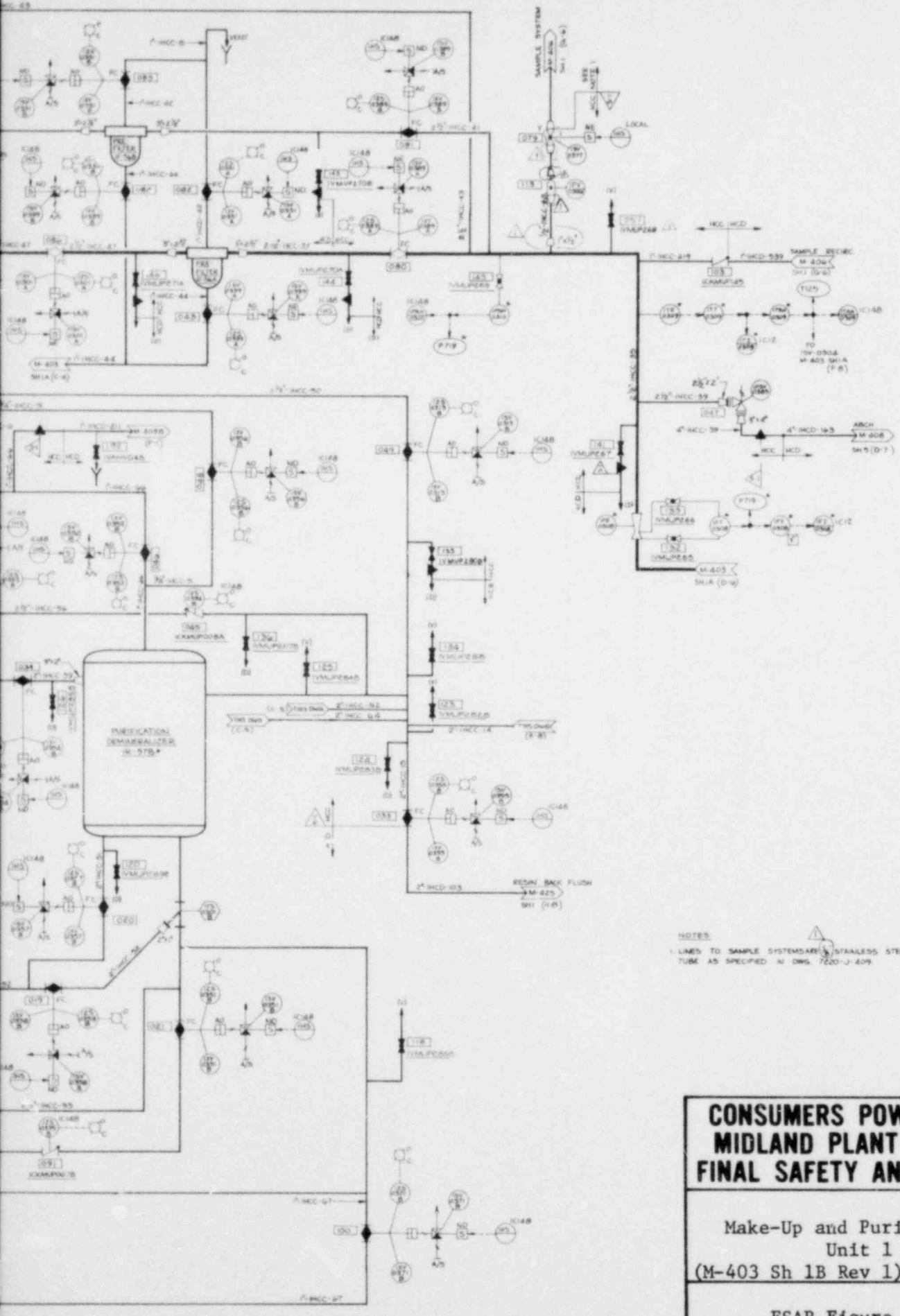
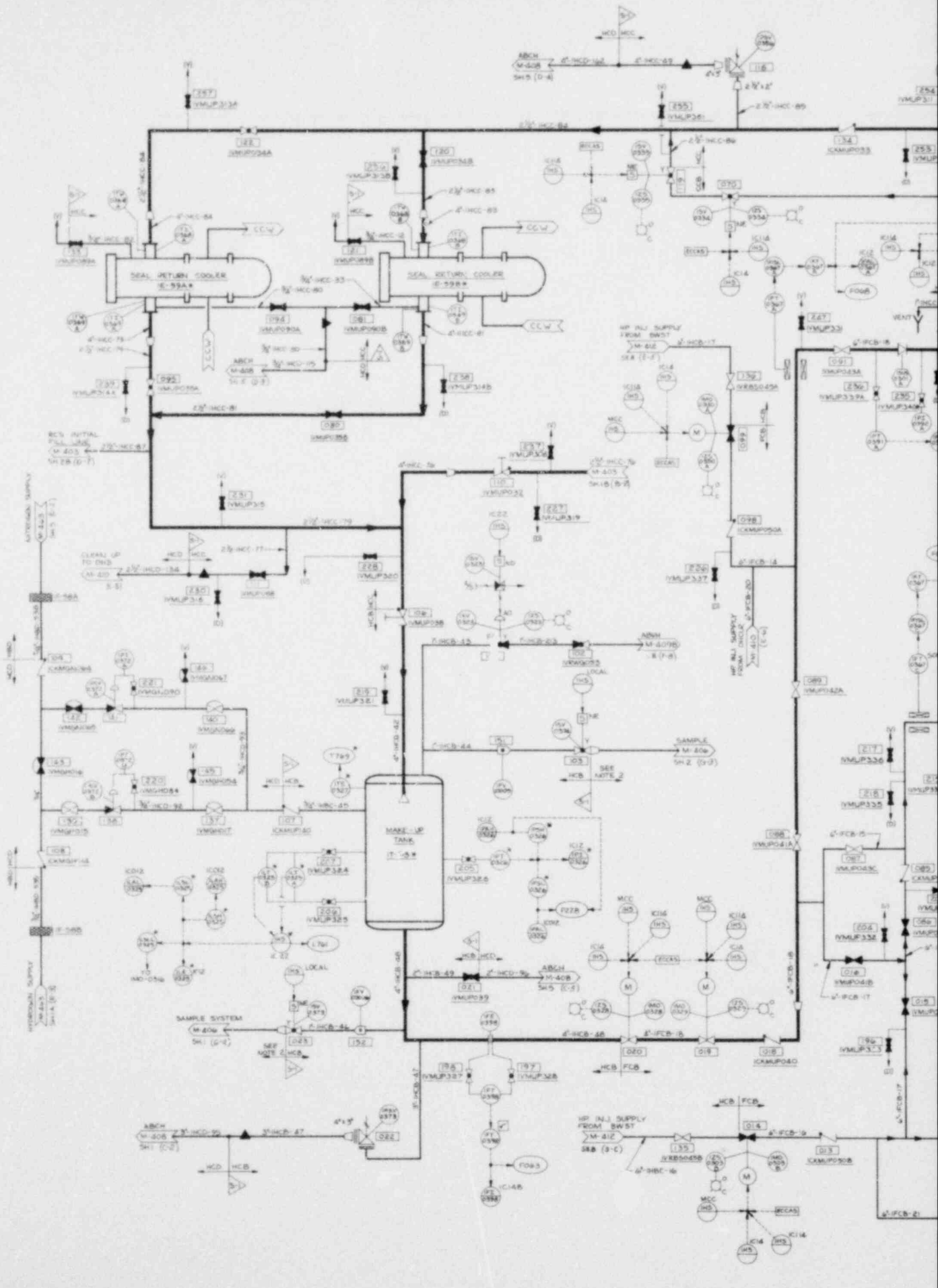
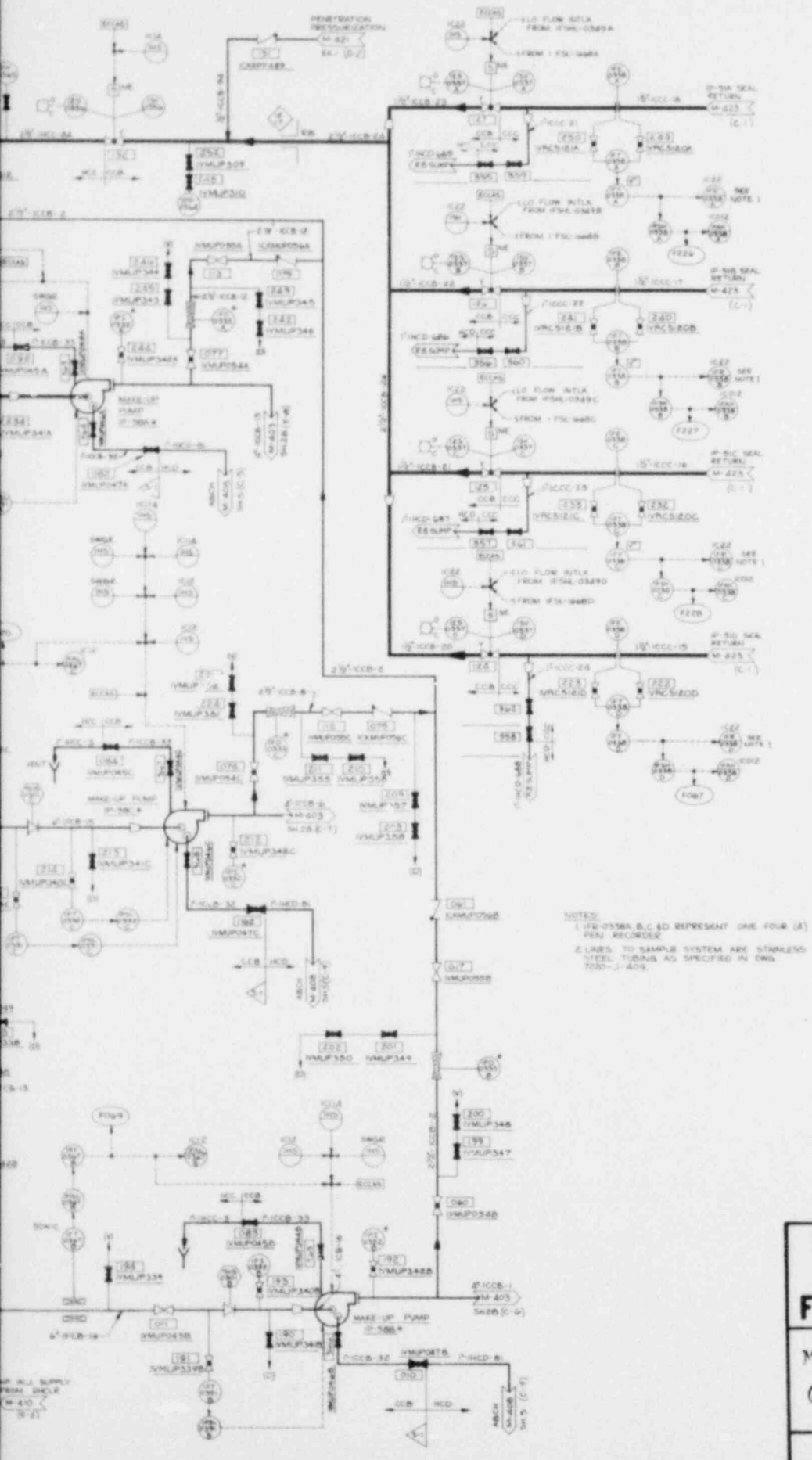


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Make-Up and Purification
Unit 1
(M-403 Sh 1B Rev 1)

FSAR Figure 9.3-31, sh. 2


SEAL RETURN COOLER
E-59A*
SEAL RETURN COOLER
E-59B*
MAKE-UP
TANK
T-65*
CCW
HCD HCC
HCB FCB
LOCAL
SAMPLE SYSTEM
M-406
SAMPLE
M-406
HP INJ SUPPLY
FROM BWST
M-412
VENT
RCS INITIAL
FILL LINE
M-405
SEE NOTE 2
HYDROGEN SUPPLY
M-445
CLEAN UP
TO CVCS
M-410
ABCH
M-608
ABGH
M-608
HP INJ SUPPLY
FROM CVCS
M-410

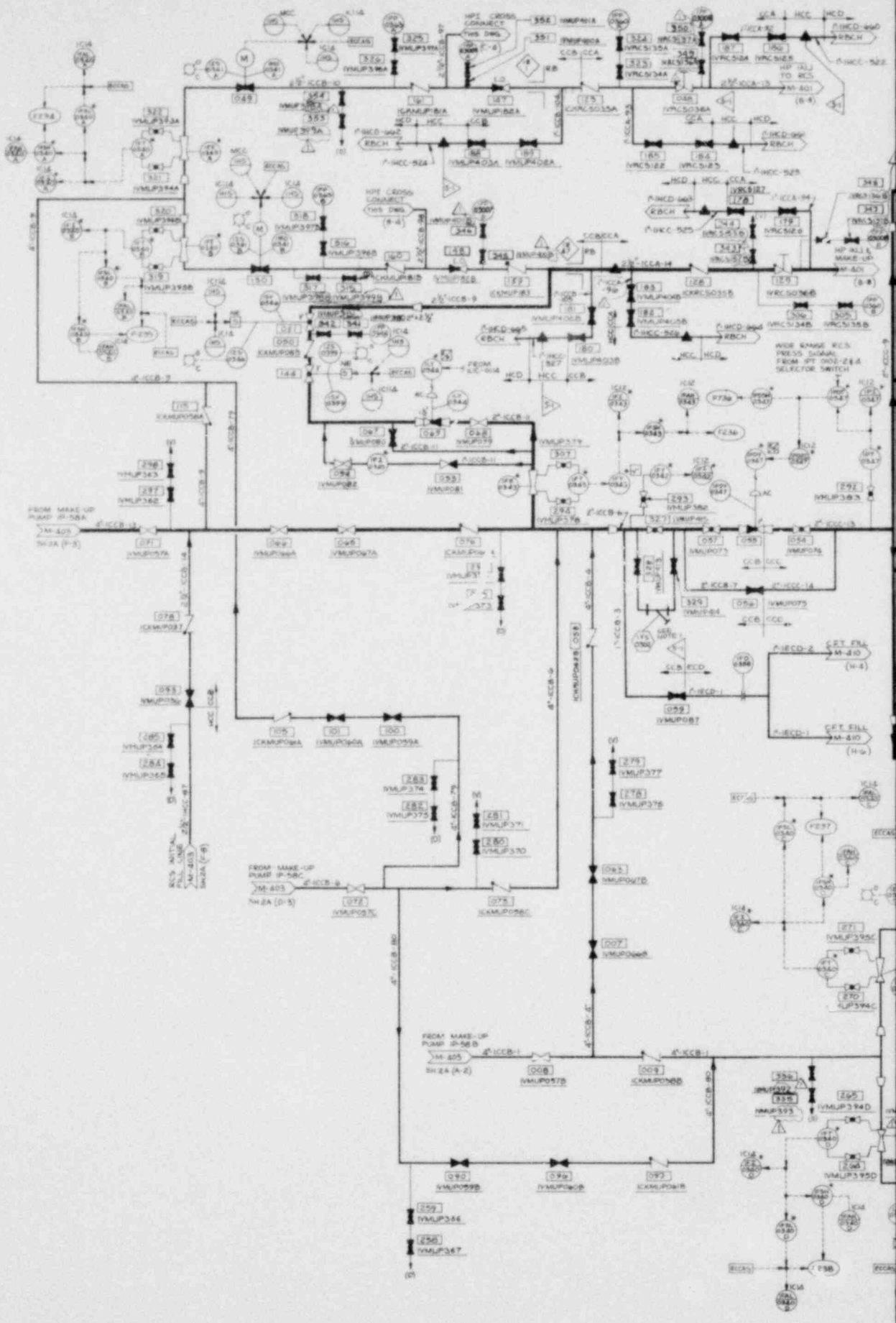


NOTES:
1. LFR-0538A,B,C &D REPRESENT ONE FOUR (4) PEN RECORDER.
2. LINES TO SAMPLE SYSTEM ARE STAINLESS STEEL TUBING AS SPECIFIED IN DWG 7080-J-409.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Makeup and Purification - Unit 1
(M-403 sh 2A, Rev 0)

FSAR Figure 9.3-32, sh. 1


FROM MAKE-UP PUMP IP-58A
FROM MAKE-UP PUMP IP-58C
FROM MAKE-UP PUMP IP-58B
WIDE RANGE RCS PRESS SIGNAL FROM IPT 0102-Z&4 SELECTOR SWITCH
HPI CROSS CONNECT THIS DWG.
HP ALT TO RCS
HP ALT MAKE-UP
RCS INITIAL FILL VMUP
CFT FILL
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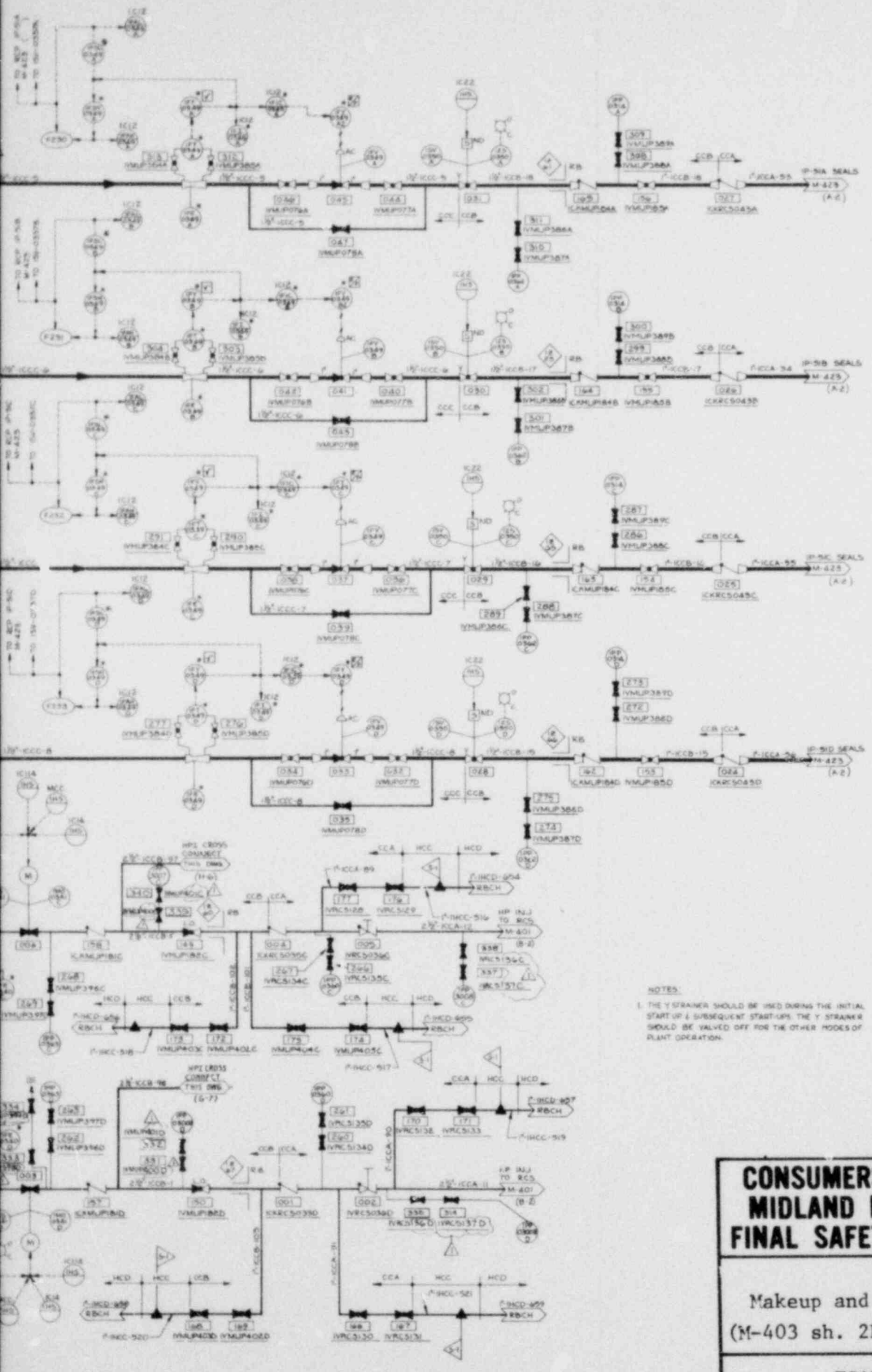
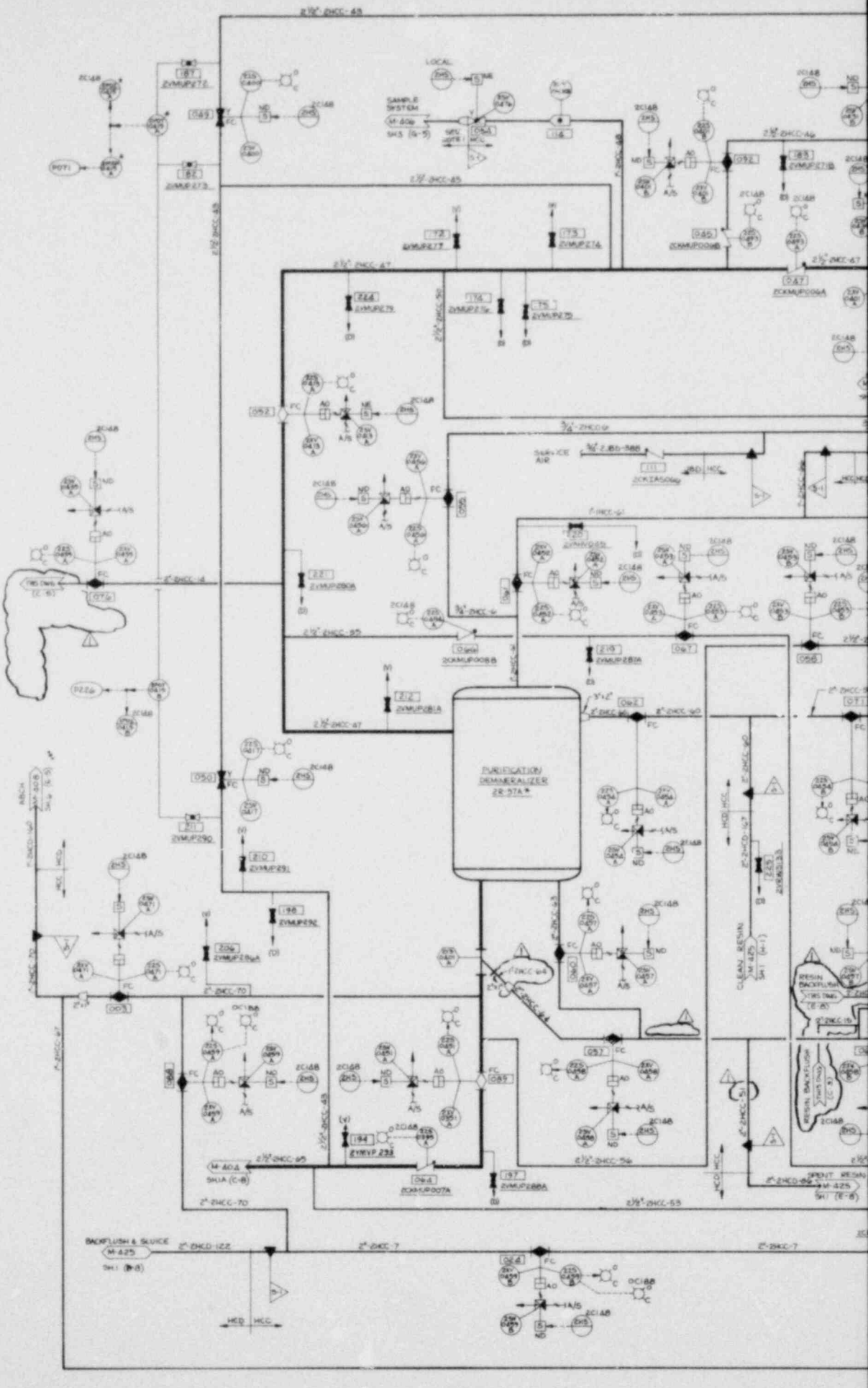


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Makeup and Purification - Unit 1
(M-403 sh. 2B, Rev 1)

FSAR Figure 9.3-32, sh. 2


PURIFICATION DEMINERALIZER 2R-57A*
SAMPLE SYSTEM
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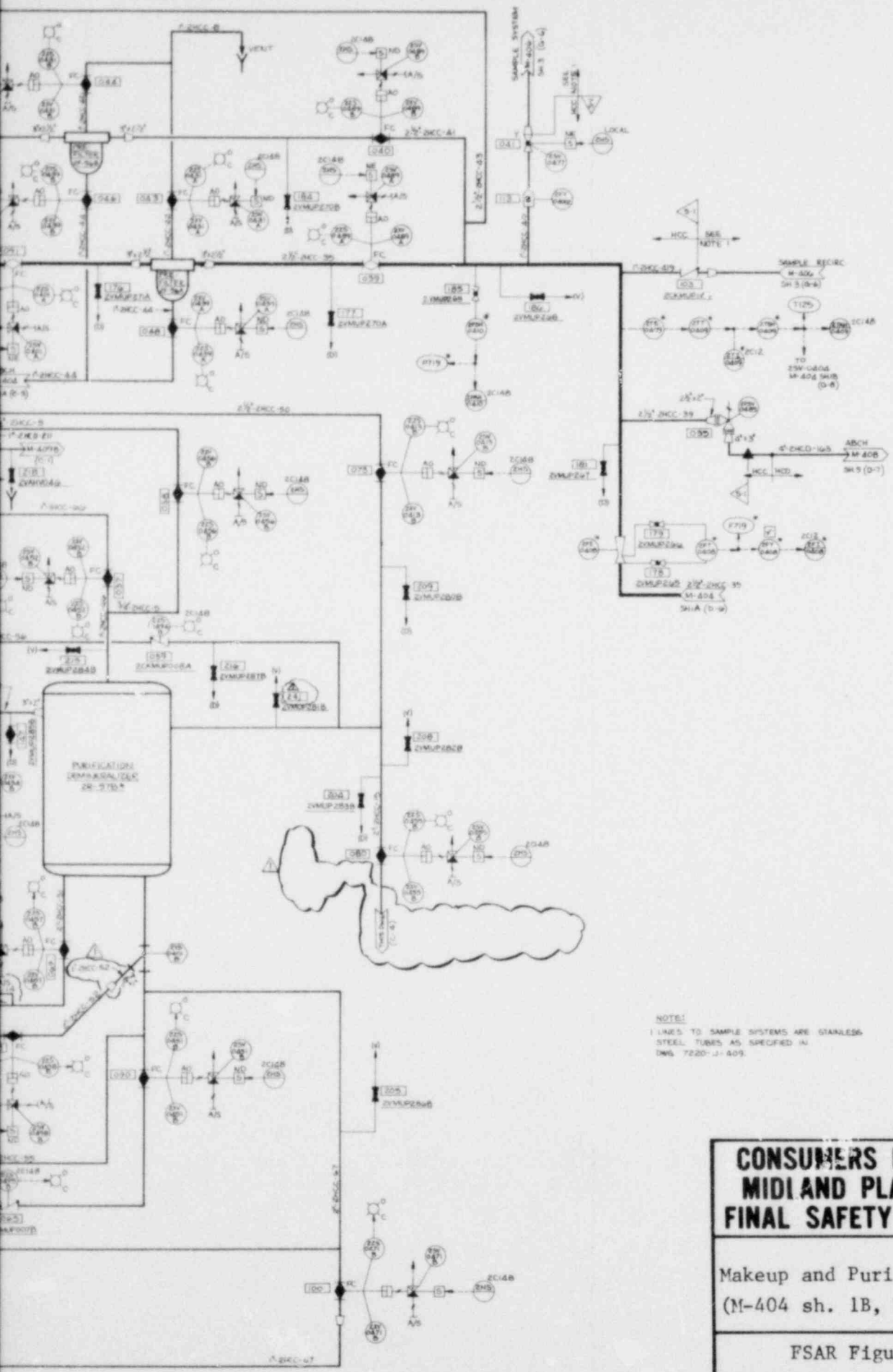
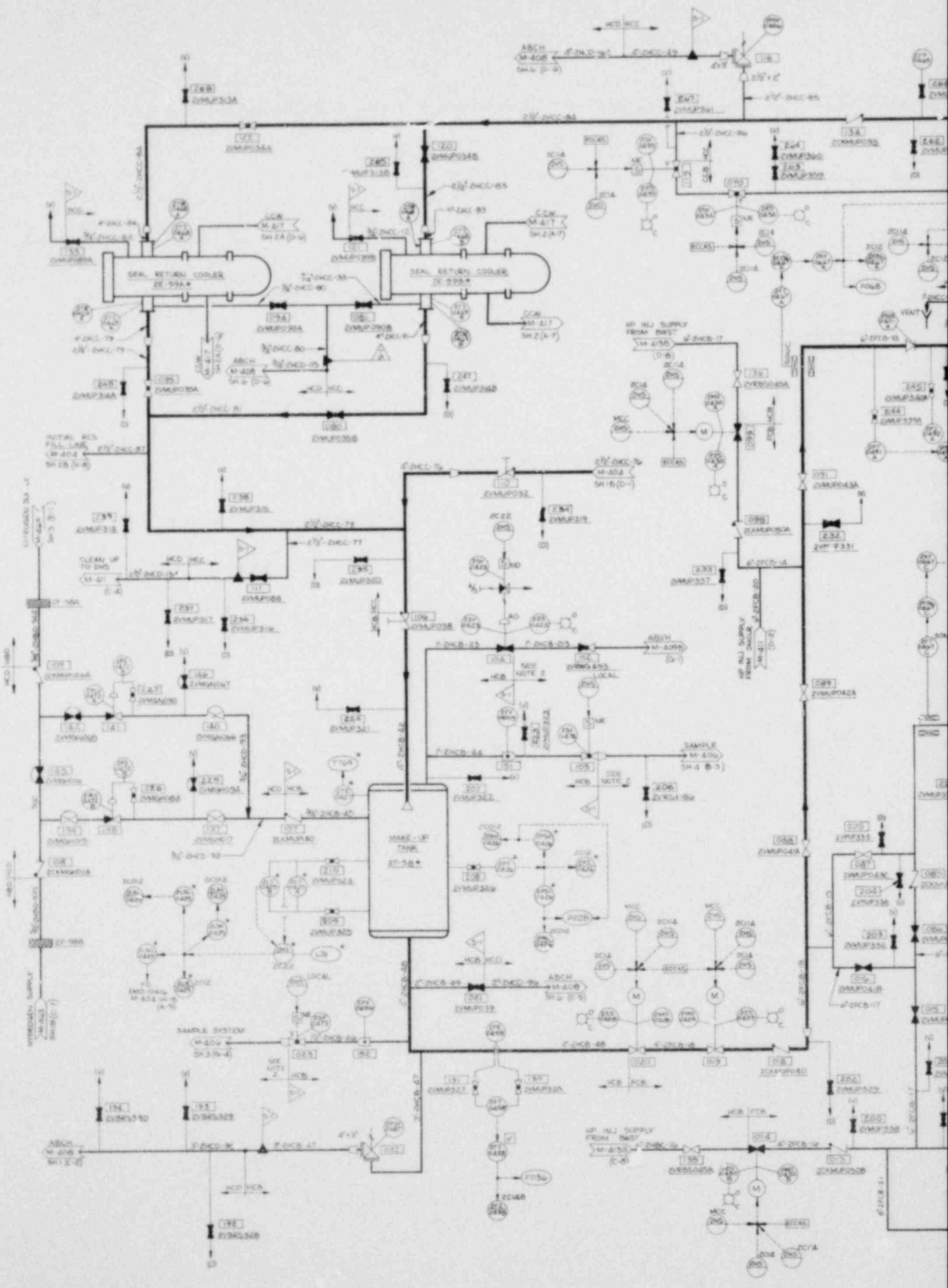
SERVICE AIR
CLEAN RESIN
SPENT RESIN
RESIN BACKFLUSH
BACKFLUSH & SLUICE
HCD
HCC
HCL
NCH



CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Makeup and Purification - Unit 2
(M-404 sh. 1B, Rev 1)

FSAR Figure 9.3-33, sh. 2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2E-99A*
SEAL RETURN COOLER
2E-99B*
MAKE-UP
TANK
2T-58*
CCW
M-417
SH 2A (D-6)
CCW
M-417
SH 2 (A-7)
HCD HCC
HCD HCB
HCB PCB
HCC MCC
INITIAL RCS
FILL LINE
LM-404
SH 2B (H-8)
CLEAN UP
TO DHS
M-411
(C-4)
SAMPLE
M-404
SH 4 (B-3)
SAMPLE SYSTEM
M-404
SH 3 (D-4)
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M-415B
(D-8)
HP INJ SUPPLY
FROM DHCLG
M-411
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SH 3 (C-8)
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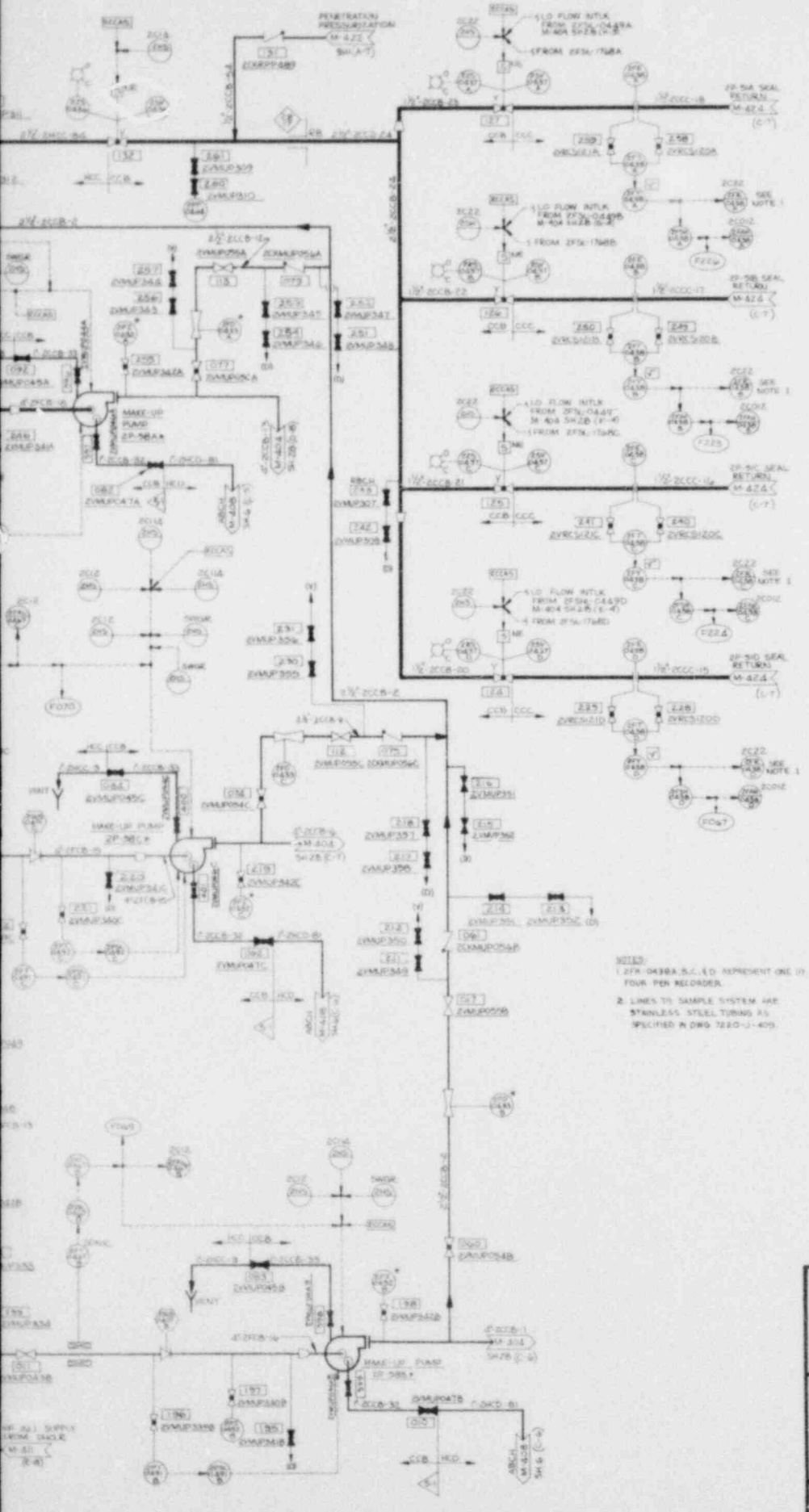
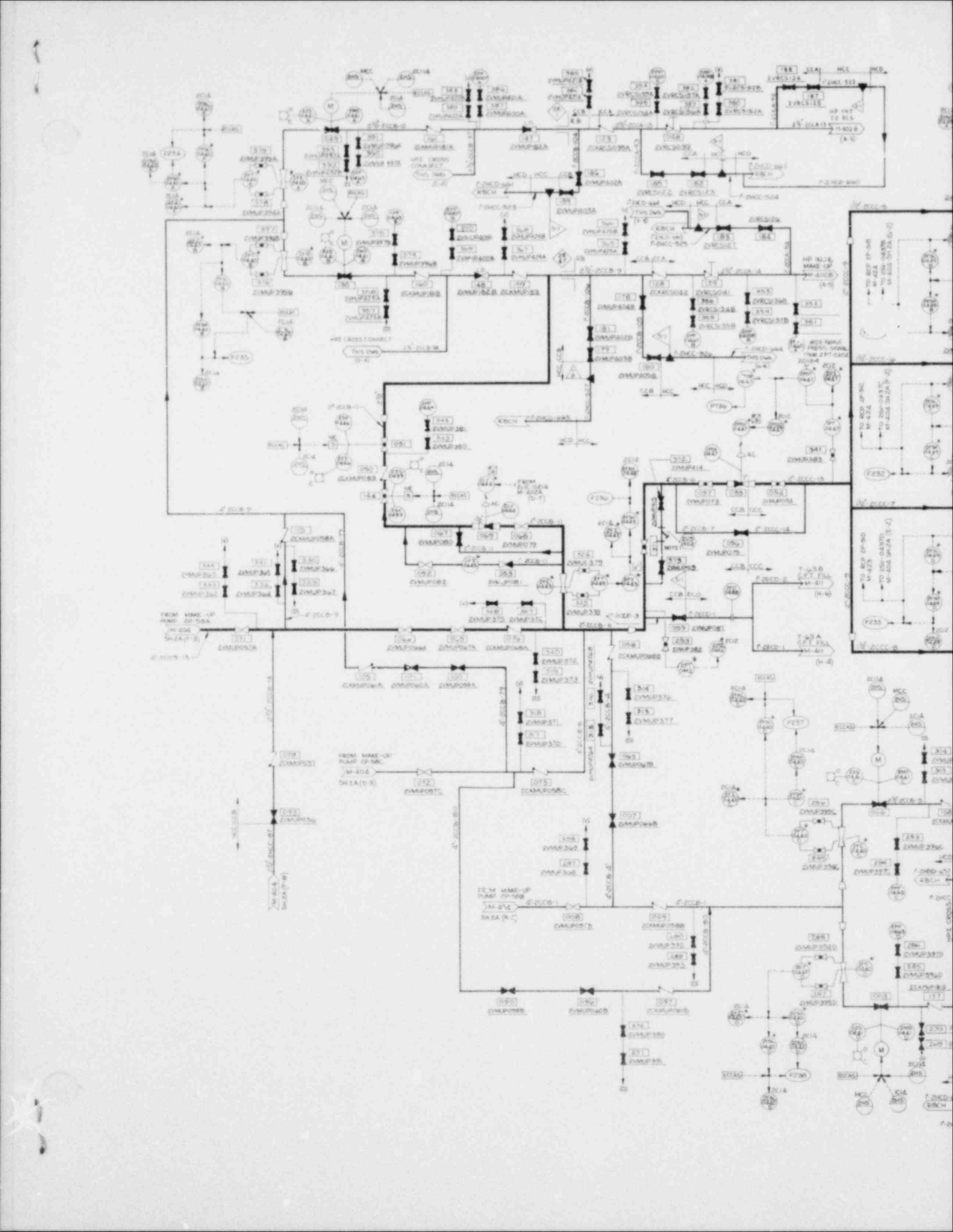
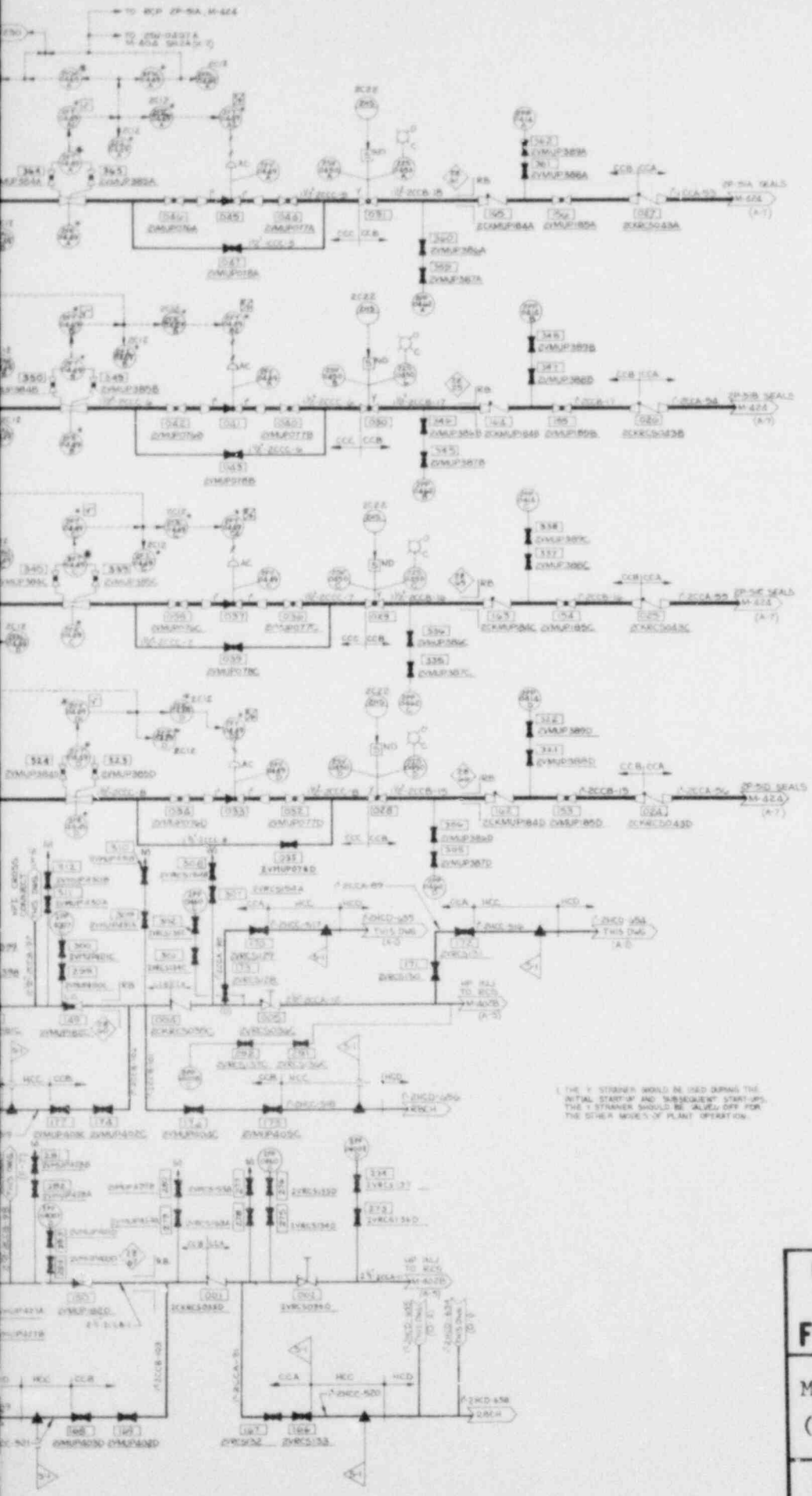


CONSUMERS POWER COMPANY MIDLAND PLANT UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Makeup and Purification - Unit 2 (M-404 sh 2A, Rev 0)
FSAR Figure 9.3-34, sh. 1

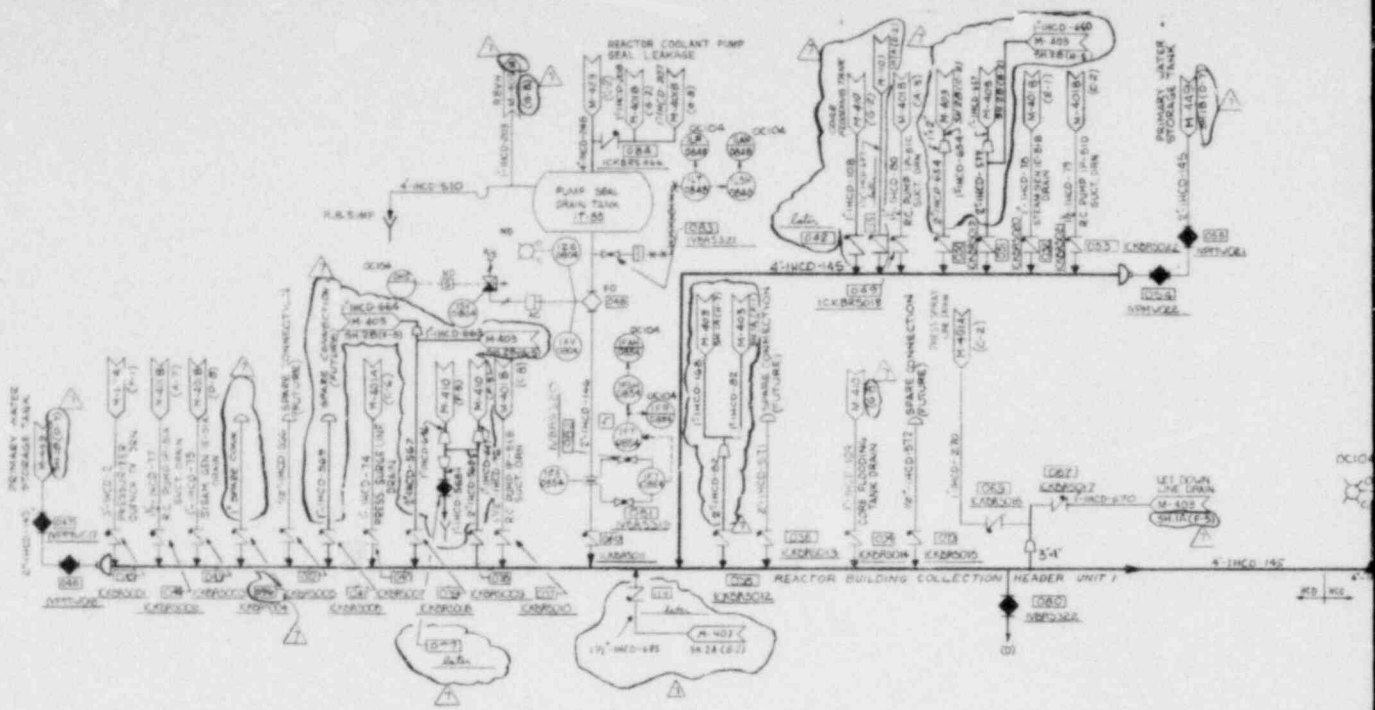


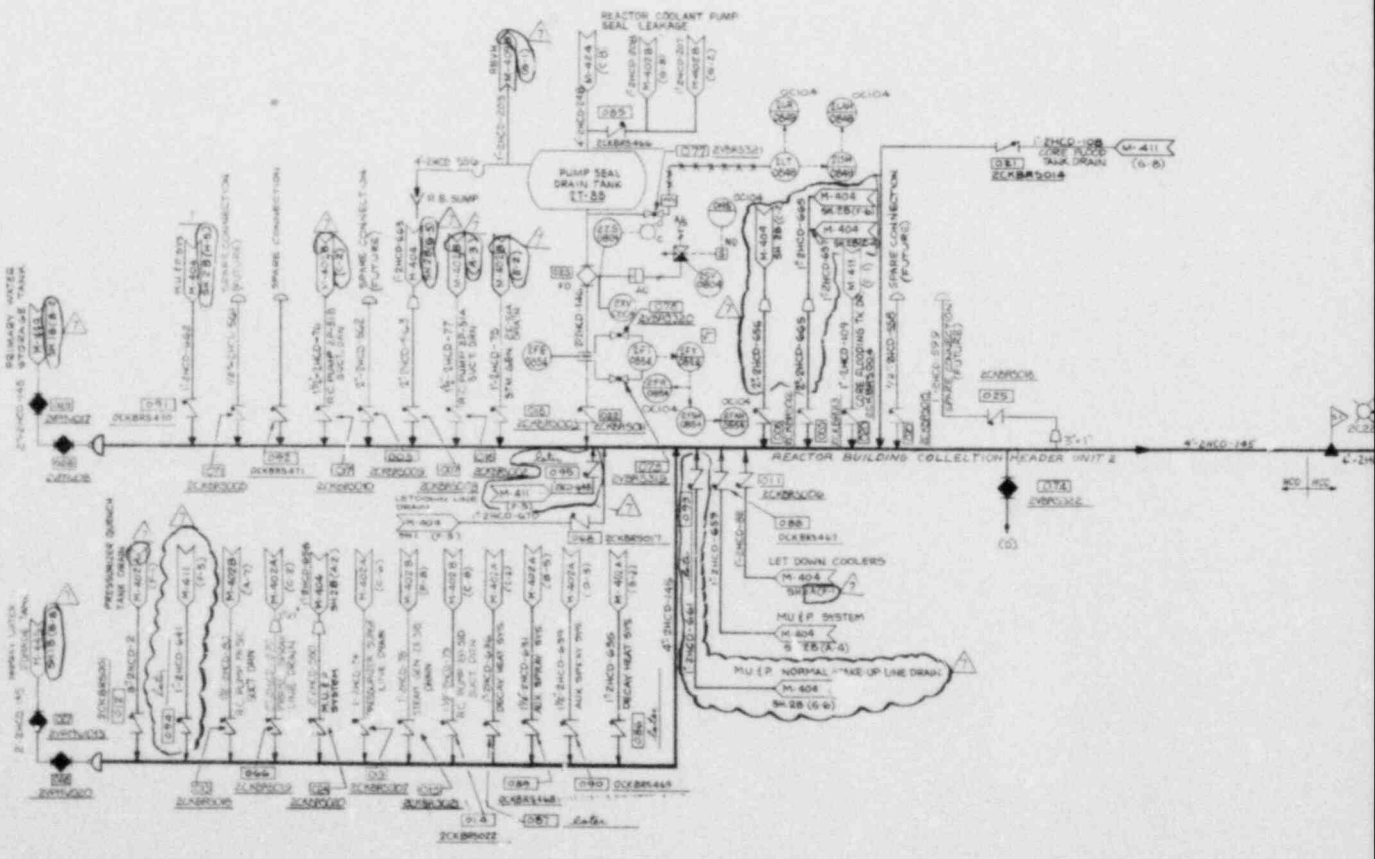


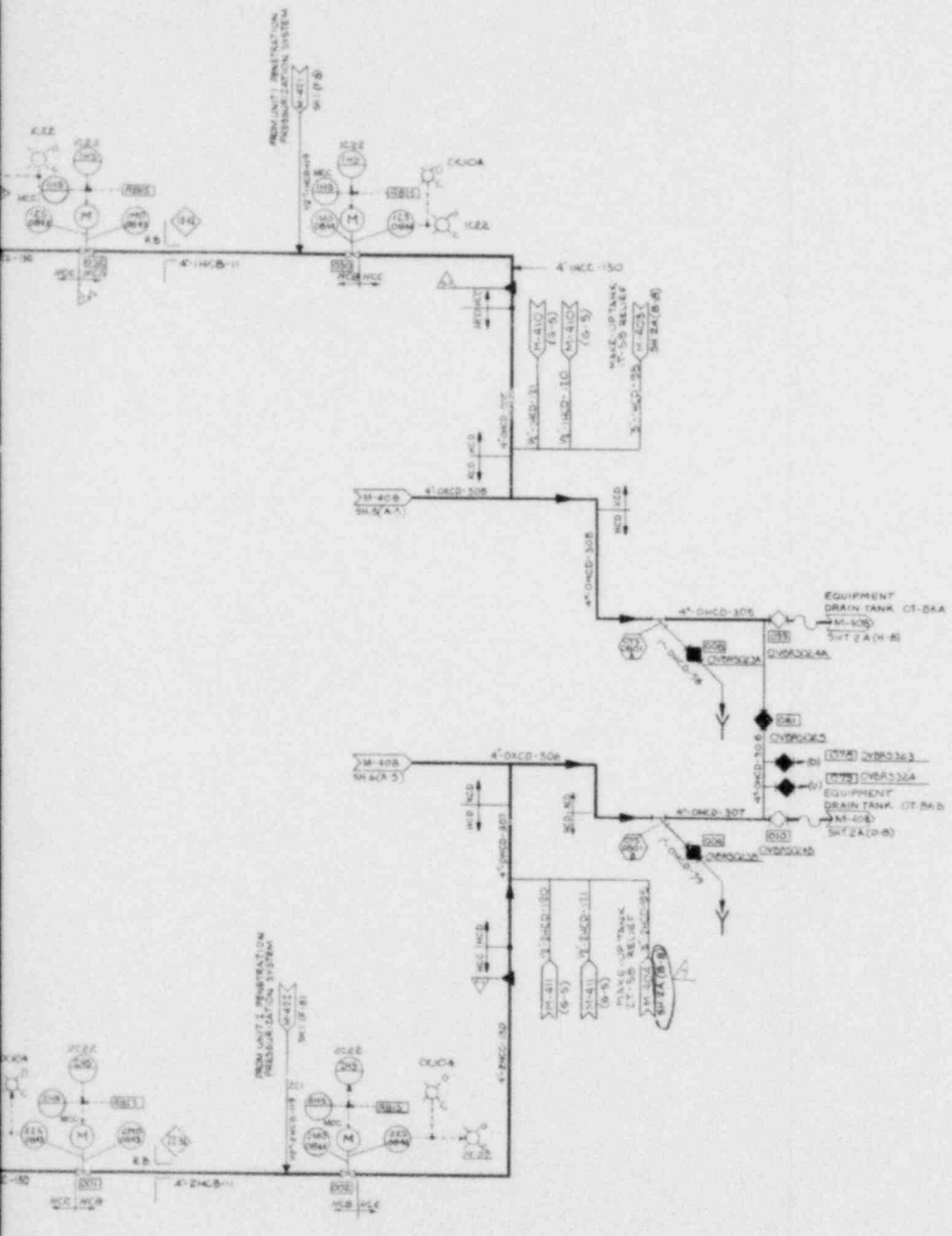
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Makeup and Purification - Unit 2
(M-404 sh 2B, Rev 0)

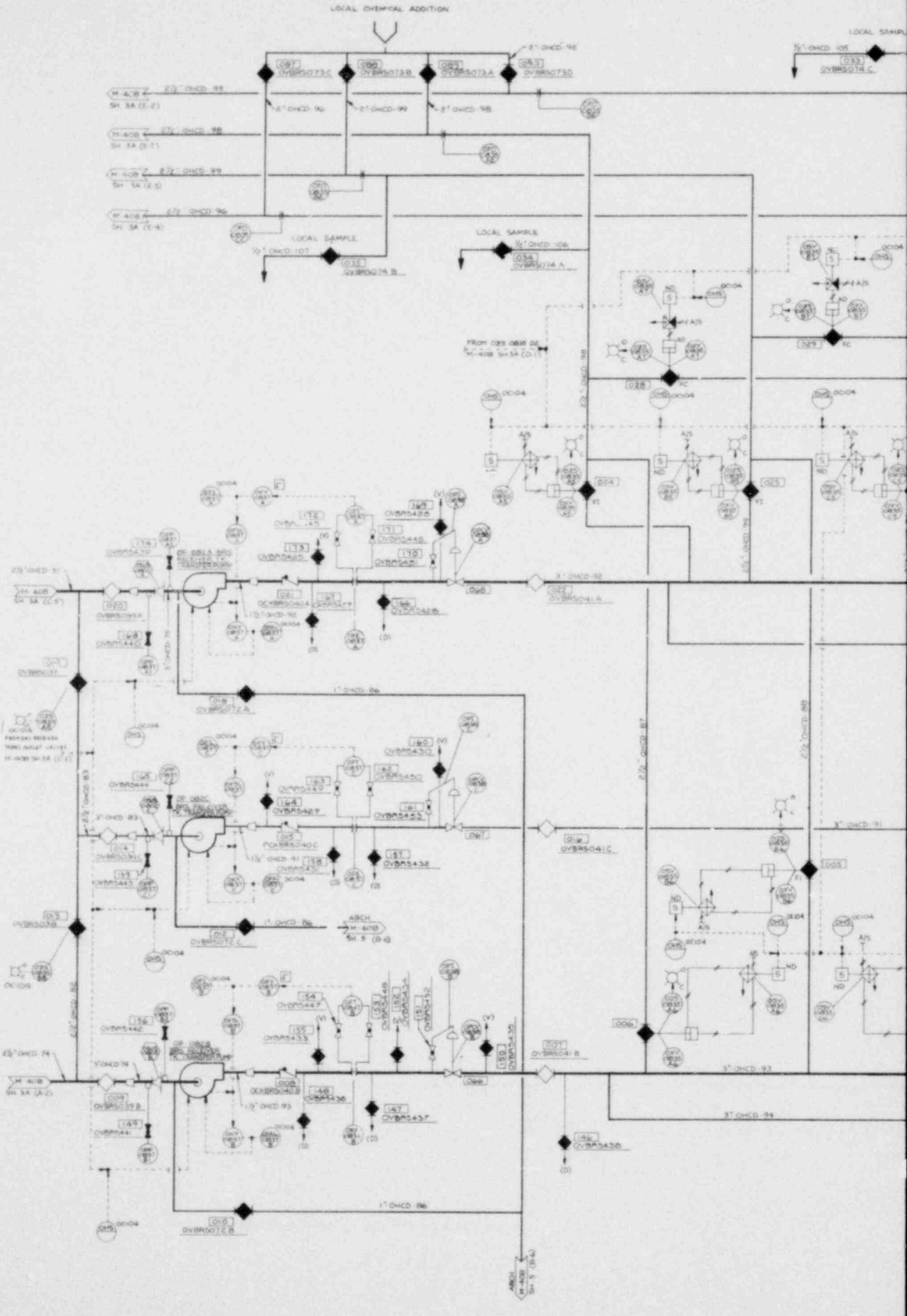
FSAR Figure 9.3-34, sh. 2


REACTOR COOLANT PUMP SEAL LEAKAGE
PLANT SEAL DRAIN TANK T-55
PRIMARY WATER STORAGE TANK
REACTOR BUILDING COLLECTION HEADER UNIT 1
SPARE CONNECTION (FUTURE)
LET DOWN LINE DRAIN
CORE FLOODING TANK DRAIN


REACTOR COOLANT PUMP SEAL LEAKAGE
PUMP SEAL DRAIN TANK ET-89
PRIMARY WATER STORAGE TANK
REACTOR BUILDING COLLETION HEADER UNIT 2
SPARE CONNECTION (FUTURE)
LET DOWN COOLERS
M.U.P. SYSTEM
M.U.P. NORMAL MAKE UP LINE DRAIN



CONSUMERS POWER COMPANY MIDLAND PLANT UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Boron Recovery Unit 1 & 2 (M-408 Sh 1 Rev 7)
FSAR Figure 9.3-35


LOCAL CHEMICAL ADDITION
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LOCAL SAMPLE
LOCAL SAMPLE
FROM 039-0835-02
M-408 SH 3A (D-1)
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SH. 5 (B-4)
ABCH
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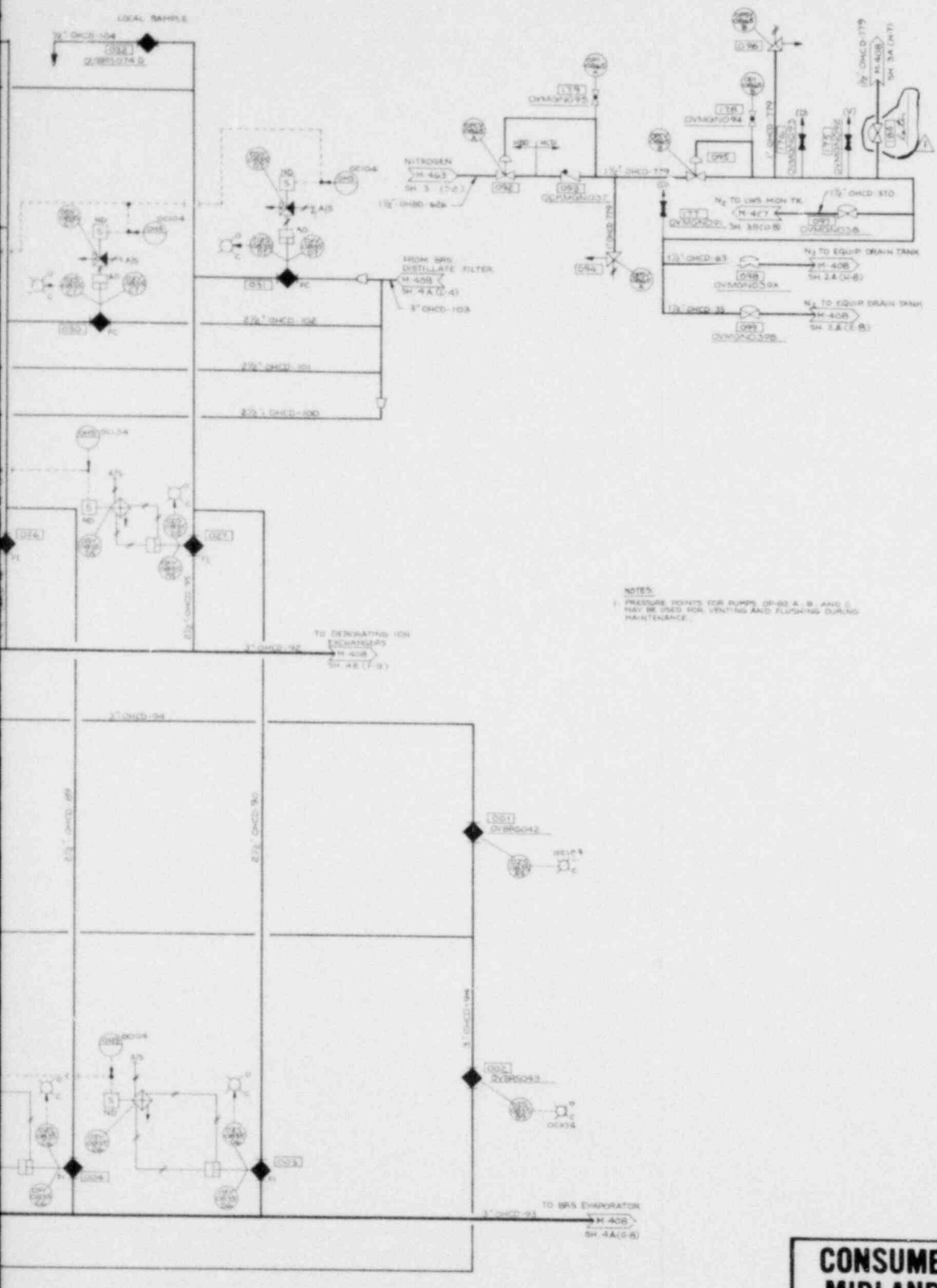
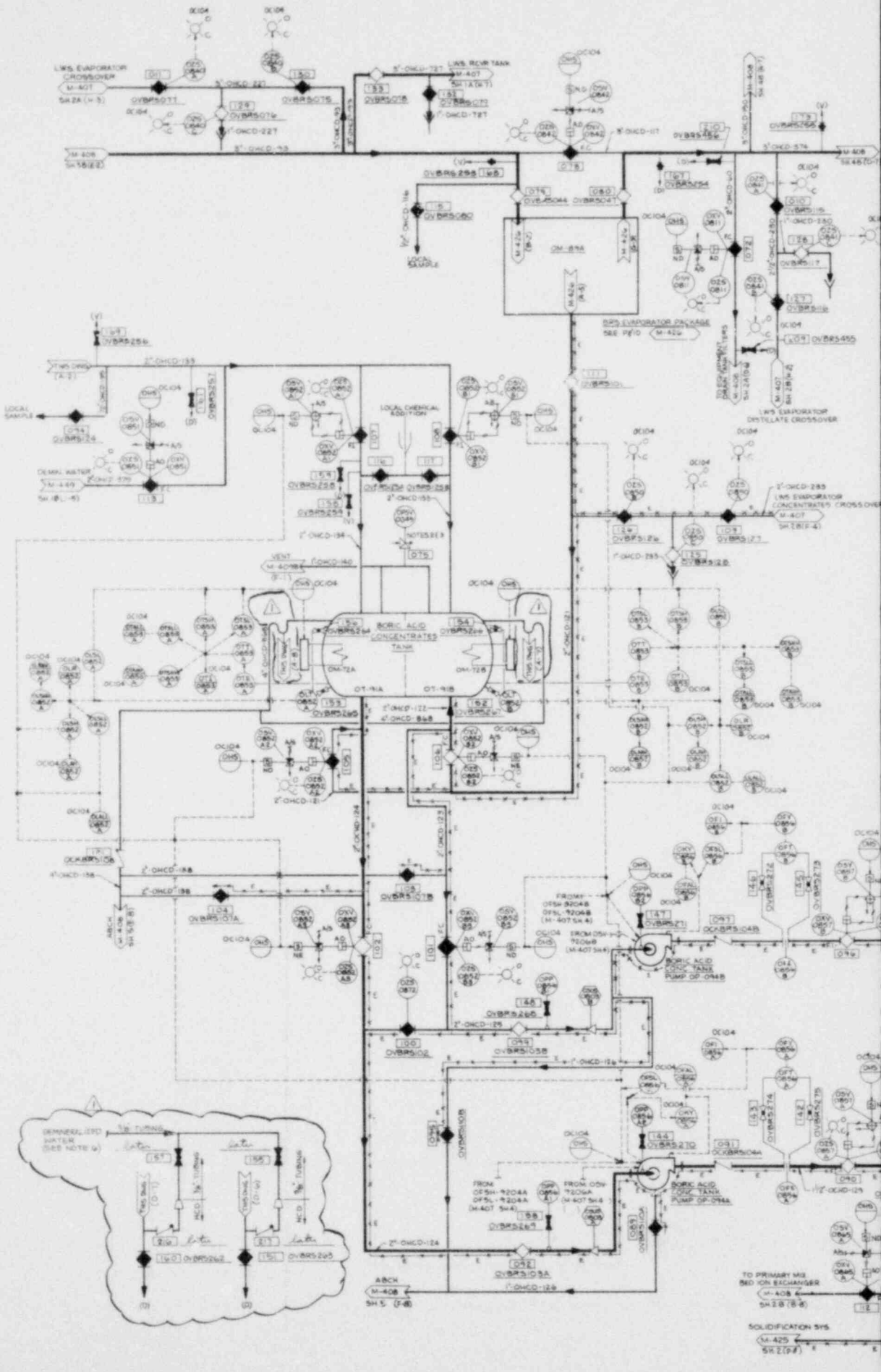
SH. 5 (B-4)

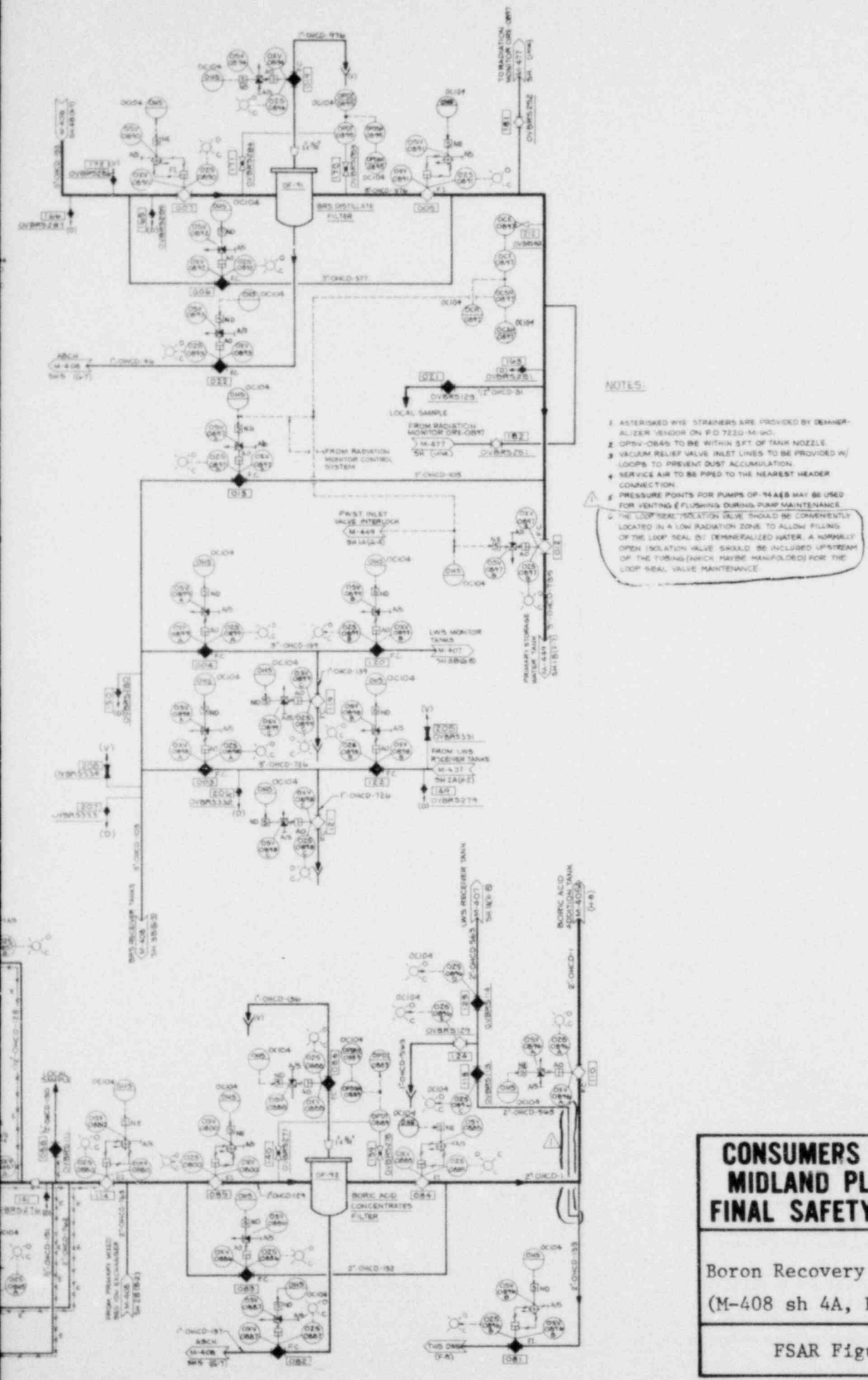


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Boron Recovery - Units 1 & 2
(M-408 sh 3B, Rev 1)

FSAR Figure 9.3-37, sh. 2


LWS EVAPORATOR CROSSOVER
LWS RCVR TANK
LOCAL SAMPLE
LOCAL CHEMICAL ADDITION
DEMIN. WATER
VENT
BORIC ACID CONCENTRATES TANK
OM-72A
OM-72B
OT-91A
OT-91B
BORIC ACID TRANSFER PUMP OP-094B
BORIC ACID TRANSFER PUMP OP-094A
DEMINERALIZED WATER (SEE NOTE 4)
LWS EVAPORATOR DISTILLATE CROSSOVER
LWS EVAPORATOR CONCENTRATES CROSSOVER
TO PRIMARY MIX BED ION EXCHANGER
SOLIDIFICATION SYS.

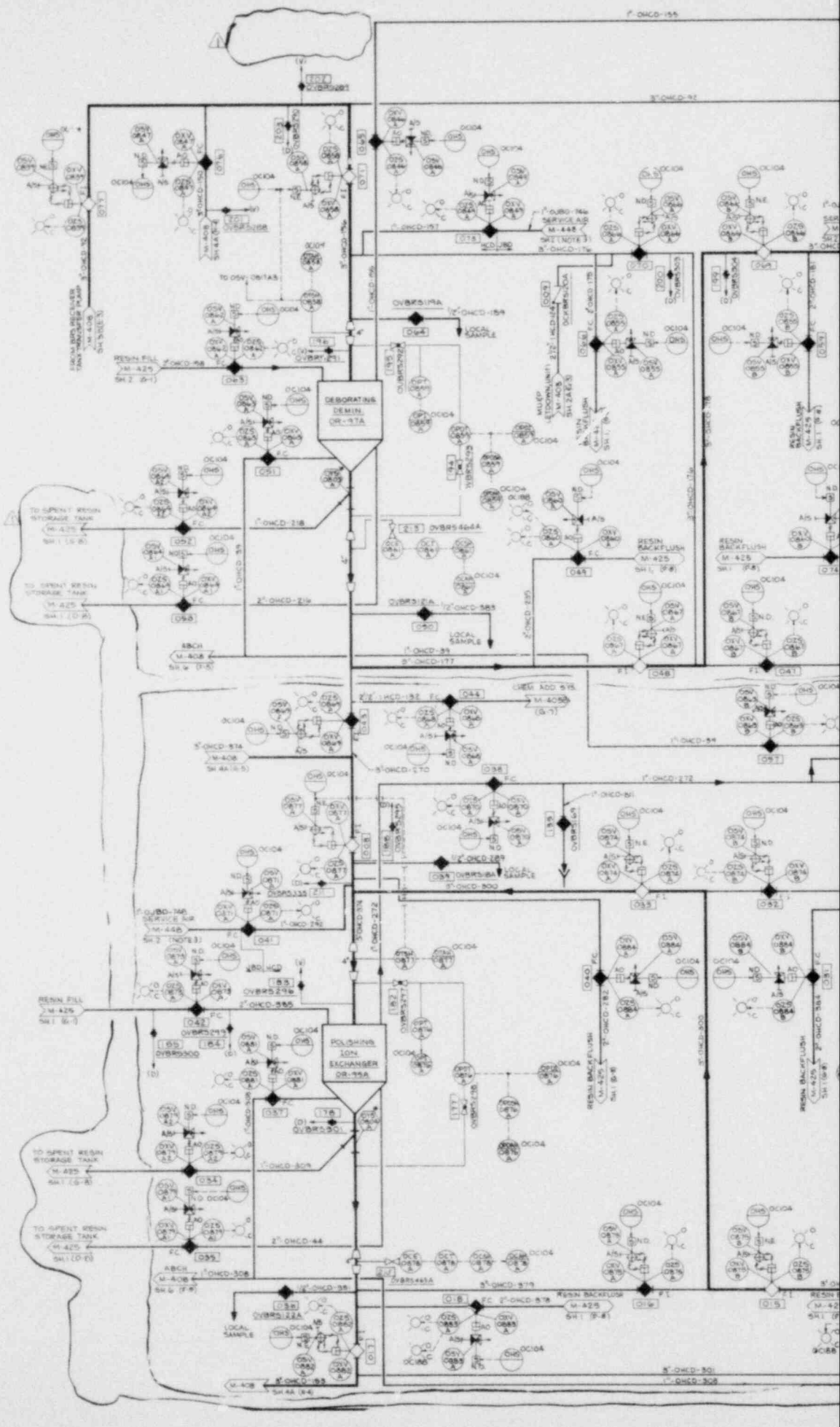


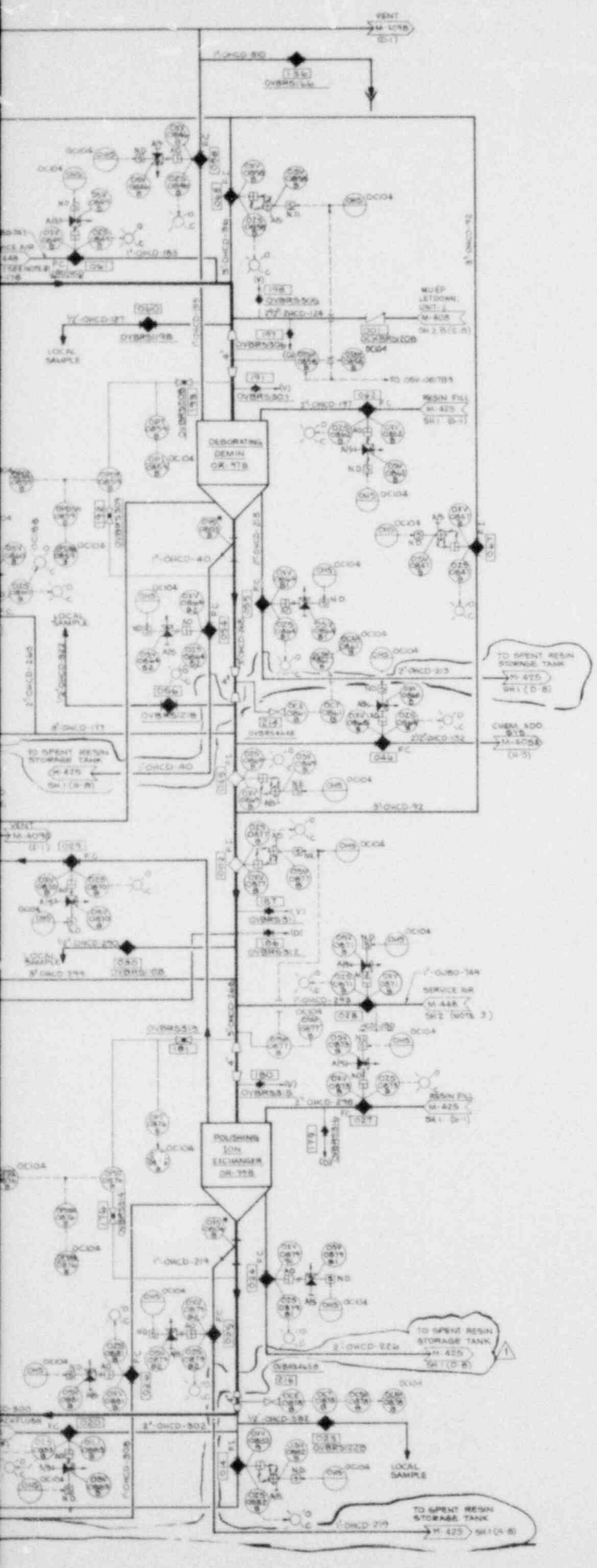
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Boron Recovery - Units 1 & 2

(M-408 sh 4A, Rev 1)

FSAR Figure 9.3-38, sh. 1


DEBORATING DEMIN. DR-97A
POLISHING ION EXCHANGER DR-95A
RESIN FILL
RESIN BACKFLUSH
LOCAL SAMPLE
TO SPENT RESIN STORAGE TANK
SERVICE AIR
3"-OHCD-92
3"-OHCD-301
3"-OHCD-308



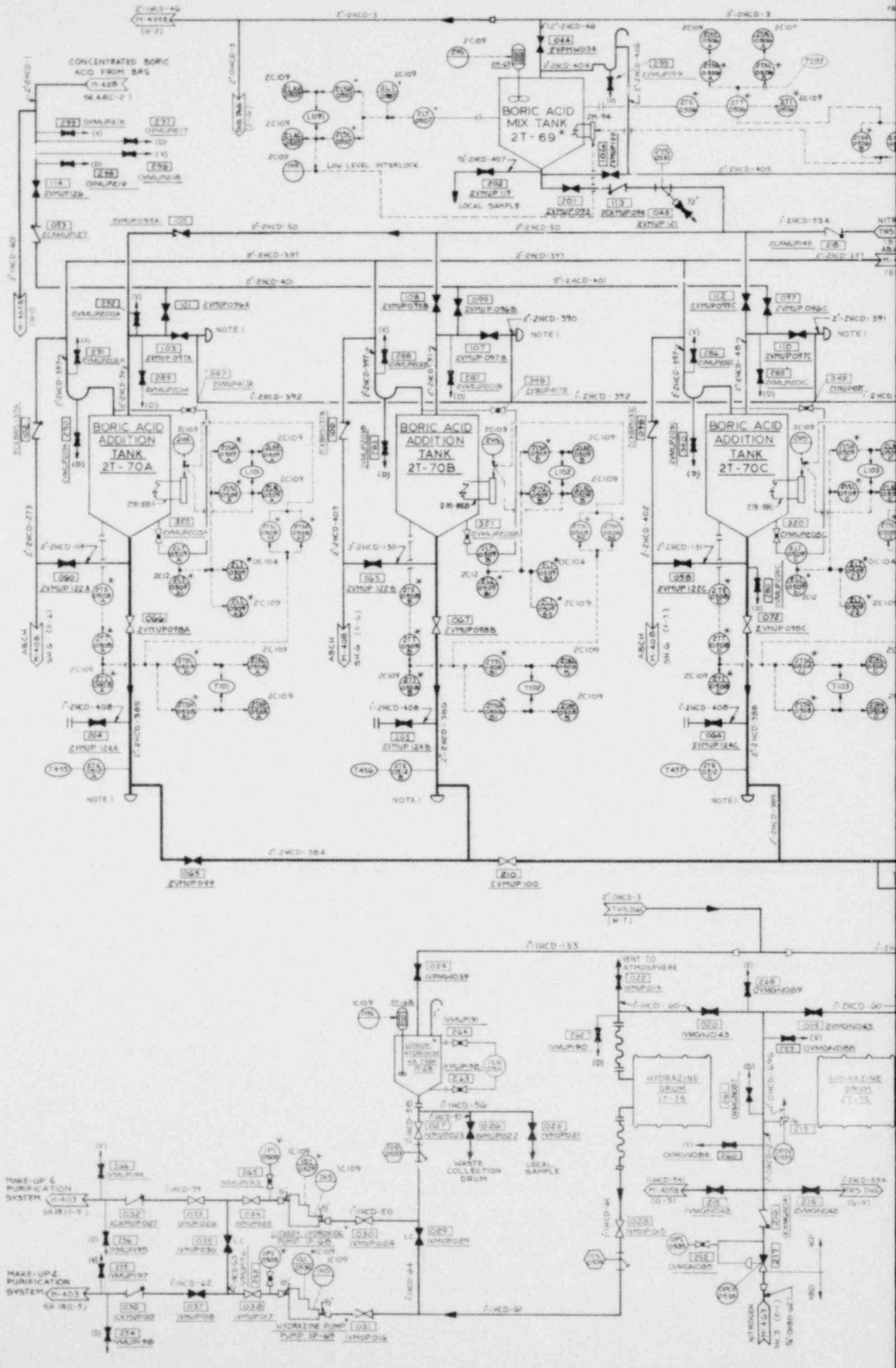
NOTES:

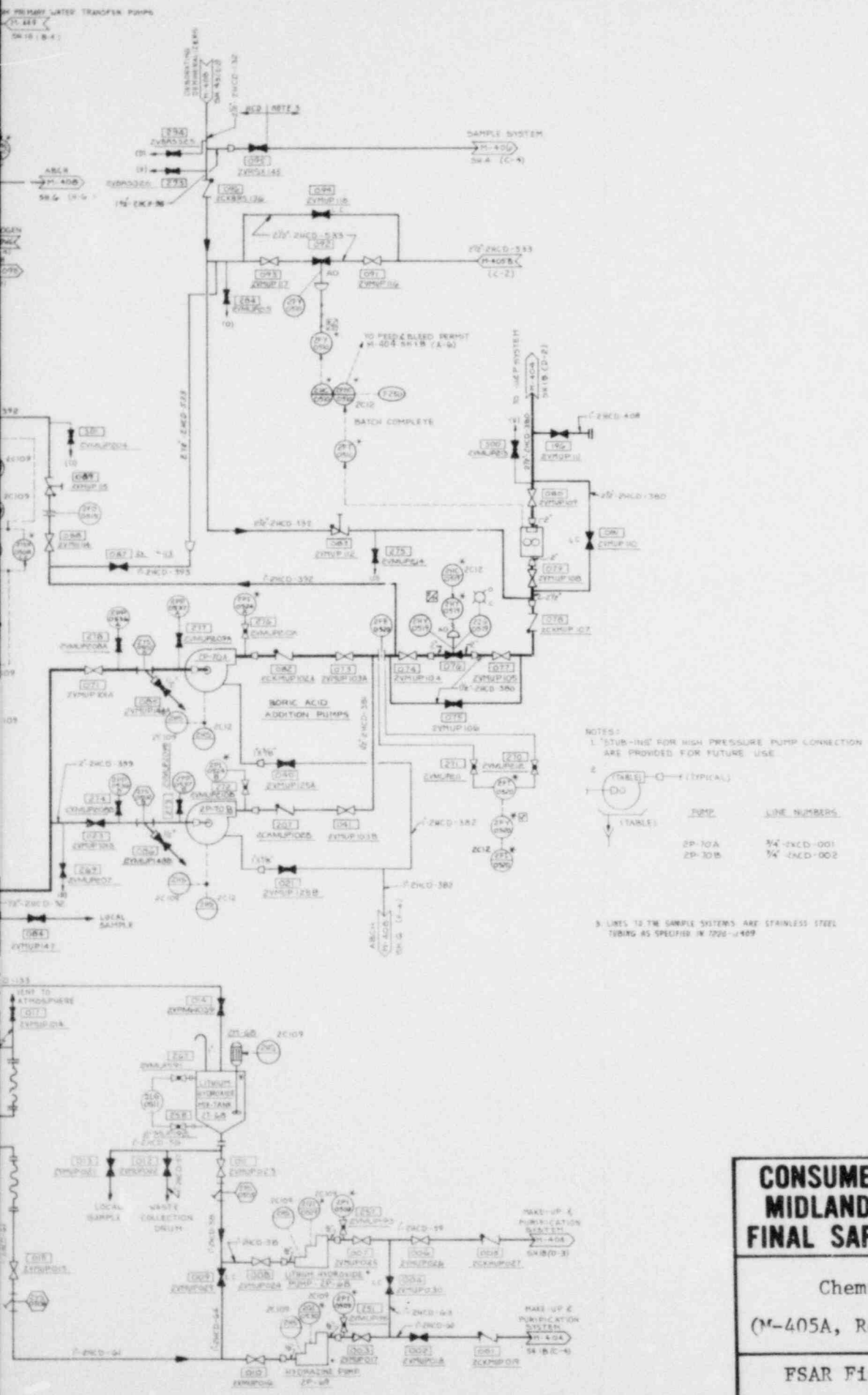
1. ASTERISKED WYE STRAINERS ARE PROVIDED BY DEMINERALIZER VENDOR ON PO. 12.80-M-40.
2. VACUUM RELIEF VALVE INLET LINES TO BE PROVIDED WITH LOOPS TO PREVENT DUST ACCUMULATION.
3. SERVICE AIR TO BE PIPED TO THE NEAREST HEADER CONNECTION.
4. LINES 1"-OHCD-809 THRU 811 HAVE BEEN PROVIDED TO ENABLE THE OPERATOR TO DETECT WATER IN THE VENT LINE AND SHOULD BE LOCATED IN A READILY ACCESABLE LOCATION.
5. VALVES 213, 214, 215, AND 216 ARE SUPPLIED WITH THE ASSOCIATED CONDUCTIVITY ELEMENTS.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Boron Recovery - Units 1 & 2
(M-408 sh 4B, Rev 1)

FSAR Figure 9.3-38, sh. 2


CONCENTRATED BORIC ACID FROM BRS
BORIC ACID MIX TANK 2T-69*
LOW LEVEL INTERLOCK
LOCAL SAMPLE
BORIC ACID ADDITION TANK 2T-70A
BORIC ACID ADDITION TANK 2T-70B
BORIC ACID ADDITION TANK 2T-70C
NOTE 1
MAKE-UP & PURIFICATION SYSTEM
HYDRAZINE PUMP
WASTE COLLECTION DRUM
VENT TO ATMOSPHERE
HYDRAZINE DRUM 2T-75
NITROGEN

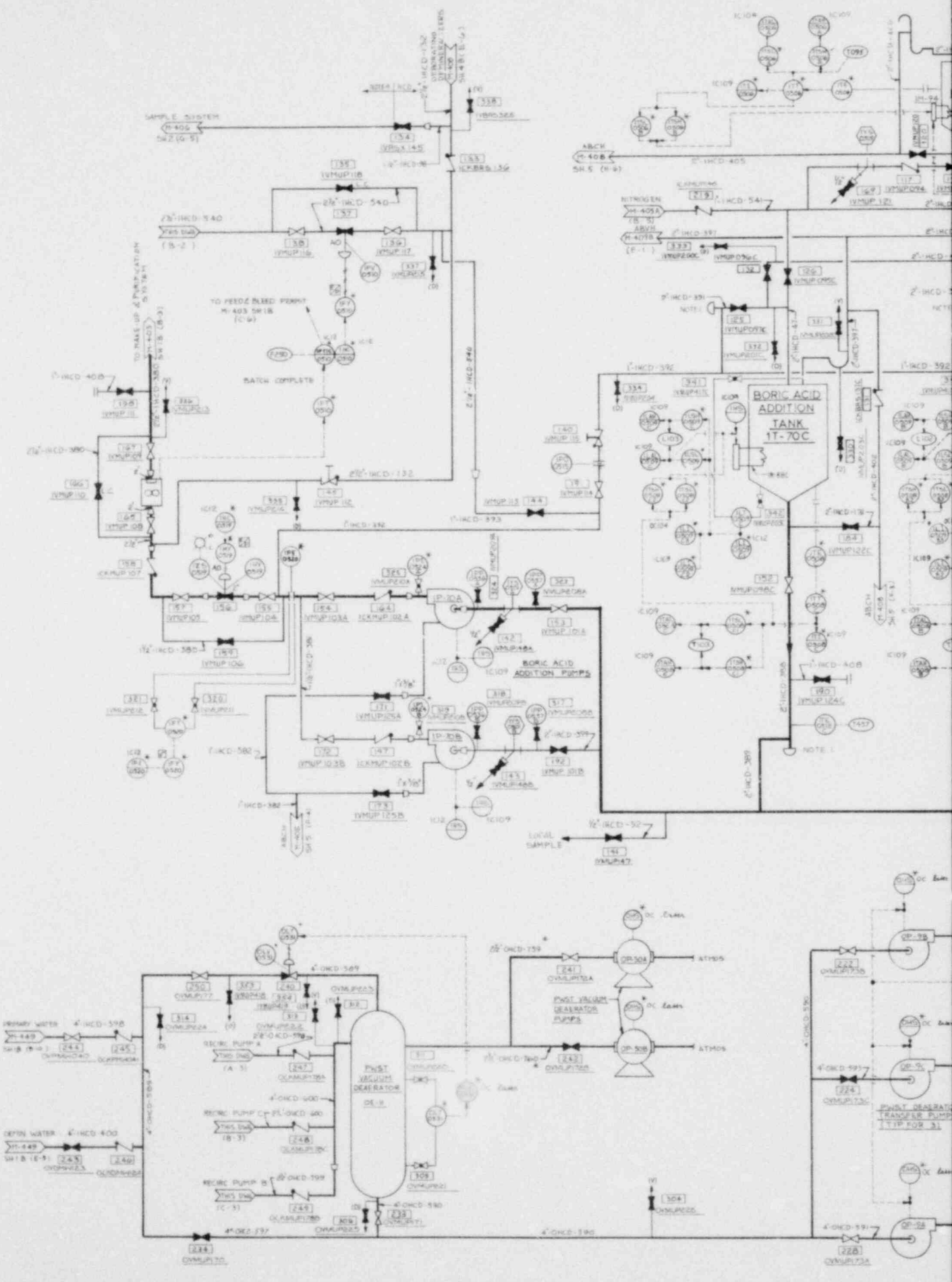


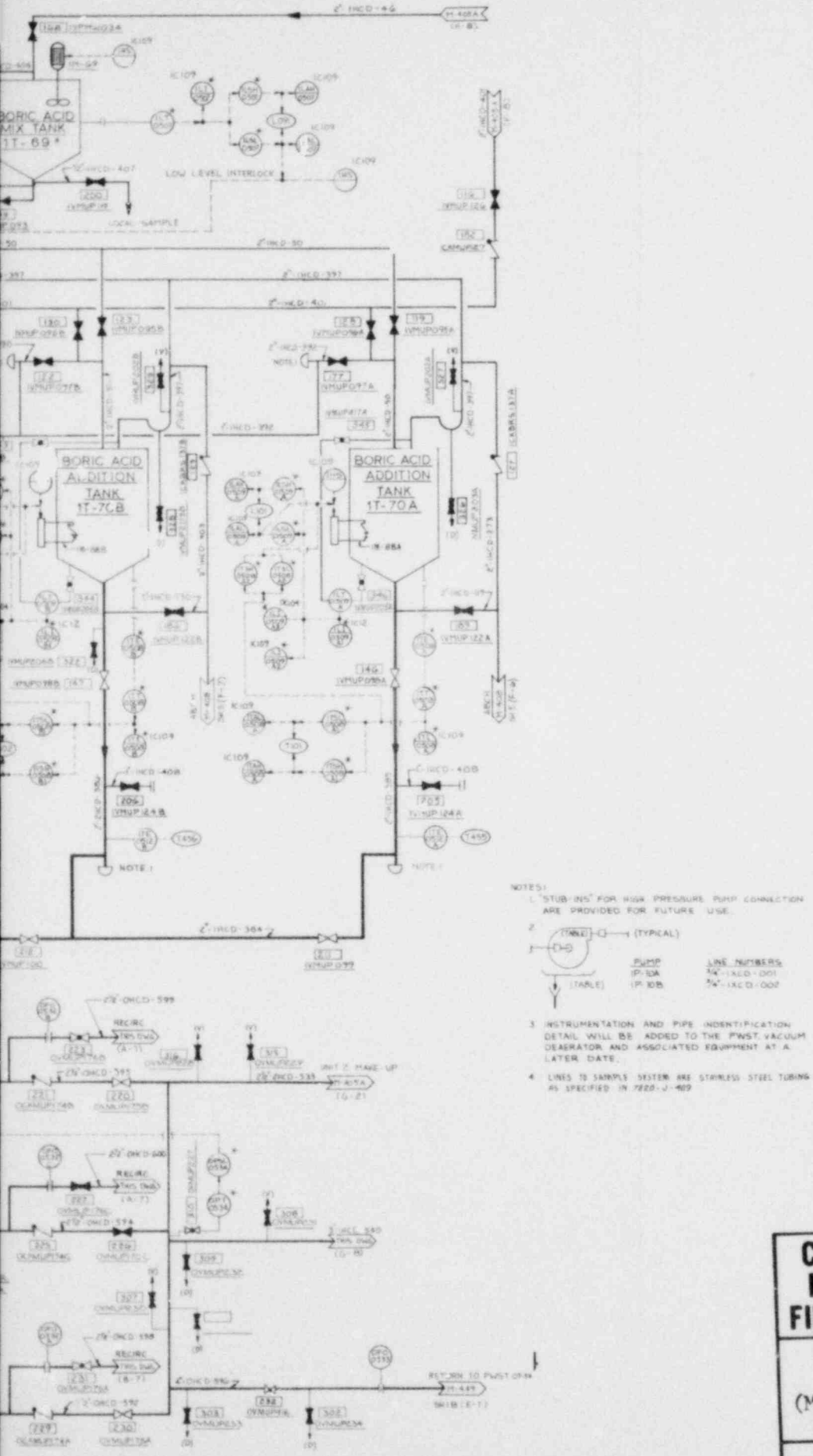
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Chemical Addition System

(M-405A, Rev 0)

FSAR Figure 9.3-40, sh. 1


BORIC ACID ADDITION TANK 1T-70C
BORIC ACID ADDITION PUMPS
PWST VACUUM DEAERATOR DE-9
PWST VACUUM DEAERATOR PUMPS
SAMPLE SYSTEM
TO FEED& BLEED PERMIT
BATCH COMPLETE
LOCAL SAMPLE
PRIMARY WATER
DEMIN WATER
RECIRC PUMP A
RECIRC PUMP B
ATMOS
NOTE 1



NOTES:

1. "STUB-INS" FOR HIGH PRESSURE PUMP CONNECTION ARE PROVIDED FOR FUTURE USE.

2. (TABLE) (TYPICAL)

PUMP	LINE NUMBERS
(P-10A	3/4"-1XCD-001
(P-10B	3/4"-1XCD-002

3. INSTRUMENTATION AND PIPE IDENTIFICATION DETAIL WILL BE ADDED TO THE PWST, VACUUM DEAERATOR AND ASSOCIATED EQUIPMENT AT A LATER DATE.

4. LINES TO SAMPLE SYSTEM ARE STAINLESS STEEL TUBING AS SPECIFIED IN 7220-J-409

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Chemical Addition System

(M-405B, Rev 0)

FSAR Figure 9.3-40, sh. 2

is provided where required for each unit for proper air distribution. The cooling coil receives chilled water from the turbine building chilled water system.

UNIT HEATERS - Thirty-one/forty (Unit 1/2) unit heaters are located throughout the periphery of the turbine building to provide localized heating during plant shutdown. Each unit heater consists of a hot water heating coil and a recirculation fan. The heating coil receives hot water from the plant heating system.

VENTILATION EXHAUST SYSTEM - Air is exhausted from the main areas of the turbine building through an exhaust system, which exhausts air from areas above the operating floor, and air from below the operating floor. The system includes two 100% capacity exhaust fans, an air operated damper at the fan discharge, associated ductwork, and instrumentation.

Separate exhaust systems are provided for the battery room and the lube oil room. The battery room and the lube oil room systems each include two 100% capacity exhaust fans, discharge dampers, and associated ductwork and instrumentation.

Eight normally closed, fusible link type, automatically actuated, smoke vents are installed in the turbine building roof for use in the event of fire. Smoke vents can be manually operated.

9.4.4.2.3 System Operation

GENERAL - The turbine building HVAC system operates continuously during normal power generation operation and during plant shutdown periods.

The system is not designed to operate subsequent to a design basis accident or safe shutdown earthquake. | 27

Failure of an operating supply or exhaust fan is alarmed in the control room. The standby unit is automatically started upon failure of the operating fan.

HEATING AND COOLING - Depending on turbine building heat loads, unit heaters, unit coolers, and the heating coils in the ventilation supply system operate as required to keep the turbine building air temperature between 50 and 104F in normally occupied areas of the turbine building. Each unit cooler and unit heater is controlled to maintain the room setpoint. | 27

AIR CIRCULATION AND EXHAUST - Outside air is supplied to the area above the operating floor by one of the two supply fans. The

supply fans deliver air to a supply duct which runs along the turbine building wall. Five/six unit coolers and eleven/fourteen unit heaters are located on the operating level to circulate and cool or heat the air above the operating level. The remaining air (ducted) flows down to the intermediate and ground levels of the turbine building. Four/four unit coolers and six/twelve unit heaters are located on the intermediate level and five/five unit coolers and thirteen/thirteen unit heaters are located on the ground level to circulate air and cool or heat those areas. Air is exhausted from the ground level through the intermediate and operating floor by one of two building exhaust fans. The supply and exhaust fans for the turbine building are located in an HVAC room.

The amount of outside air supplied and, consequently, the amount of air exhausted is kept to a minimum, with the bulk of the turbine building cooling provided by the unit coolers.

Outside air is supplied to the lube oil room by a supply system separate from the ventilation supply system provided for the remainder of the turbine building. Turbine building room air is supplied to the battery room. Air is exhausted from each of the two rooms by individual exhaust systems. Air used to ventilate these two rooms thus does not mix with the turbine building atmosphere.

SMOKE REMOVAL - Smoke vents in the turbine building roof are opened automatically by a heat sensitive fusible link to vent smoke and heat directly to the atmosphere. Manual operation is also available.

Supply and exhaust fans can be operated from a local control panel. Differential pressure indication is provided locally for all filters. Failure of any supply fan, exhaust fan, or unit cooler fan is alarmed at the local panel. A common trouble alarm is provided in the control room. Unit heaters and unit coolers are locally controlled by thermostats.

9.4.4.3 Safety Evaluation

Inasmuch as the turbine building HVAC system has no safety design bases, no safety evaluation is provided.

9.4.4.4 Tests and Inspections

Ductwork is tested for leakage during installation. A system air balance test and an adjustment to design conditions are conducted in the course of the preoperational test program. Each system is operated and tested initially with regard to flowpaths, flow capacity, and mechanical operability. An abstract of the preoperational testing is provided in Chapter 14.

9.4.7.2.3 System Operation

VENTILATION SYSTEM - The diesel generator building ventilation system is automatically placed in operation upon receipt of a diesel engine start signal. The system may also be started and stopped manually from local controls located outside the diesel generator room. In the event that the diesel generator room becomes inaccessible because of an emergency therein, the ventilation system may thus be stopped from outside of the diesel generator room. When the ventilation system is placed in operation, the supply, recirculation, and exhaust dampers modulate and the supply fans begin to run. A portion of the air discharged into the exhaust plenum flows through the recirculation damper into the supply plenum to mix with incoming air. A discharge air thermostat controls the throttling position of the dampers in order to control the temperature of the air supplied to the rooms.

Should one supply fan become unavailable and the outside air temperature is below 70F, one supply fan can provide adequate cooling to maintain room temperature below 120F. A system failure modes and effects analysis is presented in Table 9.4-10.

Diesel generator room temperatures greater than 120F or below 40F and loss of air flow are annunciated in the control room. | 27

The fans are electrically connected to the Class 1E train supplied by their respective diesel generator.

The ventilation system may be operated, as required, when the diesel generator is not operating.

HEATING SYSTEM - The electric unit heaters, which provide for freeze protection when the diesel generator is shutdown, are controlled by a thermostat located on the unit heater return air side and cycle on as required to maintain room temperature above 50F. An alarm sounds in the control room if the diesel generator room temperature falls below 40F.

FIRE PROTECTION SYSTEM - Upon initiation of the CO_2 fire protection system, the inlet and exhaust dampers are closed and the supply fans are stopped automatically. The fire protection system is discussed in Subsection 9.5.1. | 26

9.4.7.2.4 Control and Instrumentation Drawings

Applicable control and instrumentation drawings are listed below and in Tables 1.7-9, 1.7-11, and 1.7-15. | 2

a. Logic - J-423

b. Control boards - J-939, 940, 941, 942

c. Schematics - E-468 | 2

9.4.7.3 Safety Evaluation

Safety evaluations are numbered to correspond to the safety design bases.

SAFETY EVALUATION ONE - The ventilation supply and exhaust of the diesel generator building HVAC system is designed in accordance with Seismic Category I requirements as specified in Section 3.2. The components and supporting structures of any system, equipment, or structure which are not Seismic Category I and whose collapse could result in loss of a required function of the ventilation system through either impact or loading are analytically checked to determine that they will not collapse when subjected to seismic loading.

SAFETY EVALUATION TWO - Electric unit heaters are provided to ensure sufficient heat input to the diesel generator room to maintain the ambient room temperature above 50F. The heater prevents freezing of water systems within the diesel generator room and aids in the maintenance of proper lubricating oil viscosity.

Failure of the heater or its electrical supply does not immediately jeopardize the diesel generator. If the ambient temperature in the diesel generator room falls below 40F, an alarm is sounded in the control room to prompt corrective action. The engine itself is warmed by circulating warm water, described in Subsection 9.5.5, or lube oil, described in Subsection 9.5.7; the operator, alerted by the low temperature, may heat the room by the use of temporary space heaters or the running of the diesel engine unloaded.

Each diesel generator room is equipped with a ventilation system to ensure a high volume airflow with sufficient cooling capacity to maintain ambient room temperature below 120F.

SAFETY EVALUATION THREE - A system failure modes and effects analysis is presented in Table 9.4-10.

9.4.7.4 Tests and Inspections

Ductwork is tested for leakage during installation. A system air balance test and an adjustment to design conditions are conducted in the course of the preoperational test program. Each system is operated and tested initially with regard to flowpaths, flow capacity, and mechanical operability. An abstract of the preoperational testing is provided in Chapter 14.

The system continues to be proved operable during normal plant operations.

Item B.1.f: Closure time for online purge (i.e., air room system) valves is less than 5 seconds as tabulated in Table 6.2-28.

Item B.1.g: Relative location of the isolation valves with respect to outside air intake and discharge points precludes the potential accumulation of debris. Moreover, supply and exhaust systems for online purge are provided with filters as described in Subsection 9.4.9.2.2 and shown in Figure 9.4-10, to prevent debris from affecting the function of the valves. Wire screens are provided on the containment side of these valves to preclude the entrance of debris which could prevent tight closure of the minipurge valves. 8 27

Item 2: The systems designed for temperature and humidity control within containment are discussed in Subsection 9.4.6. An online purge system is not relied on for temperature and humidity control within containment.

Item 3: Midland plant design includes the containment atmosphere cleanup system as discussed in Subsection 9.4.9.

Item 4: Provisions for testing the availability of the isolation function and the leakage rate of the isolation valves are described in Subsections 6.2.4 and 6.2.6 respectively.

Item 5a: An analysis of the radiological consequences of a LOCA during air room purge system operation is described in Subsection 15.6.5. The fission products in primary coolant are based on Table 15A-4. Credit for mixing in the containment or plateout on the containment surfaces is not considered. 8

Item 5b: A pressurization analysis of the auxiliary building purge room due to a main steam line break inside containment has been performed. All safety-related equipment (e.g., fans, filters, ductwork, etc) located within the purge room and structure have been designed to withstand resulting pressure differential.

Item 5c: The subject analysis has been described in Subsection 6.2.1.5. Assumption is made in this analysis that online purge valves remain fully open for the first 5 seconds and close instantaneously at the end of 5 seconds.

Item 5d: The allowable leak rates of the purge and vent isolation valves for the spectrum of design basis pressure and flows against which the valves must be closed are discussed in Subsections 6.2.4 and 6.2.6.

REFERENCES

1. Design Testing, and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Reactor Plants, NRC Branch Technical Position ETSB 11-2, November 24, 1975

2. Containment Purging During Normal Plant Operations, NRC Branch Technical Position CSB 6-4, November 24, 1975 | 8

TABLE 9.4-6

TURBINE BUILDING HVAC SYSTEM
DESIGN DATA

Turbine Building Environmental Conditions			
Temperature (°F)	Maximum	Minimum	
Normally occupied areas	104	50	27
Supply Air Handling Units			
Quantity, per unit	2 @ 100% each		
Capacity, each (cfm)	20,000		
Roll Filter			
Quantity,	1		
Filter media	Glass fiber		
Heating Coils			
Type	Fin-tube		
Quantity, per unit	1		27
Heating capacity, each (Btu/hr)	1.118×10^6		
Fans			
Type	Centrifugal		
Quantity, per unit	2		
Flowrate, each (cfm)	20,000		
Total pressure (in. w.g.)	2.46		27
Drive	Belt		
Unit Coolers			
Quantity, per Unit 1/2	14/15		
Locations (Units 1/2)			
Operating floor	5/6		
Intermediate floor	4/4		
Ground floor	5/5		
Fans			
Type	Centrifugal		
Flowrate, each (cfm)	17,000 (11 units) 28,600 (4 units) 25,000 (14 units)		
Filters (construction purpose only)			
Type	Dry, disposable		
Filter media	Glass fiber		
Pressure drop, clean (in. w.g.)	0.2		27
Efficiency (%)	45		

TABLE 9.4-6 (continued)

Cooling Coils			
Type		Fin-tube	
Cooling capacity (Btu/hr)			
Operating floor	17,000 cfm	7.7×10^5	
Intermediate floor	28,600 cfm	1.294×10^6	
	25,000 cfm	1.126×10^6	27
Ground floor	25,000 cfm	1.126×10^6	27
Turbine Building Exhaust Fans			
Type		Vaneaxial	
Quantity, per unit		2 @ 100% each	
Flowrate, each (cfm)		24,000	
Total pressure (in. w.g.)		1.3	27
Drive		Direct	
Battery Room Supply Air Handling Unit			
Quantity, per unit		1	
Capacity, each (cfm)		2,000	
Filters			
Type		Dry, disposable	
Quantity, per unit		1	
Filter media		Glass fiber	
Capacity (cfm)		2,000	
Pressure drop, clean (in. w.g.)		0.2	27
Design Efficiency (%)		20	
Cooling Coils			
Type		Fin-tube	
Quantity		1	
Cooling capacity (Btu/hr)		90,900	
Fans			
Type		Centrifugal	
Quantity		1	
Flowrate, each (cfm)		2,000	
Total pressure (in. w.g.)		1.49	27
Drive		Belt	
Battery Room Exhaust Fans			
Type		Centrifugal	
Quantity, per unit		2 @ 100% each	
Flowrate, each (cfm)		2,000	
Total pressure (in. w.g.)		0.34	27
Drive		Belt	
Lube Oil Room Supply Air Handling Units			
Quantity, per unit		1	
Capacity, each (cfm)		6,200	

TABLE 9.4-6 (continued)

Filters		
Type	Dry, disposable	
Quantity	1	
Filter media	Glass fiber	
Pressure drop, clean (in. w.g.)	0.2	27
Design Efficiency (%)	85	
Fan		
Type	Centrifugal	
Quantity	1	
Flowrate, each (cfm)	6,200	
Total pressure (in. w.g.)	2.5	27
Drive	Belt	
Cooling Coil		
Type	Fin-tube	
Quantity	1	
Cooling capacity (Btu/hr)	123,200	
Heating Coil		
Type	Fin-tube	
Quantity	1	
Heating capacity (Btu/hr)	470,000	

Lube Oil Room Exhaust Fans

Type	Vaneaxial	
Quantity, per unit	2 @ 100% each	
Flowrate, each (cfm)	6,200	
Total pressure (in. w.g.)	1.03	27
Drive	Direct	

Unit Heaters

Quantity, per Unit 1/2	31/40
Locations (Unit 1/2)	
Operating floor	11/14
Intermediate floor	6/12
Ground floor	13/13
Lube oil room	2/2
Fans	
Type	Propeller
Flowrate, each (cfm)	
Operating floor	9,770 (25 units)
Intermediate floor	3,840 (18 units)
Ground floor	725 (26 units)
Lube oil room	2,090 (2 units)

TABLE 9.4-6 (continued)

Heating Coils	
Type	Fin-tube
Heating capacity (Btu/hr)	
Operating floor	2.78×10^5 (25 units)
Intermediate floor	1.85×10^5 (18 units)
Ground floor	2.13×10^4 (26 units) | 27
Lube oil room	9.02×10^4 (2 units)

TABLE 9.4-7

ENGINEERED SAFETY FEATURES VENTILATION
SYSTEM DESIGN DATA

ESF Unit Coolers

Room Name	Quantity	Cooling Capacity, Each (Btu/hr)	Centrifugal Fan Capacity, Each (cfm)
Decay heat removal cooler rooms	4	57,500	1,350
Makeup pump rooms	6	215,300	5,100
Component cooling water pump room	2	80,800	1,900
Component cooling water pump area (El. 599'-0")	2	117,500	2,800
Component cooling water pump area (El. 584'-0")	2	137,500	3,.00
Auxiliary feedwater pump rooms (electrical)	2	230,000	5,400
Auxiliary feedwater pump rooms (steam)	2	44,000	1,000
Reactor spray and decay heat removal pump rooms	4	218,400	5,200

TABLE 9.4-8

REACTOR BUILDING HVAC SYSTEM
DESIGN DATA

Reactor Building Environmental Conditions

Temperature (°F)	Maximum	Minimum
Normal	120	---
Refueling	---	50

Transfer Air Fans

Type	Vaneaxial-two speed	
Quantity, per unit	4	
Flowrate, each (cfm)	68,000	
Static pressure (in. w.g.)	0.375	25
Drive	Direct	

Reactor Vessel Cavity Cooling Fans

Type	Vaneaxial
Quantity, per unit	2
Flowrate, each (cfm)	20,000
Static pressure (in. w.g.)	4.8
Drive	Direct

Containment Dome Air Mixing Fans

Type	Vaneaxial-two speed
Quantity, per unit	4
Flowrate, each (cfm)	10,000
Static pressure (in. w.g.)	0.5
Drive	Direct

CRDM Cooling Fans

Type	Vaneaxial	
Quantity, per unit	6	
Flowrate, each (cfm)	3,000	
Static pressure (in. w.g.)	1.5	25
Drive	Direct	

Main Steam Flued Head Cooling Fans 26

Type	Vaneaxial	25
Quantity, per unit	2	27
Flowrate, each (cfm)	3,000	
Static pressure (in. w.g.)	1.0	25
Drive	Direct	

TABLE 9.4-8 (continued)

Unit Heaters

Quantity, per unit	11
Fans	
Type	Propellor
Flowrate, each (cfm)	2,770
Heating coils	
Type	Fin-tube
Heating capacity, each (Btu/hr)	132,400

TABLE 9.4-9

DIESEL GENERATOR BUILDING HVAC SYSTEM DESIGN DATA

Diesel Generator Building Environmental Conditions		
Temperature (°F)	Maximum	Minimum
Normal (diesels not operating)	104	50
Diesel operation	120	50

Supply Fans	
Type	Vaneaxial
Quantity, per generator room	2 @ 50% each
Capacity, each (cfm)	50,000
Static pressure (in. w.g.)	1.4
Drive	Direct

Unit Heaters	
Type	Electrical
Quantity, per generator room 1A/1B; 2A/2B	7/6; 7/6
Air flow, each (cfm)	850
Heating capacity, (kW)	12

| 27

TABLE 9.4-10

DIESEL GENERATOR BUILDING HVAC SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Component	Failure Mode	Effects
Inlet damper	Fails to open	Loss of air cooling. Redundant system is available for cooling the redundant diesel generator.
Discharge damper	Fails to open	Loss of air cooling. Redundant system is available for cooling the redundant diesel generator.
Supply fan	Fails to start	Loss of air cooling. Redundant system is available for cooling the redundant diesel generator.
Recirculation damper	Fails to close in winter	No effect. The damper is not required to close in winter.
	Fails to close in summer	Introduction of warmer air to the diesel generator building. Redundant system is available for cooling the redundant diesel generator.

27

TABLE 9.4-11

SERVICE WATER PUMP STRUCTURE HVAC
SYSTEM DESIGN DATA

Environmental Conditions

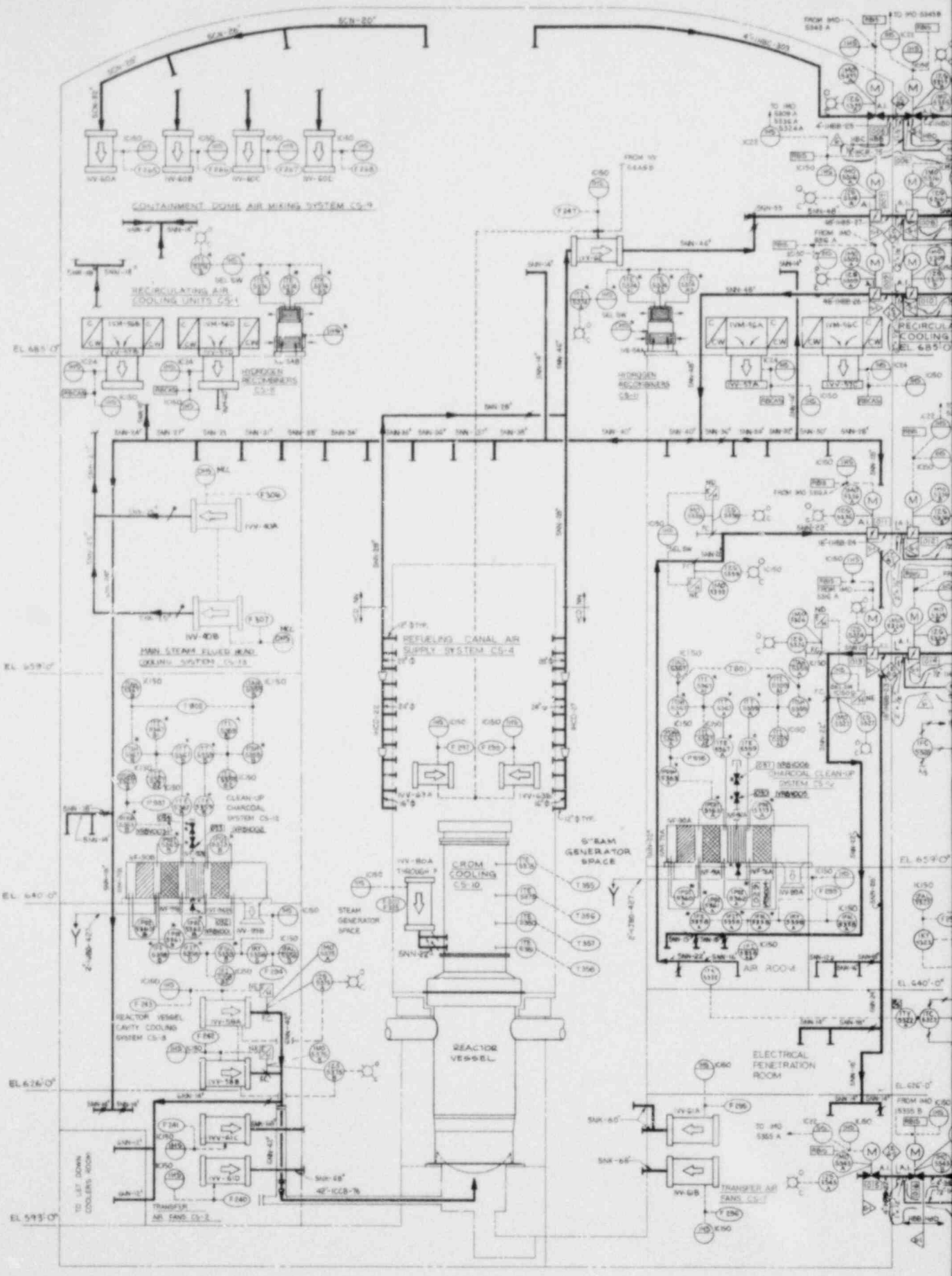
Mode	Maximum Temperature	Minimum Temperature
All pumps ON	104F	50F
All pumps OFF	104F	50F

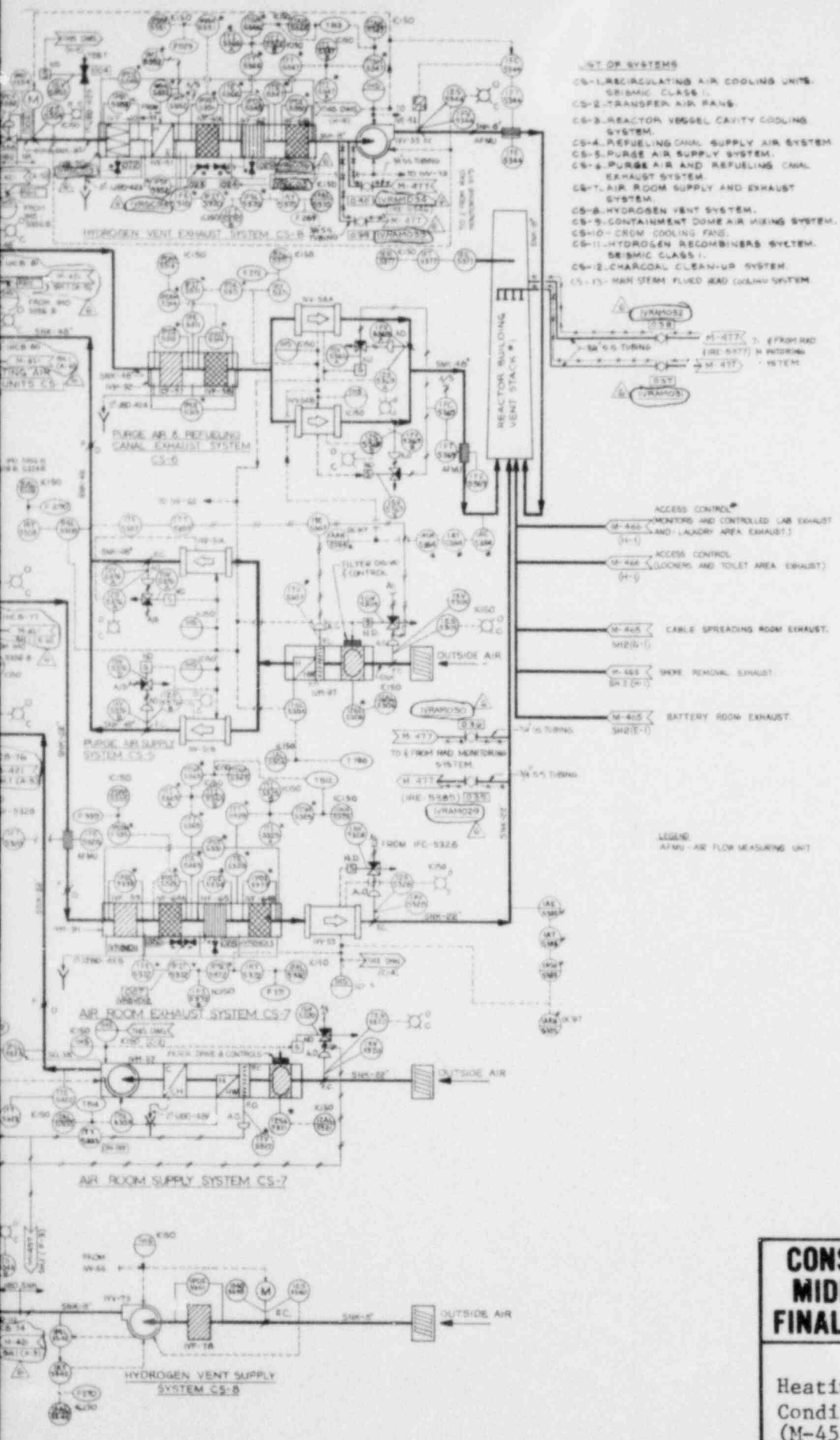
Fans

Type	Vaneaxial
Quantity	7
Flowrate, each (cfm)	5 @ 23,500 2 @ 27,700
Static pressure (in. w.g.)	0.75
Drive	Direct

Unit Heaters

Type	Electric
Quantity	20
Capacity, each (kW)	7.5

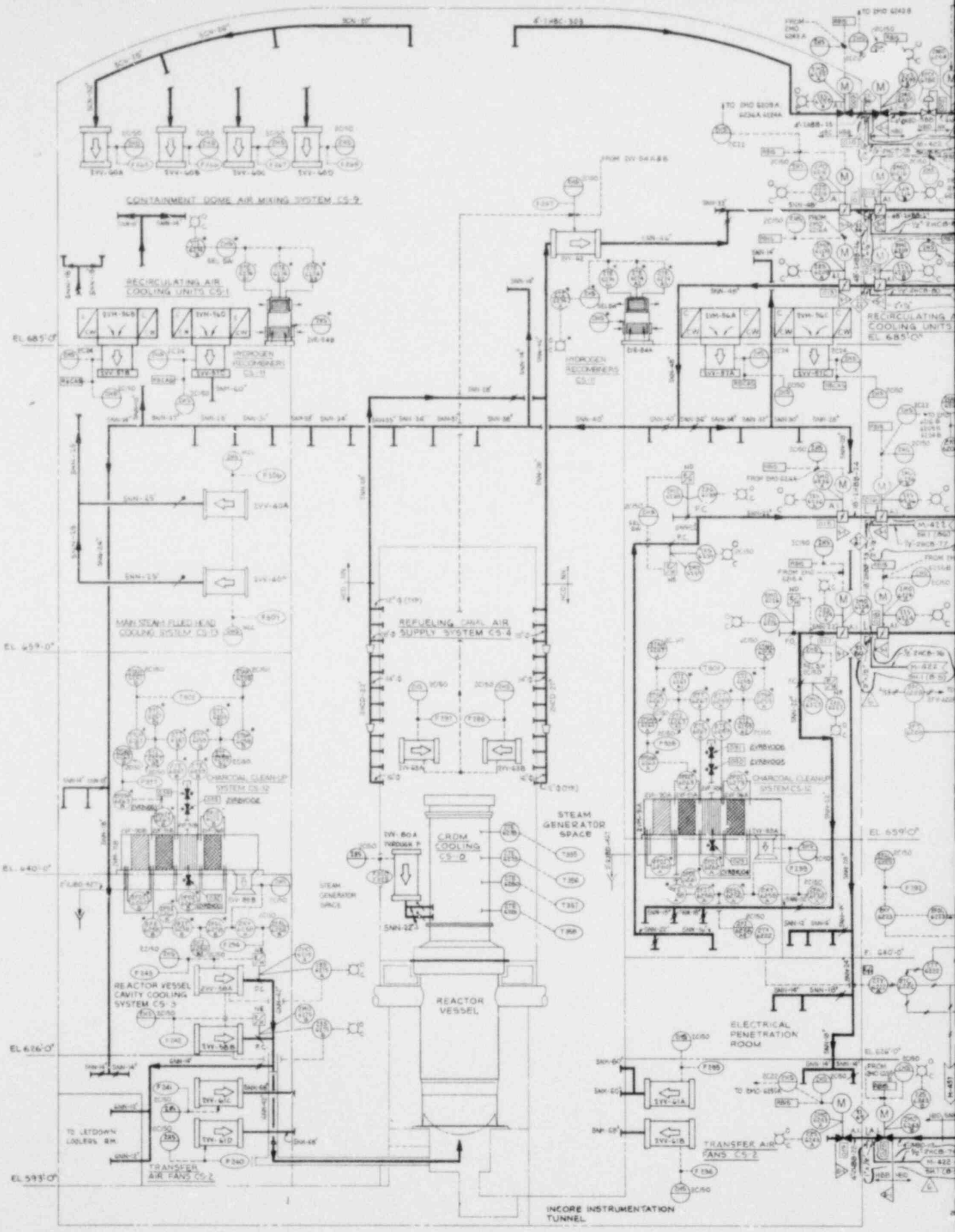

CONTAINMENT DOME AIR MIXING SYSTEM CS-9
RECIRCULATING AIR COOLING UNITS CS-1
HYDROGEN RECOMBINERS CS-11
REFUELING CANAL AIR SUPPLY SYSTEM CS-4
MAIN STEAM & FEED PIPING COOLING SYSTEM CS-13
CLEAN-UP CHARCOAL SYSTEM CS-12
CROM COOLING CS-10
REACTOR VESSEL CAVITY COOLING SYSTEM CS-8
STEAM GENERATOR SPACE
REACTOR VESSEL
AIR ROOM
ELECTRICAL PENETRATION ROOM
TRANSFER AIR FANS CS-2
EL 685'-0"
EL 659'-0"
EL 640'-0"
EL 626'-0"
EL 595'-0"

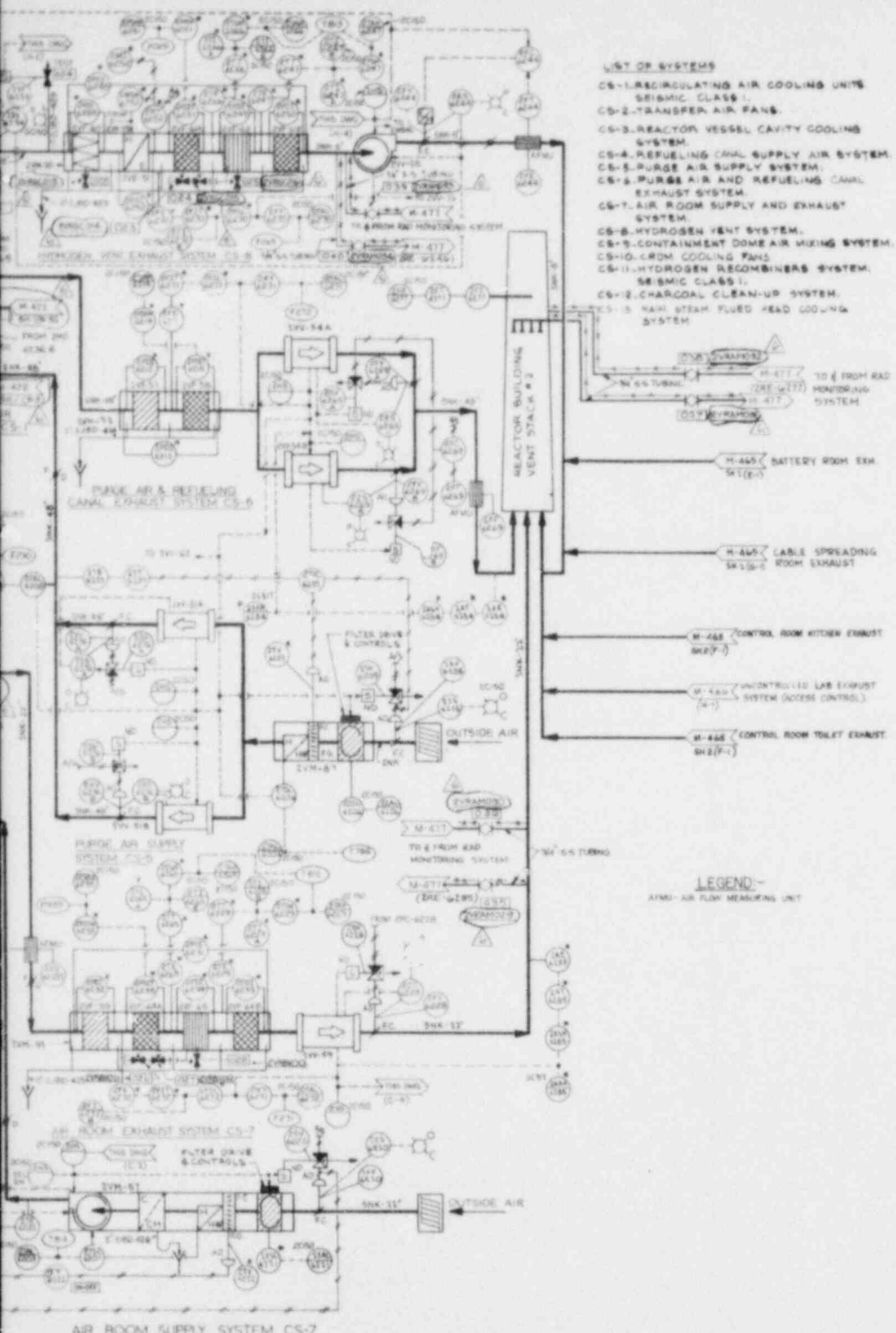


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

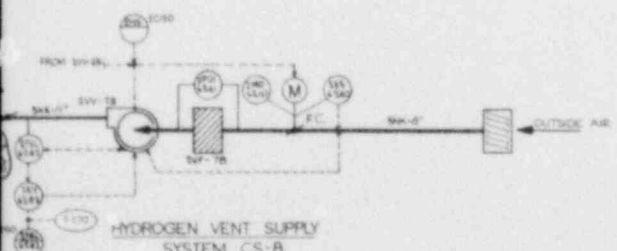
Heating, Ventilating, and Air Conditioning, Reactor Build. Unit1 (M-453, Rev 6)

FSAR Figure 9.4-10


CONTAINMENT DOME AIR MIXING SYSTEM CS-9
RECIRCULATING AIR COOLING UNITS CS-1
HYDROGEN RECOMBINERS CS-11
MAIN STEAM FLUED HEAD COOLING SYSTEM CS-13
REFUELING CANAL AIR SUPPLY SYSTEM CS-4
CHARCOAL CLEAN-UP SYSTEM CS-12
CROM COOLING CS-0
STEAM GENERATOR SPACE
REACTOR VESSEL CAVITY COOLING SYSTEM CS-3
REACTOR VESSEL
ELECTRICAL PENETRATION ROOM
TRANSFER AIR FANS CS-2
INCORE INSTRUMENTATION TUNNEL
TO LETDOWN COOLERS RM
EL 685'-0"
EL 659'-0"
EL 640'-0"
EL 626'-0"
EL 593'-0"



AIR ROOM SUPPLY SYSTEM CS-7

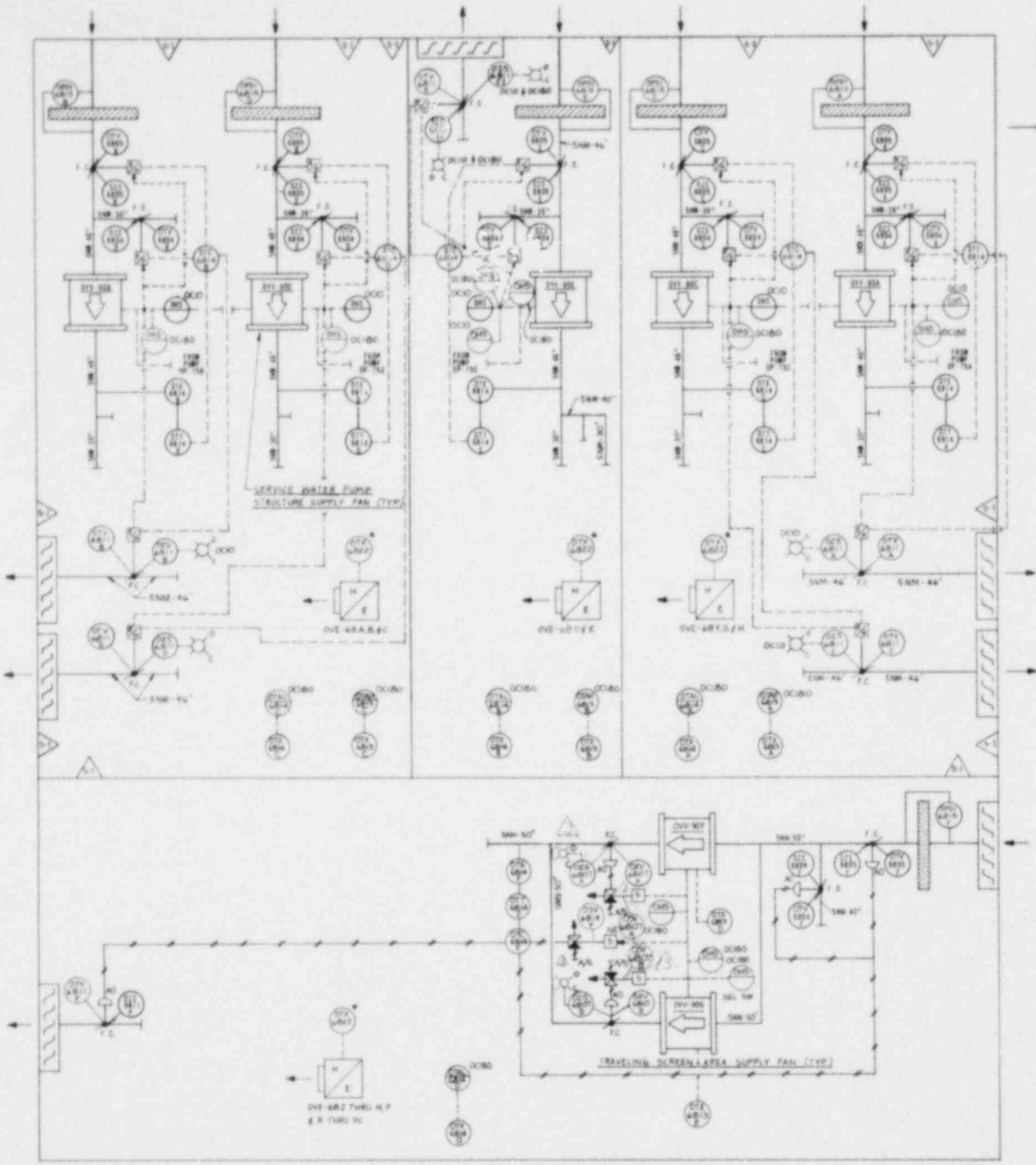


HYDROGEN VENT SUPPLY SYSTEM CS-8

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Heating, Ventilation and Air Conditioning, Reactor Building Unit 2 (M-462, Rev 6)

FSAR Figure 9.4-10A



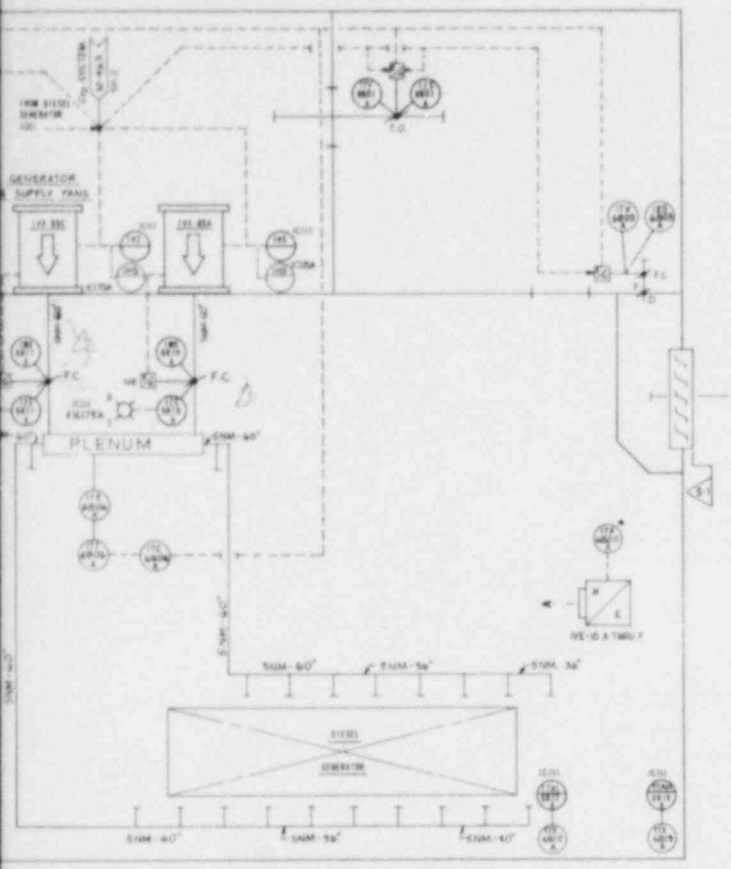
SERVICE WATER PUMP STRUCTURE

DIESEL GEN ROOM	SUPPLY FAN
ROOM A	HVS-1A
UNIT 1	HVS-1C
ROOM B	HVS-1B
UNIT 1	HVS-1D
ROOM A	HVS-2A
UNIT 2	HVS-2C
ROOM B	HVS-2B
UNIT 2	HVS-2D

DIESEL GEN ROOM	TEMPERATURE CONTROL
ROOM A	TT-1
UNIT 1	
ROOM B	TT-2
UNIT 1	
ROOM A	TT-3
UNIT 2	
ROOM B	TT-4
UNIT 2	

ELECTRIC UNIT HEATER ROOM	UNIT
A	II
B	I
B	II
A	I

EQUIPMENT ID# DIESEL GEN ROOM	VANEAXIAL FAN
ROOM A	HV-1A
UNIT 1	HV-1C
ROOM B	HV-1B
UNIT 1	HV-1D
ROOM A	HV-2A
UNIT 2	HV-2C
ROOM B	HV-2B
UNIT 2	HV-2D



DIESEL GENERATOR ROOM A - UNIT 1
TYPICAL FOR D.G. ROOM A - UNIT 2; ROOM B - UNITS 1 & 2

INSTRUMENTATION TABLE

HEATERS

EQUIPMENT No.	THERMOSTAT
2VE-10 A THRU F	2TX-6820 A THRU F
1VE-09 A THRU G	1TX-6821 A THRU G
2VE-09 A THRU G	2TX-6821 A THRU G
1VE-10 A THRU F	1TX-6820 A THRU F

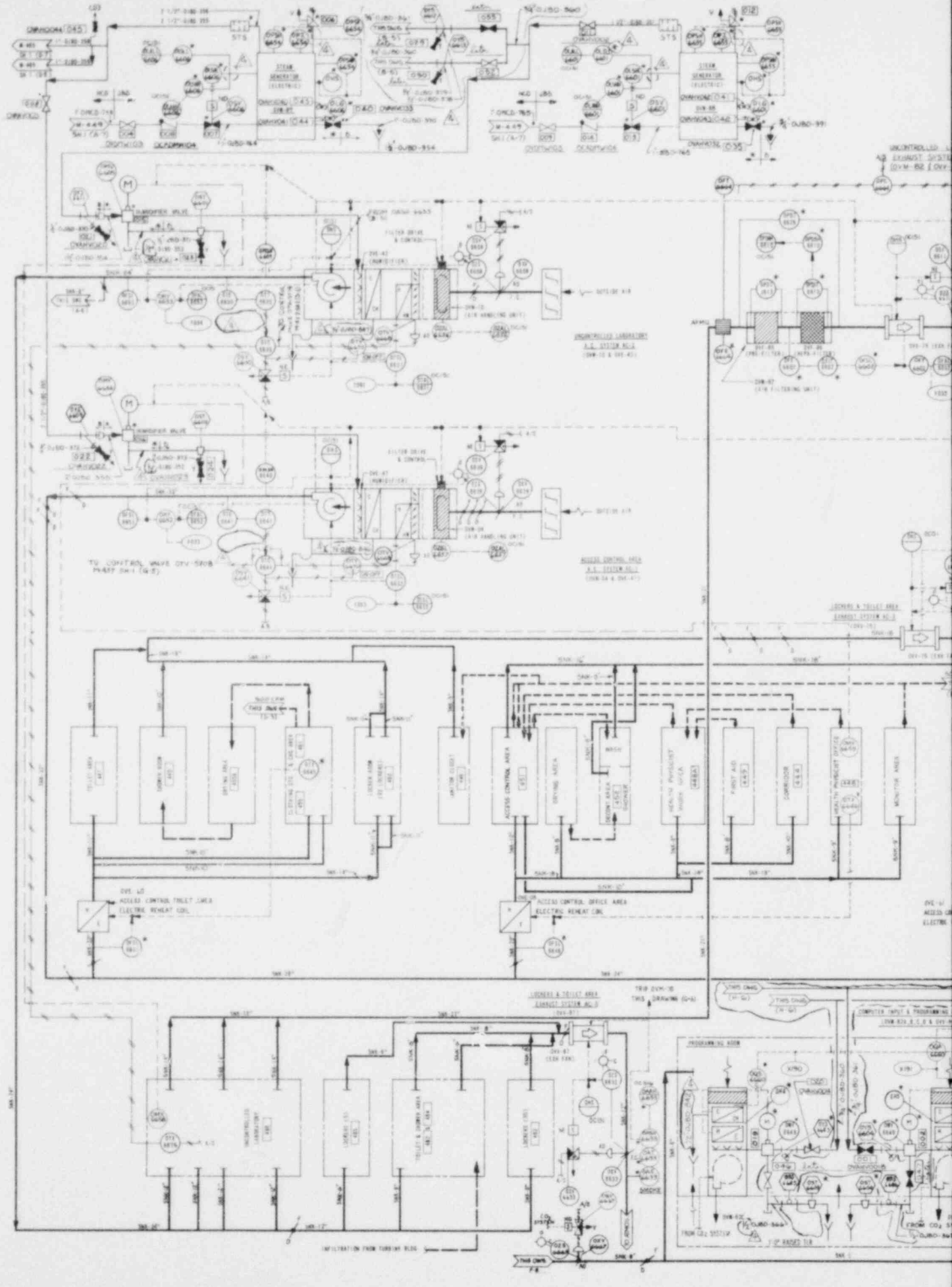
IDENTIFICATION

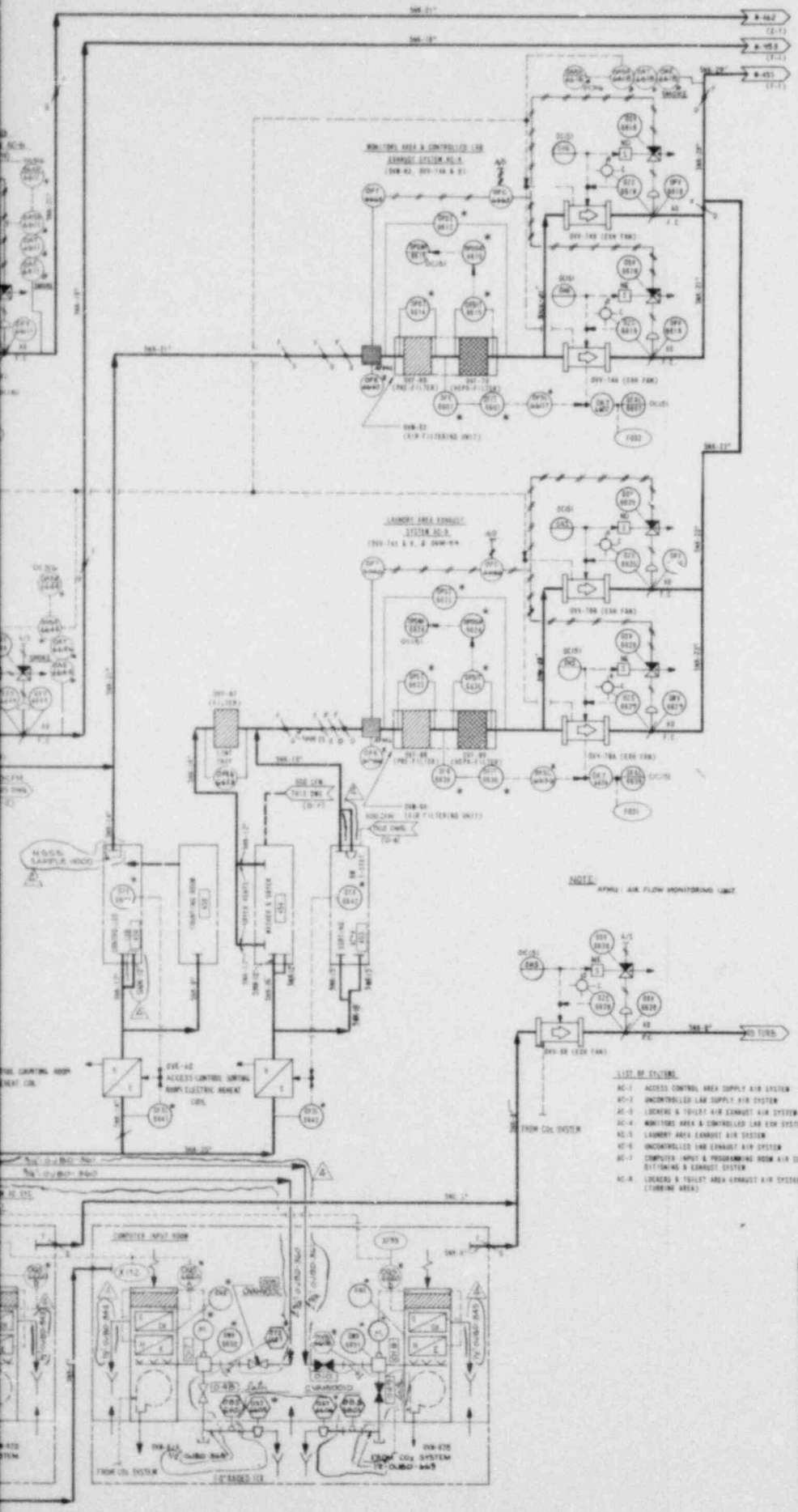
	ELECTRIC UNIT HEATERS
	1VE-10 A THRU F
	1VE-09 A THRU G
	2VE-10 A THRU F
	2VE-09 A THRU G

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

HVAC and Service
Water Pump Structure
(M-468 sh 1, Rev 3)

FSAR Figure 9.4-11

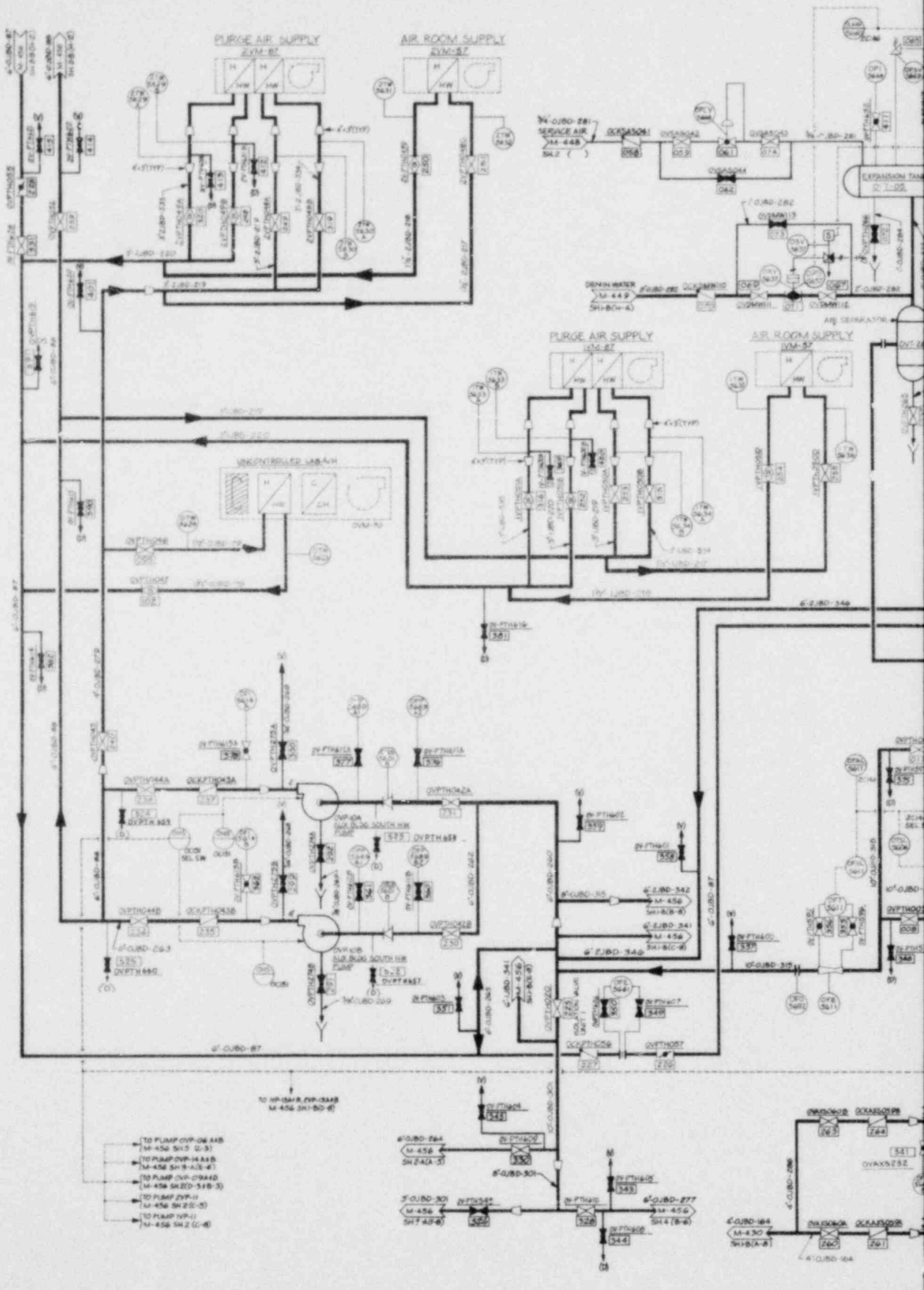


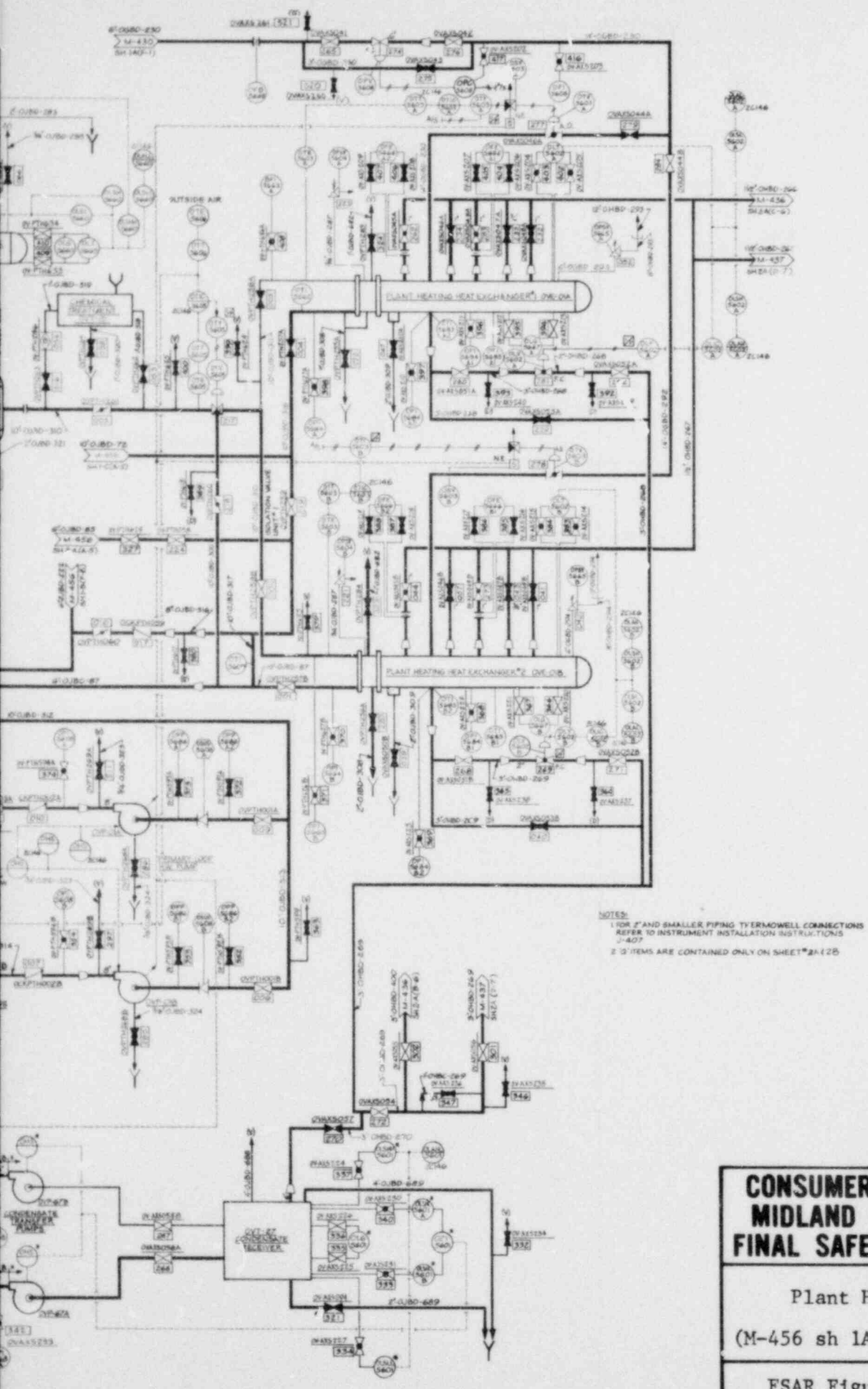


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Heating Ventilation & Air Condi.
Access Control & Computer Area
(M-466, Rev 4)

FSAR Figure 9.4-12


PURGE AIR SUPPLY
AIR ROOM SUPPLY
PURGE AIR SUPPLY
AIR ROOM SUPPLY
UNCONTROLLED LAB A/H
EXPANSION TANK
TO VP-13A/B, CVP-13A/B
TO PUMP CVP-06 A/B
TO PUMP CVP-14 A/B
TO PUMP CVP-09 A/B
TO PUMP CVP-11
TO PUMP CVP-1

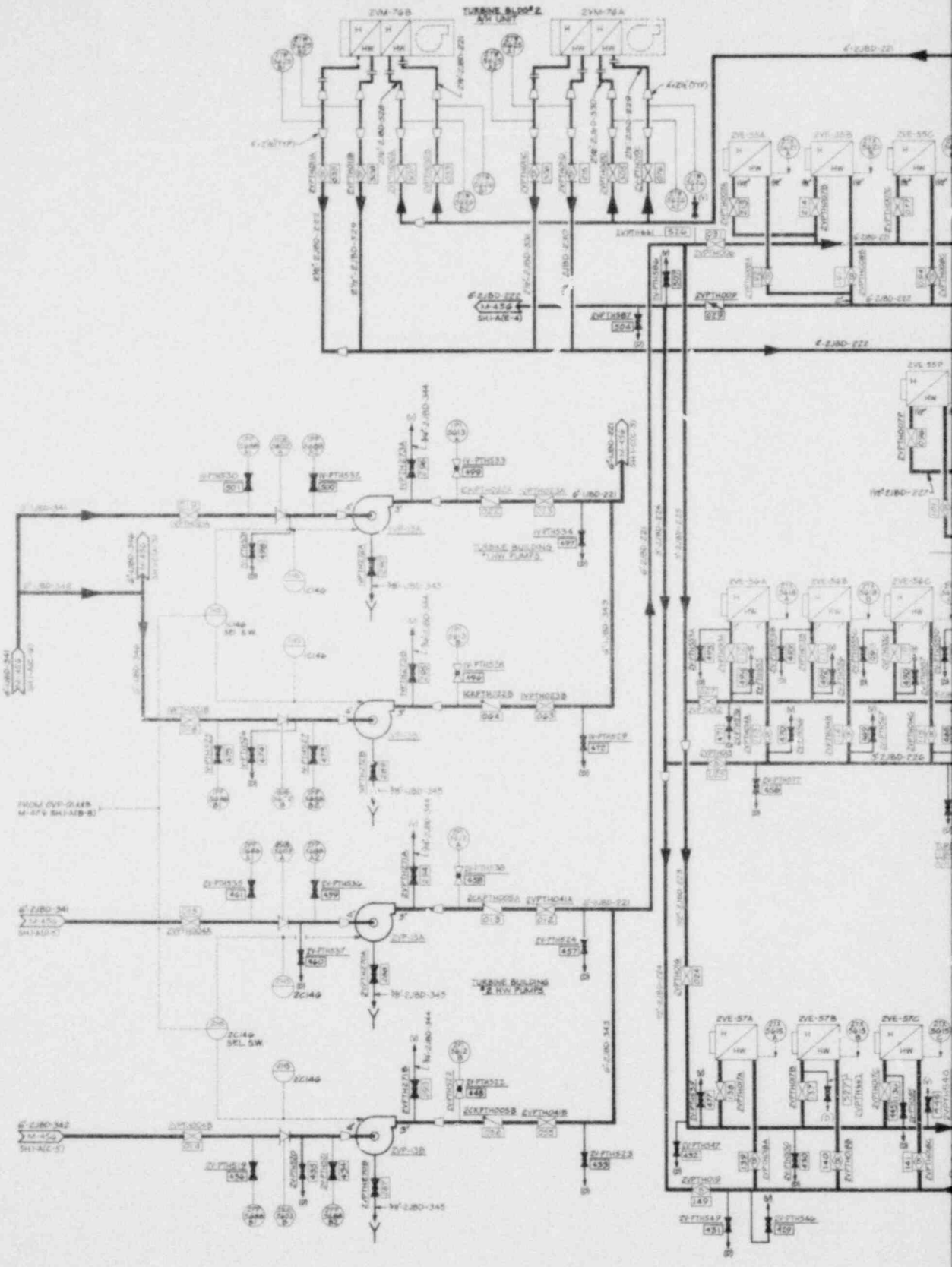


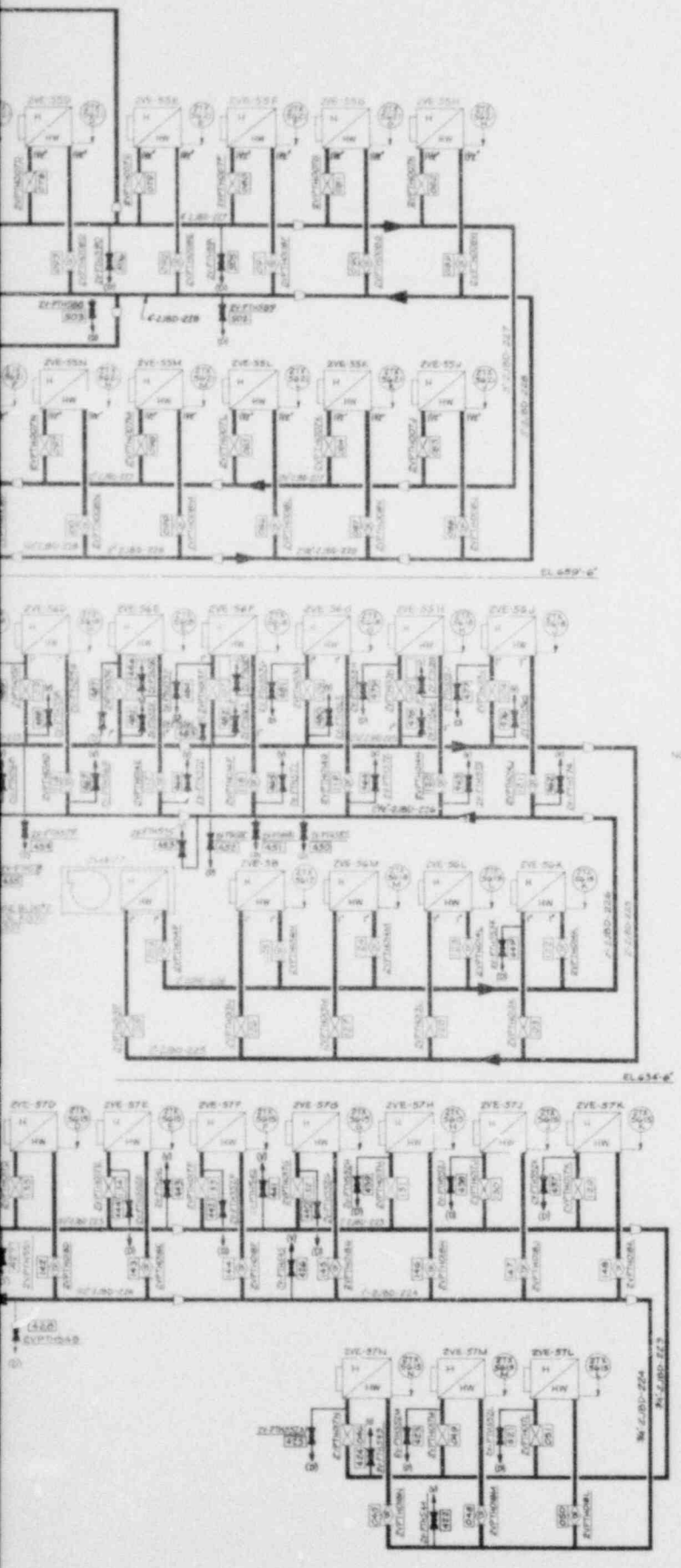
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Plant Heating Turbine Bldg.

(M-456 sh 1A, Rev 0)

FSAR Figure 9.4-13, sh. 1


TURBINE BLDG. "Z" AIR UNIT
ZVM-79B
ZVM-79A
TURBINE BUILDING "Z" HW PUMPS
ZC140
SEL. SW
FROM DVP-2 (A&B) M-47 & SH.1-A(B-8)
ZVP-3A
ZVP-3B
ZVE-55A
ZVE-55B
ZVE-55C
ZVE-55P
ZVE-56A
ZVE-56B
ZVE-56C
ZVE-57A
ZVE-57B
ZVE-57C

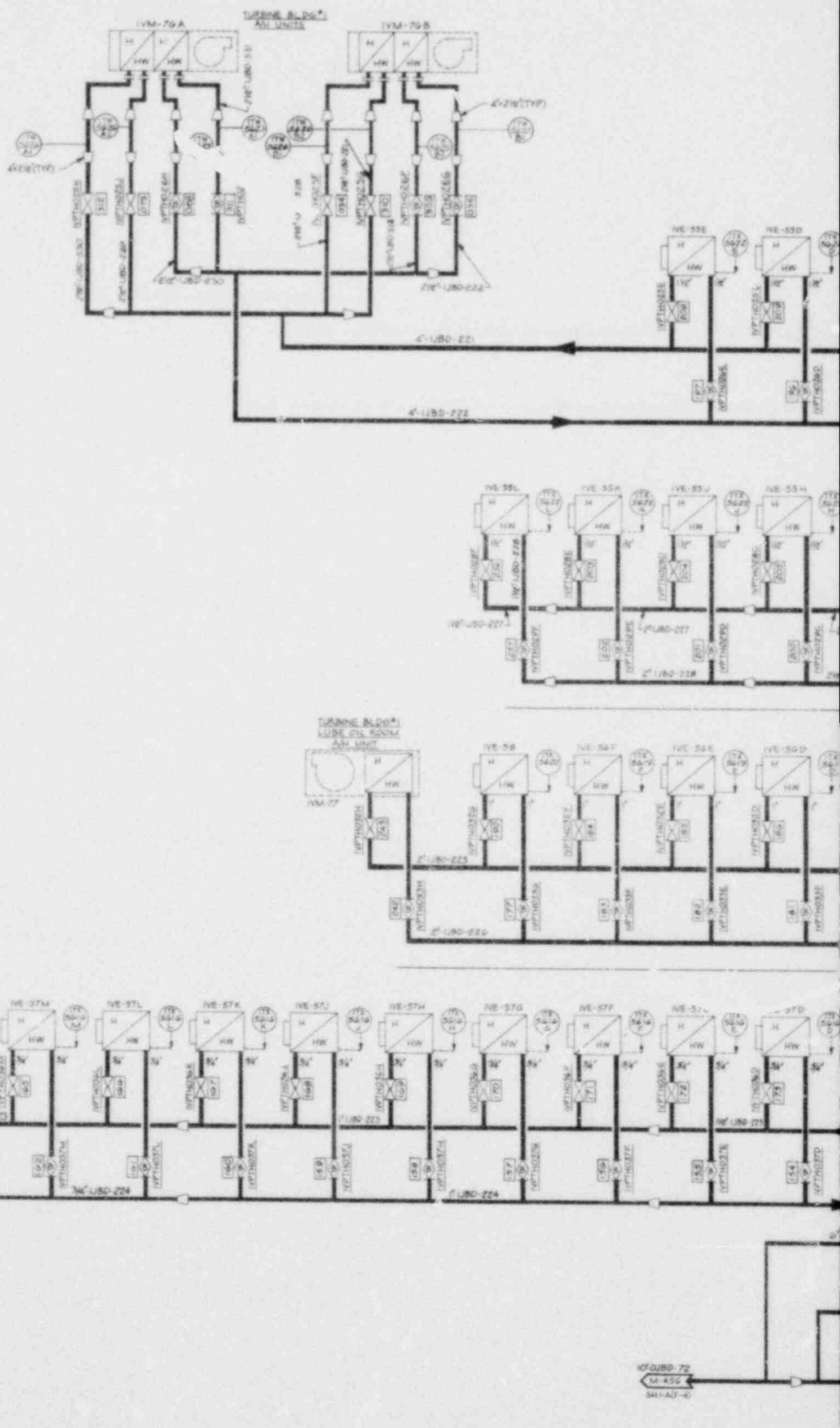


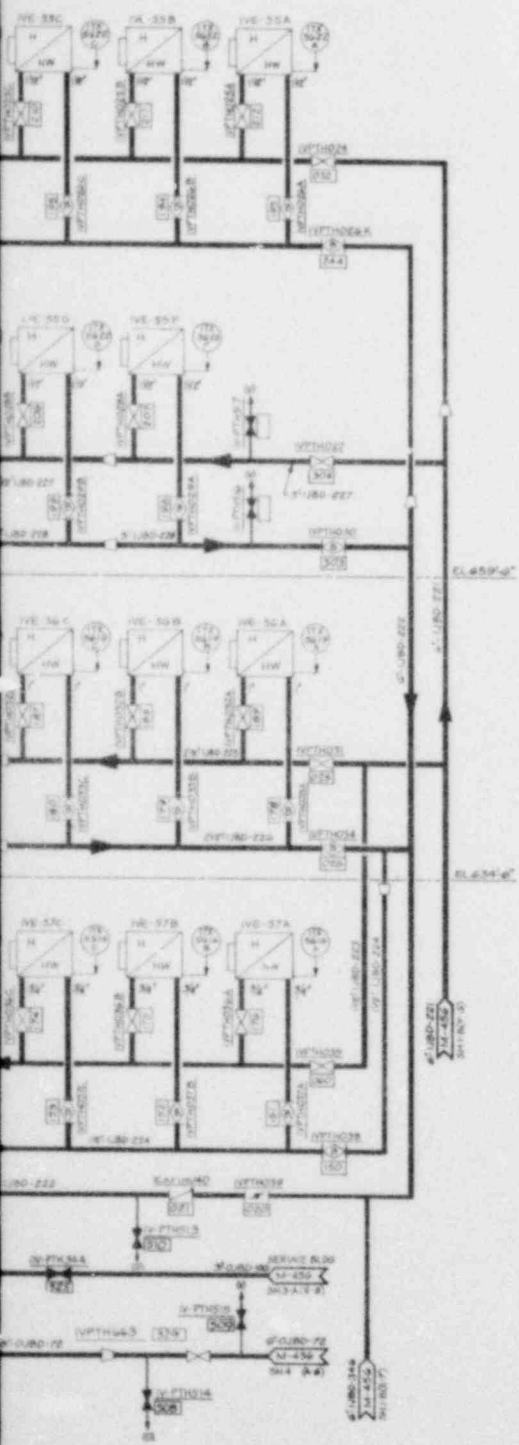
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Plant Heating Turbine Building

(M-456 sh 1B, Rev 0)

FSAR Figure 9.4-13, sh. 2


TURBINE BLDG
AH UNITS
VM-79A
VM-79B
4"-LBD-221
4"-LBD-222
TURBINE BLDG
LUBE OIL ROOM
AH UNIT
VM-77
3"-LBD-223
3"-LBD-224
10"-LBD-72

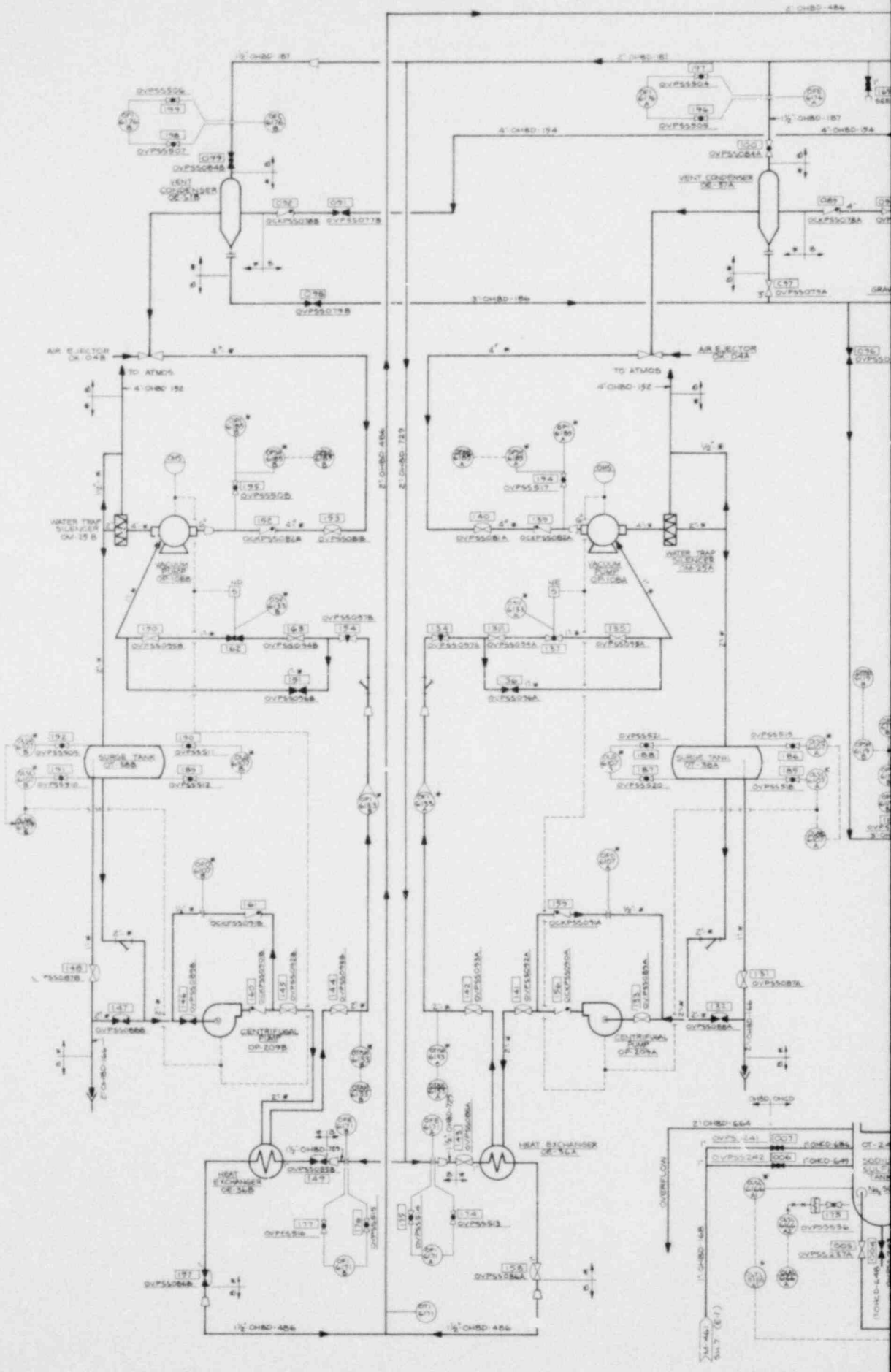


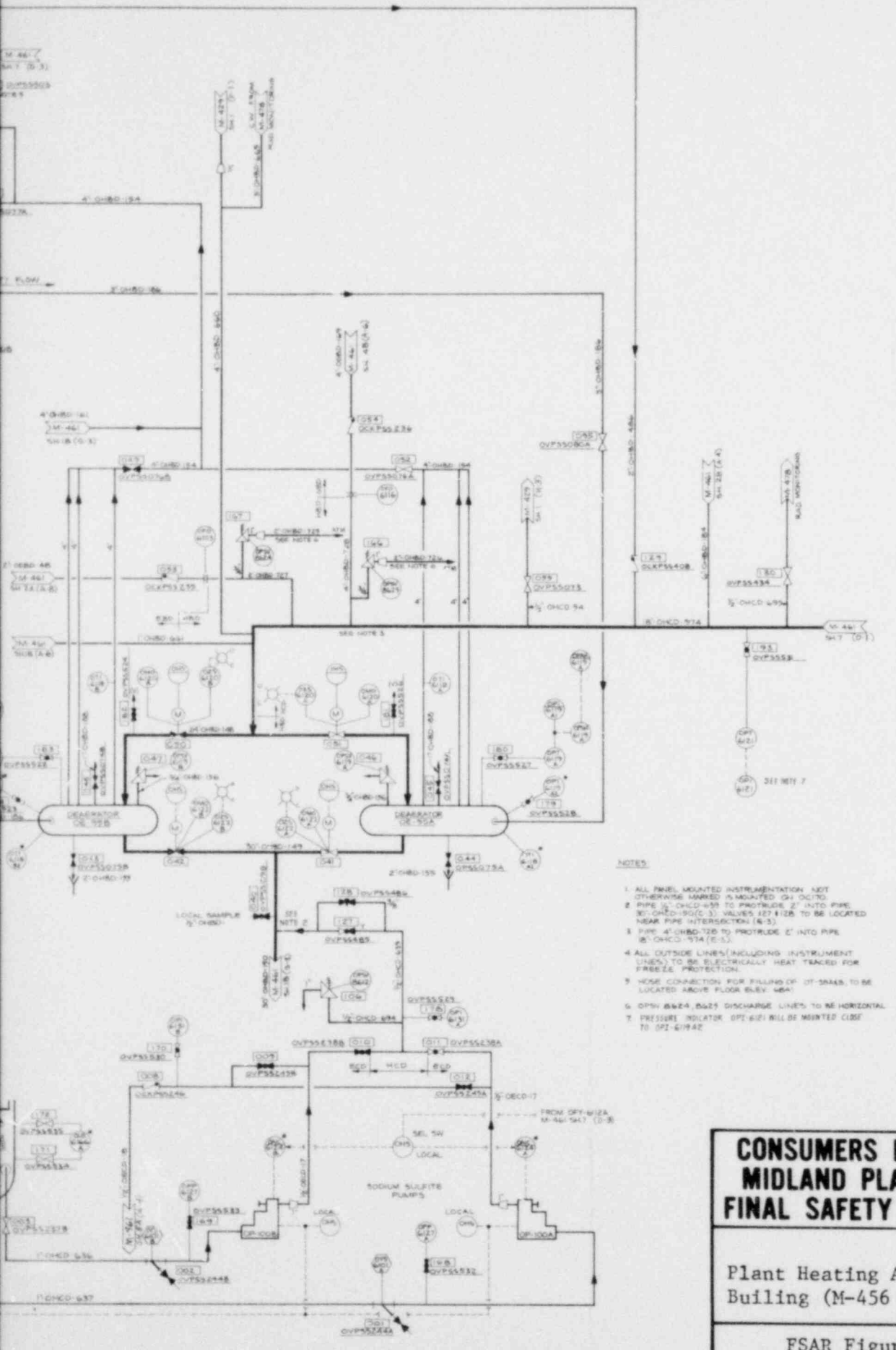
NOTES:
1. FOR 2" AND SMALLER PIPING THERMOWELL CONNECTIONS REFER TO INSTRUMENT INSTALLATION INSTRUCTIONS J-407.
2. (2) ITEMS ARE CONTAINED ONLY ON SHEET 2 OF 2.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Plant Heating Turbine Building
(M-456 sh 1C, Rev 0)

FSAR Figure 9.4-13, sh. 3

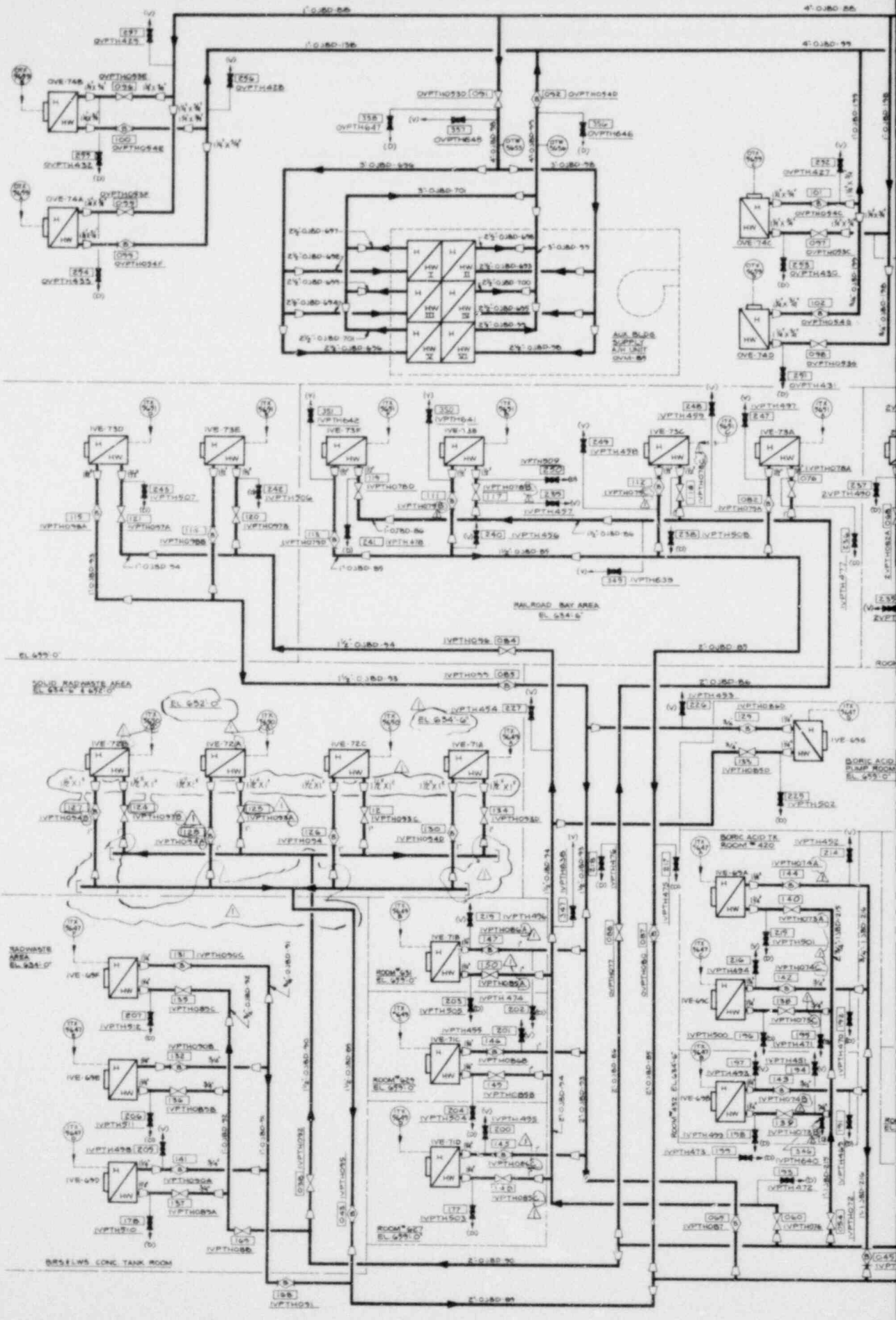




CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Plant Heating Auxiliary & Reactor Builing (M-456 sh 2A, Rev 1)

FSAR Figure 9.4-14, sh. 1


RAILROAD BAY AREA
EL 654'-6"
SOLID RADWASTE AREA
EL 654'-6" & 647'-0"
EL 652'-0"
EL 654'-6"
EL 649'-0"
RADWASTE AREA
EL 634'-0"
BORIC ACID TK ROOM # 420
BORIC ACID PUMP ROOM
EL 655'-0"
BRSELWS CONC TANK ROOM
AUX BLDG
SUPPLY
AIR UNIT
QVM-84
ROOM # 431
EL 649'-0"
ROOM # 429
EL 649'-0"
ROOM # 432
EL 634'-6"
IVE-73D
IVE-73E
IVE-73F
IVE-73G
IVE-73A
IVE-72B
IVE-72C
IVE-71A
IVE-71B
IVE-71C
IVE-71D
IVE-69A
IVE-69B
IVE-69C
IVE-69D
IVE-69E
IVE-69F
IVE-69G
QVE-74B
QVE-74A
QVE-74C
QVE-74D
QVPTH0938
QVPTH0939
QVPTH0940
QVPTH0941
QVPTH0942
QVPTH0943
QVPTH0944
QVPTH0945
QVPTH0946
QVPTH0947
QVPTH0948
QVPTH0949
QVPTH0950
QVPTH0951
QVPTH0952
QVPTH0953
QVPTH0954
QVPTH0955
QVPTH0956
QVPTH0957
QVPTH0958
QVPTH0959
QVPTH0960
QVPTH0961
QVPTH0962
QVPTH0963
QVPTH0964
QVPTH0965
QVPTH0966
QVPTH0967
QVPTH0968
QVPTH0969
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QVPTH0971
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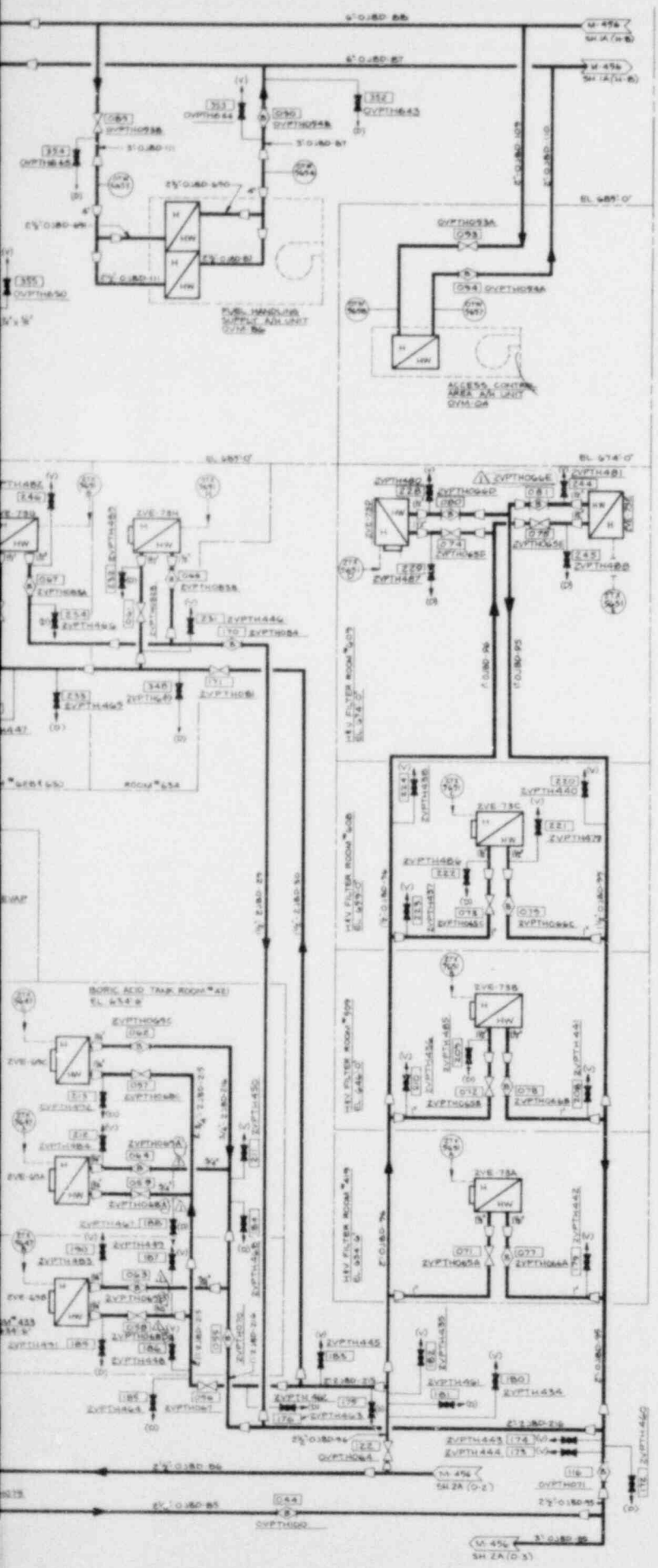
QVPTH0973
QVPTH0974
QVPTH0975
QVPTH0976
QVPTH0977

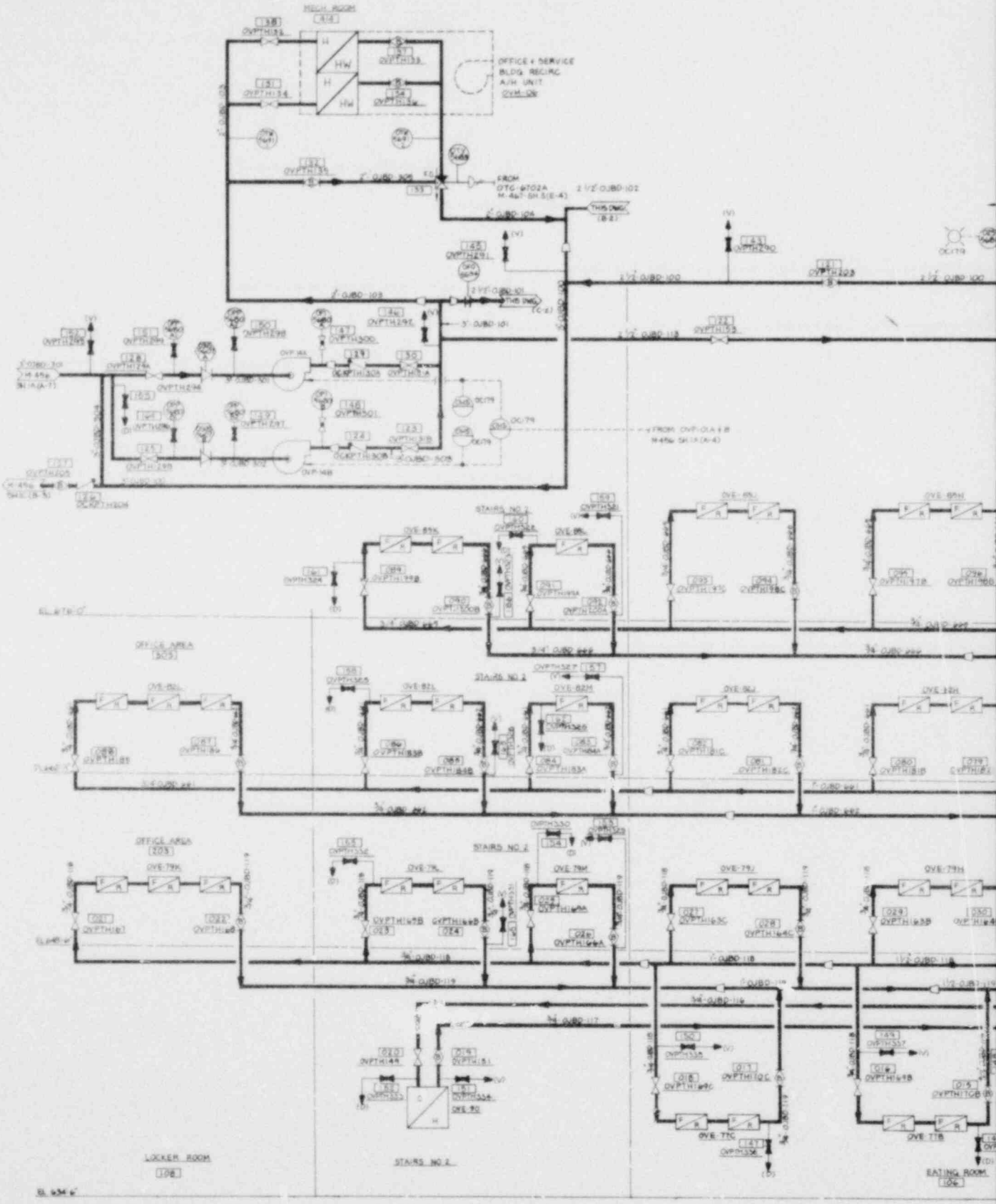


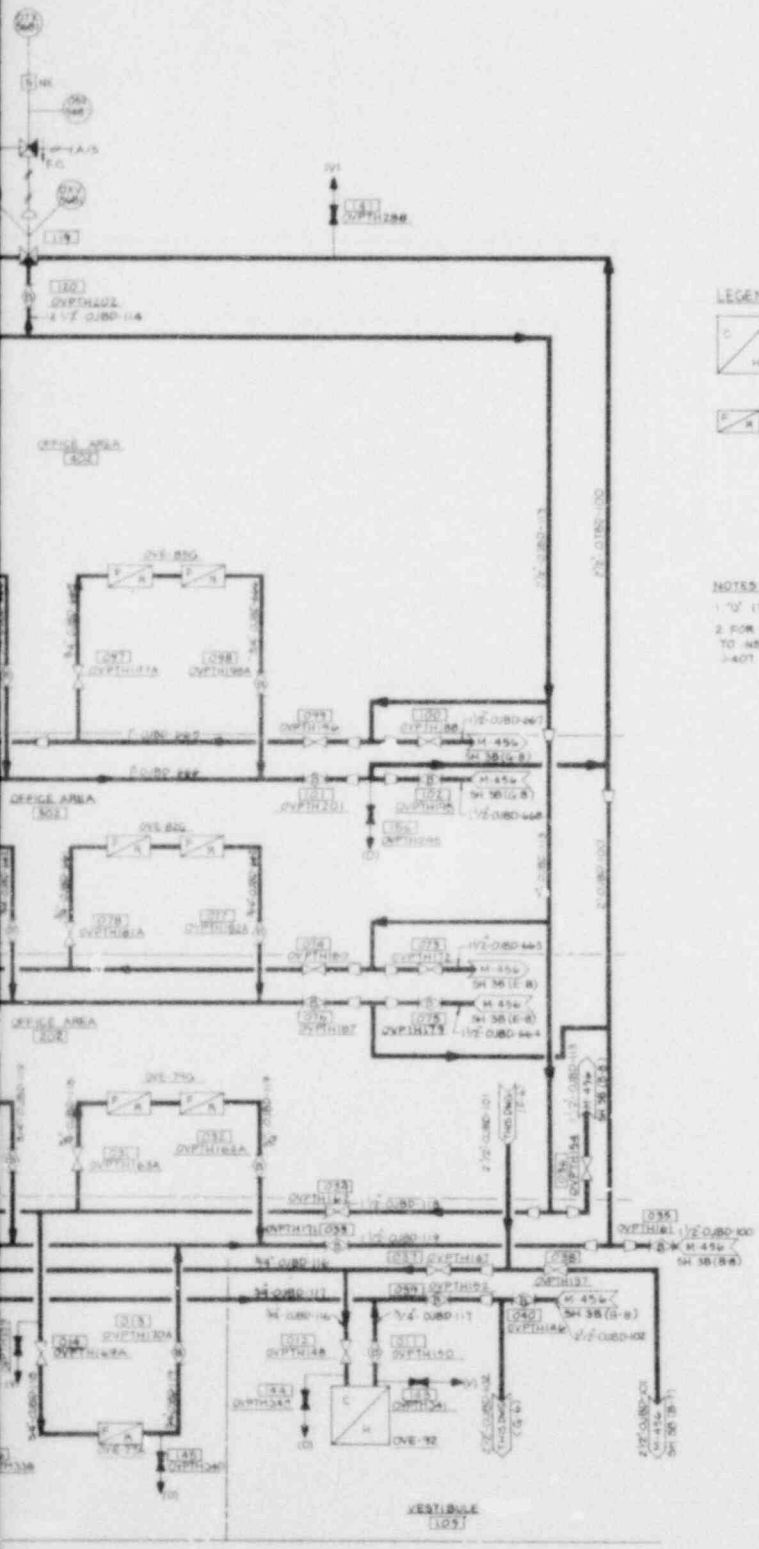
NOTES:
1. 'Q' ITEMS ARE CONTAINED ONLY ON SHEET 2.
2. FOR 2" AND SMALLER PIPING THERMOWELL CONNECTIONS REFER TO INSTRUMENTS INSTALLATION INSTRUCTIONS J-407

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Plant Heating Auxiliary & Reactor Building (M-456 sh 2B, Rev 1)

FSAR Figure 9.4-14, sh. 2

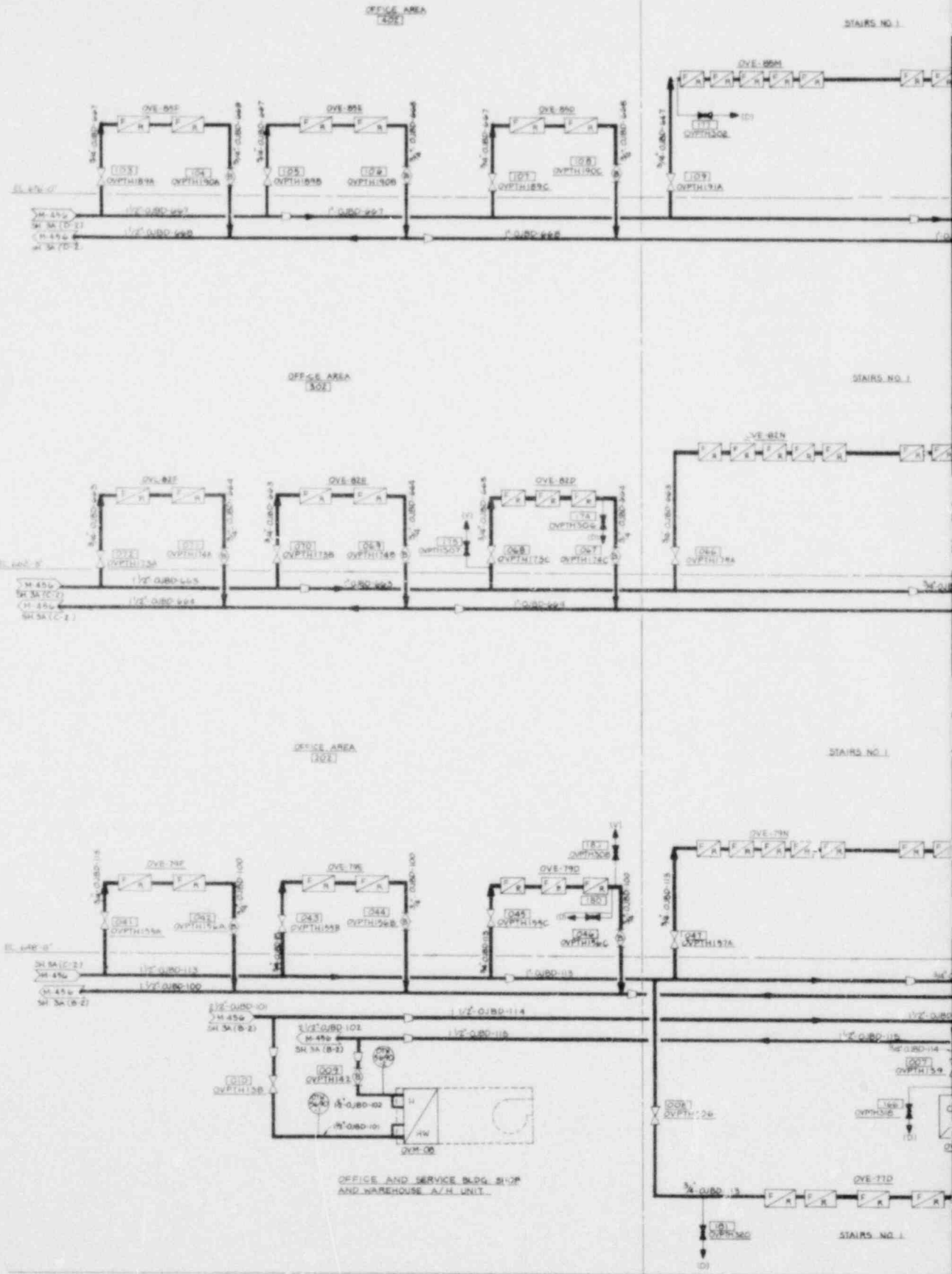

MECH. ROOM
OFFICE & SERVICE BLDG. RECIRC. A/H UNIT
OVM-126
FROM OTG-67102A
STAIRS NO. 2
OFFICE AREA
LOCKER ROOM
STAIRS NO. 2
EATING ROOM

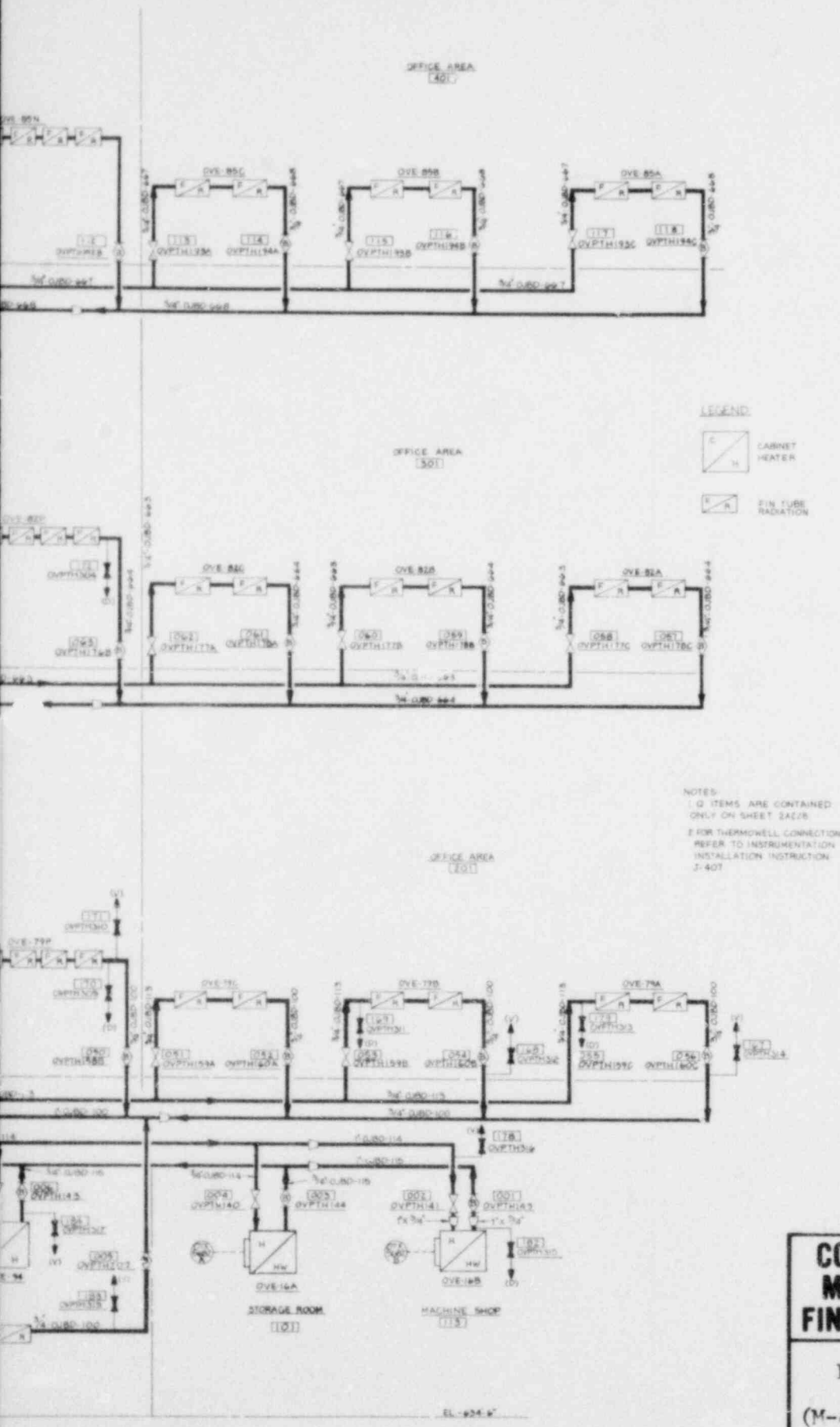


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Plant Heating Office and Service Building
(M-456 sh 3A, Rev 0)

FSAR Figure 9.4-15, sh. 1

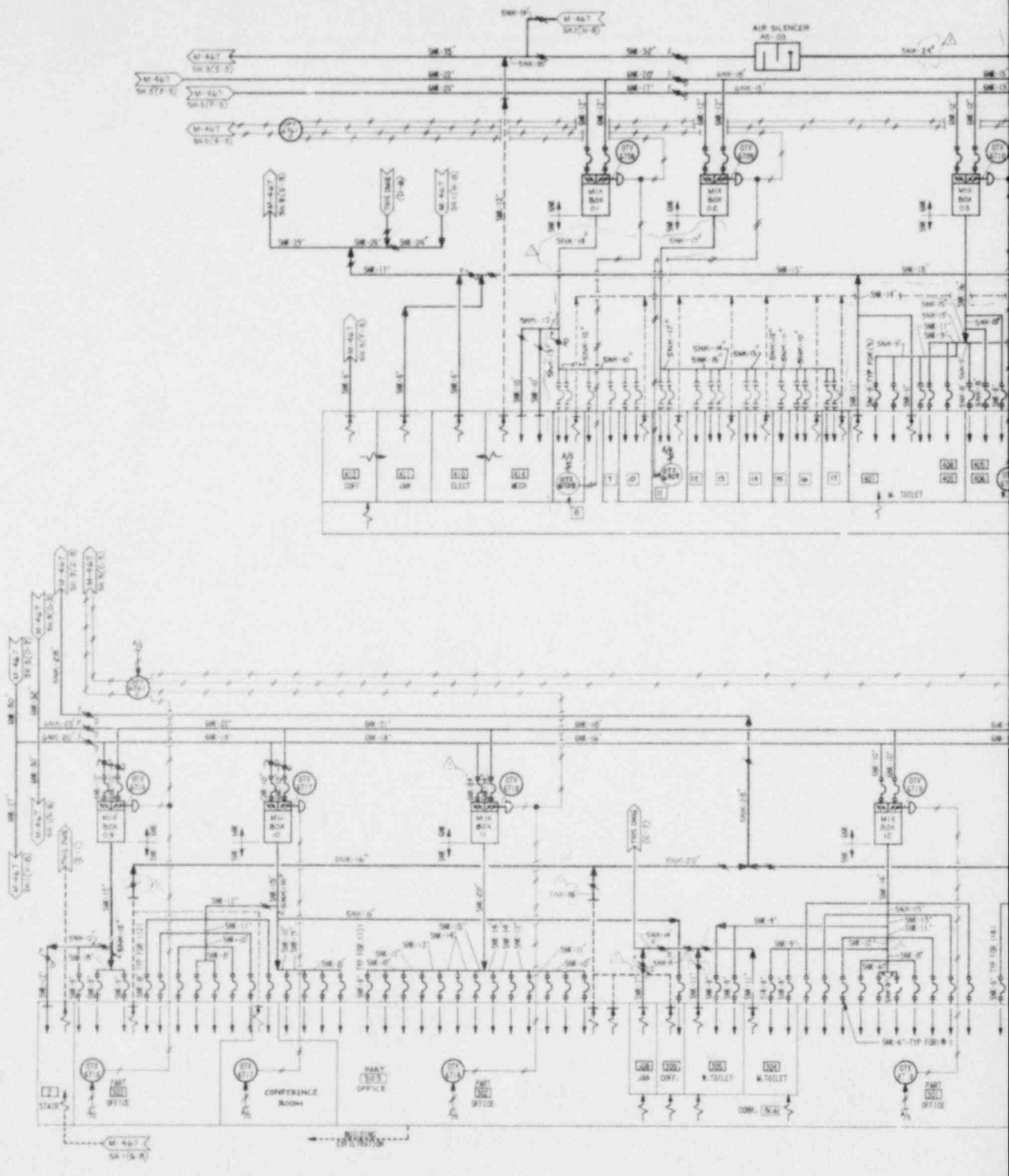

OFFICE AREA
401
STAIRS NO. 1
OVE-855
OVE-856
OVE-850
OVE-855M
OFFICE AREA
302
STAIRS NO. 1
OVE-82F
OVE-82E
OVE-82P
OVE-82N
OFFICE AREA
303
STAIRS NO. 1
OVE-79F
OVE-79E
OVE-79D
OVE-79N
OVM-08
OVE-77D
OFFICE AND SERVICE BLDG. 81-2P
AND WAREHOUSE A/H UNIT



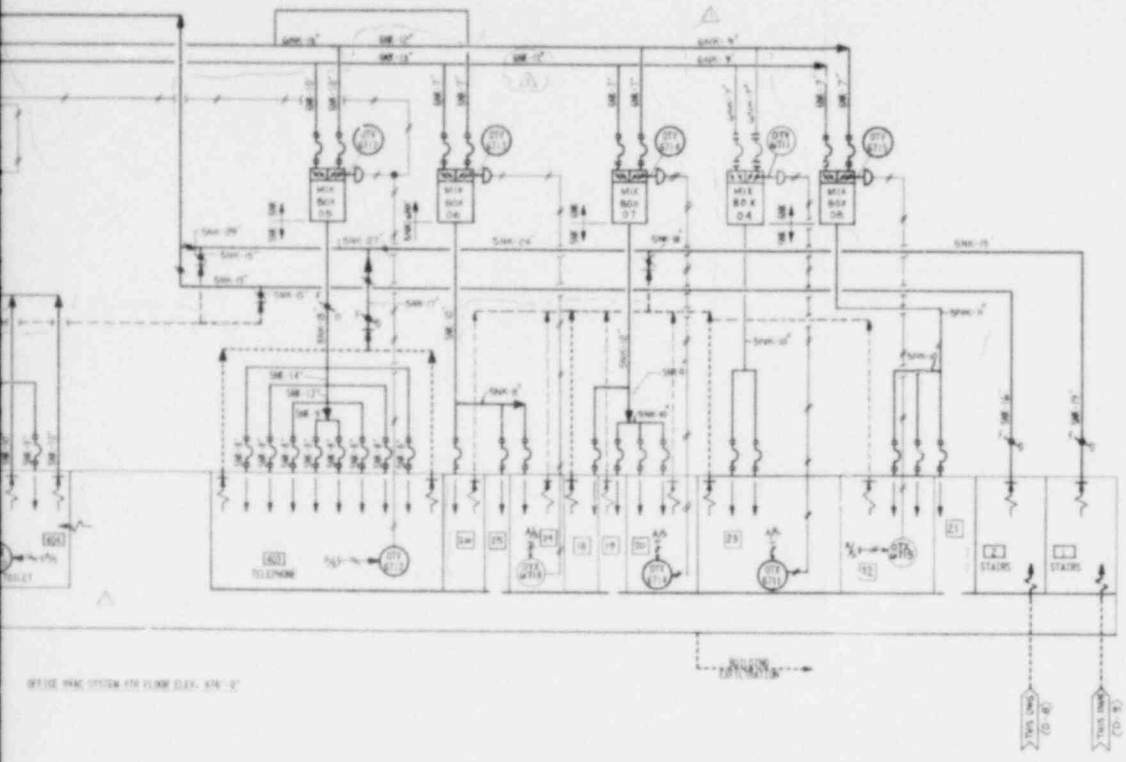
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

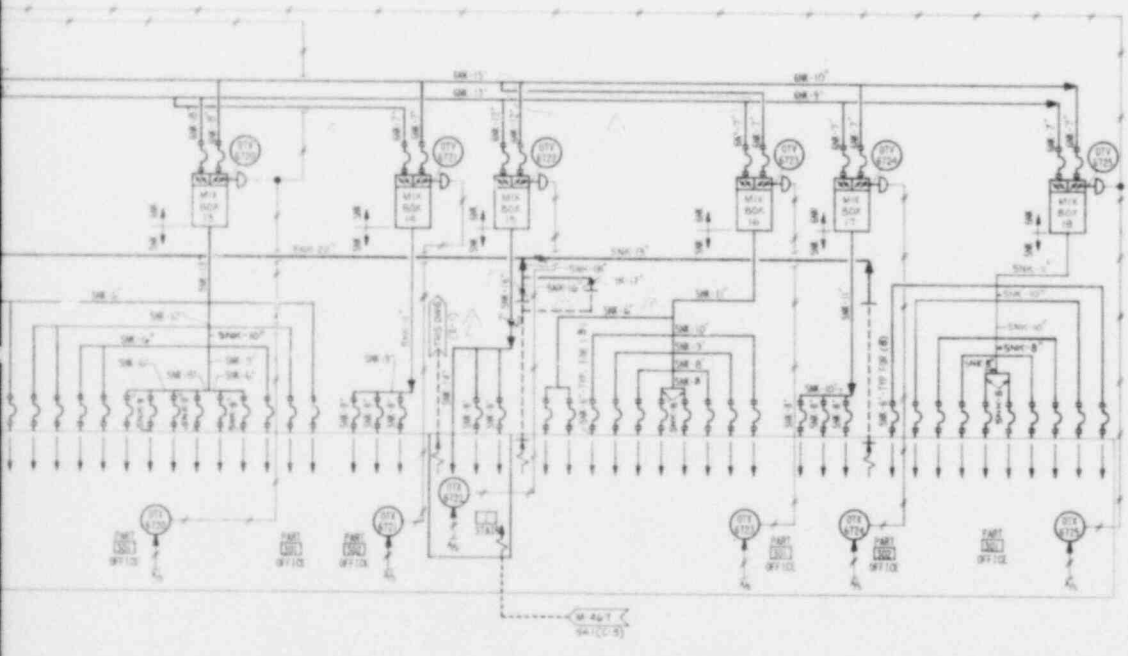
Plant Heating Office and Service Building
(M-456 sh 3B, Rev 0)

FSAR Figure 9.4-15, sh. 2



OFFICE HVAC SYSTEM





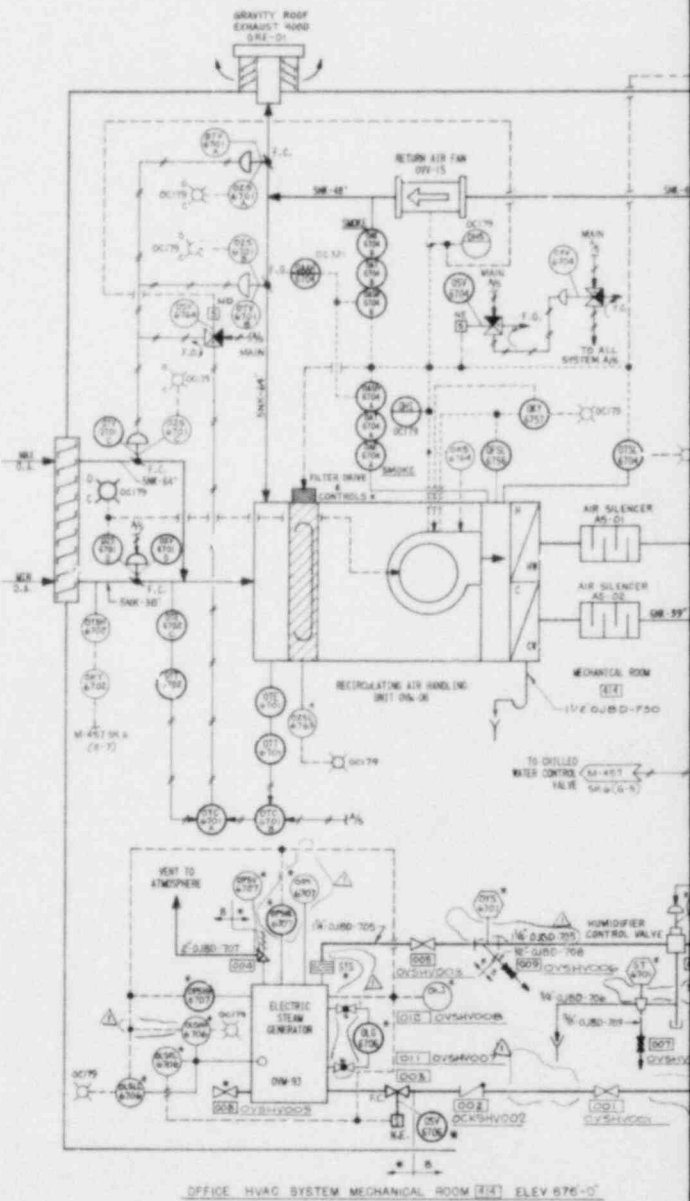
NOTES:

1. ⌒ (1) 67H800 INDICATES FLEXIBLE CONNECTION.
2. ALL DUCTWORK AND CONNECTIONS TO DIFFUSERS ARE "SNK-8" UNLESS OTHERWISE INDICATED.
3. ALL BRANCH DUCTWORK TO LIGHT TROFFER DIFFUSERS CONTAIN BALANCING DAMPERS.

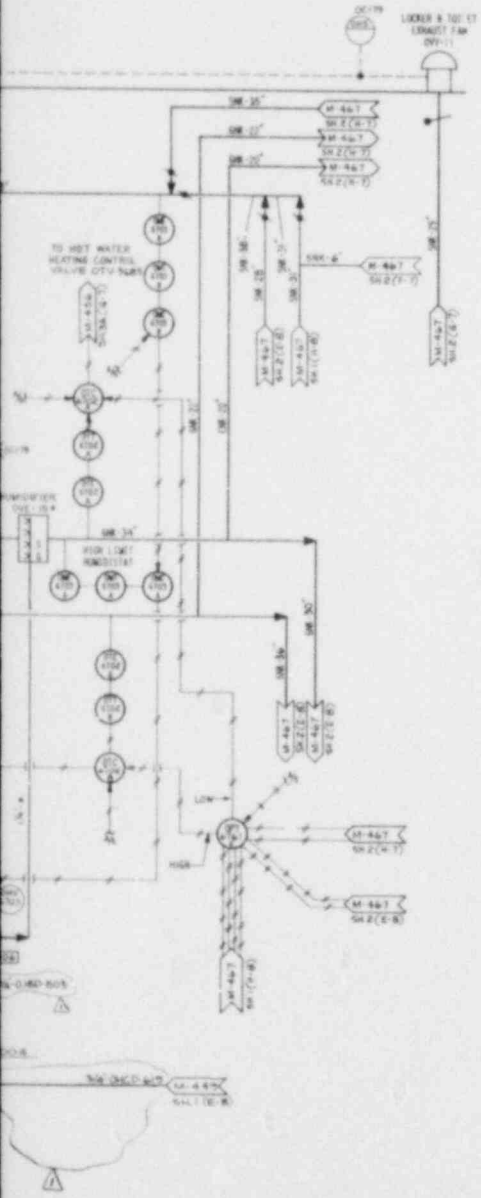
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

HVAC Office and Service Buildings
(M-467 sh 2, Rev 1)

FSAR Figure 9.4-18, sh. 1



OFFICE HVAC SYSTEM MECHANICAL ROOM [E4] ELEV 676'-0"



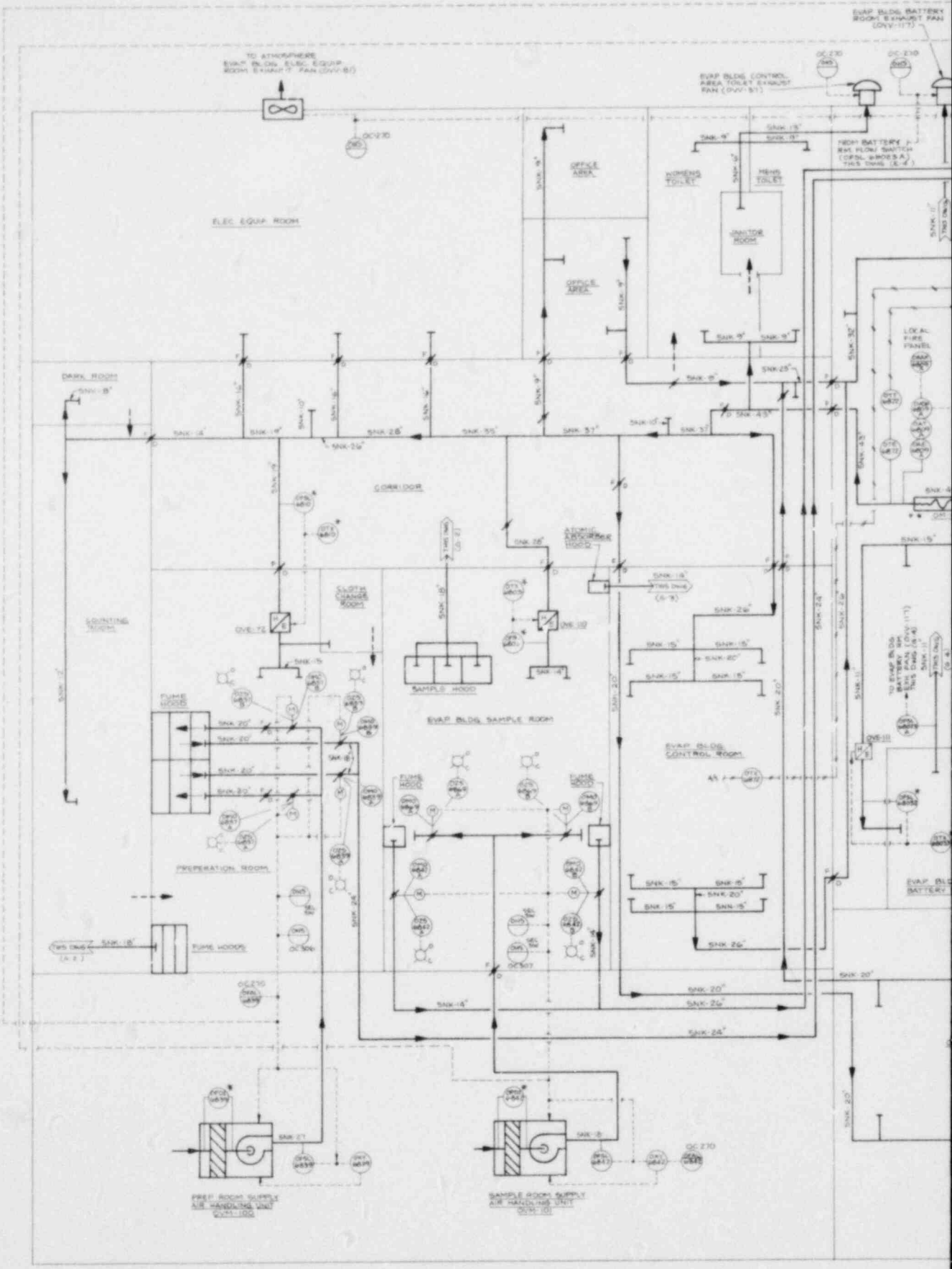
NOTES:

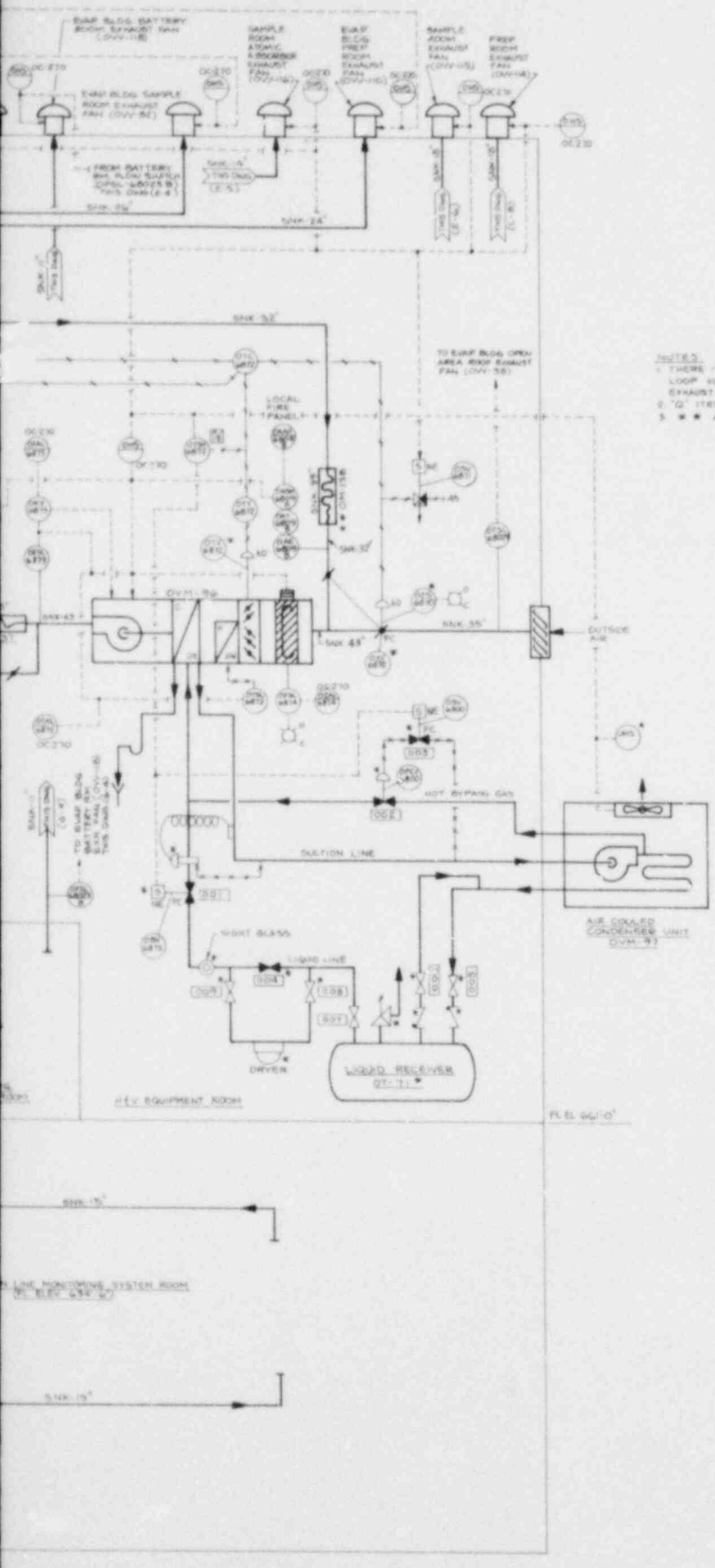
1. DEV-4704 HAS A CONSTANT MAIN AIR INPUT PRESSURE AT ALL TIMES, AND WHEN ENERGIZED PASSES AIR SUPPLY (AIR) TO ALL PNEUMATIC INSTRUMENTATION IN SYSTEM.
2. DEV-4706 IS A PNEUMATIC SELECTOR WHICH ANALYZES ALL INPUT SIGNALS AND PASSES ONLY THE HIGHEST AND LOWEST AIR PRESSURE SIGNALS AS OUTPUTS FOR RESETTING OF HOT AND COLD DISCHARGE AIR THERMOSTAT SETTINGS.
3. SYMBOL ⌒ REPRESENTS AS FLEXIBLE DUCT CONNECTION.
4. A - VENDOR SUPPLIED.
   B - BECHTEL INTERFACE.
5. (OKT 4704) IS A NIGHT SETBACK TIME SWITCH FOR AUTOMATIC AIR HANDLER SHUT DOWN AND START UP.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

HVAC Office and
Service Buildings
(M-467 sh 3, Rev 1)

FSAR Figure 9.4-18, sh. 2

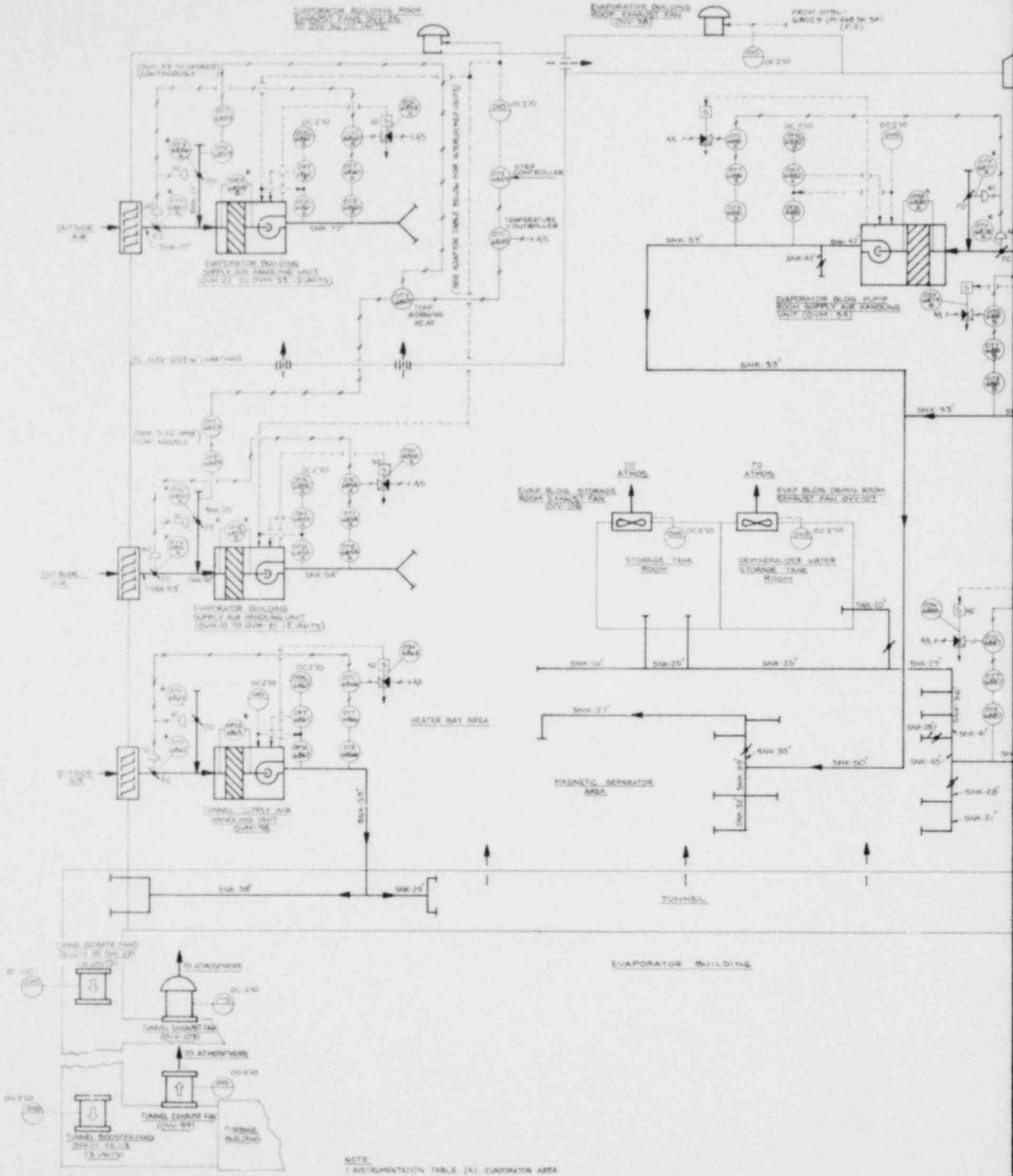

TO ATMOSPHERE
EVAP BLDG ELEC EQUIP ROOM EXHAUST FAN (DVV-61)
EVAP BLDG BATTERY ROOM EXHAUST FAN (DVV-117)
EVAP BLDG CONTROL AREA TOILET EXHAUST FAN (DVV-51)
HIGH BATTERY ROOM FLOW SWITCH (OPSL #H063A) THIS DWG (B-4)
ELEC EQUIP ROOM
OFFICE AREA
WOMENS TOILET
MENS TOILET
JANITOR ROOM
OFFICE AREA
DARK ROOM
LOCAL FIRE PANEL
CORRIDOR
ATOMIC ABSORBER HOOD
SAMPLE HOOD
SLOTH CHANGE ROOM
COUNTING ROOM
EVAP BLDG SAMPLE ROOM
EVAP BLDG CONTROL ROOM
FUME HOODS
PREPERATION ROOM
FUME HOODS
FUME HOOD
FUME HOOD
TO EVAP BLDG BATTERY ROOM EXH FAN (DVV-117) THIS DWG (B-4)
EVAP BLDG BATTERY
FIRST ROOM SUPPLY AIR HANDLING UNIT (DVH-100)
SAMPLE ROOM SUPPLY AIR HANDLING UNIT (DVH-101)



CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Heating, Ventilating, and Air Conditioning, Misc. Structure (M-468 sh 3A, Rev 0)

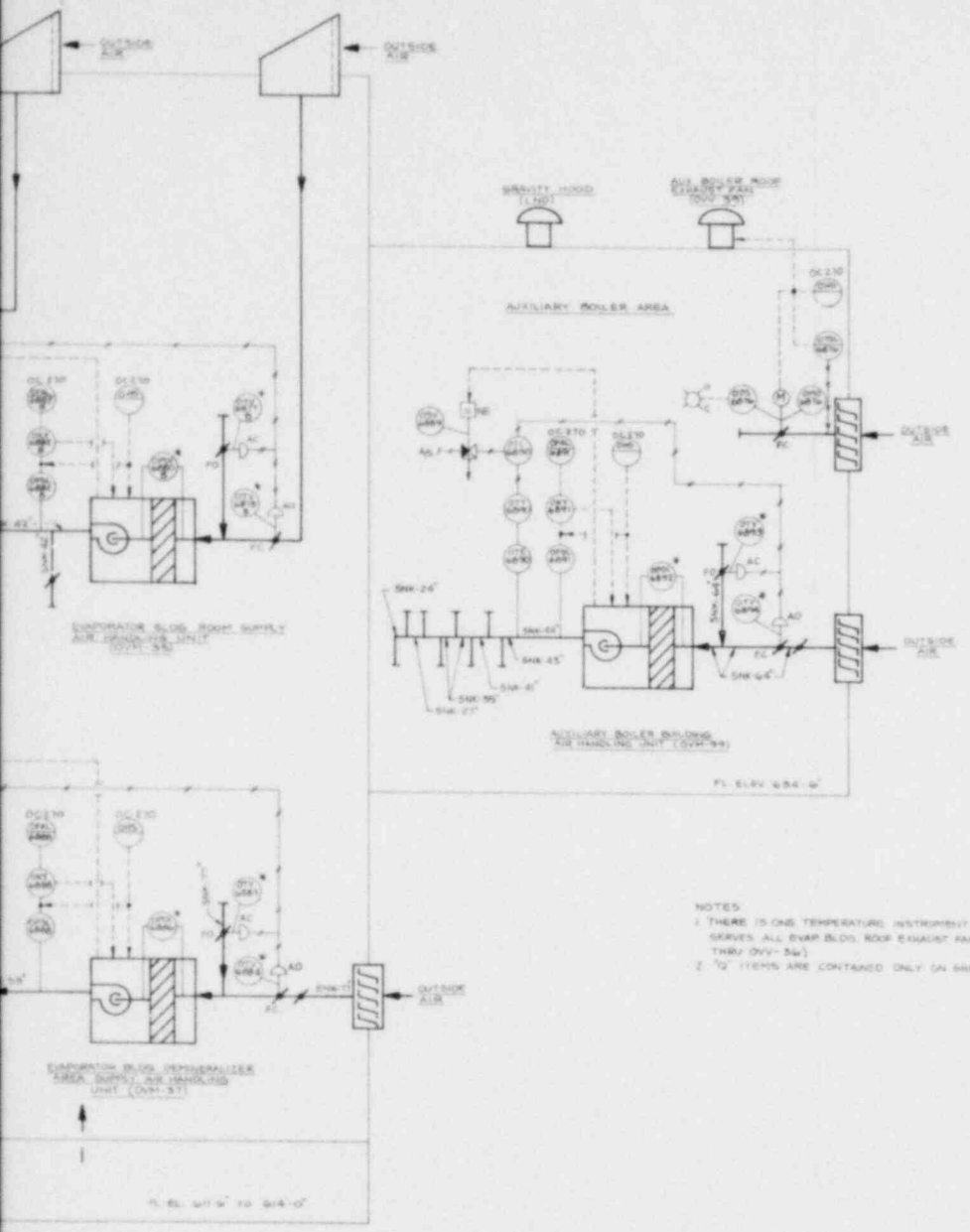
FSAR Figure 9.4-19, sh. 1



NOTE:
1. INSTRUMENTATION TABLE (A) EVAPORATOR AREA

SUPPLY FAN												
EQUIP. HEAT NO.	LOW FLOW SWITCH (FSL)	LOW FLOW ALARM (FAL)	PRESS DIFF INDI (PDI)	INTAKE AIR DAMPER		RETURN AIR DAMPER	LOW FLOW	TEMPERATURE		
				SOL. VALVE (SV)	VALVE NO. (TV)	VALVE NO. (TV)	TIMER (KY)	CONTROLLER (TC)	TRANSMITTER (TT)	ELEMENT (TE)
OVM-10	OFSL-6855A	OFAL-6855A	OPDI-6855A	OSV-6852A	OTV-6851A	OTV-6850A	OKY-6850A	OTC-6854A	OTT-6854A	OTE-6854A
OVM-20	OFSL-6856A	OFAL-6856A	OPDI-6856A	OSV-6858A	OTV-6857A	OTV-6856A	OKY-6856A	OTC-6860A	OTT-6860A	OTE-6860A
OVM-30	OFSL-6862A	OFAL-6862A	OPDI-6860A	OSV-6879A	OTV-6878A	OTV-6877A	OKY-6862A	OTC-6861A	OTT-6861A	OTE-6861A
OVM-11	OFSL-6855B	OFAL-6855B	OPDI-6855B	OSV-6852B	OTV-6851B	OTV-6850B	OKY-6855B	OTC-6854B	OTT-6854B	OTE-6854B
OVM-23	OFSL-6861B	OFAL-6861B	OPDI-6859B	OSV-6858B	OTV-6857B	OTV-6856B	OKY-6861B	OTC-6860B	OTT-6860B	OTE-6860B
OVM-31	OFSL-6855C	OFAL-6855C	OPDI-6855C	OSV-6852C	OTV-6850C	OKY-6855C	OTC-6854C	OTT-6854C	OTE-6854C	
OVM-24	OFSL-6862C	OFAL-6862C	OPDI-6859C	OSV-6858C	OTV-6856C	OKY-6860C	OTE-6860C	OTT-6860C	OTE-6860C	
OVM-12	OFSL-6855D	OFAL-6855D	OPDI-6855D	OSV-6852D	OTV-6850D	OKY-6855D	OTC-6854D	OTT-6854D	OTE-6854D	
OVM-29	OFSL-6860D	OFAL-6860D	OPDI-6859D	OSV-6858D	OTV-6857D	OTV-6856D	OKY-6860D	OTC-6860D	OTT-6860D	OTE-6860D
OVM-36	OFSL-6862D	OFAL-6862D	OPDI-6860D	OSV-6878D	OTV-6877D	OKY-6862D	OTC-6861D	OTT-6861D	OTE-6861D	
OVM-14	OFSL-6855E	OFAL-6855E	OPDI-6855E	OSV-6852E	OTV-6850E	OKY-6855E	OTC-6854E	OTT-6854E	OTE-6854E	
OVM-32	OFSL-6860E	OFAL-6860E	OPDI-6859E	OSV-6858E	OTV-6856E	OKY-6860E	OTC-6860E	OTT-6860E	OTE-6860E	
OVM-15	OFSL-6855F	OFAL-6855F	OPDI-6855F	OSV-6852F	OTV-6850F	OKY-6855F	OTC-6854F	OTT-6854F	OTE-6854F	
OVM-27	OFSL-6860F	OFAL-6860F	OPDI-6859F	OSV-6858F	OTV-6856F	OKY-6860F	OTC-6860F	OTT-6860F	OTE-6860F	
OVM-76	OFSL-6870	OFAL-6813		OSV-6831	OTV-6870		OKY-6875	OTC-6872	OTT-6872	OTE-6872

SUPPLY FAN												
EQUIP. MENT NO.	LOW FLOW SWITCH (FSL)	LOW FLOW ALARM (FAL)	PRESS DIFF INDI (PDI)	INTAKE AIR DAMPER		RETURN AIR DAMPER	LOW FLOW	TEMP		
				SOL VALVE (SV)	VALVE NO (TV)	VALVE NO (TV)	TIMER (KY)	CONTROLLER (TC)		
OVM-19	OFSL-6855G	OFAL-6855G	OPDI-6855G	OSV-6852G	OTV-6851G	OTV-6850G	OKY-6855G	OTC-6854G	OT	
OVM-28	OFSL-6860G	OFAL-6860G	OPDI-6859G	OSV-6858G	OTV-6857G	OTV-6856G	OKY-6860G	OTC-6860G	OT	
OVM-37	OFSL-6868	OFAL-6868	OPDI-6866	OSV-6865	OTV-6864	OTV-6865	OKY-6868	OTC-6867	OT	
OVM-17	OFSL-6855H	OFAL-6855H	OPDI-6855H	OSV-6852H	OTV-6851H	OTV-6850H	OKY-6855H	OTC-6854H	OT	
OVM-29	OFSL-6861H	OFAL-6861H	OPDI-6859H	OSV-6858H	OTV-6857H	OTV-6856H	OKY-6861H	OTC-6860H	OT	
OVM-8	OFSL-6855J	OFAL-6855J	OPDI-6855J	OSV-6852J	OTV-6851J	OTV-6850J	OKY-6855J	OTC-6854J	OT	
OVM-30	OFSL-6861J	OFAL-6861J	OPDI-6859J	OSV-6858J	OTV-6857J	OTV-6856J	OKY-6861J	OTC-6860J	OT	
OVM-18	OFSL-6855K	OFAL-6855K	OPDI-6855K	OSV-6852K	OTV-6851K	OTV-6850K	OKY-6855K	OTC-6854K	OT	
OVM-5	OFSL-6861K	OFAL-6861K	OPDI-6859K	OSV-6858K	OTV-6857K	OTV-6856K	OKY-6861K	OTC-6860K	OT	
OVM-20	OFSL-6855L	OFAL-6855L	OPDI-6855L	OSV-6852L	OTV-6851L	OTV-6850L	OKY-6855L	OTC-6854L	OT	
OVM-32	OFSL-6861L	OFAL-6861L	OPDI-6859L	OSV-6858L	OTV-6857L	OTV-6856L	OKY-6861L	OTC-6860L	OT	
OVM-21	OFSL-6855M	OFAL-6855M	OPDI-6855M	OSV-6852M	OTV-6851M	OTV-6850M	OKY-6855M	OTC-6854M	OT	
OVM-33	OFSL-6861M	OFAL-6861M	OPDI-6859M	OSV-6858M	OTV-6857M	OTV-6856M	OKY-6861M	OTC-6860M	OT	
OVM-98	OFSL-6867	OFAL-6867	OPDI-6865	OSV-6864	OTV-6862	OTV-6863	OKY-6867	OTC-6866	OT	
OVM-99	OFSL-6891	OFAL-6891	OPDI-6892	OSV-6869	OTV-6894	OTV-6893	OKY-6891	OTC-6890	OT	



FAN EQUIP NO	INTERLOCKED EXHAUST FANS	FAN EQUIP NO	INTERLOCKED EXHAUST FANS
OVM-31	OVV-31	OVM-33	OVV-34
OVM-32	OVV-30	OVM-34	OVV-27
OVM-35	OVV-32	OVM-36	OVV-33
OVM-37	OVV-29	OVM-38	OVV-26
OVM-39	OVV-35	OVM-40	OVV-36
OVM-41	OVV-28	OVM-42	OVV-25

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Heating, Ventilating, and Air Conditioning, Misc. Structure (M-468 sh 3B, Rev 0)

FSAR Figure 9.4-19, sh. 2

low temperature alarm. This alarm prompts operator investigation and remedial action.

SAFETY EVALUATION FIVE - The entire diesel generator system, including the cooling water system, may be tested during all normal modes of power plant operation. During these tests, coolant flowrates and temperatures are monitored to ensure that the jacket water coolers, coolant pump, and three-way thermostatic valve are functioning properly. In standby status, operability of the heater and electric circulating pump is evident by inspection. All components of the emergency diesel generator cooling water system are available for inspection at all times. Detection and control of leakage is visual and manual.

9.5.5.4 Tests and Inspections

Testing of the diesel generator system is discussed in Subsection 8.3.1.1.3. Abstracts concerning testing the diesel generator system are described in Chapter 14. Visual inspections, pressure and leak testing in accordance with the governing ASME Code, and operational checks of the cooling system components are performed as the unit is installed. The emergency diesel generator cooling water system is operationally checked during the periodic testing of the diesel generator system. The warming water system is operationally checked during diesel generator shutdown periods. Periodic testing of the diesel generator is performed as described in Chapter 16.

9.5.5.5 Instrumentation Applications

A discussion of the controls, instrumentation, and annunciation provided locally and in the control room is provided in Subsection 8.3.1.1.3.

9.5.6 DIESEL GENERATOR STARTING SYSTEM

This subsection discusses the mechanical features of the diesel generator starting system. The standby power supply (i.e., the diesel generator system) and its automatic actuation are discussed in detail in Subsection 8.3.1.1.3.

9.5.6.1 Design Bases

Criteria for selection of design bases are stated in Subsection 1.1.2.2.

Protection of the diesel generator starting system from wind and tornado effects is discussed in Section 3.3. Flood design is discussed in Section 3.4. Missile protection is discussed in

Section 3.5. Protection against dynamic effects associated with postulated rupture of piping is discussed in Section 3.6. Environmental design is discussed in Section 3.11.

9.5.6.1.1 Safety Design Bases

SAFETY DESIGN BASIS ONE - The diesel generator starting system initiates an engine start such that within 10 seconds after receipt of the start signal, the diesel generator is operating at rated speed and is ready to begin load sequencing.

SAFETY DESIGN BASIS TWO - No single active failure in the diesel generator starting system will impair the capability of the system to comply with safety design basis one.

SAFETY DESIGN BASIS THREE - Portions of the diesel generator starting system which are required in order to start the diesel upon receipt of an engineered safety features actuation signal are designed to remain functional after a safe shutdown earthquake.

SAFETY DESIGN BASIS FOUR - Active components of the system can be tested during plant operation in accordance with 10 CFR 50 General Design Criterion 18.

9.5.6.1.2 Power Generation Design Bases

The diesel generator starting system has no power generation design basis.

9.5.6.1.3 Codes and Standards

Codes and standards applicable to the diesel generator starting system are listed in Table 3.2-1.

9.5.6.2 System Description

9.5.6.2.1 General Description

The diesel generator starting system is shown schematically in Figure 9.5-27. Each diesel generator is equipped with independent and redundant air starting systems. Each starting system consists of the air receiver and dryer with prefilter/separators and postfilters intake air filters, injection lines and valves, air to cylinder distributor and starting valves, and an air compressor. Automatic drain traps are provided on the air receivers and the lines are sloped to low point drain traps. A drip leg with blow off connection is provided upstream of the air valves. Strainers are provided immediately upstream of the two starting air valves in each

27

train. The standby power supply (i.e., the diesel generator system) is discussed in detail in Subsection 8.3.1.1.3. 27

9.5.6.2.2 Component Description

AIR COMPRESSOR - The air compressors are motor driven, conventional piston type, air cooled compressors. Each compressor is sized to completely recharge its air receiver to 250 psig in 30 minutes following five successful engine starts. 10

AIR RECEIVER - A stainless steel compressed air storage tank is provided in each starting train. Automatic drain traps are provided on the air receivers and lines are sloped to the low point drain traps or low point drip legs with blow off connections. The receiver is sized to provide five diesel engine starts without recharging from the air compressor. The diesel engine will start with receiver air pressure as low as 90 psig. 27

AIR DRYER - A stainless steel dessicant air dryer for each air receiver unit is sized to dry required air capacities to a dewpoint of -40F at 250 psi. As shown in Figure 9.5-27, each air dryer is provided with prefilter/separator units and postfilters which ensure that the starting air will be essentially free from oil and particulate contamination. 27

PIPING - All piping and components from the air receiver aftercooler to the engine inlet connection are stainless steel to ensure that corrosion products do not interfere with operation of the starting air solenoid valves and related components. 10

9.5.6.2.3 System Operation

Two trains of air start equipment are provided for each diesel engine. The compressors start when air receiver pressure drops to approximately 225 psig and stops when pressure is increased to approximately 250 psig. Two compressors are provided. Each compressor keeps one receiver pressurized. Physical independence of the two trains of starting air receivers and compressors ensures that a ruptured receiver or broken line in one charging system will not affect the other charging system.

Start signals for the emergency diesel generators are produced by Class 1E bus undervoltage, or by a start signal from ESFAS.

The starting signal causes the engine starting air solenoids in each train to energize to distribute air to the engine cylinders through the air distributor and starting valves. Thus, receiver air at high pressure is released by solenoid valves to turn the engine. Starting air flow is stopped when the engine is running under its own power. Two solenoid valves are connected in parallel in each starting system train so that a failure of one solenoid does not compromise the safety of the system. Two

separate starting air distributors, one for each bank of cylinders, provide the timed pilot air signals to operate the starting air valve on each cylinder. Each bank of cylinders is independent with respect to having a separate air distributor and separate starting valves. The engine may be started by operation of either train of these starting systems.

9.5.6.2.4 Control and Instrumentation Drawings

Applicable control and instrumentation drawings are listed below and in Table 1.7-15.

a. Logic - not applicable

b. Control boards - not applicable

c. Schematics - E-402

2

9.5.6.3 Safety Evaluation

Safety evaluations are numbered to correspond to the safety design bases. A failure modes and effects analysis is presented in Table 9.5-5.

SAFETY EVALUATION ONE - Compressed air for each diesel is stored in individual storage and starting systems. Each system holds sufficient air to start the diesel five times under a no-load condition without compressor assistance. The continuous availability of the air starting system will keep the diesel engine in constant readiness.

SAFETY EVALUATION TWO - Solenoid air start valves are installed in parallel in each system. If one valve fails to operate, the parallel valve will supply starting air. A failure of the compressor is indicated by an air receiver low-pressure alarm; this alarm prompts the operator to take corrective action. The air receiver contains sufficient air to start its associated diesel engine at least five times. A single active failure in either starting system will not compromise the ability of the systems to accomplish their function.

SAFETY EVALUATION THREE - The diesel engine starting system, exclusive of the air compressors, air dryers, and piping to the double check valves, is designed in accordance with Seismic Category I requirements as specified in Section 3.2. Any system, equipment, or structure which is not Seismic Category I and whose collapse could result in loss of a required function of the diesel generator starting system through either impact or flooding is analytically checked to determine that it will not collapse when subjected to seismic loading.

SAFETY EVALUATION FOUR - All active components of the system can be separately tested during plant power generation operation, as discussed in Subsection 9.5.6.4 below.

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9.5.7.2.2 System Operation

When the engine is operating, circulation is accomplished by an engine driven positive displacement pump which draws oil through a strainer from the sump, and passes it through a full-flow 10 micron filter, an 80 mesh duplex strainer, and a lube oil cooler before distribution to bearings. Oil returns to the sump by gravity drain. During this process, the lube oil cools internal components, such as pistons. All heat transferred to the lube oil is given up to the engine closed loop cooling water system, which in turn gives its heat to the service water system. | 1

During standby periods, the lube oil is heated by an immersion heater and then circulated through the lower half of the engine by an electric motor driven pump. The upper half of the engine is primed by a 1/4 inch priming line except for the turbo chargers. By keeping the engine warm and lubricated in this way, quick starting is ensured. This warming pump runs continuously during standby only and is rated for such use. Heating of the oil is automatically controlled by thermostats. Failure of the heating unit will not adversely affect the diesel generator system since the unit may be readily replaced and the large mass of the diesel generator and lube oil retains heat for lengthy periods. Moreover, reduction to room temperature does not seriously lengthen the time required to start the engine. The diesel generator heating and ventilating system maintains the room air temperature at a minimum of 50F. Finally, failure of the warming unit would be indicated by the lube oil low temperature alarm; this annunciation would prompt operators to replace the failure unit or start the engine to prevent the extreme lube oil viscosities which accompany low lube oil temperatures. | 27

During starting or operation of the diesel generator, failure of the lubrication system engine driven pump would initiate operation of the auxiliary motor driven pump. Failure of a constant pressure recirculation valve could result in unsatisfactory low lube oil pressure. Receipt of a 2-out-of-3 coincidence logic low lube oil pressure signal will shut down the diesel engine during normal or emergency operation. | 1 | 10

9.5.7.2.3 Control and Instrumentation Drawings

Applicable control and instrumentation drawings are listed below and in Table 1.7-15.

a. Logic - not applicable

b. Control boards - not applicable

c. Schematics - E-402 | 2

9.5.7.3 Safety Evaluation

Safety evaluations are numbered to correspond to the safety design bases. A failure modes and effects analysis is provided in Table 9.5-6.

SAFETY EVALUATION ONE - The main diesel engine driven pump provides oil to the engine bearings during engine operational periods. Oil is kept at a constant pressure and temperature by use of regulating valves and a lube oil cooler. After engine shutdown or during periods of standby status, the standby motor driven pump and electric heater keep the bearings lubricated and warmed to 150F. 1

SAFETY EVALUATION TWO - The diesel generator lubrication system is designed in accordance with Seismic Category I requirements as specified in Section 3.2. The components (and supporting structures) of any system, equipment, or structure which are not Seismic Category I and whose failure could result in loss of a required function of the diesel generator lubrication system through either impact or flooding are analytically checked to determine that they will not fail when subjected to seismic loading.

SAFETY EVALUATION THREE - The lubricating oil supply to each diesel generator is sized to provide adequate diesel generator lubrication as discussed in safety evaluation one above. The lubrication system for each generator is capable of supplying lube oil without augmentation from other sources. The engine driven lube oil pump is driven by the diesel engine with which it is associated. The auxiliary motor driven lube oil pump starts automatically in the event of failure of the engine driven pump. Because of these arrangements and the redundancy of emergency diesel generator design and installation, a high degree of availability is assured. A single failure may be assessed as a failure of the diesel generator with which the failure is associated. In such a circumstance, safe shutdown is attained and maintained by the appropriate redundant diesel generator installation.

SAFETY EVALUATION FOUR - The diesel generator lubrication system is provided with an electric pump and immersion heater unit which circulates warmed lube oil through the engine. Extreme lube oil viscosities which accompany low lube oil temperatures are thus prevented, and quick starting of the diesel engine is assured. Failure of the unit is annunciated by a lube oil low temperature alarm. Diesel generator room low air temperature is annunciated at 40F. Either alarm prompts operator investigation and remedial action.

SAFETY EVALUATION FIVE - All active components are capable of being tested during power generation operation to ensure proper functioning of the system, as discussed in Subsection 9.5.7.4 below.

9.5.8.3 Safety Evaluation

Safety evaluations are numbered to correspond to the safety design bases.

SAFETY EVALUATION ONE - The combustion air intake provides enough air to the turbochargers to ensure rated diesel output under the most adverse conditions.

SAFETY EVALUATION TWO - The diesel intake and exhaust system is designed in accordance with Seismic Category I requirements as specified in Section 3.2. Systems, equipment, or structures whose failure could result in loss of a required function of the diesel generator intake and exhaust system are checked to determine that they will not fail when subjected to seismic loadings.

SAFETY EVALUATION THREE - The diesel generator air intake is sized to provide adequate combustion air as described in safety evaluation one above. A single failure of the air intake or exhaust may be assessed as a failure of the diesel generator with which the failure is associated. In such a circumstance, safe shutdown is attained and maintained by the appropriate redundant diesel generator installation.

SAFETY EVALUATION FOUR - All active components are capable of being tested during power generation to ensure proper functioning of the system as discussed in Subsection 9.5.8.4 below.

9.5.8.4 Tests and Inspection

Testing of the diesel generator system is discussed generally in Subsection 8.3.1.1.3. Abstracts of the diesel generator system are provided in Chapter 14. Visual inspections, pressure and leak testing, and operational checks of the combustion air intake and exhaust system are performed as the system is installed. The diesel generator combustion air intake and exhaust system is operationally checked during the periodic testing of the diesel generator system. Periodic testing of the diesel generator is discussed in Chapter 16.

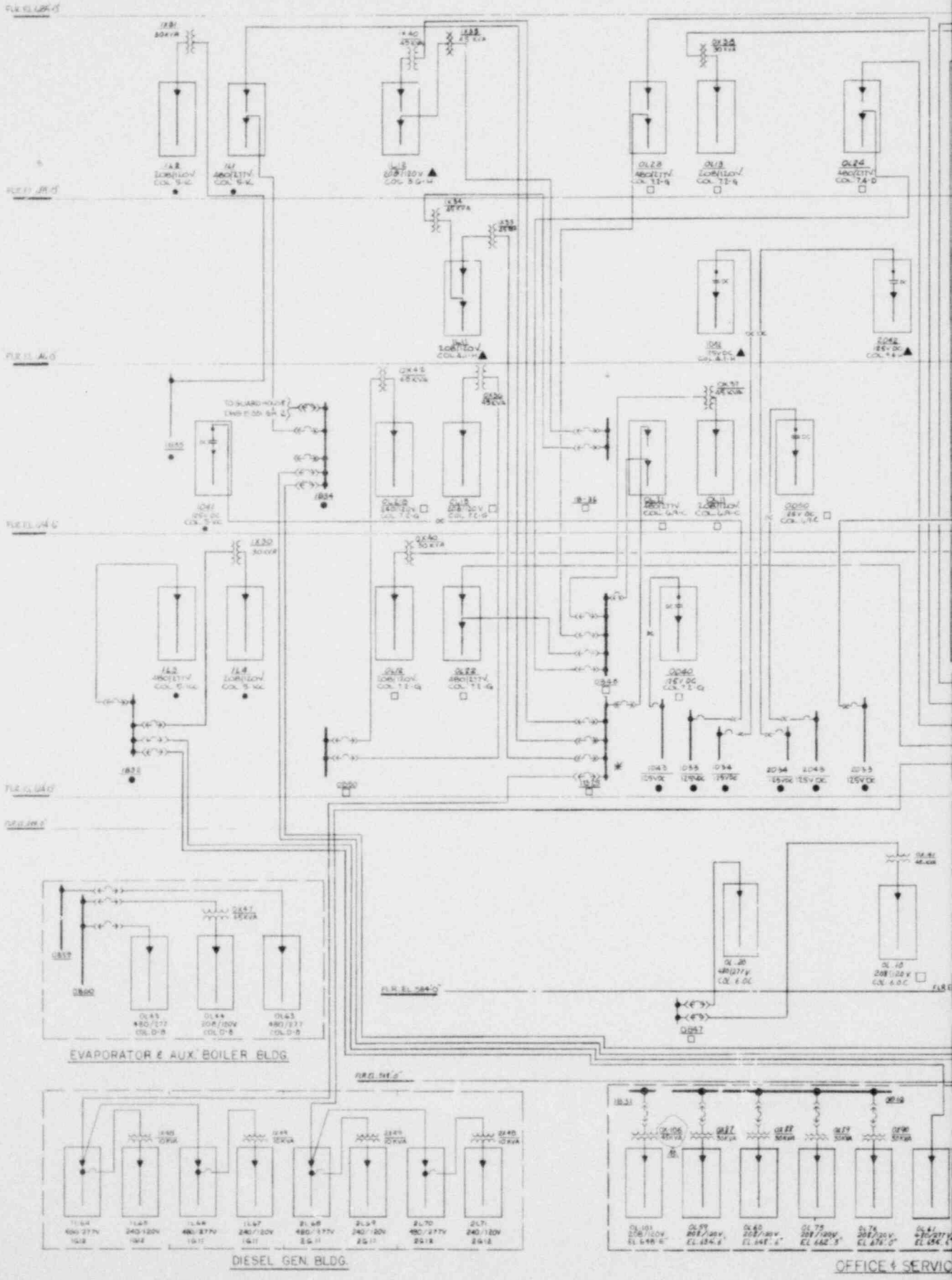
9.5.8.5 Instrumentation Application

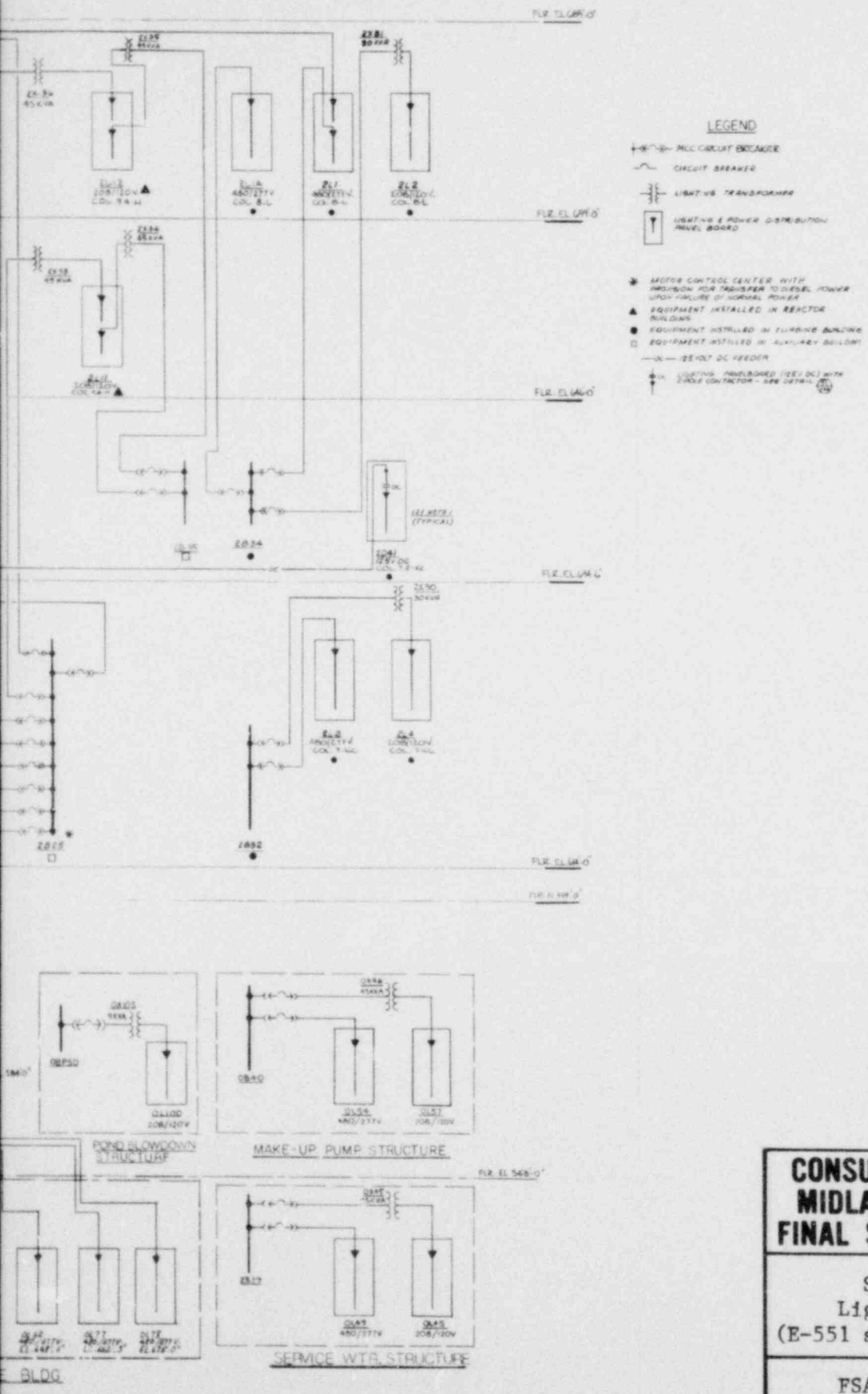
Diesel generator controls and indication are provided at the local diesel generator control panels and in the control room. The local diesel generator control panels are mounted on the diesel generator building foundation, which is structurally isolated from the diesel generator pedestals. The controls, instruments, and annunicators, associated with the diesel generators are discussed in Subsection 8.3.1.1.3. 27

9.5.9 CHEMICAL WASTE SYSTEM

9.5.9.1 Design Bases

Criteria for selection of design bases are stated in Subsection 1.1.2.2.


EVAPORATOR & AUX. BOILER BLDG.
DIESEL GEN. BLDG.
OFFICE & SERVIC



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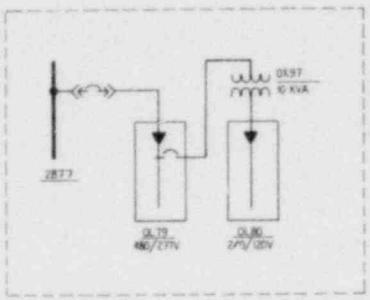
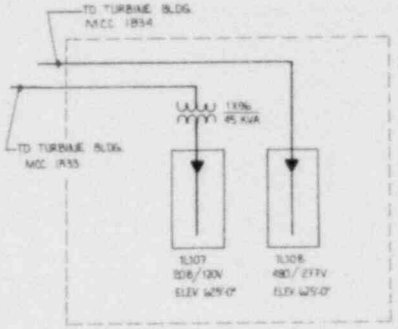
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Single Line Diagram
Lighting Distribution
(E-551 sh 1, Rev 8)

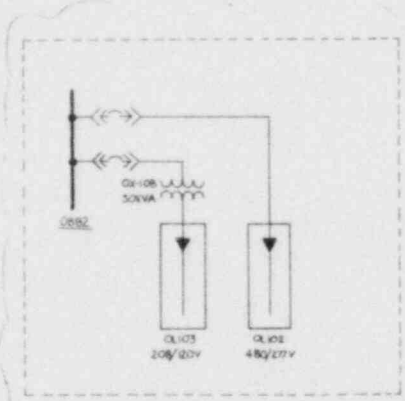
FSAR Figure 9.5-24, sh. 1



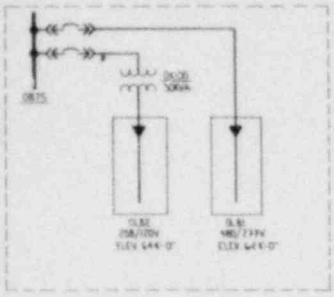
OILY WASTE TREATMENT BLDG.



GUARDHOUSE



CONDENSATE RETURN BLDG.



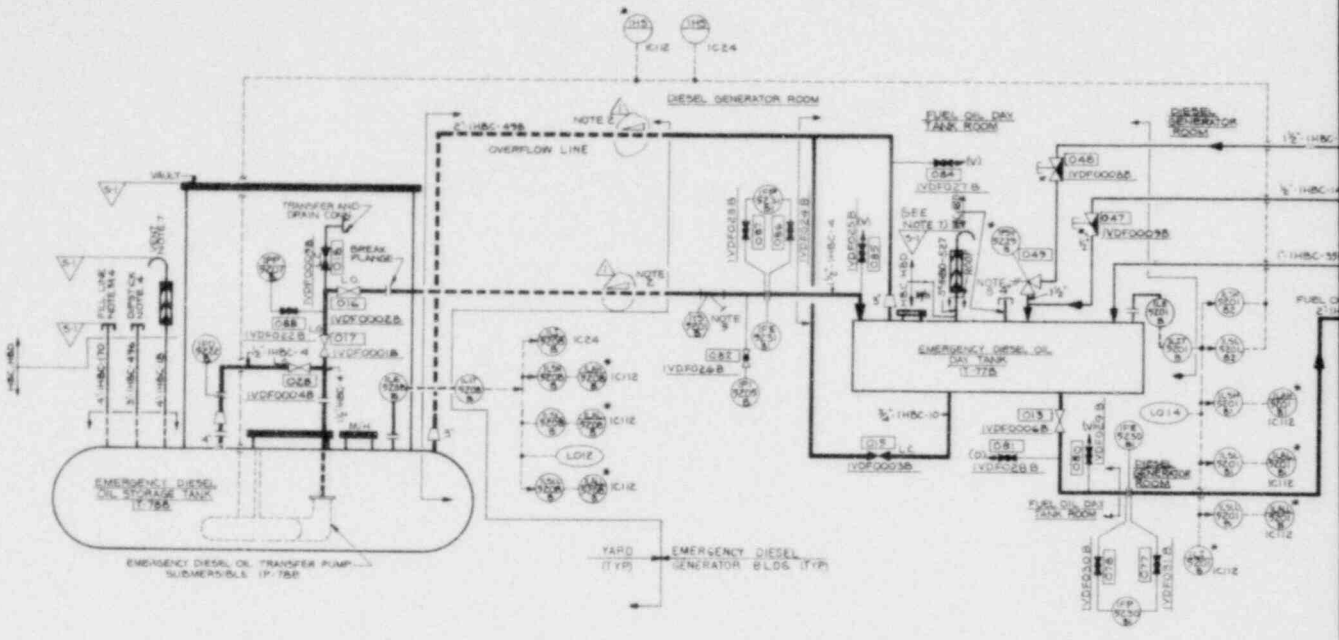
NOTES:

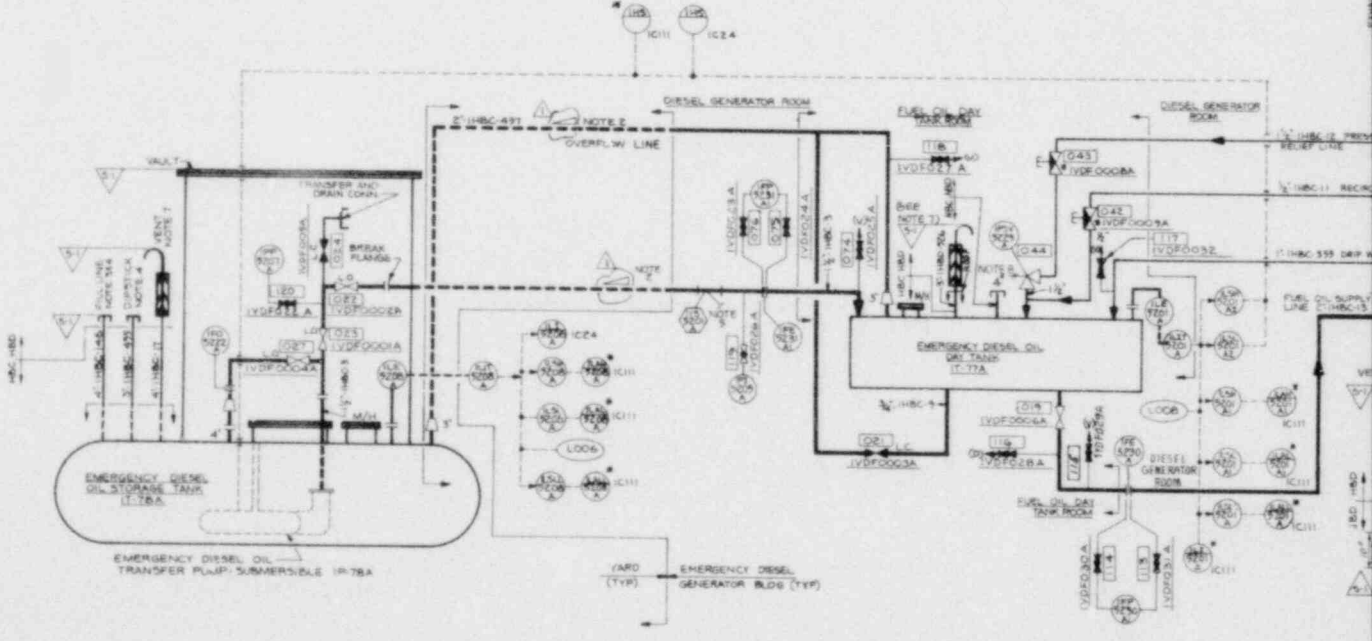
FOR NOTES AND REFERENCE DRAWINGS SEE E-551 SH.1

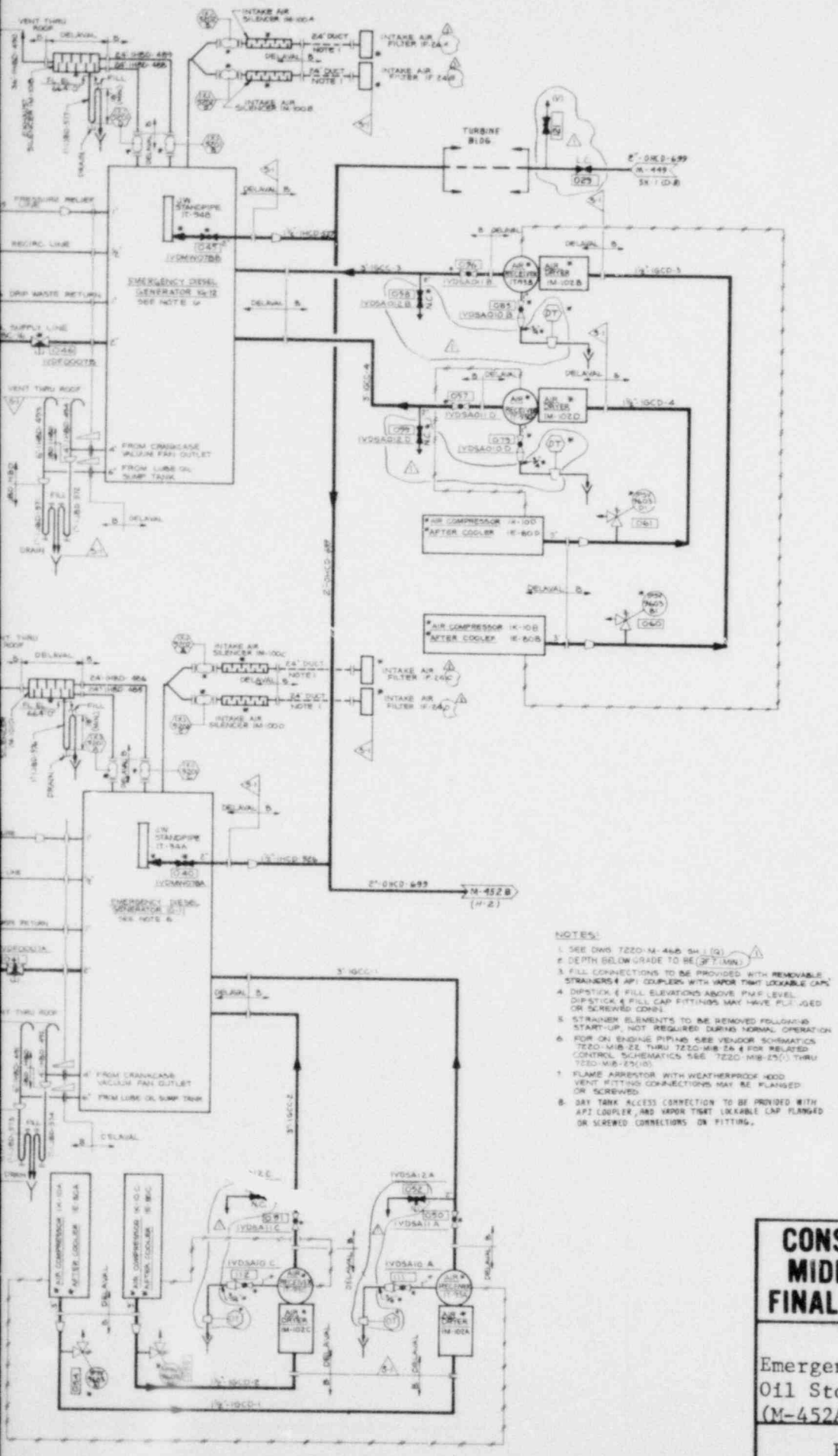
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Single Line Diagram
Lighting and Distribution
(E-551 sh 2, Rev 2)

FSAR Figure 9.5-24, sh. 2


DIESEL GENERATOR ROOM
OVERFLOW LINE
VAULT
TRANSFER AND DRAIN CONN.
BREAK FLANGE
EMERGENCY DIESEL OIL STORAGE TANK T-78B
EMERGENCY DIESEL OIL TRANSFER PUMP SUBMERSIBLE (P-78B)
EMERGENCY DIESEL OIL DAY TANK T-77B
FUEL OIL DAY TANK ROOM
YARD (TYP)
EMERGENCY DIESEL GENERATOR BLDG (TYP)


DIESEL GENERATOR ROOM
OVERFLOW LINE
VAULT
TRANSFER AND DRAIN CONN.
BREAK FLANGE
EMERGENCY DIESEL OIL STORAGE TANK T-78A
EMERGENCY DIESEL OIL TRANSFER PUMP SUBMERSIBLE (P-78A)
EMERGENCY DIESEL OIL DAY TANK T-77A
FUEL OIL DAY TANK ROOM
(ARD (TYP)
EMERGENCY DIESEL GENERATOR BLDG (TYP)



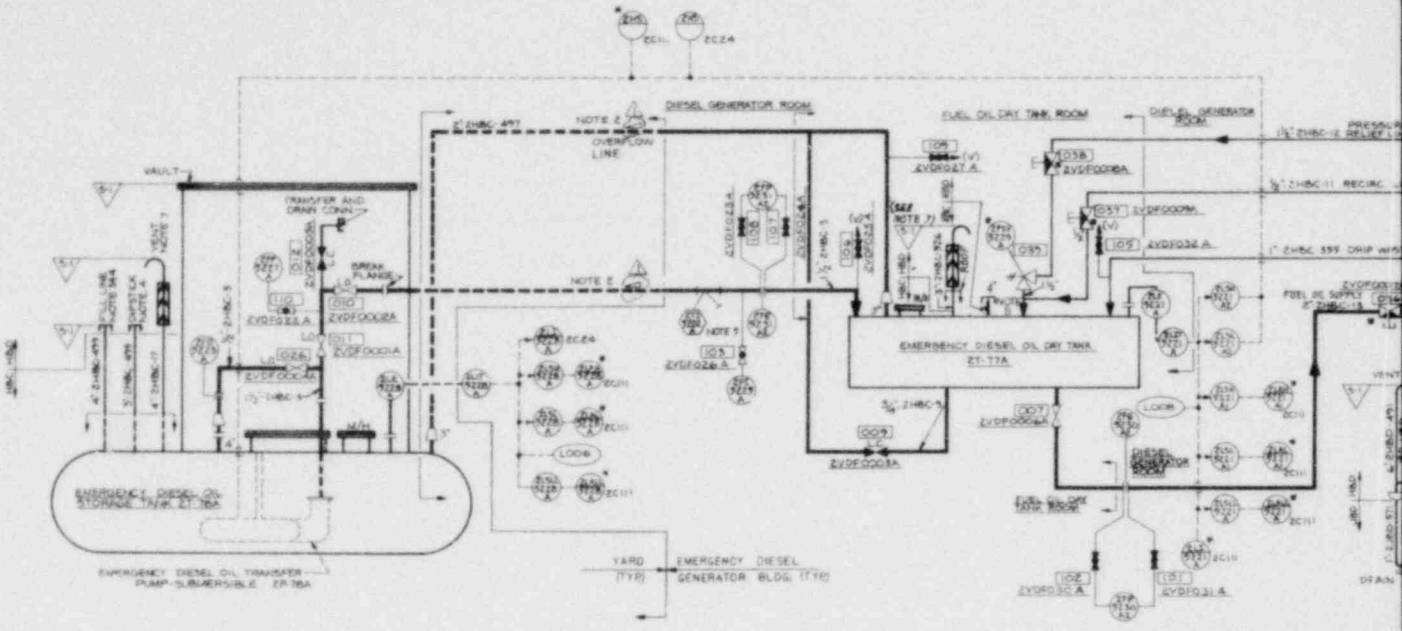
NOTES:

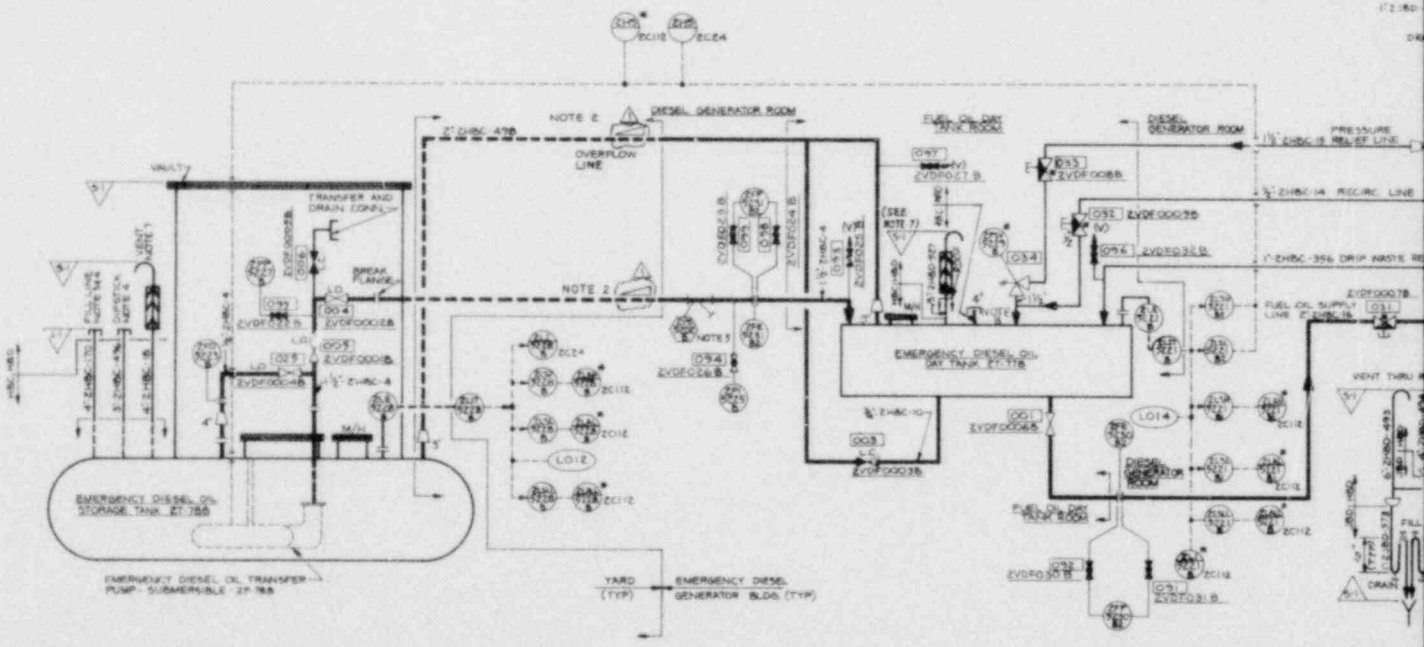
1. SEE DWG. 7220-M-468 SH. 1 (Q)
2. DEPTH BELOW GRADE TO BE 3FT. (MIN.)
3. FILL CONNECTIONS TO BE PROVIDED WITH REMOVABLE STRAINERS & API COUPLERS WITH VAPOR TIGHT LOCKABLE CAPS.
4. DIPSTICK & FILL ELEVATIONS ABOVE PUMP LEVEL. DIPSTICK & FILL CAP FITTINGS MAY HAVE PLUGGED OR SCREWED CONN.
5. STRAINER ELEMENTS TO BE REMOVED FOLLOWING START-UP, NOT REQUIRED DURING NORMAL OPERATION
6. FOR ON ENGINE PIPING SEE VENDOR SCHEMATICS 7220-M18-22 THRU 7220-M18-24 & FOR RELATED CONTROL SCHEMATICS SEE 7220-M18-25(1) THRU 7220-M18-25(10).
7. FLAME ARRESTOR WITH WEATHERPROOF HOOD. VENT FITTING CONNECTIONS MAY BE FLANGED OR SCREWED.
8. DAY TANK ACCESS CONNECTION TO BE PROVIDED WITH API COUPLER, AND VAPOR TIGHT LOCKABLE CAP FLANGED OR SCREWED CONNECTIONS ON FITTING.

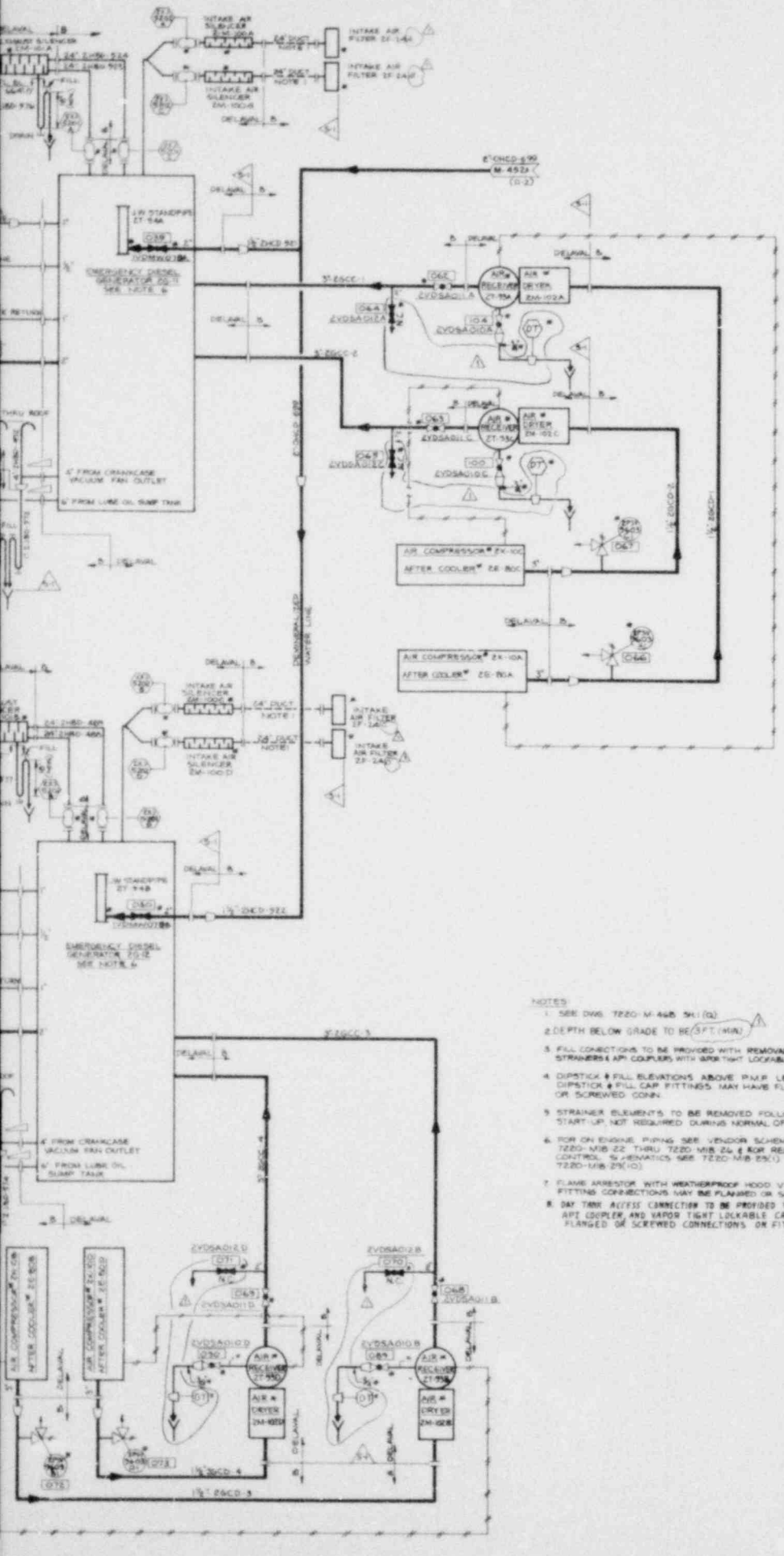
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Emergency Diesel Generator Fuel Oil Storage & Transfer - Units 1&2 (M-452A, Rev 1)

FSAR Figure 9.5-25, sh. 1


DIESEL GENERATOR ROOM
FUEL OIL DAY TANK ROOM
DIESEL GENERATOR ROOM
VAULT
NOTE 2
OVERFLOW LINE
TRANSFER AND DRAIN CONN.
BREAK FLANGE
NOTE 7
EMERGENCY DIESEL OIL DAY TANK ZT-77A
EMERGENCY DIESEL OIL STORAGE TANK ZT-76A
EMERGENCY DIESEL OIL TRANSFER PUMP-SUBMERSIBLE ZP-76A
YARD (TYP)
EMERGENCY DIESEL GENERATOR BLDG. (TYP)
VENT THRU ROOF
FUEL OIL SUPPLY
DRAIN


DIESEL GENERATOR ROOM
FUEL OIL DAY TANK ROOM
DIESEL GENERATOR ROOM
VAULT
NOTE 2
OVERFLOW LINE
TRANSFER AND DRAIN CONN.
BREAK FLANGE
NOTE 7
EMERGENCY DIESEL OIL DAY TANK ZT-77B
EMERGENCY DIESEL OIL STORAGE TANK ZT-76B
EMERGENCY DIESEL OIL TRANSFER PUMP-SUBMERSIBLE ZP-76B
YARD (TYP)
EMERGENCY DIESEL GENERATOR BLDG. (TYP)
VENT THRU ROOF
FUEL OIL SUPPLY
DRAIN



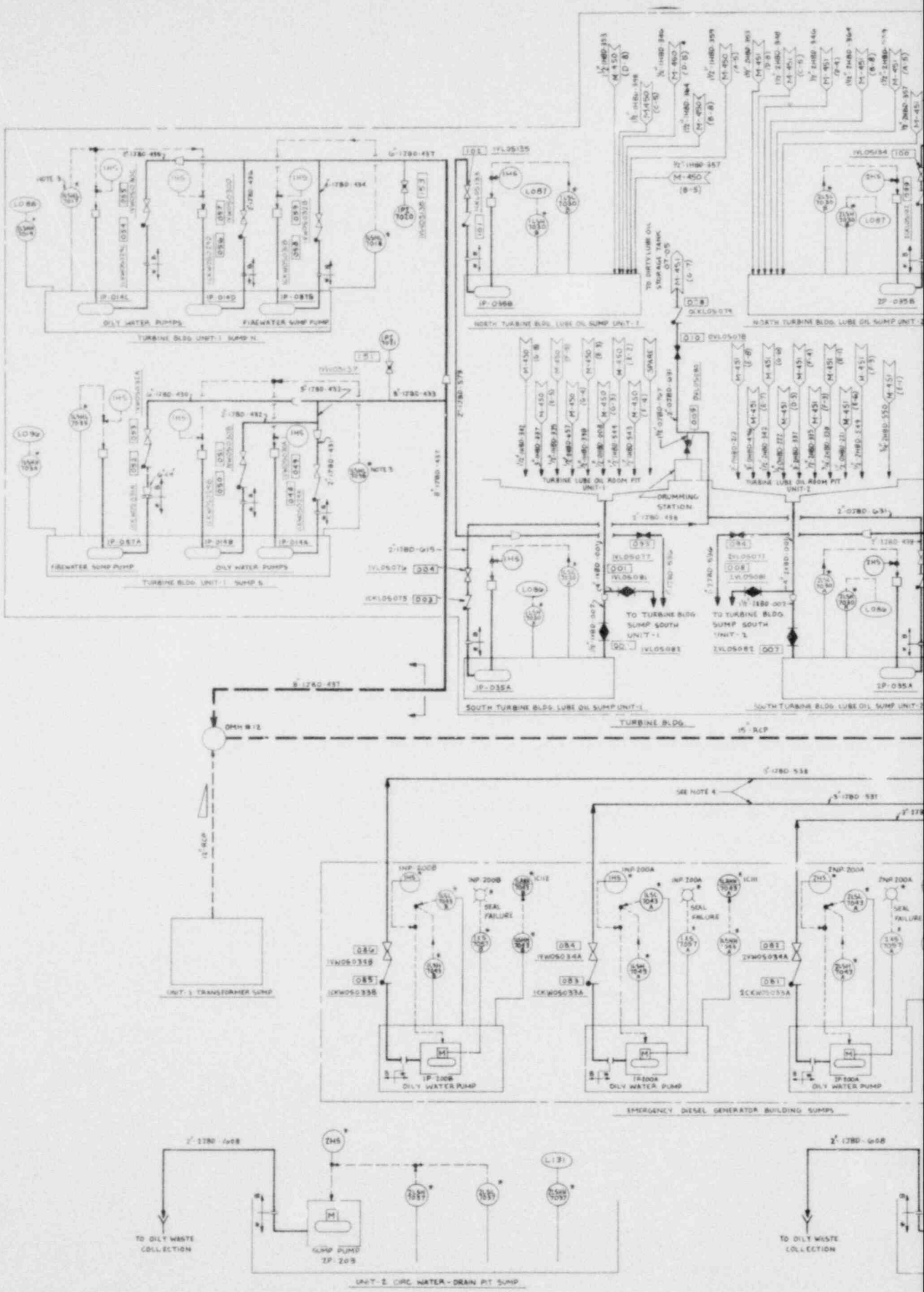
NOTES:

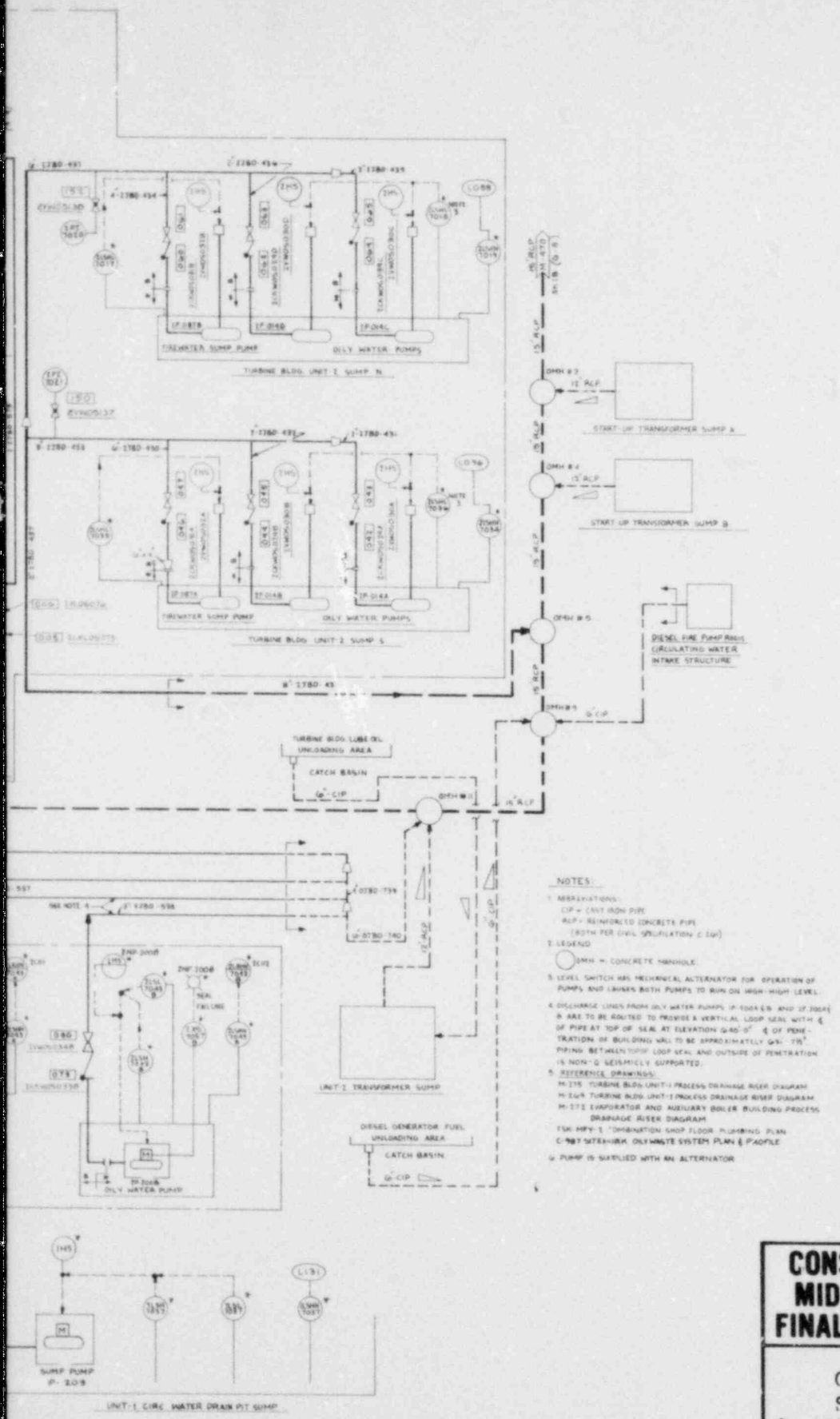
1. SEE DWG. 7220-M-468 SH.1 (Q).
2. DEPTH BELOW GRADE TO BE 3 FT. (MIN.)
3. FILL CONNECTIONS TO BE PROVIDED WITH REMOVABLE STRAINERS & API COUPLERS WITH VAPOR TIGHT LOCKABLE CAPS.
4. DIPSTICK & FILL ELEVATIONS ABOVE P.M.F. LEVEL. DIPSTICK & FILL CAP FITTINGS MAY HAVE FLANGED OR SCREWED CONN.
5. STRAINER ELEMENTS TO BE REMOVED FOLLOWING START-UP, NOT REQUIRED DURING NORMAL OPERATION.
6. FOR ON ENGINE PIPING SEE VENDOR SCHEMATICS 7220-M1B-22 THRU 7220-M1B-24 & FOR RELATED CONTROL SCHEMATICS SEE 7220-M1B-23(1) THRU 7220-M1B-23(10).
7. FLAME ARRESTOR WITH WEATHERPROOF HOOD VENT FITTING CONNECTIONS MAY BE FLANGED OR SCREWED.
8. DAY TANK ACCESS CONNECTION TO BE PROVIDED WITH API COUPLER AND VAPOR TIGHT LOCKABLE CAP WITH FLANGED OR SCREWED CONNECTIONS OR FITTING.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Emergency Diesel Generator Fuel Oil Storage & Transfer - Units 1&2 (M-452B, Rev 1)

FSAR Figure 9.5-25, sh. 2


TURBINE BLDG. UNIT-1 SUMP N.
OILY WATER PUMPS
FIREWATER SUMP PUMP
TURBINE BLDG. UNIT-1 SUMP S.
FIREWATER SUMP PUMP
OILY WATER PUMPS
NORTH TURBINE BLDG. LUBE OIL SUMP UNIT-1
NORTH TURBINE BLDG. LUBE OIL SUMP UNIT-2
TURBINE LUBE OIL ROOM PIT UNIT-1
TURBINE LUBE OIL ROOM PIT UNIT-2
DRUMMING STATION
TO TURBINE BLDG SUMP SOUTH UNIT-1
TO TURBINE BLDG SUMP SOUTH UNIT-2
SOUTH TURBINE BLDG. LUBE OIL SUMP UNIT-1
SOUTH TURBINE BLDG. LUBE OIL SUMP UNIT-2
TURBINE BLDG.
15" RCP
12" RCP
UNIT-1 TRANSFORMER SUMP
SEE NOTE 4
SEAL FAILURE
OILY WATER PUMP
EMERGENCY DIESEL GENERATOR BUILDING SUMPS
TO OILY WASTE COLLECTION
SUMP PUMP
UNIT-2 CIRC. WATER-DRAIN PIT SUMP



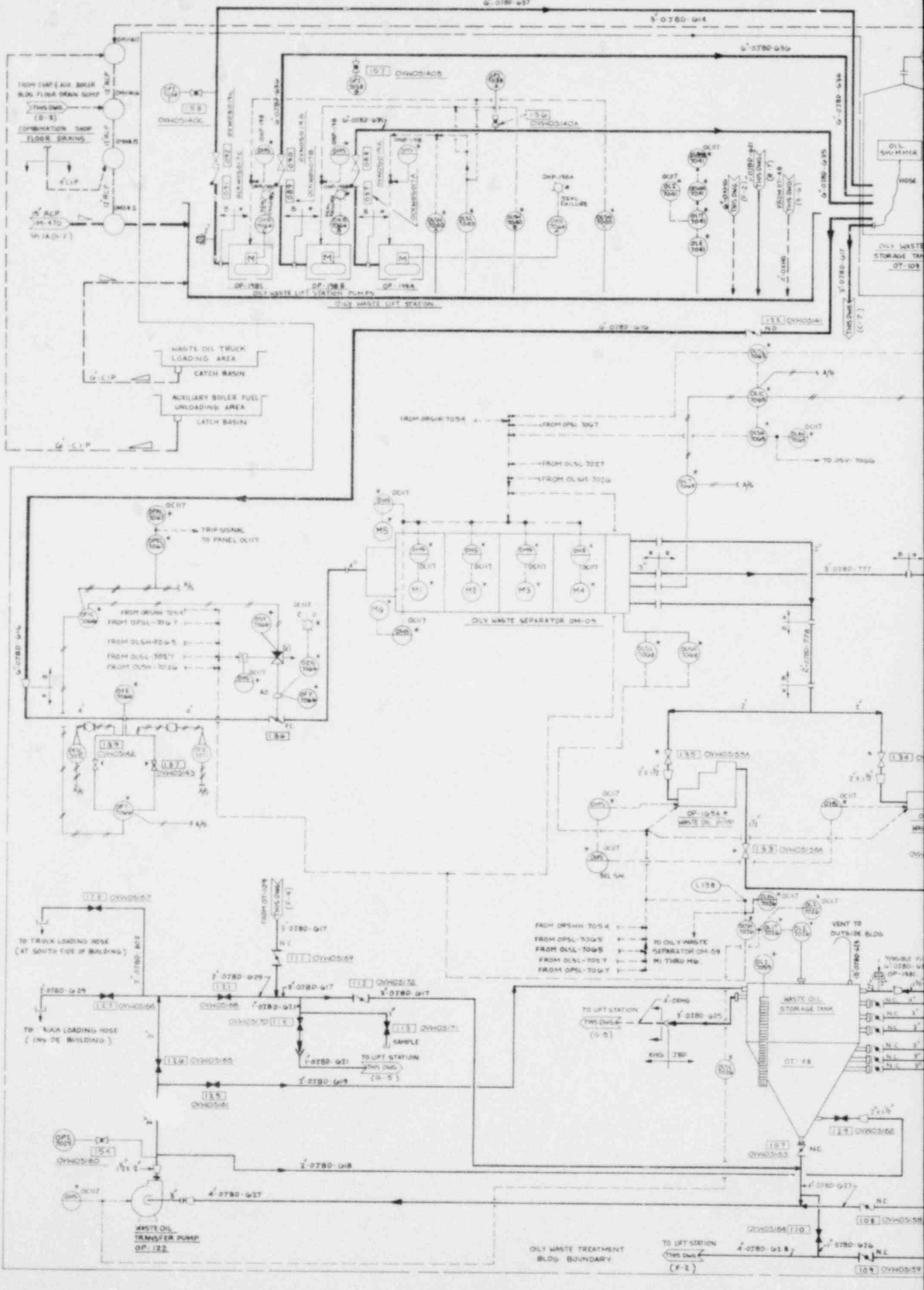
NOTES:

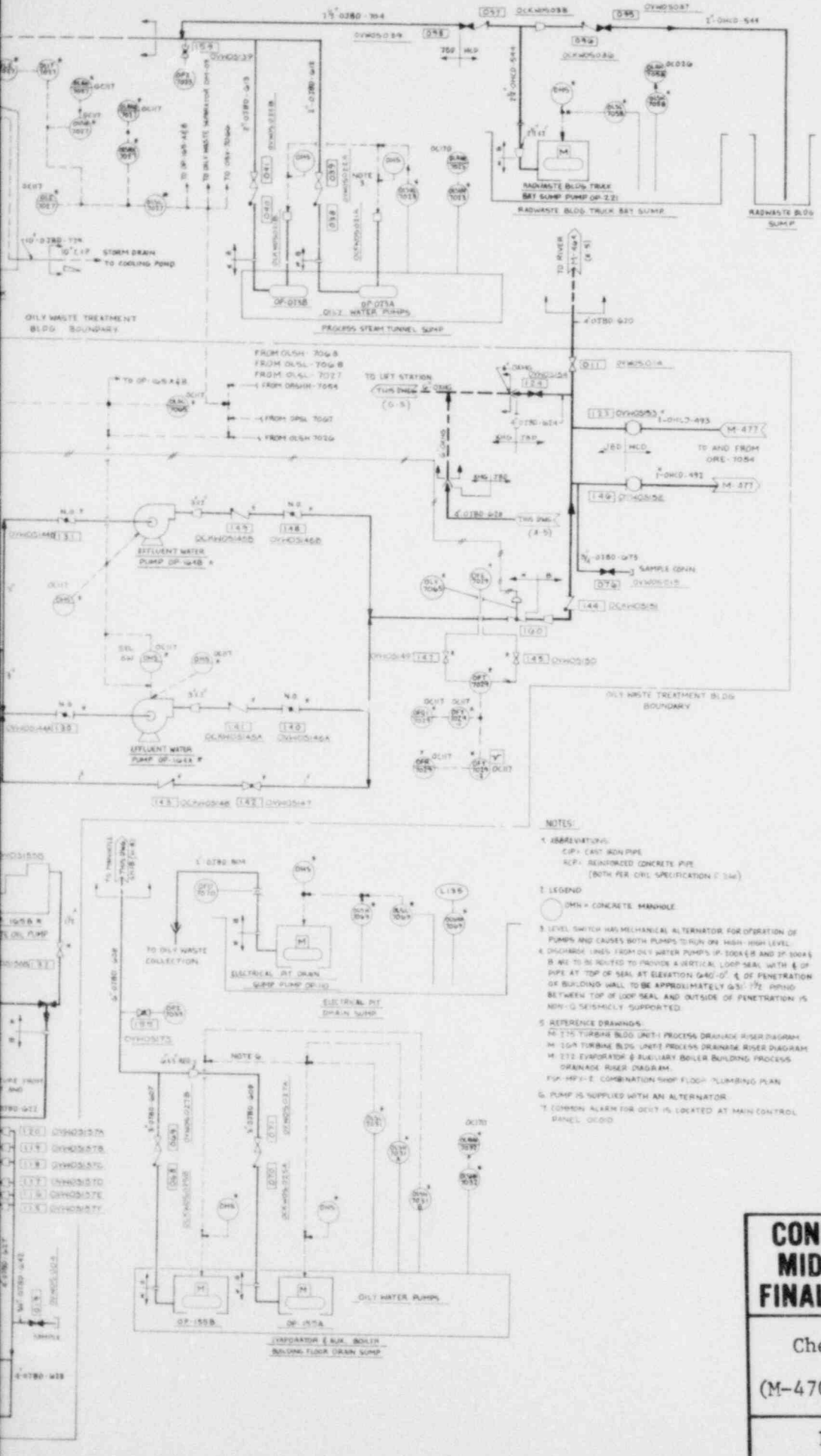
1. ABBREVIATIONS:
   CIP = CAST IRON PIPE
   RCP = REINFORCED CONCRETE PIPE
   (BOTH PER CIVIL SPECIFICATION C-210)
2. LEGEND:
   ○ DMH = CONCRETE MANHOLE
3. LEVEL SWITCH HAS MECHANICAL ALTERNATOR FOR OPERATION OF PUMPS AND CAUSES BOTH PUMPS TO RUN ON HIGH-HIGH LEVEL.
4. DISCHARGE LINES FROM OILY WATER PUMPS (P-208A & B) AND (P-209A & B) ARE TO BE ROUTED TO PROVIDE A VERTICAL LOOP SEAL WITH ℄ OF PIPE AT TOP OF SEAL AT ELEVATION Q 610'-0" ℄ OF PENETRATION OF BUILDING WALL TO BE APPROXIMATELY Q 611'-7½". PIPING BETWEEN TOP OF LOOP SEAL AND OUTSIDE OF PENETRATION IS NON-Q SEISMICLY SUPPORTED.
5. REFERENCE DRAWINGS:
   M-175 TURBINE BLDG. UNIT-1 PROCESS DRAINAGE RISER DIAGRAM
   M-164 TURBINE BLDG. UNIT-2 PROCESS DRAINAGE RISER DIAGRAM
   M-272 EVAPORATOR AND AUXILIARY BOILER BUILDING PROCESS DRAINAGE RISER DIAGRAM
   FOR MFP-1 "COMBINATION SHOP FLOOR PLUMBING PLAN
   C-987 SITE-WORK OILY WASTE SYSTEM PLAN & PROFILE
6. PUMP IS SUPPLIED WITH AN ALTERNATOR

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Chemical and Oily Waste System - Sheet A
(M-470 sh 1A, Rev 0)

FSAR Figure 9.5-30, sh. 1


FROM SWP & AUX BOILER BLDG FLOOR DRAIN SUMP
COMBINATION SHOP FLOOR DRAINS
OIL WASTE LIFT STATION PUMPS
OIL WASTE LIFT STATION
OP-198C
OP-198B
OP-198A
WASTE OIL TRUCK LOADING AREA
CATCH BASIN
AUXILIARY BOILER FUEL UNLOADING AREA
CATCH BASIN
TRIP SIGNAL TO PANEL OC117
OIL WASTE SEPARATOR OM-09
OP-195A WASTE OIL PUMP
SEL SW
TO TRUCK LOADING HOSE (AT SOUTH SIDE OF BUILDING)
TO TRUCK LOADING HOSE (INSIDE BUILDING)
SAMPLE
TO LIFT STATION
WASTE OIL STORAGE TANK
OT-118
VENT TO OUTSIDE BLDG
WASTE OIL TRANSFER PUMP OP-122
OILY WASTE TREATMENT BLDG BOUNDARY
TO LIFT STATION
FROM ORWH 705A
FROM OPSL 706T
FROM OLSL 705T
FROM OLSH 705A
FROM OLSL 709T
FROM OPSL 706T
TO OILY WASTE SEPARATOR OM-09 M1 THRU M4
OIL SKIMMER
HOSE
OILY WASTE STORAGE TANK OT-109



NOTES:

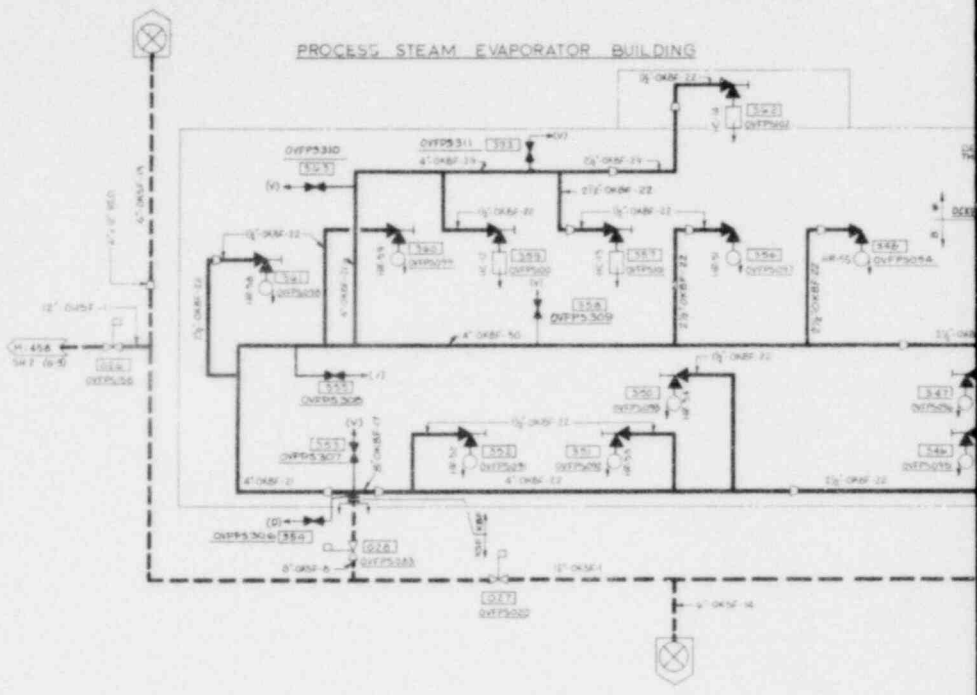
1. ABBREVIATIONS:
   CIP= CAST IRON PIPE
   RCP= REINFORCED CONCRETE PIPE
   (BOTH PER CPCL SPECIFICATION C-346)
2. LEGEND:
   ○ DMH = CONCRETE MANHOLE
3. LEVEL SWITCH HAS MECHANICAL ALTERNATOR FOR OPERATION OF PUMPS AND CAUSES BOTH PUMPS TO RUN ON HIGH-HIGH LEVEL.
4. DISCHARGE LINES FROM OILY WATER PUMPS (P-300A & B AND P-300A & B ARE TO BE ROUTED TO PROVIDE A VERTICAL LOOP SEAL WITH 6" OF PIPE AT TOP OF SEAL AT ELEVATION 640'-0" & OF PENETRATION OF BUILDING WALL TO BE APPROXIMATELY 635'-7½". PIPING BETWEEN TOP OF LOOP SEAL AND OUTSIDE OF PENETRATION IS NON-Q SEISMICLY SUPPORTED.
5. REFERENCE DRAWINGS:
   M-215 TURBINE BLDG. UNIT-1 PROCESS DRAINAGE RISER DIAGRAM
   M-169 TURBINE BLDG. UNIT-2 PROCESS DRAINAGE RISER DIAGRAM
   M-272 EVAPORATOR & AUXILIARY BOILER BUILDING PROCESS DRAINAGE RISER DIAGRAM.
   FSK-MPY-E COMBINATION SHOP FLOOR PLUMBING PLAN
6. PUMP IS SUPPLIED WITH AN ALTERNATOR.
7. COMMON ALARM FOR OCIT IS LOCATED AT MAIN CONTROL PANEL OC010

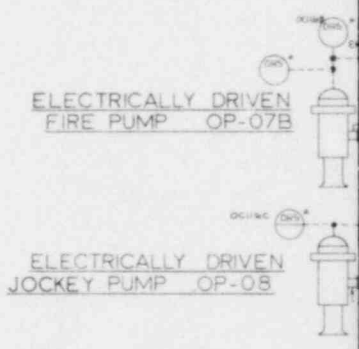
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

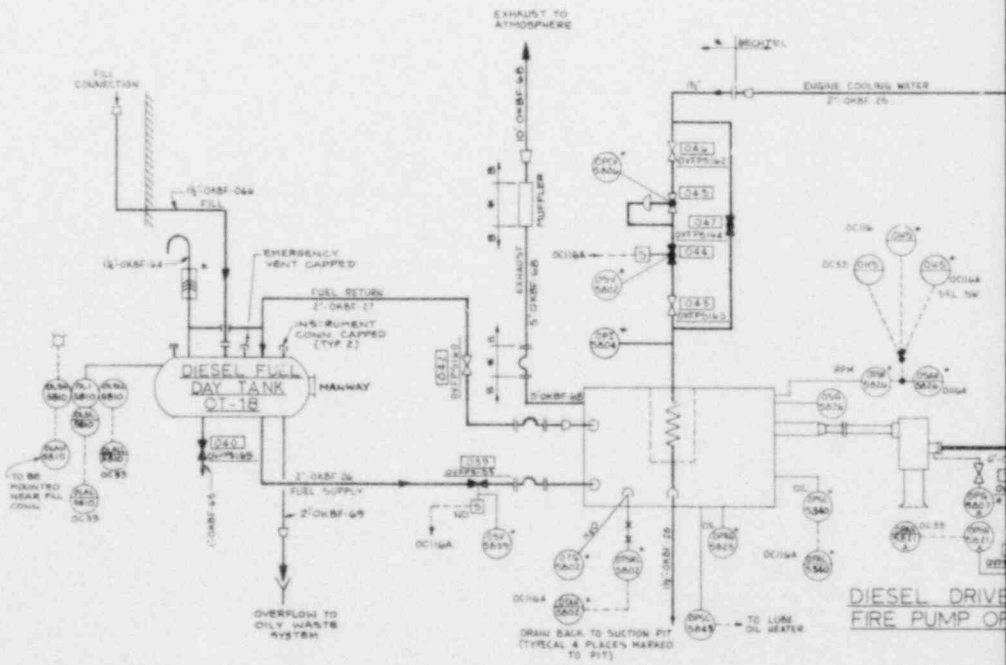
Chemical and Oily Waste System

(M-470 sh 1B, Rev 0)

FSAR Figure 9.5-30, sh. 2


PROCESS STEAM EVAPORATOR BUILDING


ELECTRICALLY DRIVEN
FIRE PUMP OP-07B
ELECTRICALLY DRIVEN
JOCKEY PUMP OP-08


EXHAUST TO ATMOSPHERE
FILL CONNECTION
EMERGENCY VENT CAPPED
FUEL RETURN
INSTRUMENT CONN. CAPPED (TYP 2)
DIESEL FUEL DAY TANK OT-18
MANWAY
FUEL SUPPLY
OVERFLOW TO OILY WASTE SYSTEM
ENGINE COOLING WATER
DRAIN BACK TO SUCTION PIT (TYPICAL 4 PLACES MARKED TO PIT)
TO LUBE OIL HEATER
DIESEL DRIVE
FIRE PUMP OP

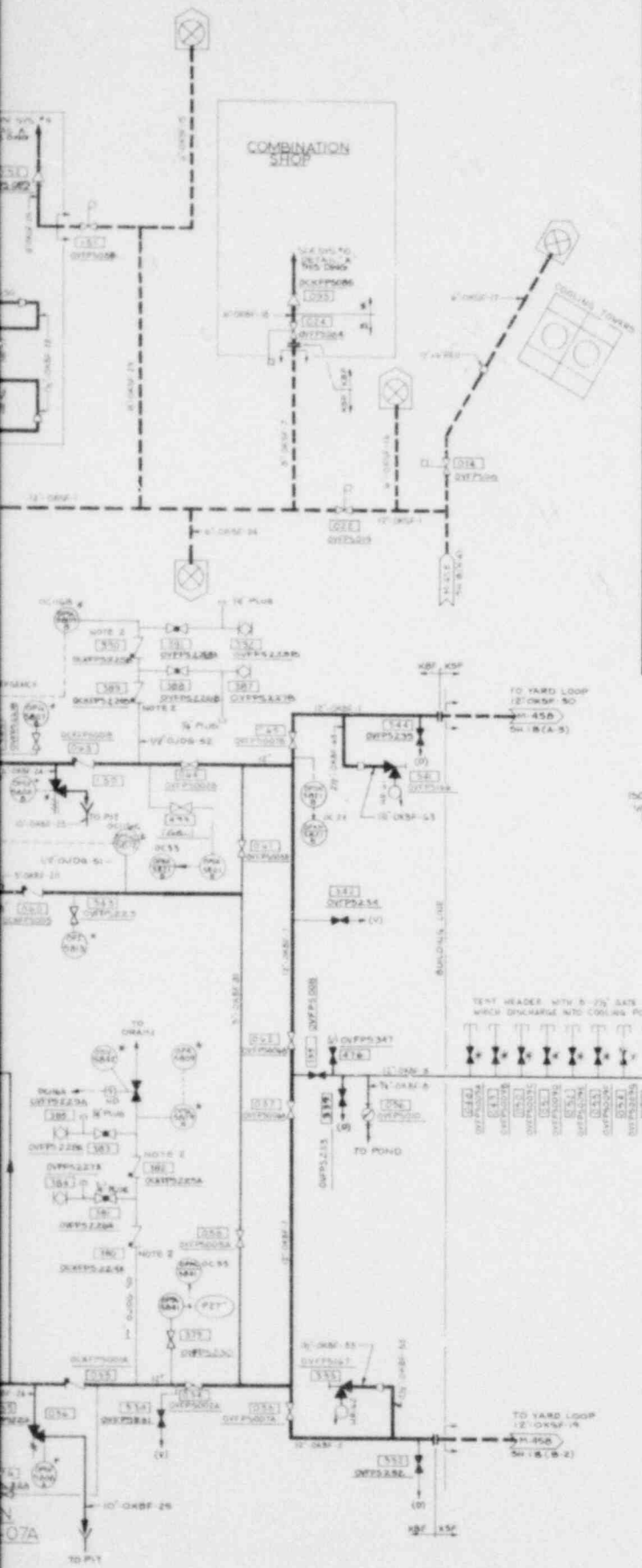
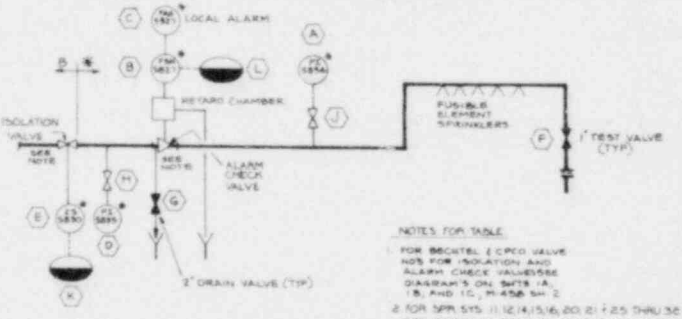


TABLE A FOR DETAIL A ONLY												
SPR SYS NO.	SPR SYS INSTR IDENTIFICATION: WATER FLOW SWITCH	INDICATIONS: COND. SHUT HIGH	INDICATIONS: FLOW ALARM HIGH	PRESS SWITCH	VALVE SUPERVISORY SWITCH	VALVE IDENTIFICATION: GT NUMBER, CPCo VALVE NUMBER				PLANT SECURITY COMPUTER I/O	
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(K)	(L)
1	PI 5834 1	PSH 5827 1	PAH 5827 1	PI 5835 1	ZS 5830 1	176	161	394	335	D15	D46
						WFP5203	WFP5180	WFP5312	WFP5328		
2	2PI 5834 1	2PSH 5827 1	2PAH 5827 1	2PI 5836 1	2ZS 5830 1	177	160	396	337	D16	D47
						2VFP5204	2VFP5130	2VFP5158	2VFP5329		
3	PI 5834 2	PSH 5827 2	PAH 5827 2	PI 5835 2	ZS 5830 2	178	163	398	339	D17	D48
						WFP5205	WFP5160	WFP5314	WFP5330		
4	2PI 5834 2	2PSH 5827 2	2PAH 5827 2	2PI 5835 2	2ZS 5830 2	179	164	400	401	D18	D49
						2VFP5206	2VFP5136	2VFP5316	2VFP5331		
5	PI 5834 3	PSH 5827 3	PAH 5827 3	PI 5835 3	ZS 5830 3	180	165	402	403	D19	D50
						2VFP5207	2VFP5133	WFP5336	WFP5332		
6	2PI 5834 3	2PSH 5827 3	2PAH 5827 3	2PI 5835 3	2ZS 5830 3	181	166	404	405	D20	D51
						2VFP5208	2VFP5133	2WFP5317	2WFP5333		
7	OPI 5834 4	OPSH 5827 4	OPAH 5827 4	OPI 5835 3	OZS 5830 4	182	167	406	407	D21	D52
						OWFP5209	OVFP5150	OVFP5318	OWFP5334		
8	OPI 5834 6	OPSH 5827 6	OPAH 5827 1	OPI 5835 6	OZS 5830 6	183	168	408	409	D22	D53
						OWFP5210	OWFP5153	OWFP5319	OWFP5335		
9	OPI 5834 3	OPSH 5827 3	OPAH 5827 3	OPI 5835 3		184	169	410	411		D54
						OWFP5211	OVFP5090	OWFP5320	OWFP5336		
10	OPI 5834 4	OPSH 5827 4	OPAH 5827 4	OPI 5835 4	OZS 5830 4	185	170	412	413	D23	D55
						OWFP5212	OWFP5088	OWFP5321	OWFP5337		
11	OPI 5834 5	OPSH 5827 5	OPAH 5827 5	OPI 5835 5	OZS 5830 5	186	171	414	415	D24	D56
						OVFP5213	OWFP5079	OWFP5322	OWFP5338		
12	OPI 5834 6	OPSH 5827 6	OPAH 5829 2	OPI 5835 6	OZS 5830 6	187	172	416	417	D25	D59
						OWFP5214	OWFP5075	OWFP5323	OWFP5339		
19	OPI 5834 7	OPSH 5827 7	OPAH 5827 5	OPI 5835 7	OZS 5830 7	188	173	418	419	D36	D60
						OVFP5215	OWFP5076	OWFP5324	OVFP5340		
22	OPI 5834 10	OPSH 5827 10	OPAH 5827 10	OPI 5836 10	OZS 5830 10	———	———	420	421	D39	D61
						———	———	OWFP5325	OWFP5341		
23	OPI 5834 11	OPSH 5827 11	OPAH 5827 11	OPI 5836 11	OZS 5830 11	———	———	422	423	D38	D62
						———	———	OWFP5326	OWFP5342		
24	OPI 5834 12	OPSH 5827 12	OPAH 5827 12	OPI 5836 12	OZS 5830 12	———	———	424	425	D37	D63
						———	———	OWFP5327	OWFP5343		



DETAIL "A"

TYPICAL WET SPRINKLER SYSTEM

SEE TABLE FOR INSTRUMENT AND VALVE IDENTIFICATION

NOTES FOR TABLE

1. FOR BECHTEL & CPCO VALVE NOS FOR ISOLATION AND ALARM CHECK VALVES SEE DIAGRAMS ON SHTS 1A, 1B, AND 1C, M-458 SH 2
2. FOR SPR SYS 1, 12, 14, 15, 16, 20, 21, 25 THRU 36 SEE DIAGRAMS ON SHTS 1A, 1B, 1C, OR M-458 SH 2
3. SPR SYS. 11 AND 13 HAVE BEEN DELETED

LEGEND

- DRY PIPE VALVE
- WALL POST INDICATOR VALVE
- PLANT SECURITY COMPUTER I/O

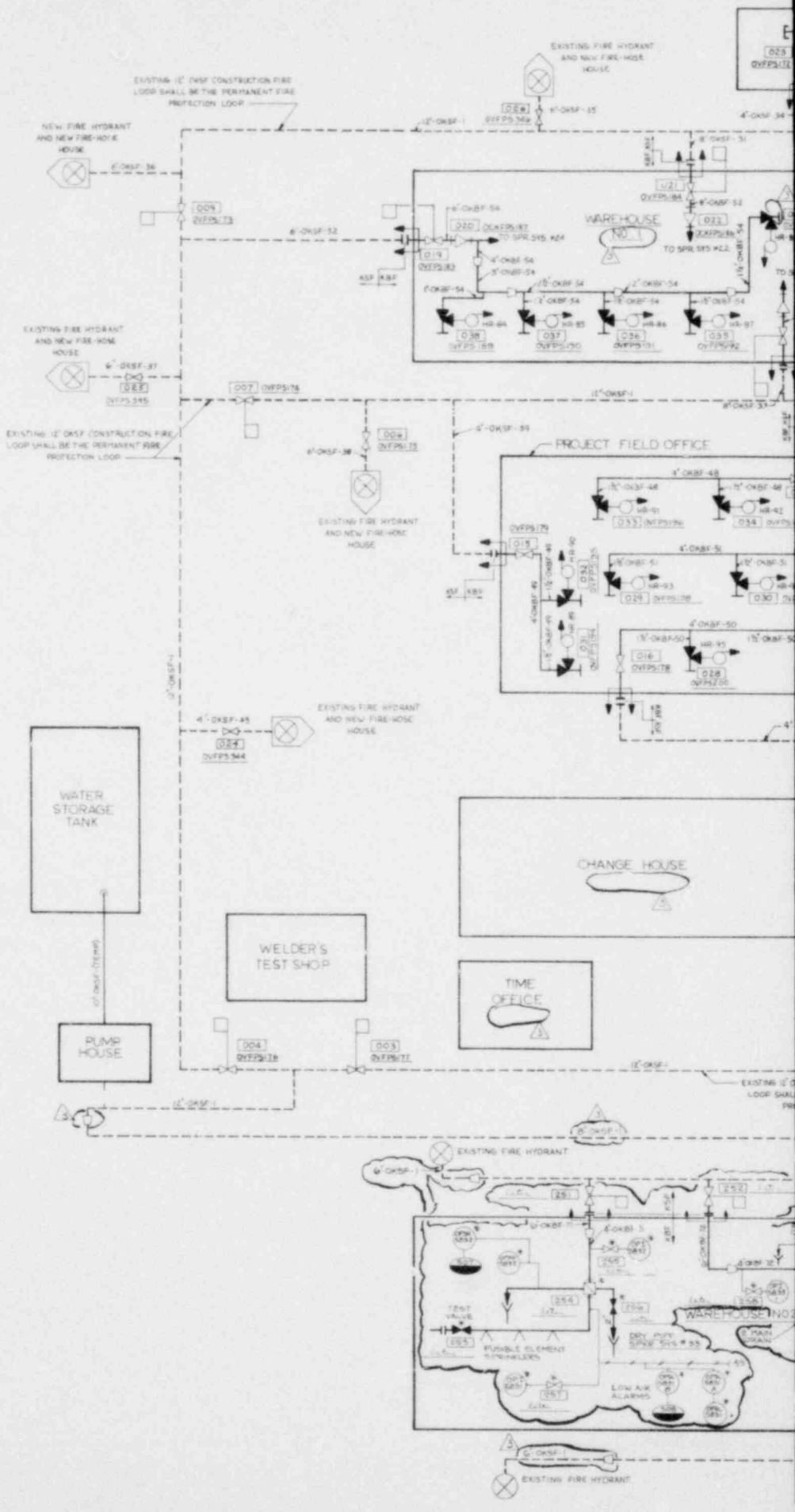
NOTES

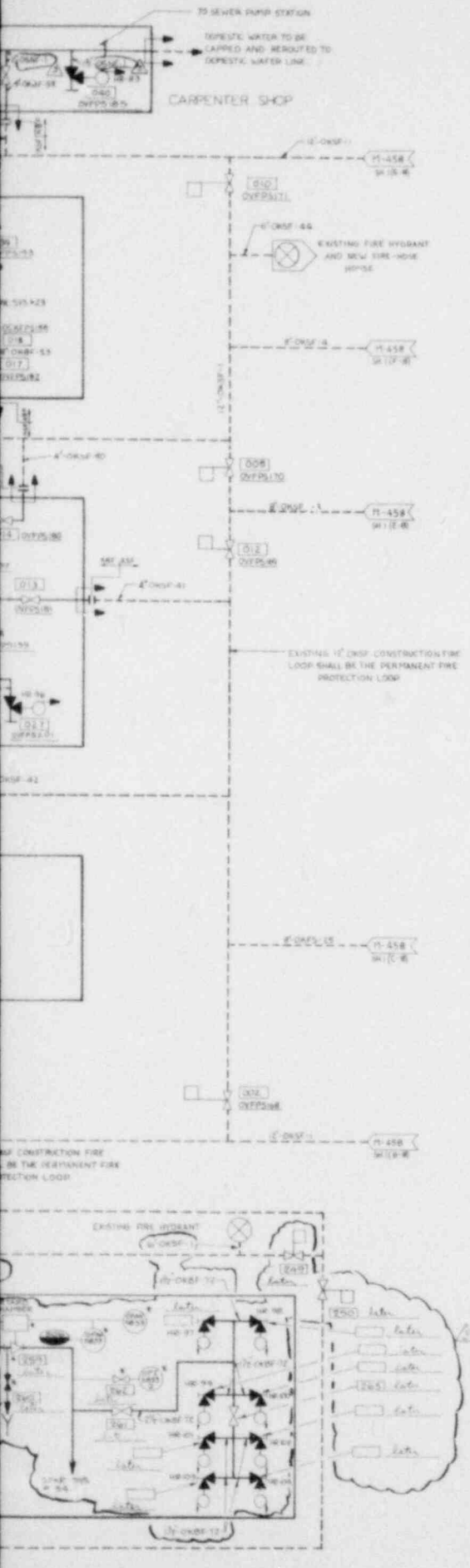
1. HOSE REEL NOS. 58, 60 ARE DELETED
2. BRONZE CHECK VALVES WITH 7/32 INCH ORIFICE DRILLED IN CLAPPER

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Fire Protection
(M-458 sh 1C, Rev 0)

FSAR Figure 9A-30, sh. 3


EXISTING FIRE HYDRANT AND NEW FIRE-HOSE HOUSE
EXISTING 12" OKSF CONSTRUCTION FIRE LOOP SHALL BE THE PERMANENT FIRE PROTECTION LOOP
NEW FIRE HYDRANT AND NEW FIRE-HOSE HOUSE
EXISTING FIRE HYDRANT AND NEW FIRE-HOSE HOUSE
WAREHOUSE NO. 1
PROJECT FIELD OFFICE
WATER STORAGE TANK
PUMP HOUSE
WELDER'S TEST SHOP
TIME OFFICE
CHANGE HOUSE
EXISTING FIRE HYDRANT
WAREHOUSE NO.2
TEST VALVE
FUSIBLE ELEMENT SPRINKLERS
DRY PIPE SPRINKLER SYS. # 55
LOW AIR ALARMS
MAIN DRAIN
EXISTING FIRE HYDRANT

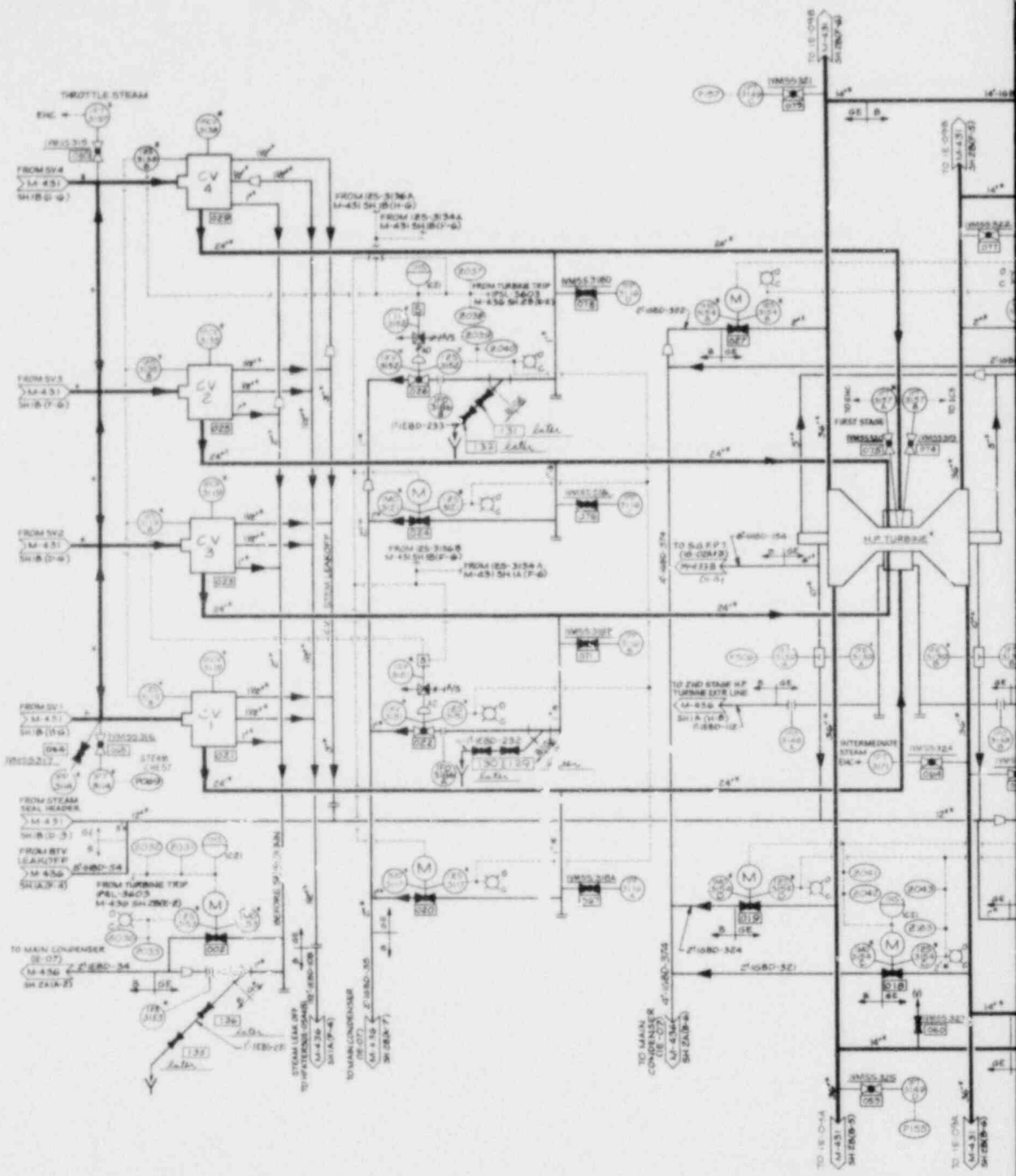


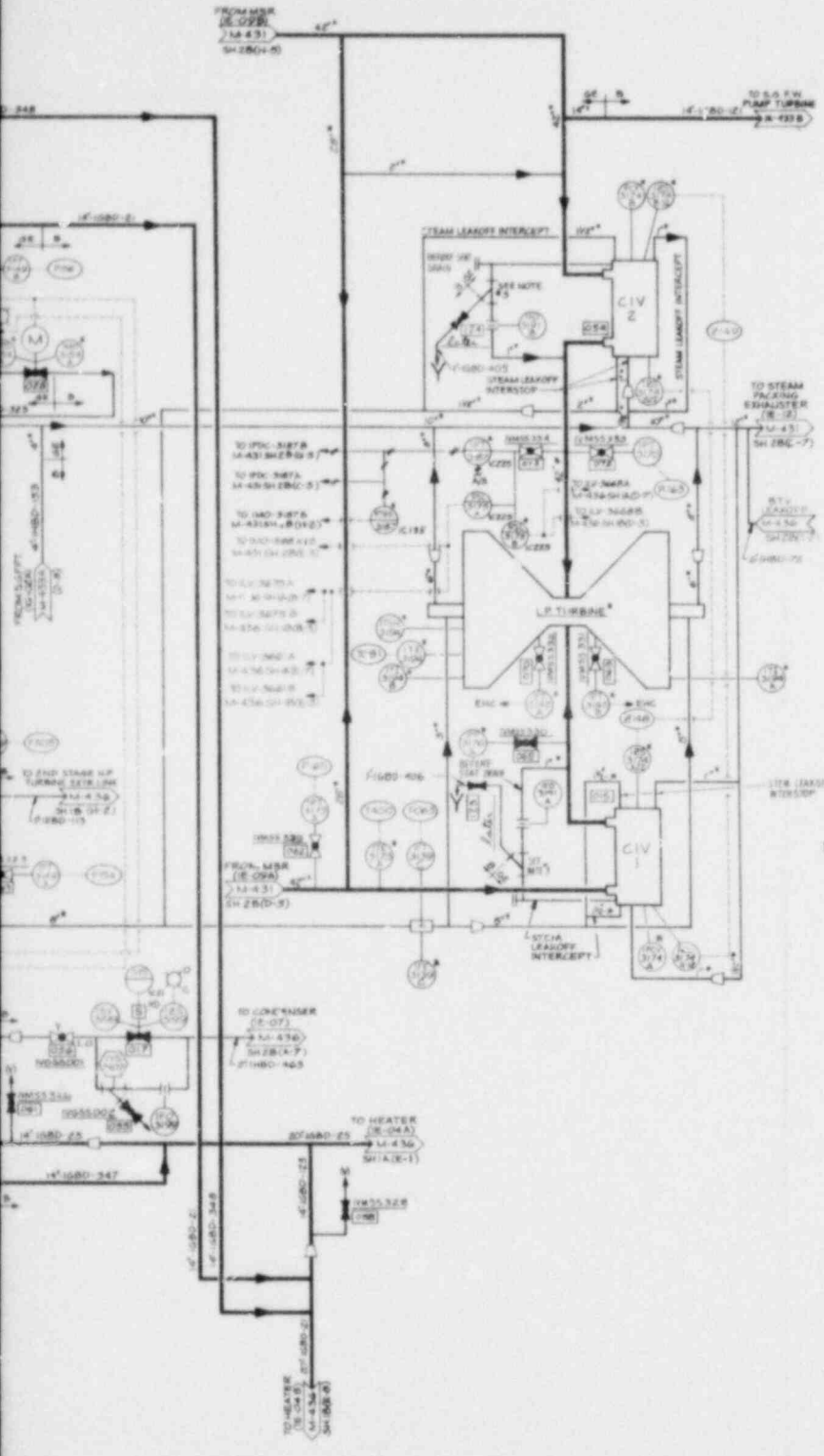
NOTES:
1. FOR DETAILS AND TABLE FOR SPRAY SYSTEMS #2,23,24 SEE M-458 SH 1C

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Fire Protection
(M-458 sh 2, Rev 3)

FSAR Figure 9A-30, sh. 4


THROTTLE STEAM
FROM SV4
FROM SV3
FROM SV2
FROM SV1
CV 4
CV 3
CV 2
CV 1
H.P. TURBINE
FIRST STAGE
INTERMEDIATE STEAM
FROM STEAM SEAL HEADER
FROM BTV LEAKOFF
TO MAIN CONDENSER
TO 2ND STAGE H.P. TURBINE EXTR LINE
TO G.S.F.P.T.
TO I.E. CHB
TO I.E. CHA

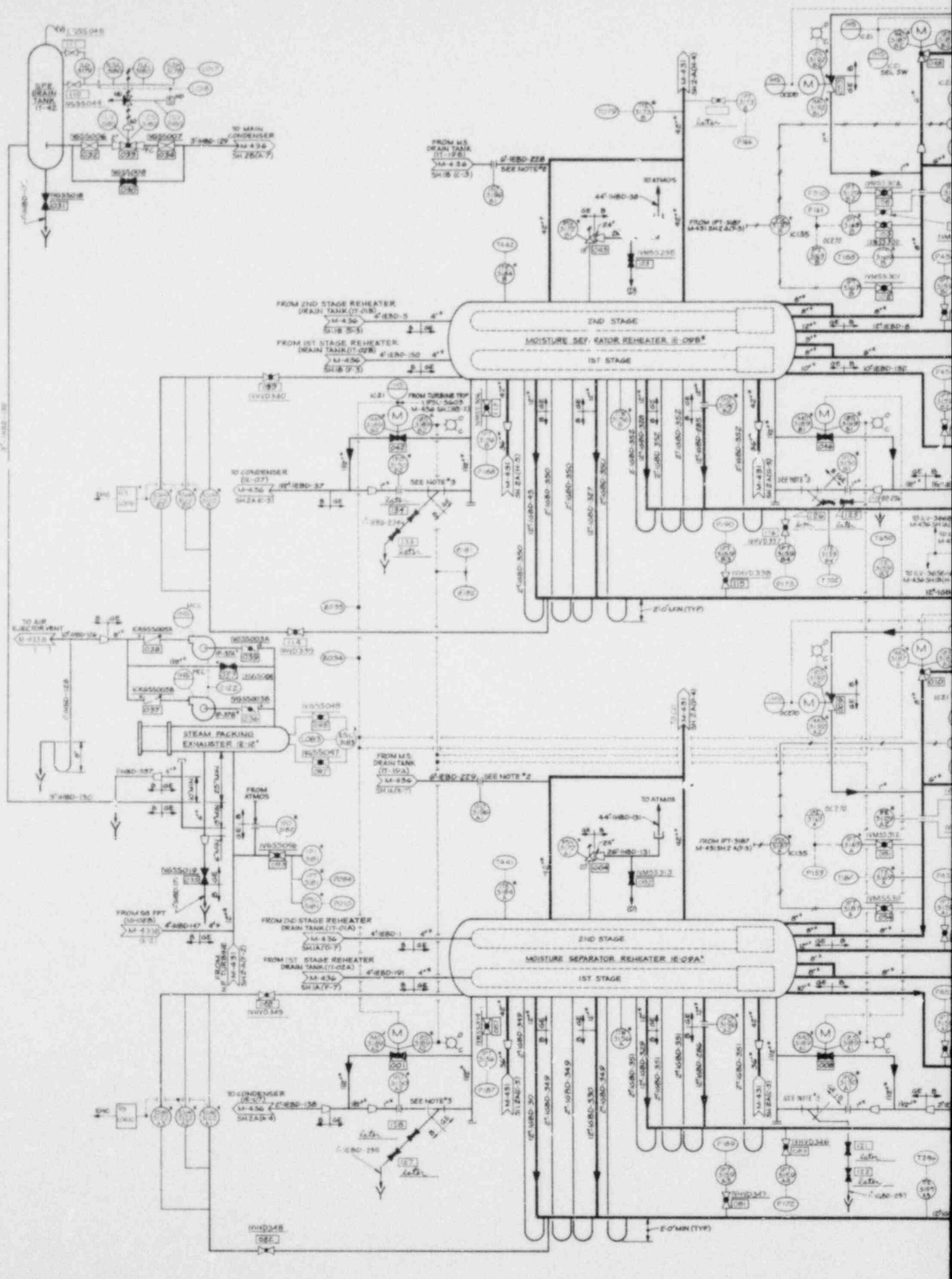


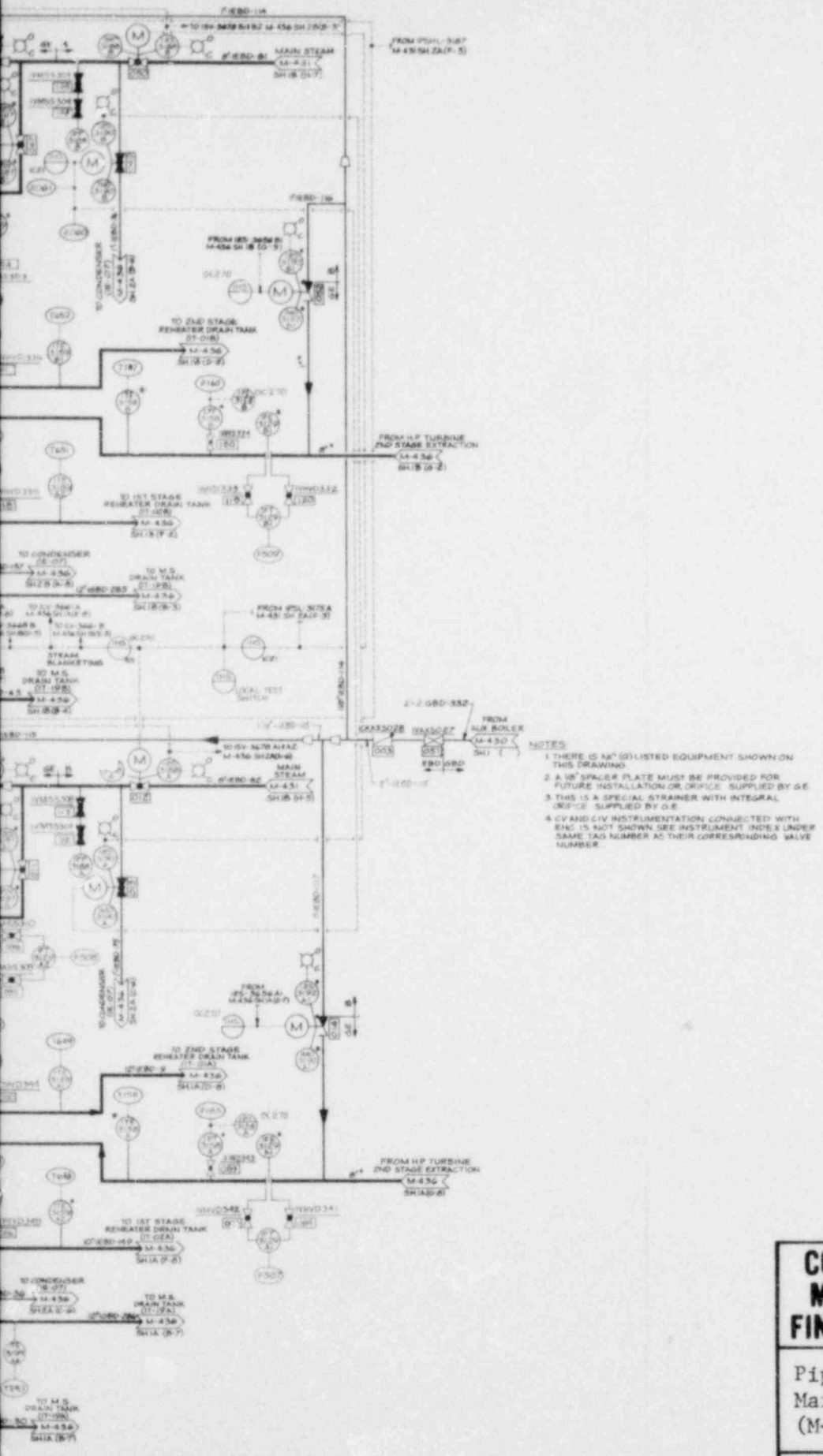
NOTES:
1. THERE IS NO (0) LISTED EQUIPMENT SHOWN ON THIS DRAWING.
2. A 1/8" SPACER PLATE MUST BE PROVIDED FOR FUTURE INSTALLATION OF ORIFICE AS REQUIRED BY G.E.
3. THIS IS A SPECIAL STRAINER WITH INTEGRAL ORIFICE SUPPLIED BY G.E.
4. CV AND CIV INSTRUMENTATION CONNECTED WITH EHC IS NOT SHOWN. SEE INSTRUMENT INDEX UNDER SAME TAG NUMBER AS THEIR CORRESPONDING VALVE NUMBER.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Piping and Instrument Diagram
Main Steam & Turbine Steam Unit 1
(M-431, Sh 2A, Rev 0)

FSAR Figure 10.3-2, sh. 1

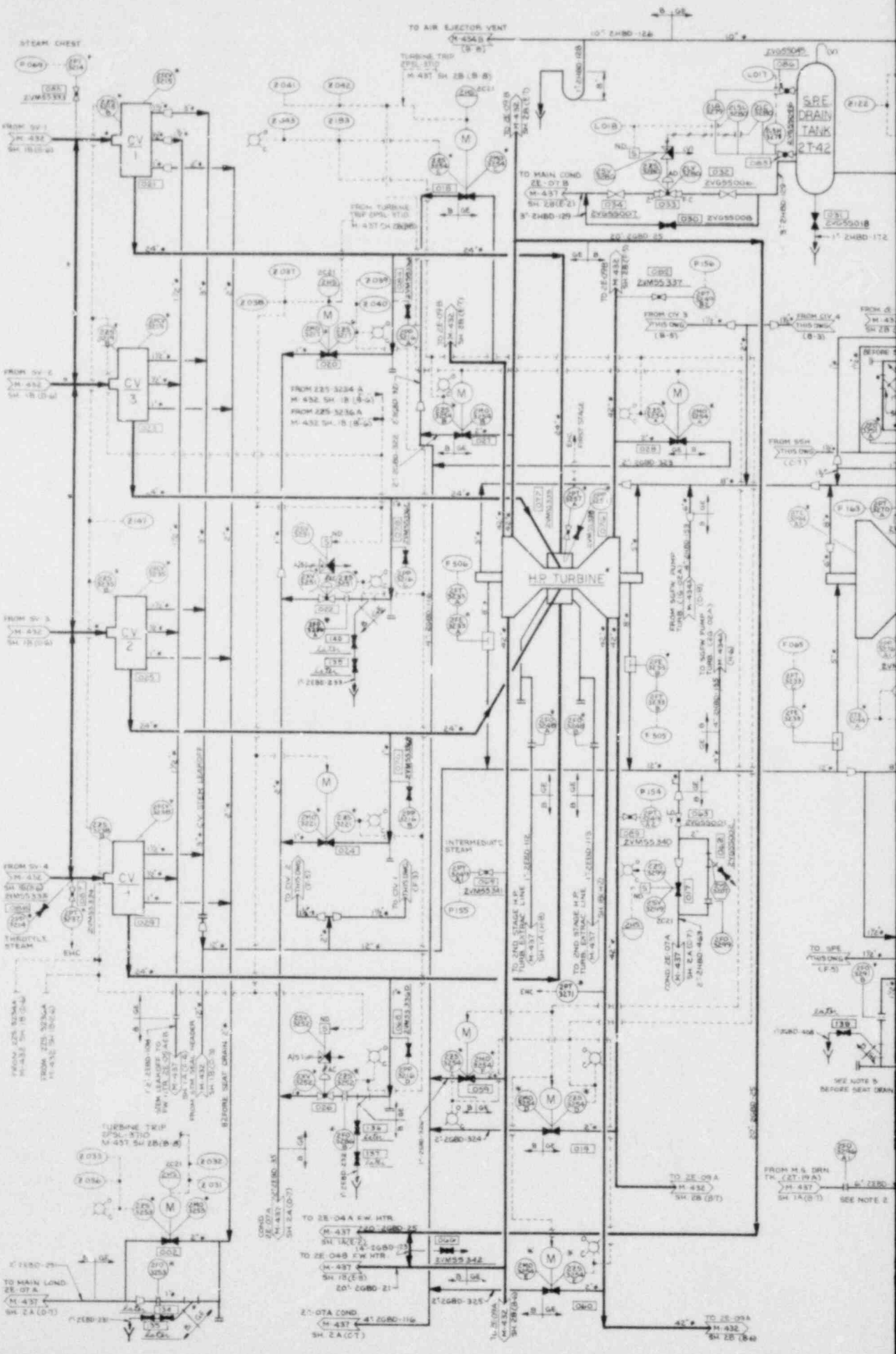

S/E DRAIN TANK (T-42)
TO MAIN CONDENSER
FROM M.S. DRAIN TANK (T-19B)
TO ATMOS
FROM IPT-3&6
2ND STAGE
MOISTURE SEPARATOR REHEATER (E-09B)
1ST STAGE
FROM 2ND STAGE REHEATER DRAIN TANK (T-01B)
FROM 1ST STAGE REHEATER DRAIN TANK (T-02B)
TO CONDENSER
SEE NOTE #3
TO AIR EJECTOR VENT
STEAM PACKING EXHAUSTER (E-16)
FROM TURBINE
FROM 2ND STAGE REHEATER DRAIN TANK (T-01A)
FROM 1ST STAGE REHEATER DRAIN TANK (T-02A)
2ND STAGE
MOISTURE SEPARATOR REHEATER (E-09A)
1ST STAGE
E-0" MIN (TYP)

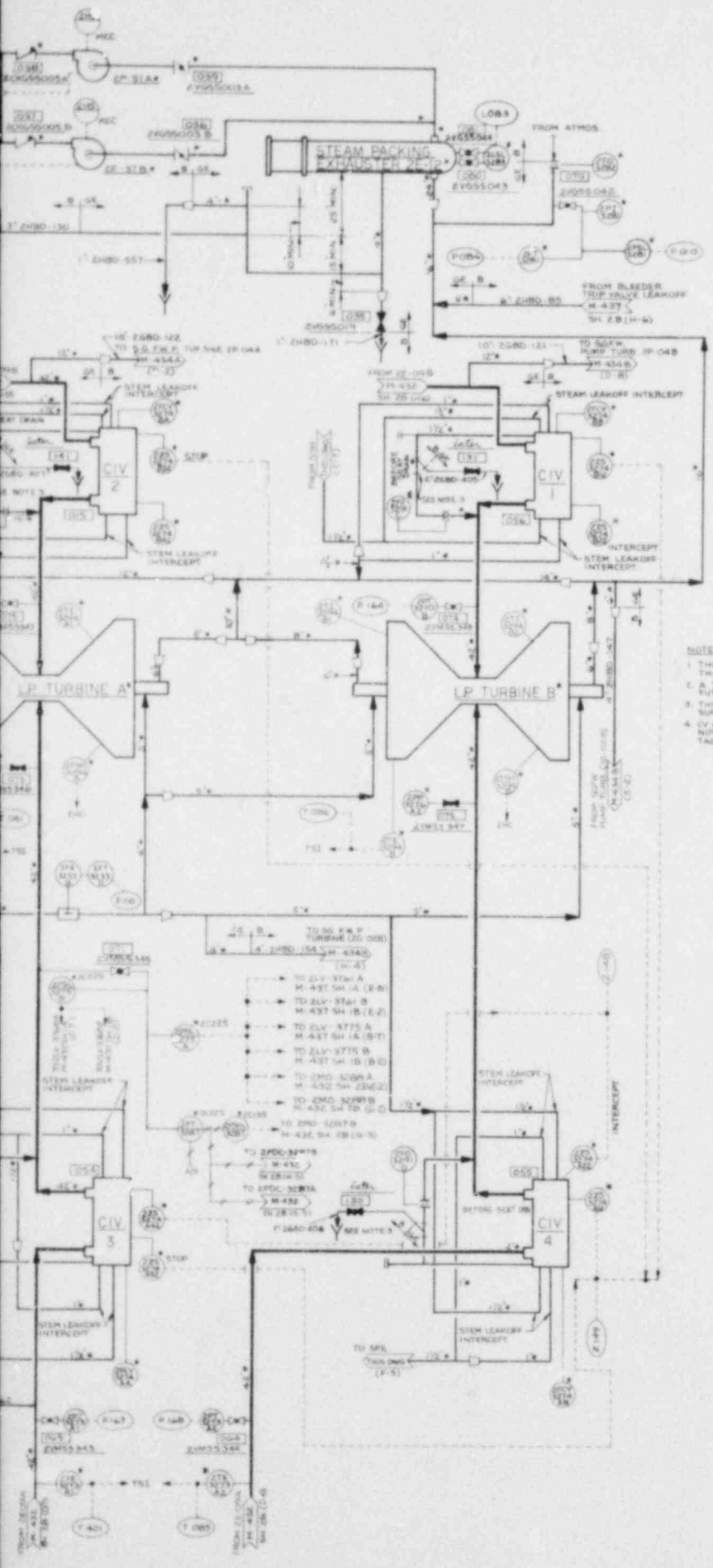


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Piping and Instrument Diagram
Main Steam & Turbine Steam Unit 1
(M-431 sh 2B, Rev 0)

FSAR Figure 10.3-2, sh. 2


STEAM CHEST
TO AIR EJECTOR VENT
S.R.E. DRAIN TANK 2T-42
H.P. TURBINE
CV 1
CV 2
CV 3
CV 4
FROM SV-1
FROM SV-2
FROM SV-3
FROM SV-4
THROTTLE STEAM
EHC
INTERMEDIATE STEAM
TURBINE TRIP (OPEN STOP)
FROM TURBINE TRIP (OPEN STOP)
TO MAIN COND. 2E-07B
TO MAIN COND. 2E-07A
TO 2E-04A F.W. HTR.
TO 2E-04B F.W. HTR.
2T-07A COND.
TO 2E-09A
TO 2E-09B
FROM M.S. DRN. TK. (2T-19A)
SEE NOTE 2
SEE NOTE 5 BEFORE SEAT DRAIN



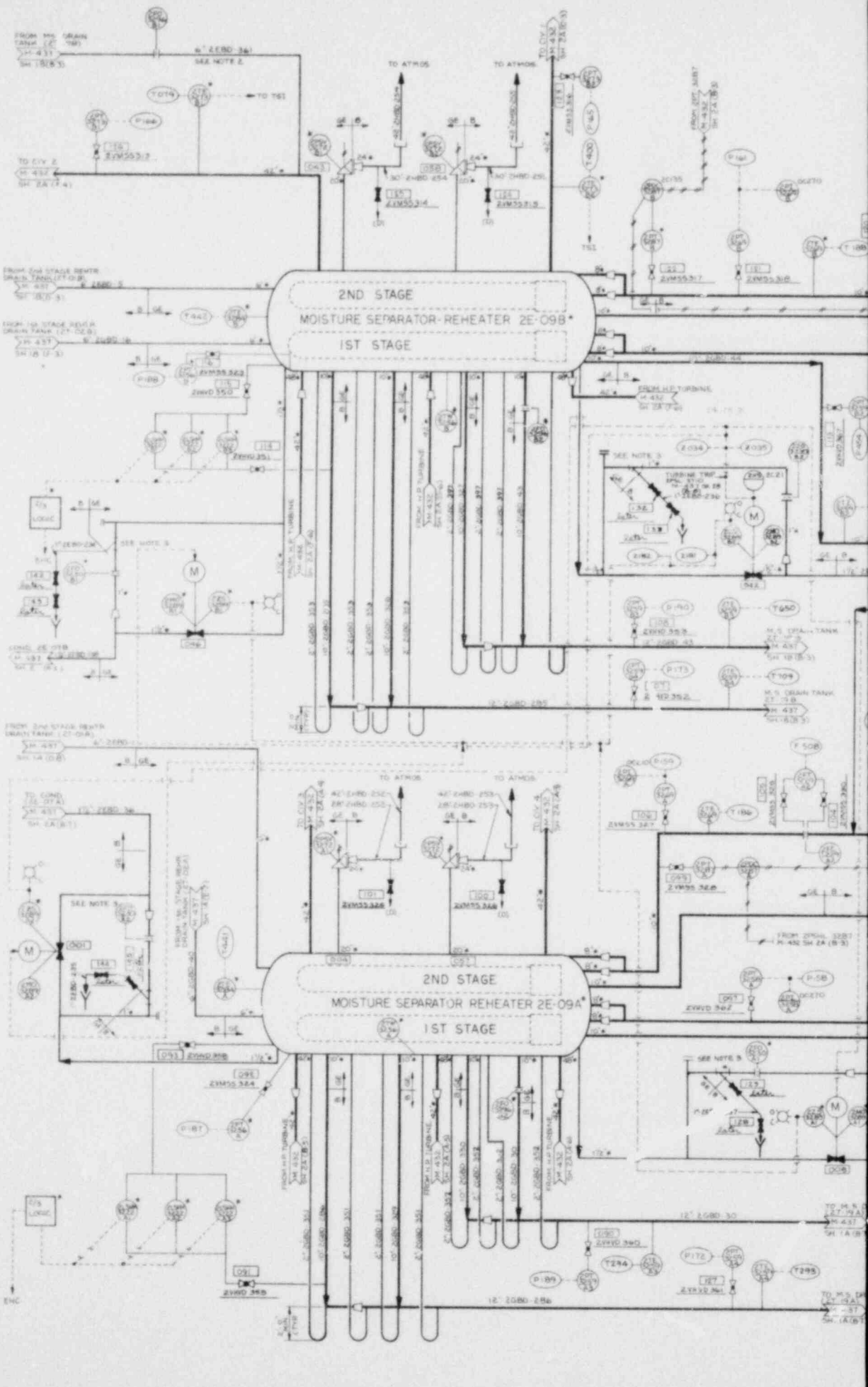
NOTES:

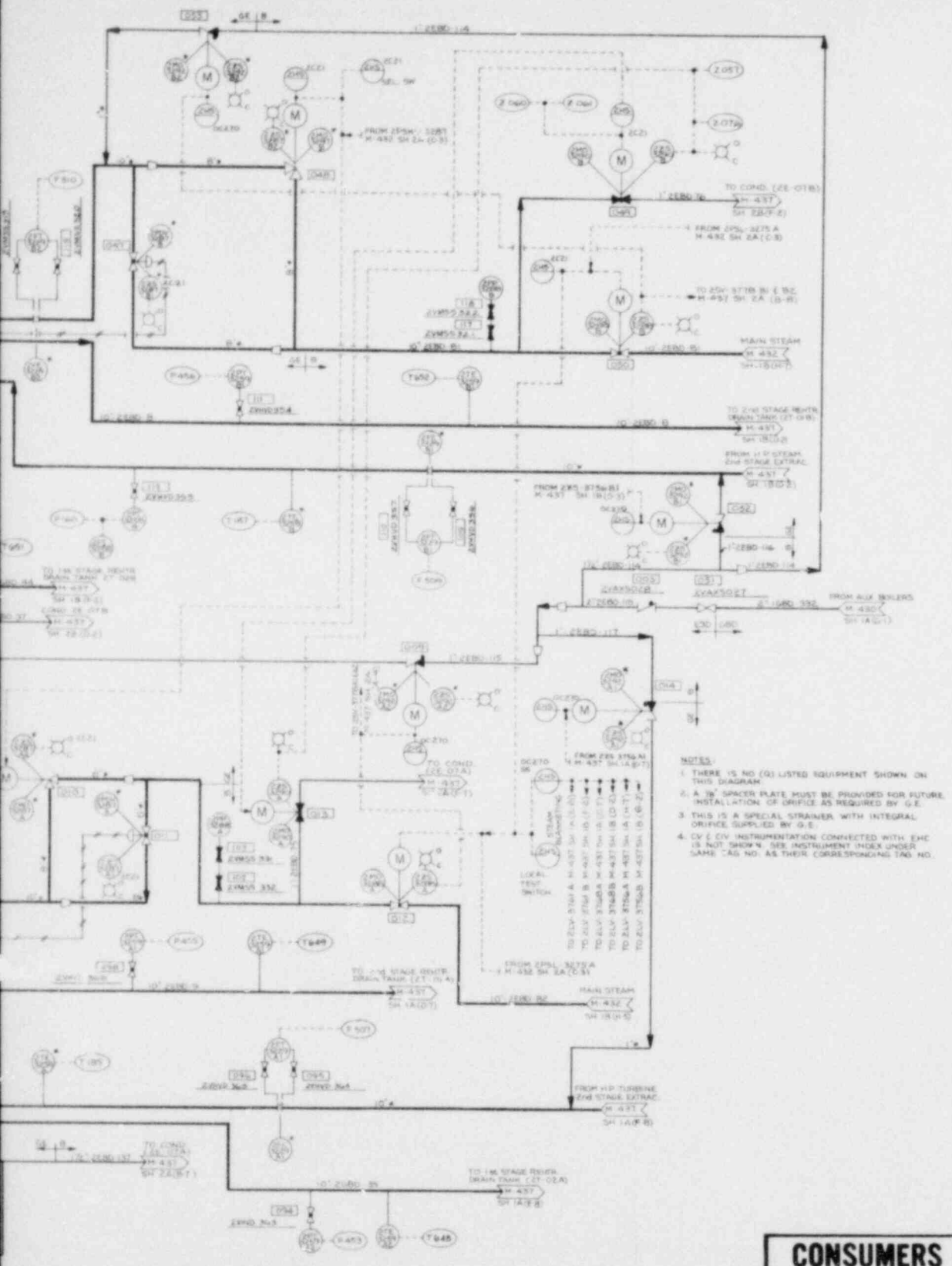
1. THERE IS NO (20) LISTED EQUIPMENT SHOWN ON THIS DIAGRAM.
2. A 1/8" ORIFICE PLATE MUST BE PROVIDED FOR FUTURE INSTALLATION OF ORIFICE AS REQUIRED BY G.E.
3. THIS IS A SPECIAL STRAINER WITH INTEGRAL ORIFICE SUPPLIED BY G.E.
4. CV & CIV INSTRUMENTATION CONNECTED WITH EHC IS NOT SHOWN. SEE INSTRUMENT INDEX UNDER SAME TAG NO. AS THEIR CORRESPONDING VALVE NO.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Main Steam & Turbine Steam Unit 2
(M-432 sh 2A, Rev 0)

FSAR Figure 10.3-4, sh. 1


2ND STAGE
MOISTURE SEPARATOR-REHEATER 2E-09B*
1ST STAGE
2ND STAGE
MOISTURE SEPARATOR REHEATER 2E-09A*
1ST STAGE
TO ATMOS
TO ATMOS
TO ATMOS
TO ATMOS
SEE NOTE 3
SEE NOTE 3
SEE NOTE 3
SEE NOTE 3
FROM H.P. TURBINE
FROM H.P. TURBINE
FROM H.P. TURBINE
FROM H.P. TURBINE
TO COND. 2E-01A
TO COND. 2E-01B
M.S. DRAIN TANK 2T-10A
M.S. DRAIN TANK 2T-10B
TO M.S. DRAIN TANK 2T-10A
TO M.S. DRAIN TANK 2T-10B
TO T.G.
TO T.G.
TO C.V. 2
TO C.V. 2
TO C.V. 3
TO C.V. 3
FROM 1st STAGE REHTR DRAIN TANK (2T-09B)
FROM 1st STAGE REHTR DRAIN TANK (2T-09A)
FROM M.S. DRAIN TANK 2T-10A
FROM M.S. DRAIN TANK 2T-10B
FROM 2nd STAGE REHTR DRAIN TANK (2T-09B)
FROM 2nd STAGE REHTR DRAIN TANK (2T-09A)
TO M.S. DRAIN TANK 2T-10A
TO M.S. DRAIN TANK 2T-10B
TO COND. 2E-01B
TO COND. 2E-01A
FROM LP TURBINE
FROM LP TURBINE
FROM LP TURBINE



CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Main Steam & Turbine Steam Unit 2
(M-432 sh 2B, Rev 0)

FSAR Figure 10.3-4, sh. 2

condensate storage tank is sized to accommodate the plant at hot shutdown for about 8 hours followed by a cooldown to 280F.

SAFETY EVALUATION TWO - The auxiliary feedwater system provides redundant and diverse means of supplying feedwater to the steam generators for cooling the reactor coolant system under emergency conditions. Either pump has the capability of supplying 100% of the feedwater requirements for safe cooldown of the reactor coolant system. The auxiliary feedwater system can perform its safety-related function assuming any single active component failure coincident with loss of offsite power.

The pump discharges are cross-connected through two normally open, remote manually actuated isolation valves. Complete physical and electrical separation is maintained throughout the pump controls, control signals, electrical power supplies, and instrumentation for each auxiliary feedwater pump.

SAFETY EVALUATION THREE - Instrumentation and controls are provided which enable operation of the pumps at the auxiliary shutdown panel in the event of evacuation of the control room. Instruments provided at the auxiliary shutdown panel are described in Subsection 7.4.3. The auxiliary feedwater controls are discussed in Subsection 7.4.1.1.1.

SAFETY EVALUATION FOUR - The auxiliary feedwater system, including the two sources from the essential service water system, is designed to Seismic Category I requirements.

The auxiliary feedwater pumps take emergency suction from two sources. The normal source is the nonseismic Category I condensate storage tank. In the case of unavailability of this source, water can be supplied from the Seismic Category I service water system to the auxiliary feedwater system through two separate trains. Each service water system train is isolated from the other so that failure of one does not affect the other. Each service water line is also isolated by manually operated isolation valves from the nonseismic Category I piping leading to the condensate storage tank and the condenser hotwell. Check valves are also provided to prevent backflow to the condenser hotwell or condensate storage tank.

If the condensate storage tank is not available due to a tornado or seismic event, the operator is notified by low-pressure alarms on the pump suction, and provisions are provided for switchover to the Seismic Category I tornado protected service water system. 3

SAFETY EVALUATION FIVE - Diversity is provided in the type and number of pumps, sources of water supply, power supplies, and

arrangement of piping and pump and valve controls, so that any single failure will not negate the auxiliary feedwater system's ability to perform its safety function. The features which provide this capability are detailed in Subsections 10.4.9.2.2 and 7.3.3. The motor driven pump and associated equipment are powered by Class 1E ac power supplies as discussed in Subsection 8.3.1. The turbine driven pump receives steam from either or both main steam lines prior to exiting the containment. Valves (except control valves) and controls necessary for the function of the turbine driven pump and its associated equipment are energized by Class 1E dc power supplies.

SAFETY EVALUATION SIX - The auxiliary feedwater system is designed to avoid the effects of hydraulic instability (water hammer).

10.4.9.4 Test and Inspections

Each of the auxiliary feedwater pumps is hydrostatically tested in accordance with the requirements of ASME Section III, Class 3. The turbine driver is given a hydrostatic test, a mechanical running test, and an overspeed trip test prior to shipment.

The wall thicknesses of pressure boundary castings of the pumps, turbines, trip and throttle valve, and governor valve are checked and recorded by the manufacturer. The entire auxiliary feedwater system is hydrostatically tested after assembly is completed. Preoperational testing of the auxiliary feedwater system is described in Chapter 14.

The auxiliary feedwater pumps will be tested periodically during plant operation as described in Subsection 16.3/4.7.1.2. The discharge flowpath will be via the recirculating piping back to the condensate storage tank, or to the cooling pond, depending on the suction source. 27

10.4.9.5 Instrumentation Applications

Safety-related display instrumentation related to the auxiliary feedwater system is discussed in Section 7.5. Information indicative of the readiness of the auxiliary feedwater system prior to operation and the status of active components during system operation is displayed for the operator in the main control room.

Equipment which has built-in bypasses for operators' use is monitored by a status light which is illuminated to indicate availability of that component. Should the component be deliberately bypassed (e.g., by switchgear breaker racked out or in test or fuses pulled, etc), it is indicated by an extinguished lamp. This indication satisfies the bypass indication requirement of Regulatory Guide 1.47 as discussed in Appendix 3A.

Indication is provided in the control room and on the auxiliary shutdown panel for the following parameters:

a. Steam generator water level

b. Steam generator pressure

c. Auxiliary feedwater pump suction pressure

d. Motor (running/stopped)

e. Turbine (running/stopped)

f. Auxiliary feedwater pump discharge pressure

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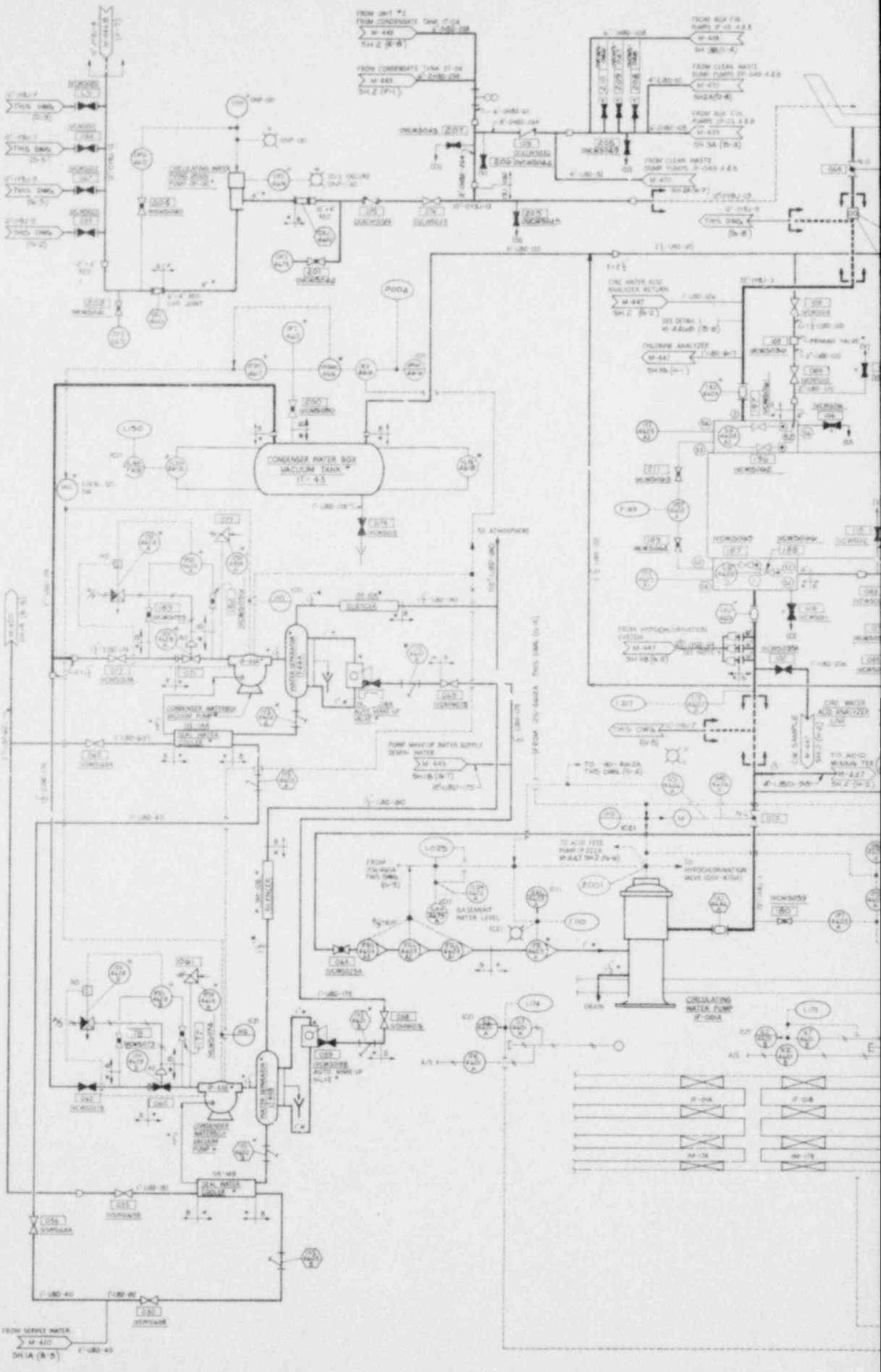
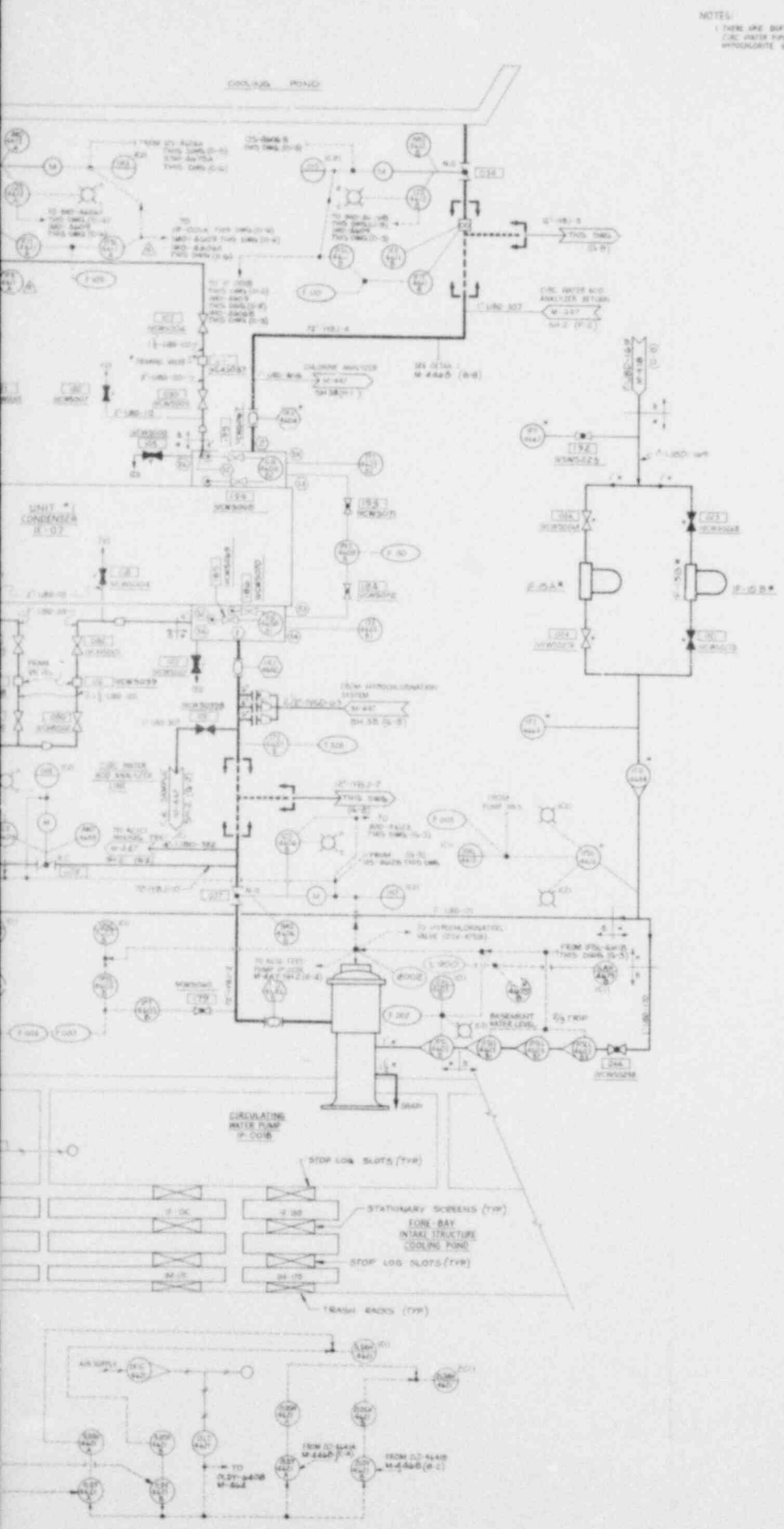
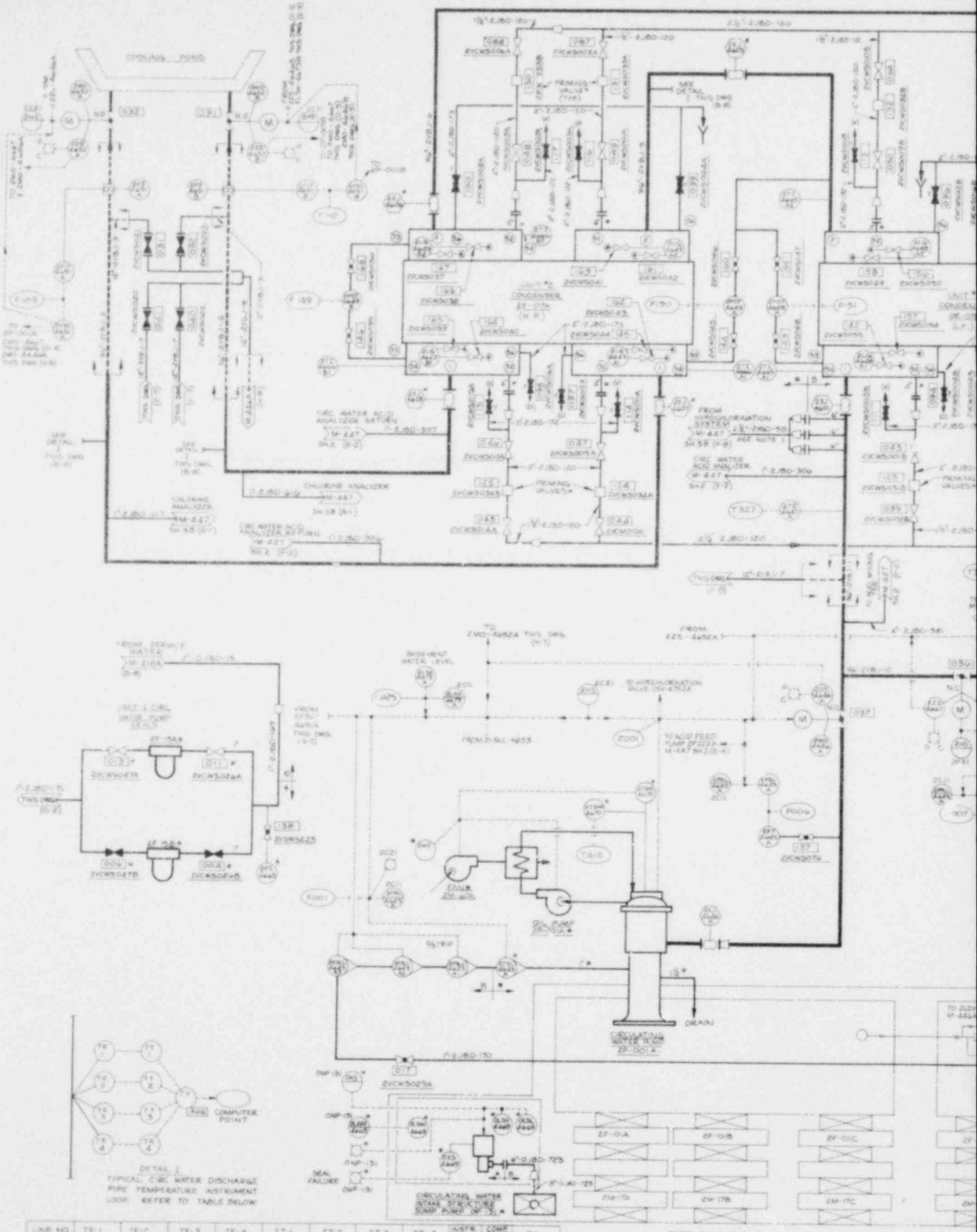

CONDENSER WATER BOX VACUUM TANK
TO ATMOSPHERE
TO HYPOCHLORINATION
CIRCULATING WATER PUMP
FROM SERVICE WATER



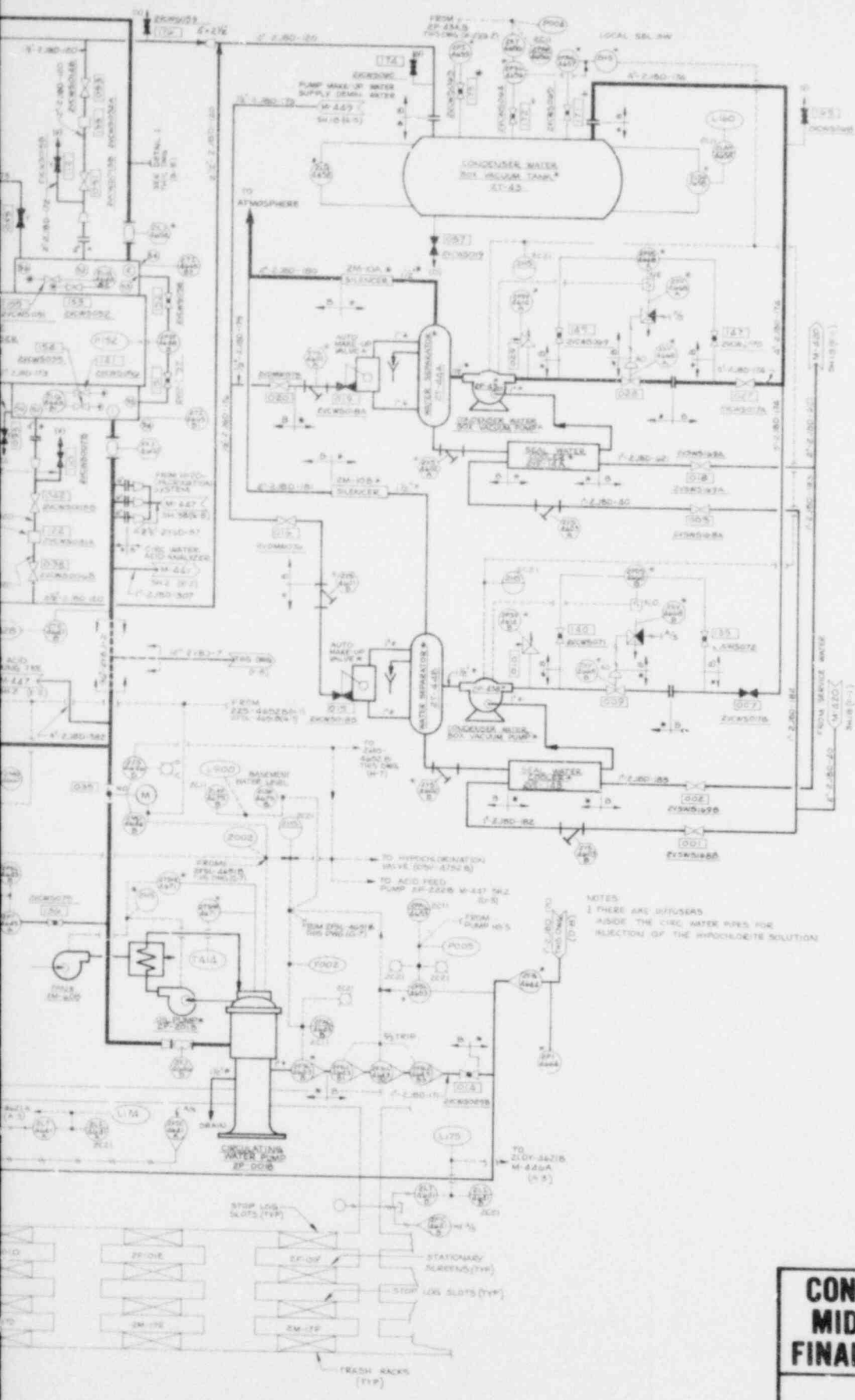
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Circulating Water Units 1 & 2
(M-446A, Rev 0)

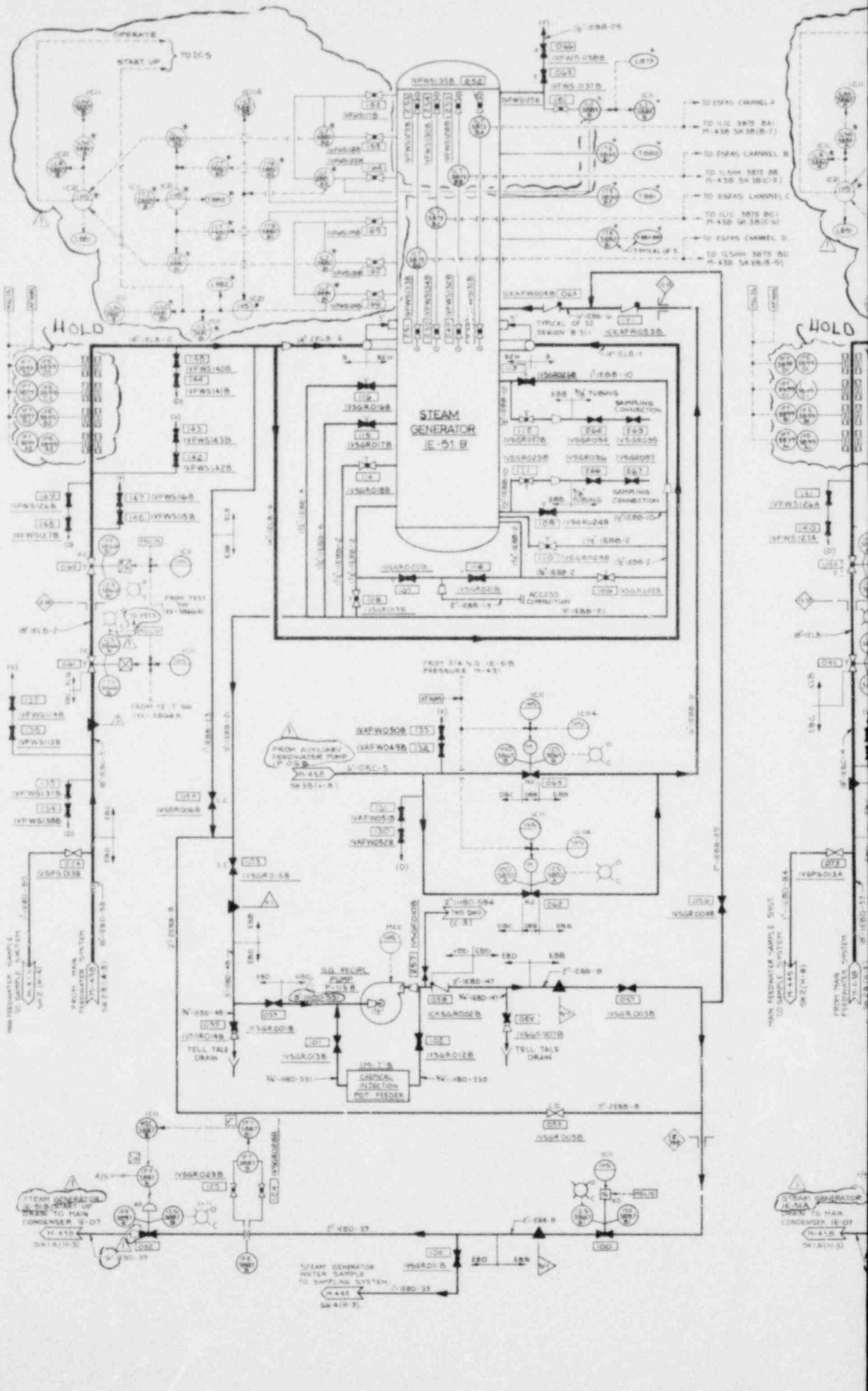
FSAR Figure 10.4-3, sh. 1

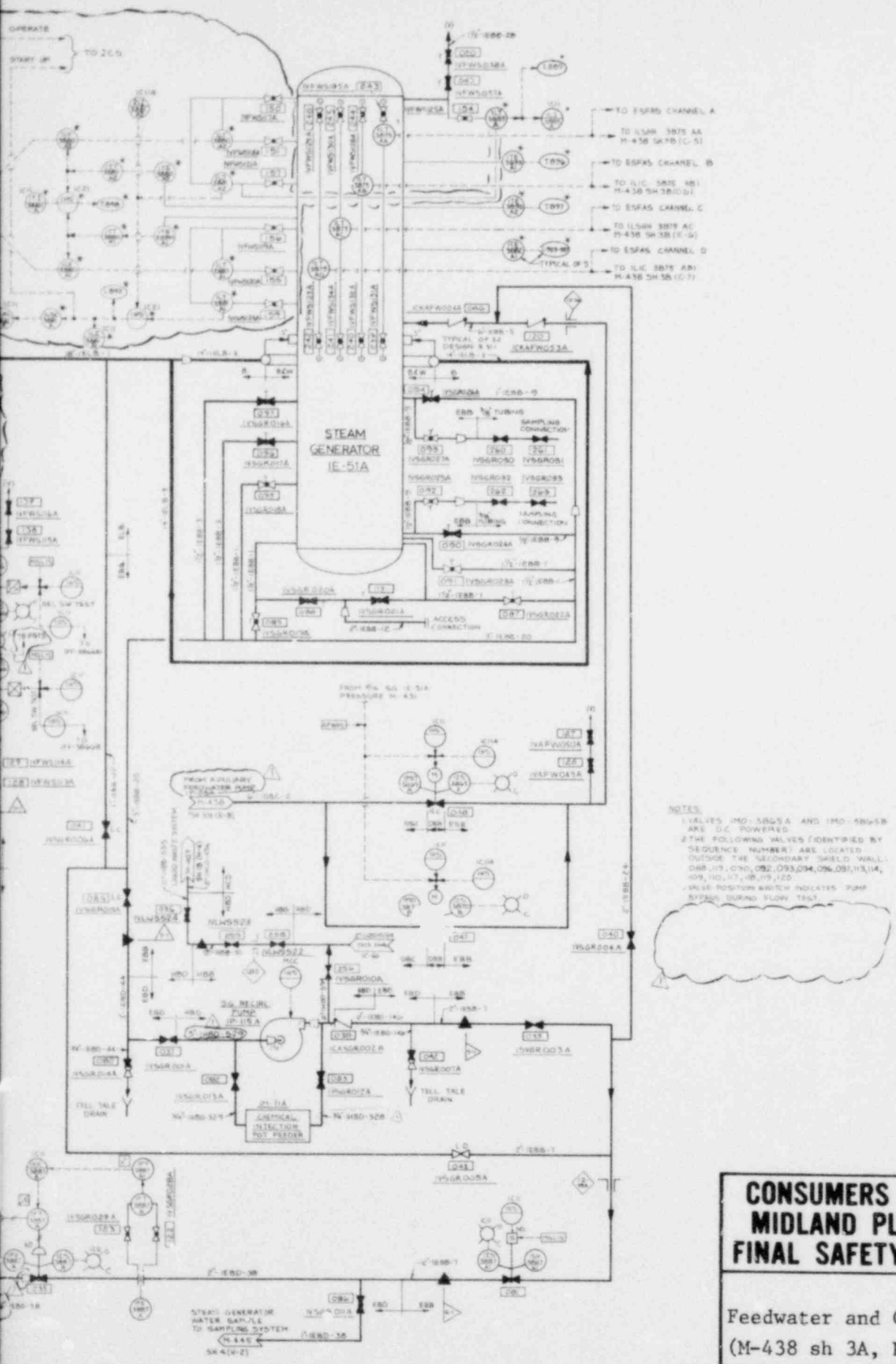


LINE NO.	TE-1	TE-2	TE-3	TE-4	TT-1	TT-2	TT-3	TT-4	MSTR. RACK NO.	COMP. POINT	TY
78"-SYB-J-3	ZTE-4401-A1	ZTE-4401-A2	ZTE-4401-A3	ZTE-4401-A4	ZTT-4401-A1	ZTT-4401-A2	ZTT-4401-A3	ZTT-4401-A4	IC53	T034	ITY-4401-A
72"-SYB-J-4	ZTE-4401-B1	ZTE-4401-B2	ZTE-4401-B3	ZTE-4401-B4	ZTT-4401-B1	ZTT-4401-B2	ZTT-4401-B3	ZTT-4401-B4	IC53	T035	ITY-4401-B
96"-SYB-J-3	ZTE-4651-A1	ZTE-4651-A2	ZTE-4651-A3	ZTE-4651-A4	ZTT-4651-A1	ZTT-4651-A2	ZTT-4651-A3	ZTT-4651-A4	IC53	T034	ZTY-4651-A
96"-SYB-J-4	ZTE-4651-B1	ZTE-4651-B2	ZTE-4651-B3	ZTE-4651-B4	ZTT-4651-B1	ZTT-4651-B2	ZTT-4651-B3	ZTT-4651-B4	IC55	T035	ZTY-4651-B
96"-SYB-J-5	ZTE-4650-A1	ZTE-4650-A2	ZTE-4650-A3	ZTE-4650-A4	ZTT-4650-A1	ZTT-4650-A2	ZTT-4650-A3	ZTT-4650-A4	IC53	T032	ZTY-4650-A
96"-SYB-J-6	ZTE-4650-B1	ZTE-4650-B2	ZTE-4650-B3	ZTE-4650-B4	ZTT-4650-B1	ZTT-4650-B2	ZTT-4650-B3	ZTT-4650-B4	IC53	T033	ZTY-4650-B



CONSUMERS POWER COMPANY MIDLAND PLANT UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Circulating Water Units 1 & 2 (M-446B, Rev 0)
FSAR Figure 10.4-3, sh. 2

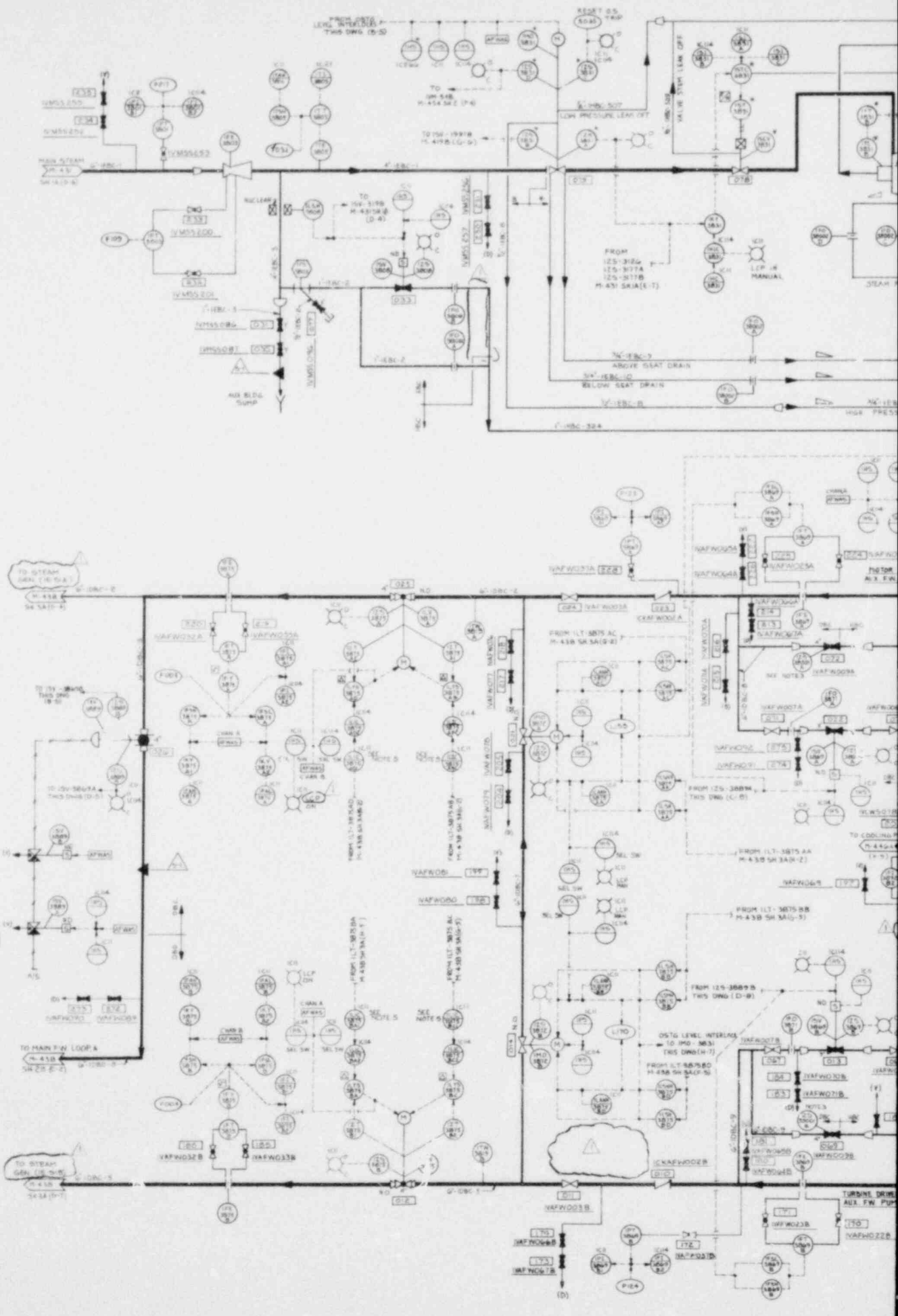

OPERATE
START UP
TO ICS
HOLD
STEAM GENERATOR IC-51 B
TO ESFAS CHANNEL A
TO ESFAS CHANNEL B
TO ESFAS CHANNEL C
TO ESFAS CHANNEL D
TYPICAL OF 5
TYPICAL OF 12
SAMPLING CONNECTION
ACCESS CONNECTION
FROM AUXILIARY FEEDWATER PUMP
FROM MAIN FEEDWATER SYSTEM
TELL TALE DRAIN
STEAM GENERATOR WATER SAMPLE TO SAMPLING SYSTEM
TO MAIN CONDENSER IE-07
HOLD

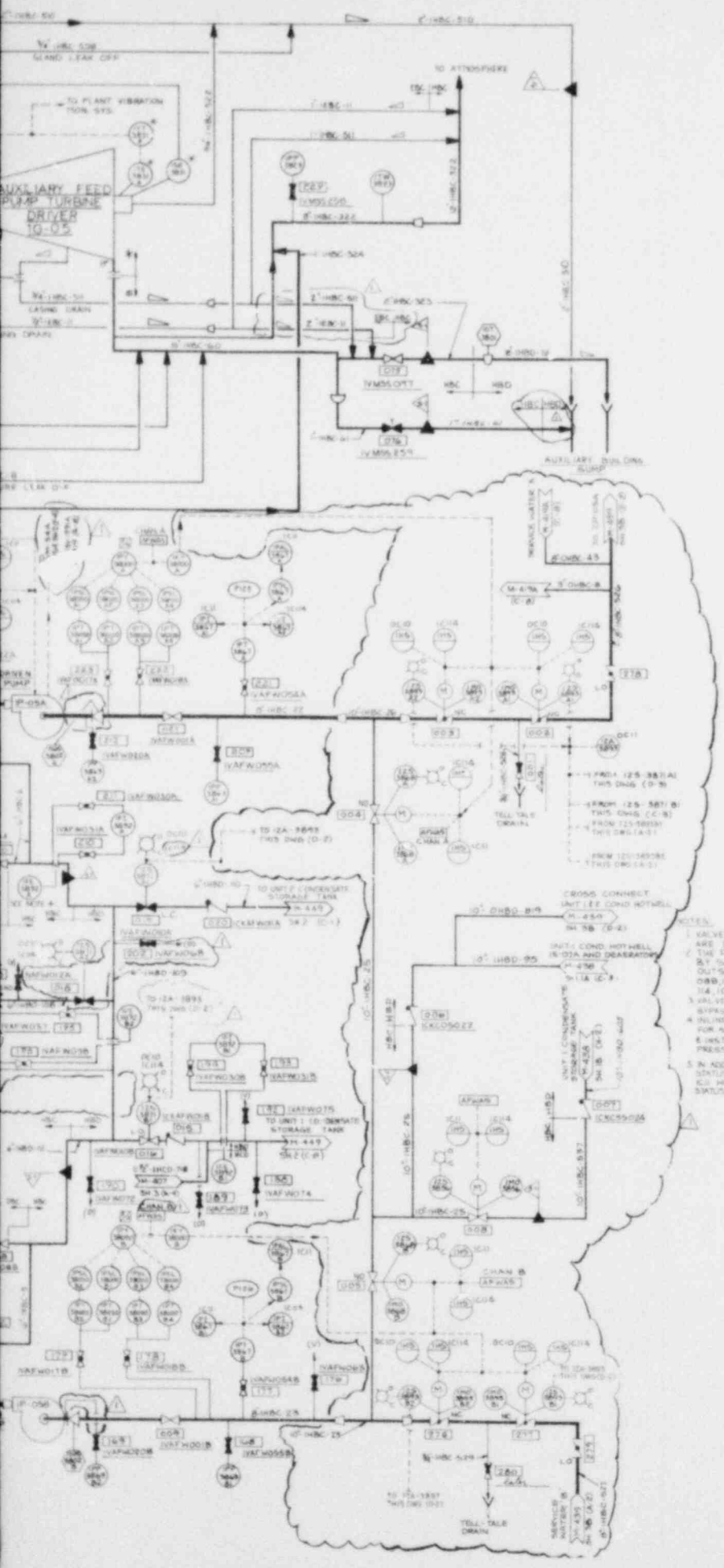


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Feedwater and Condensate - Unit 1
(M-438 sh 3A, Rev 1)

FSAR Figure 10.4-10, sh. 1

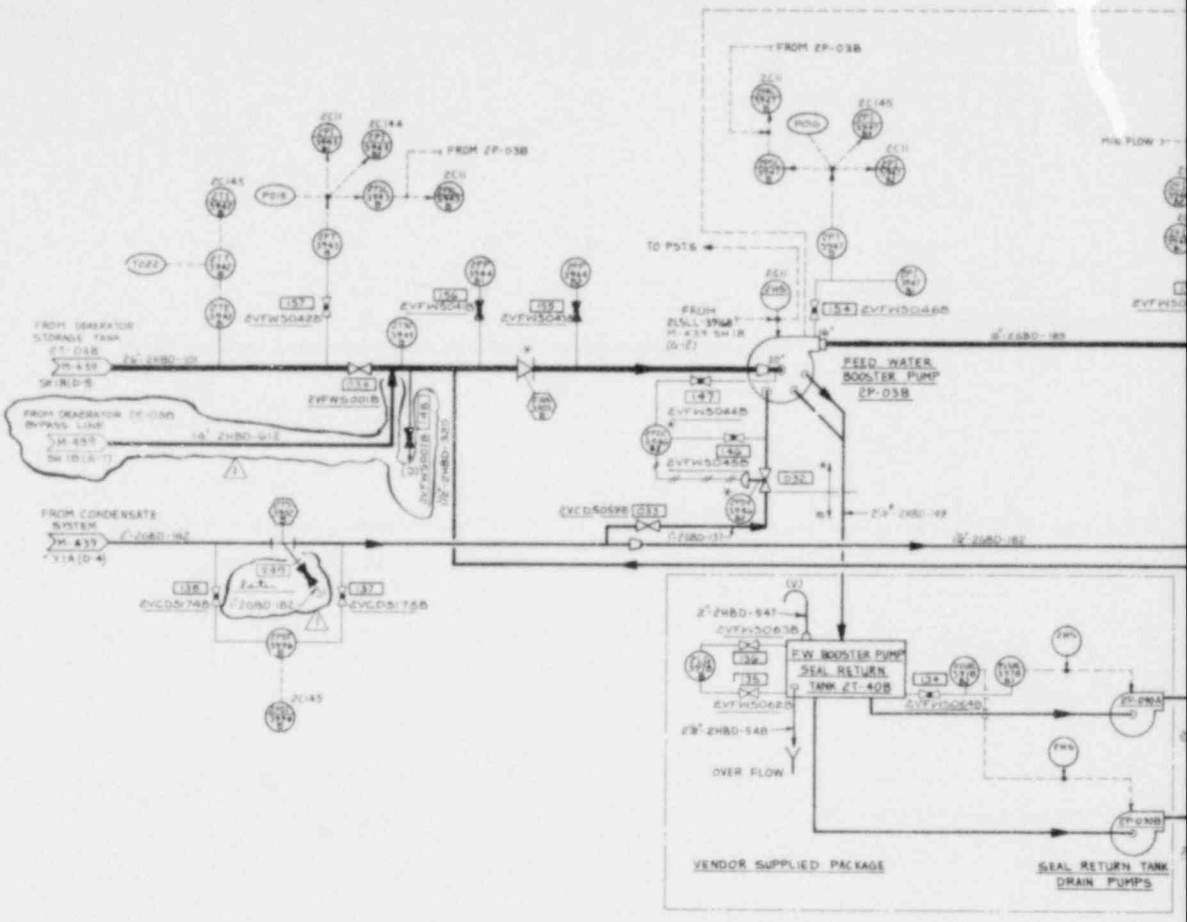


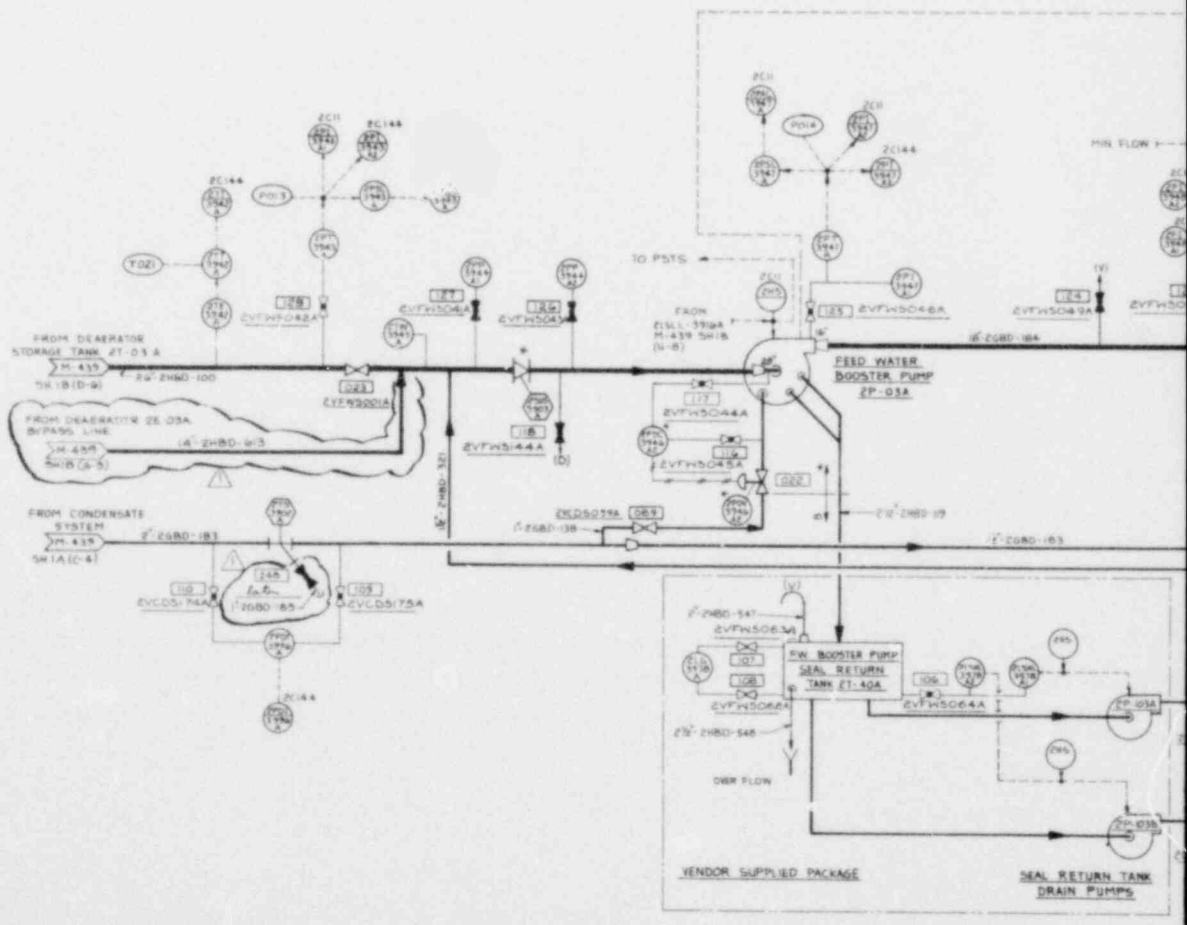


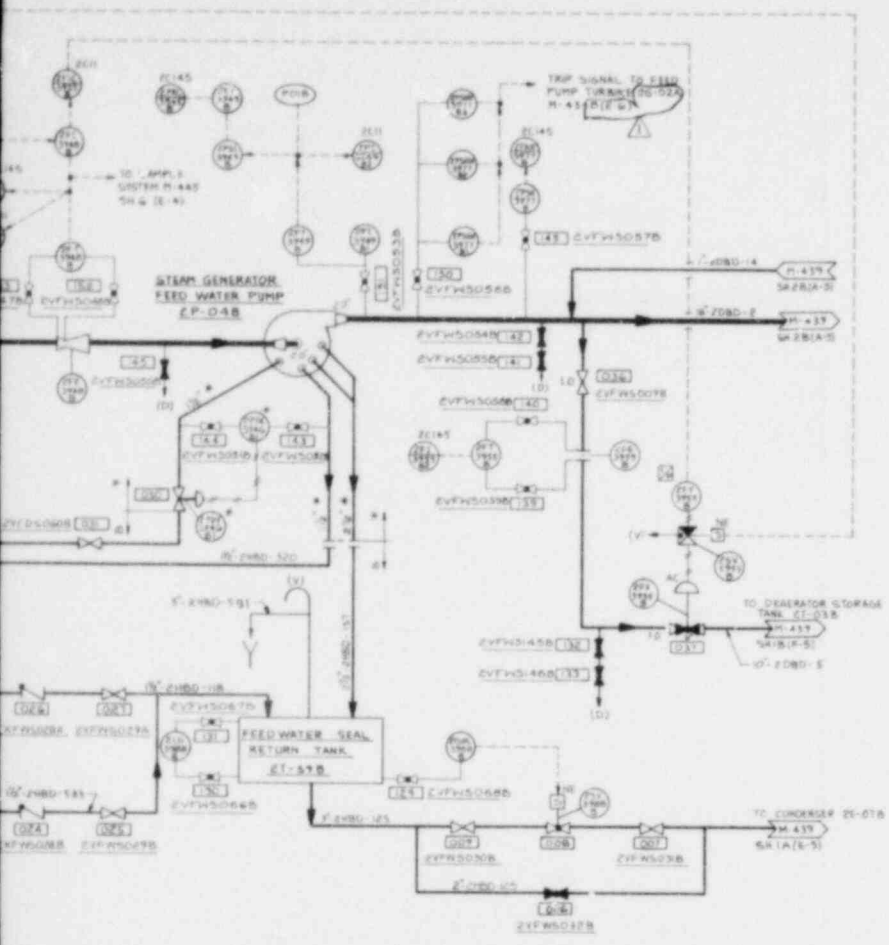
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

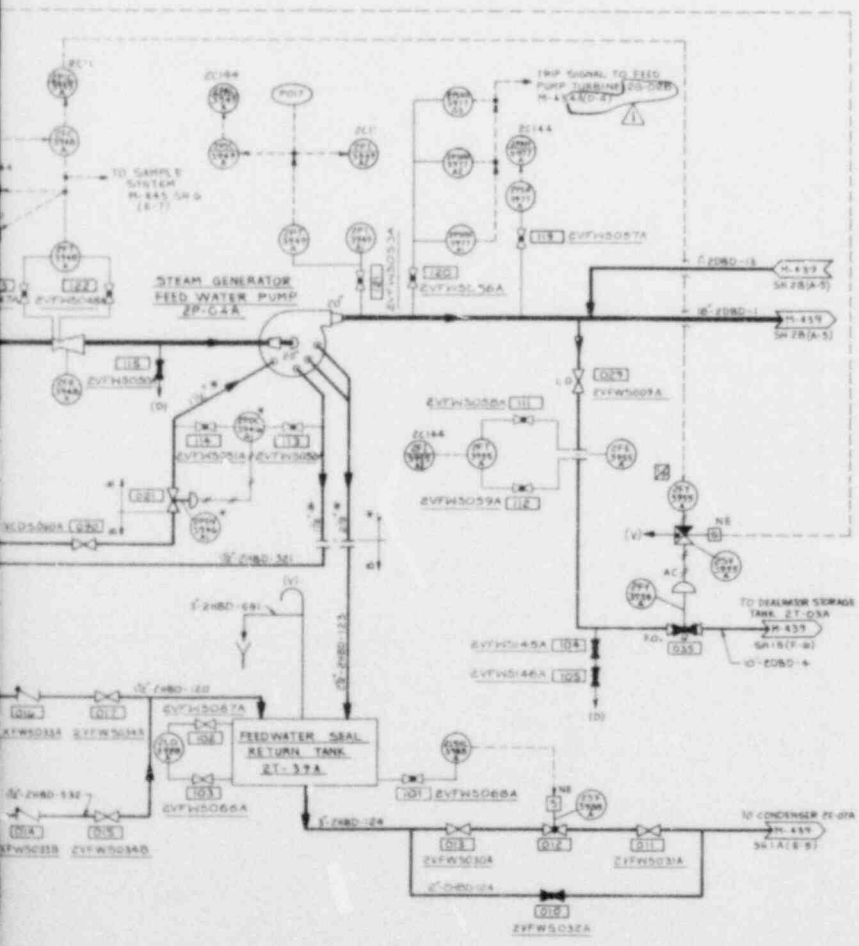
Feedwater and Condensate - Unit 1
(M-438 sh 3B, Rev 1)

FSAR Figure 10.4-10, sh. 2


FROM ZP-038
TO PSTS
FEED WATER BOOSTER PUMP ZP-038
FROM DEAERATOR STORAGE TANK ZT-038
FROM DEAERATOR ZE-035 BYPASS LINE
FROM CONDENSATE SYSTEM
FW BOOSTER PUMP SEAL RETURN TANK ZT-40B
OVER FLOW
VENDOR SUPPLIED PACKAGE
SEAL RETURN TANK DRAIN PUMPS


TO PSTS
FEED WATER BOOSTER PUMP ZP-03A
FROM DEAERATOR STORAGE TANK ZT-03A
FROM DEAERATOR ZE-03A BYPASS LINE
FROM CONDENSATE SYSTEM
FW BOOSTER PUMP SEAL RETURN TANK ZT-40A
OVER FLOW
VENDOR SUPPLIED PACKAGE
SEAL RETURN TANK DRAIN PUMPS



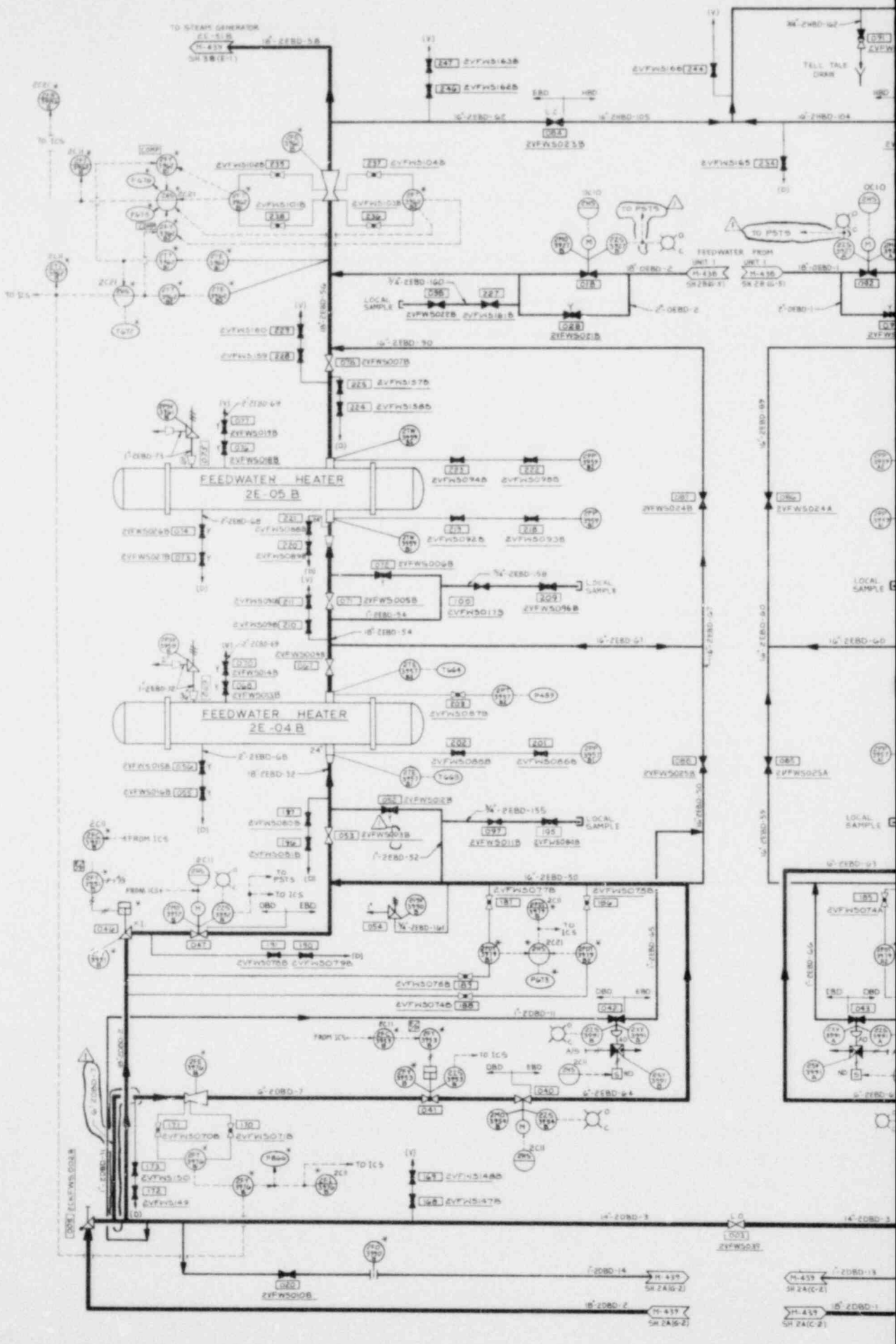


NOTE:
1. FIELD TO PROCURE AND ROUTE LINE 3"-2HBD-53 FROM FEEDWATER SEAL RETURN TANK VENTS TO DRAIN.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Feedwater & Condensate - Unit 2
(M-439 sh 2A, Rev 1)

FSAR Figure 10.4-12, sh. 1


FEEDWATER HEATER
2E-05 B
FEEDWATER HEATER
2E-04 B
TO STEAM GENERATOR
FEEDWATER FROM
UNIT 1
TO PST5
FROM ICS
TO ICS
LOCAL SAMPLE
TELL TALE DRAIN
ZVFW50238
ZVFW50228
ZVFW50218
ZVFW50078
ZVFW50058
ZVFW50038
ZVFW50018
ZVFW50248
ZVFW50258
ZVFW50778
ZVFW50758
ZVFW50738
ZVFW50718
ZVFW50698
ZVFW50678
ZVFW50658
ZVFW50638
ZVFW50948
ZVFW50928
ZVFW50908
ZVFW50888
ZVFW50868
ZVFW50848
ZVFW50828
ZVFW50808
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ZVFW50768
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ZVFW50688
ZVFW50668
ZVFW50648
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ZVFW50408
ZVFW50388
ZVFW50368
ZVFW50348
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ZVFW50308
ZVFW50288
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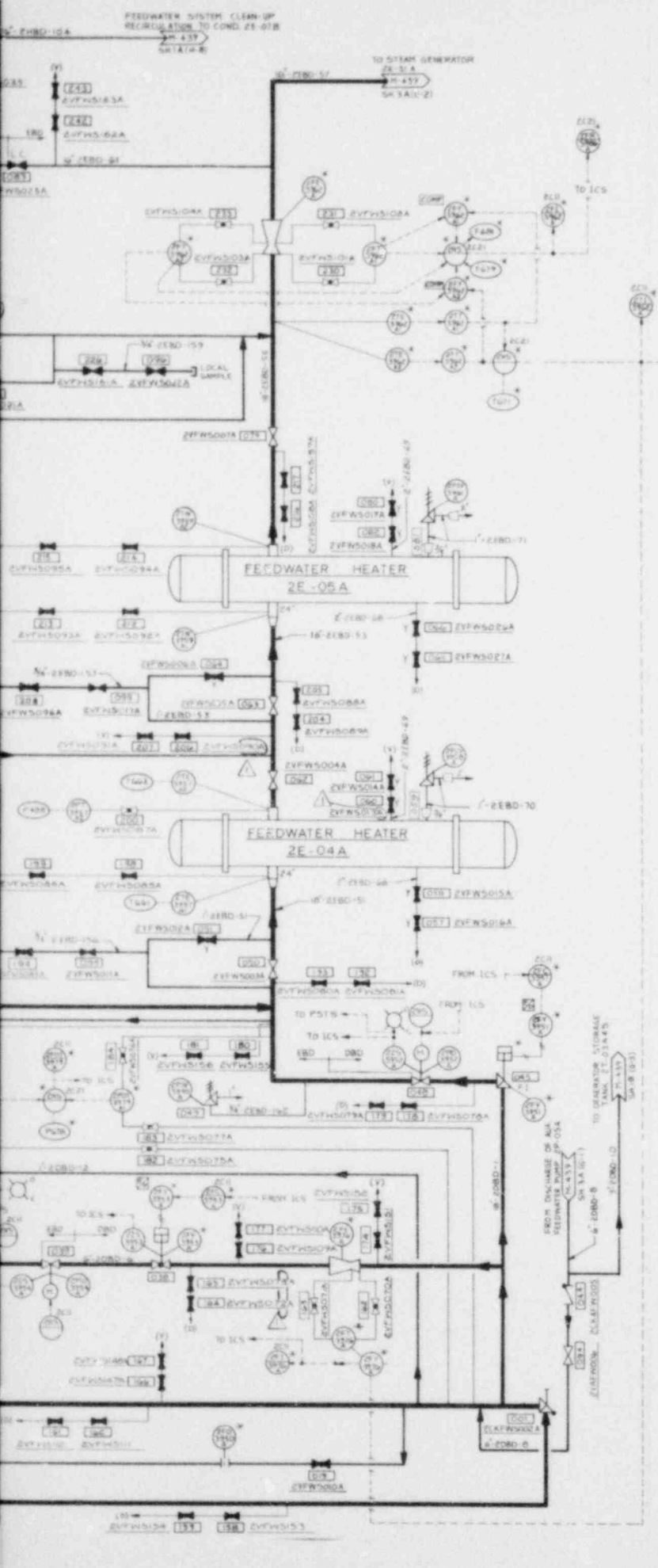
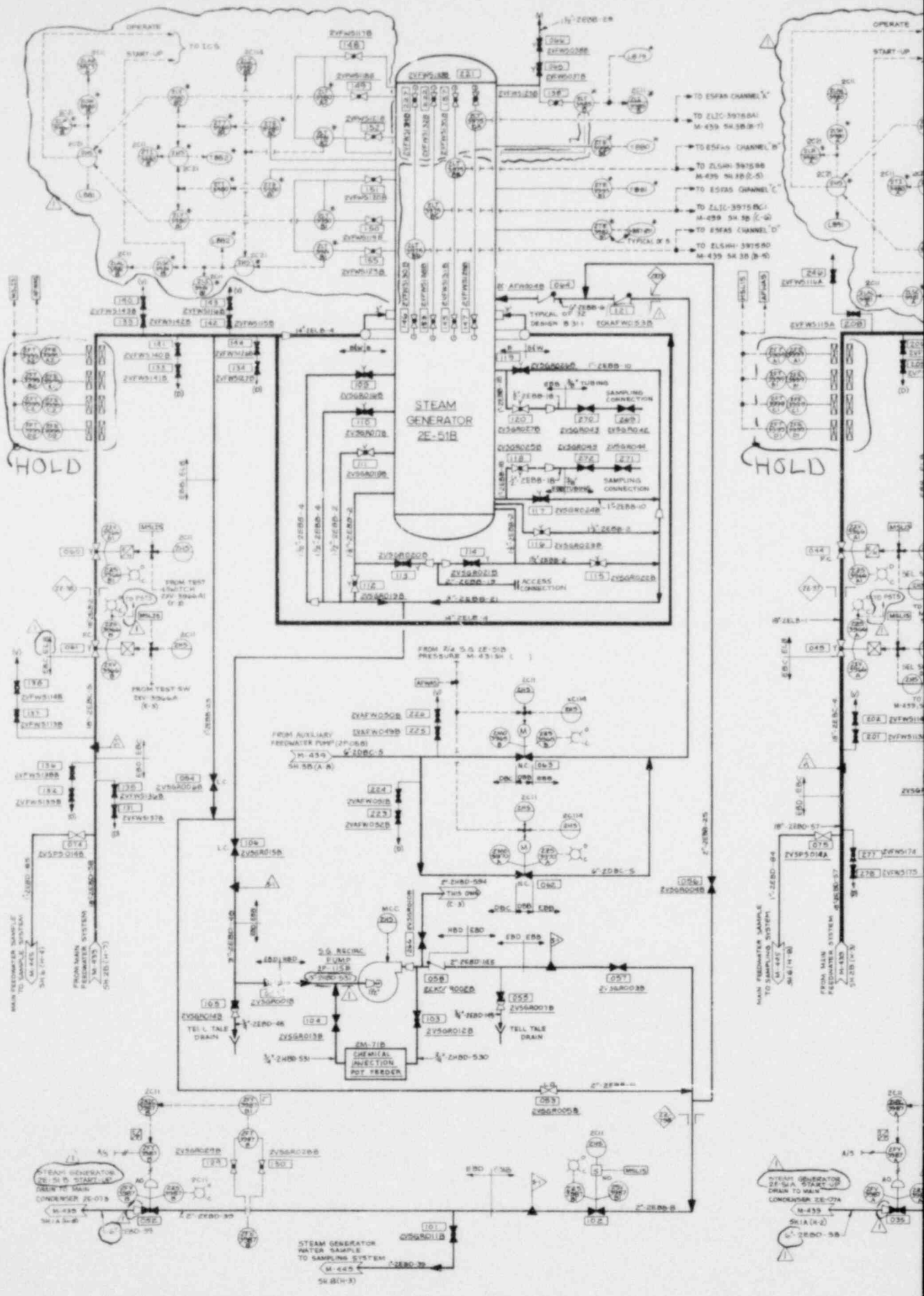
ZVFW50028
ZVFW50008

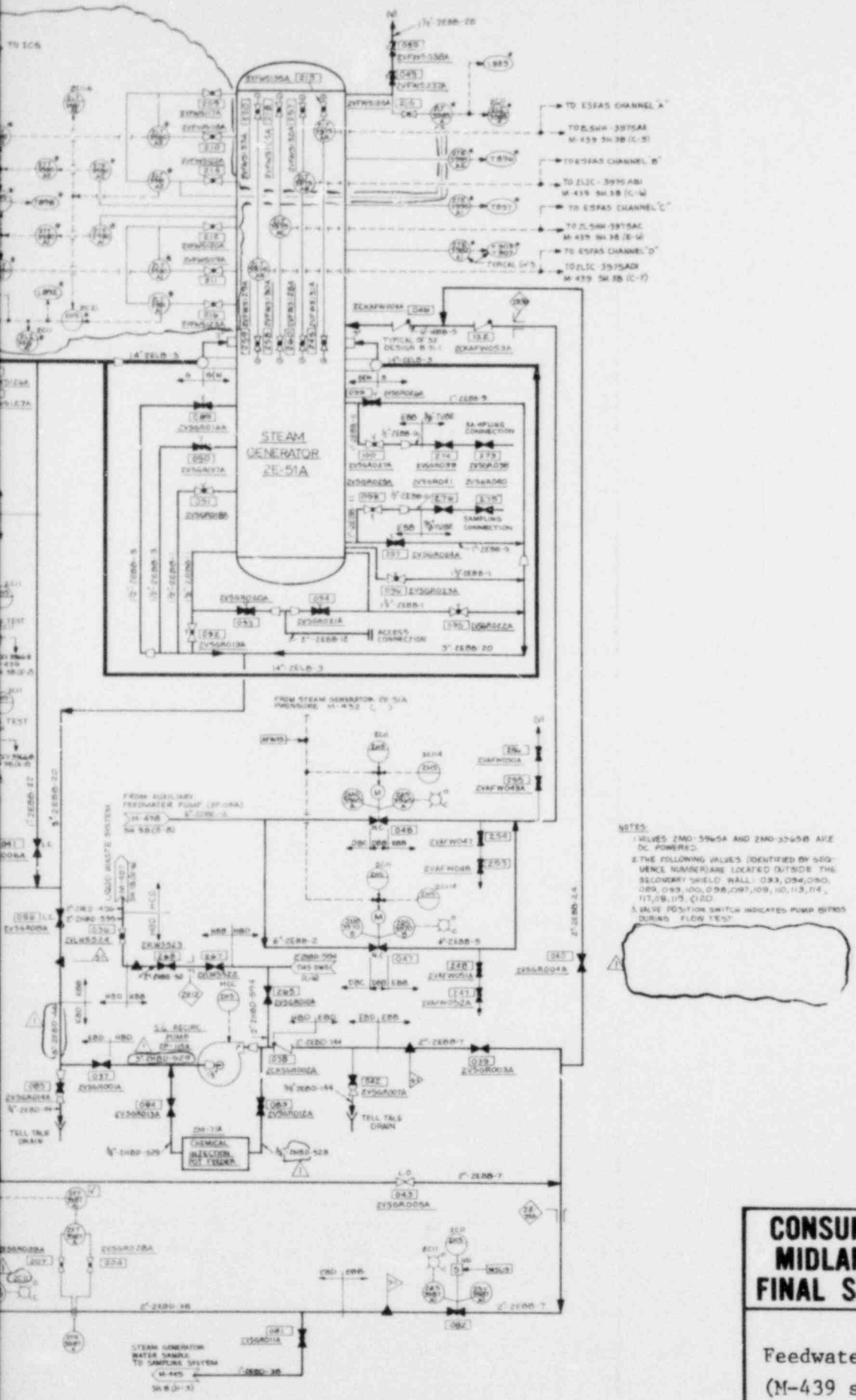


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Feedwater & Condensate - Unit 2
(M-439 sh 2B, Rev 1)

FSAR Figure 10.4-12, sh. 2


STEAM GENERATOR 2E-51B
HOLD
HOLD
TO ESFAS CHANNEL 'A'
TO ESFAS CHANNEL 'B'
TO ESFAS CHANNEL 'C'
TO ESFAS CHANNEL 'D'
TYPICAL OF 5
SAMPLING CONNECTION
ACCESS CONNECTION
FROM TEST SWITCH
FROM TEST SW
FROM AUXILIARY FEEDWATER PUMP (2P-66B)
SG RECIRC PUMP 2P-55B
CHEMICAL INJECTION POT FEEDER
TELL TALE DRAIN
TELL TALE DRAIN
STEAM GENERATOR WATER SAMPLE TO SAMPLING SYSTEM
MAIN FEEDWATER SAMPLE TO SAMPLING SYSTEM
FROM MAIN FEEDWATER SYSTEM
STEAM GENERATOR 2E-51B START-UP DRAIN TO MAIN CONDENSER 2E-07B
STEAM GENERATOR 2E-51A START-UP DRAIN TO MAIN CONDENSER 2E-07A



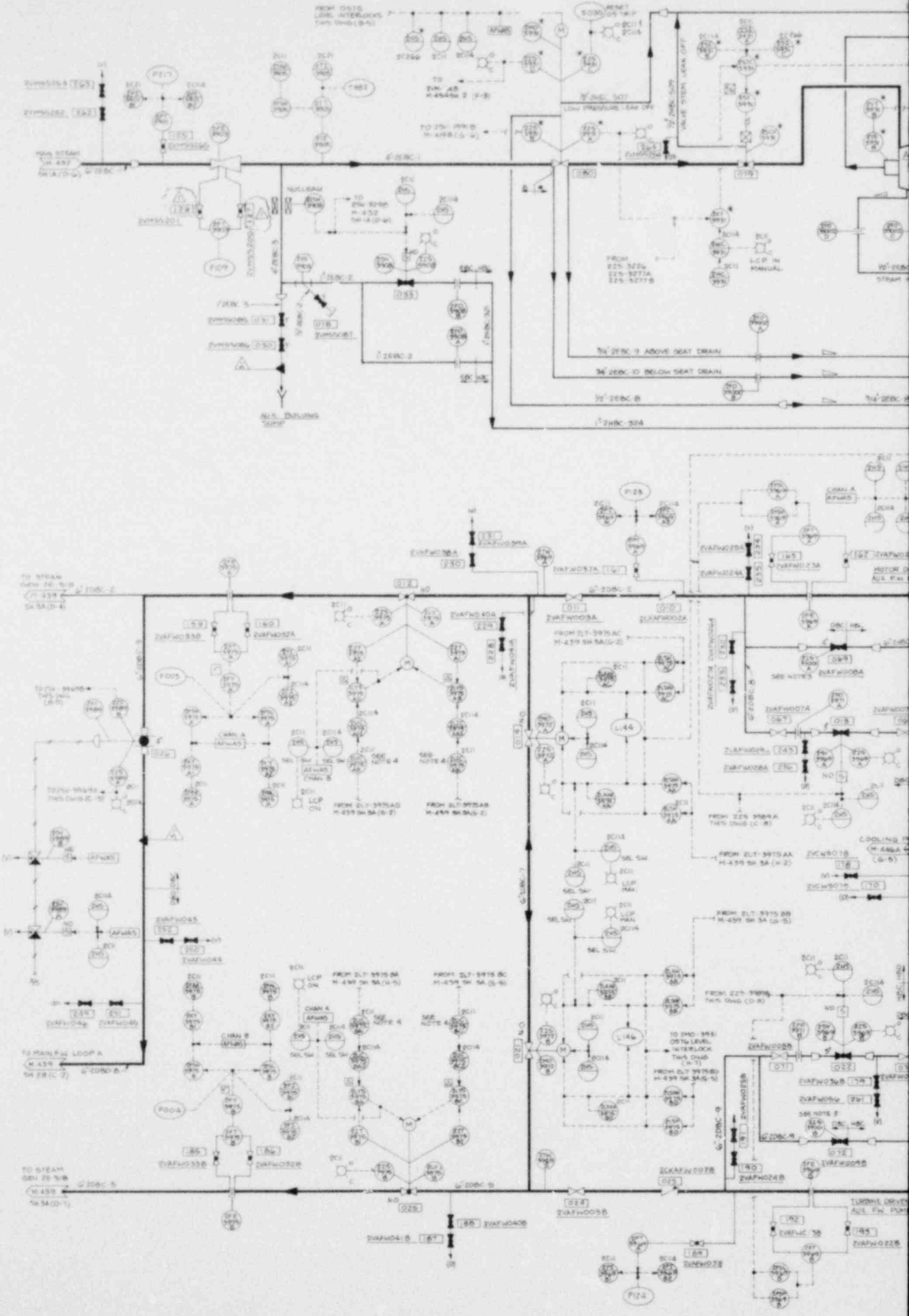
NOTES:

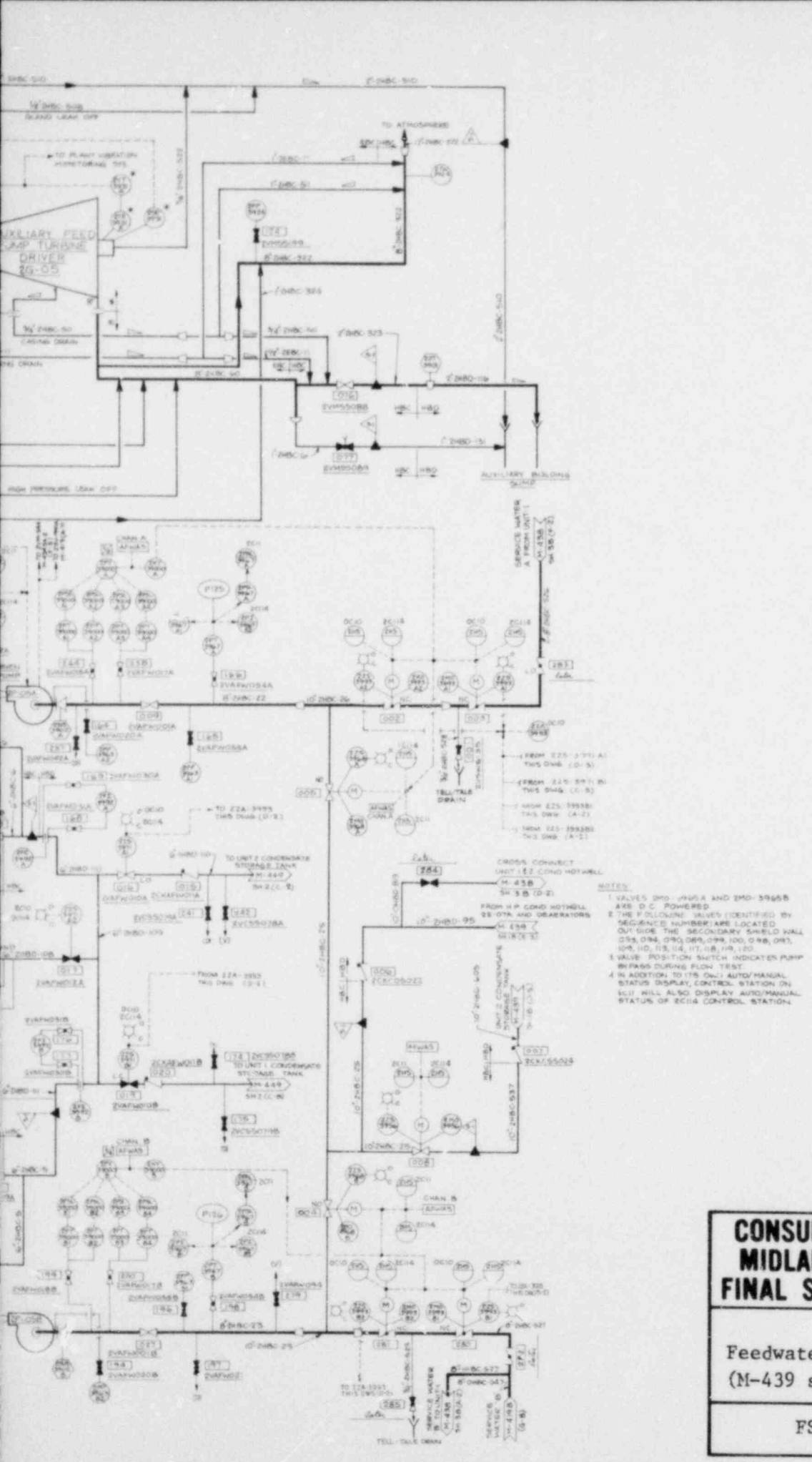
1. VALVES ZMO-3965A AND ZMO-3965B ARE DC POWERED.
2. THE FOLLOWING VALVES (IDENTIFIED BY SEQUENCE NUMBER) ARE LOCATED OUTSIDE THE SECONDARY SHIELD WALL: 093, 094, 090, 089, 099, 100, 098, 097, 109, 110, 113, 114, 117, 118, 115, 120.
3. VALVE POSITION SWITCH INDICATES PUMP ISTROS DURING FLOW TEST.

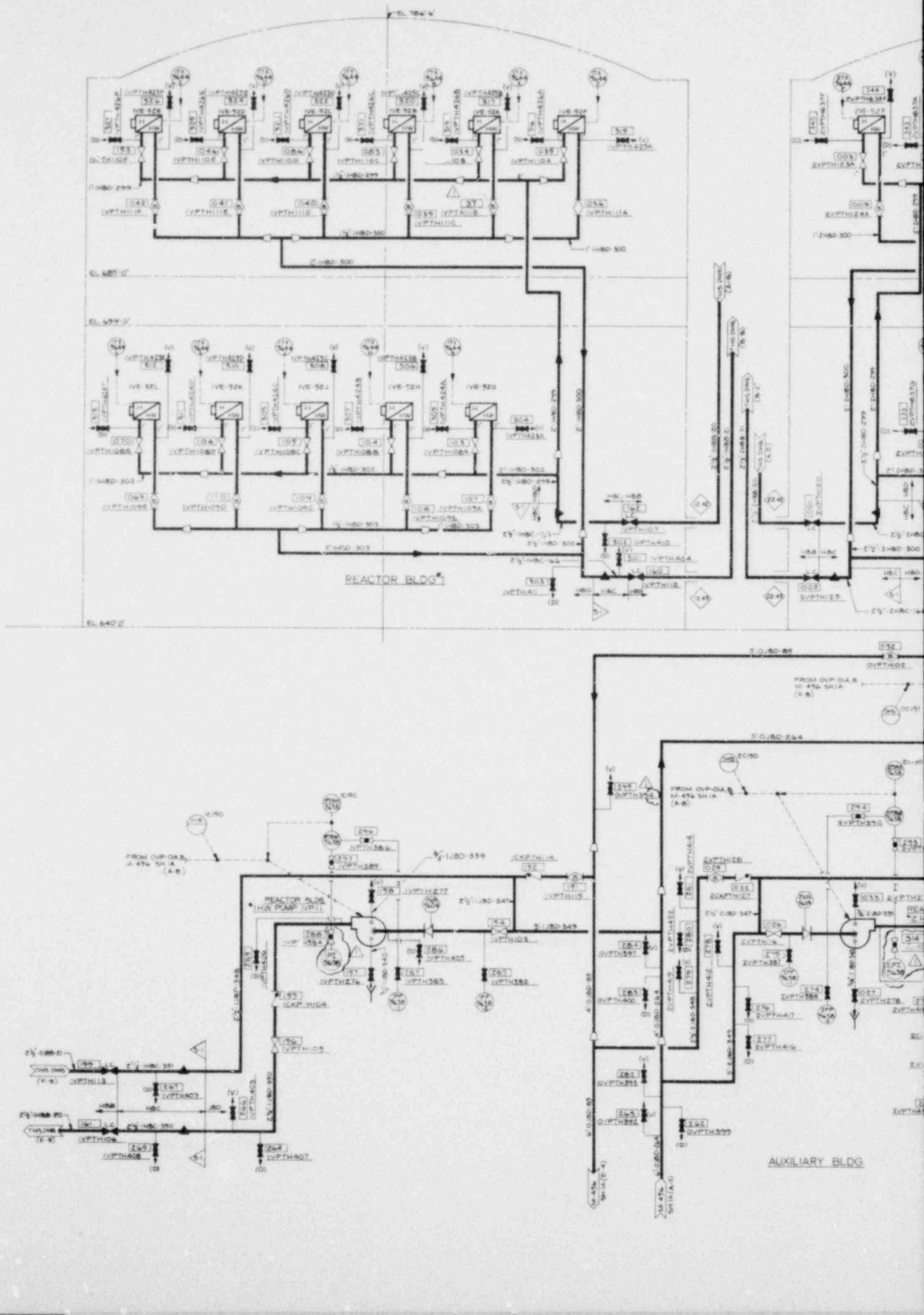
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

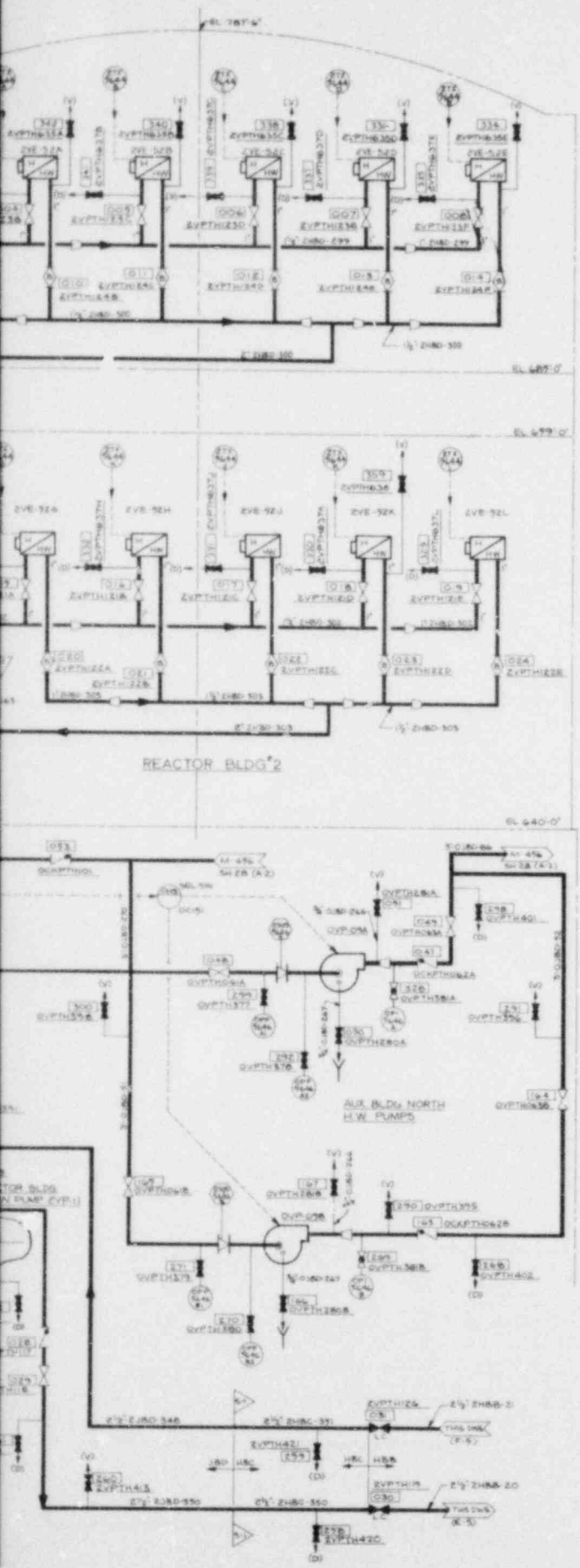
Feedwater & Condensate - Unit 2
(M-439 sh 3A, Rev 1)

FSAR Figure 10.4-13, sh. 1




AUXILIARY FEED PUMP TURBINE DRIVER 2G-05
TO ATMOSPHERE
TO PLANT VIBRATION MONITORING SYS.
2VM55099
2VM55088
2VM55089
AUXILIARY BUILDING
SERVICE WATER A FROM UNIT 1
CHAN A AFWAS1
2VAFW054A
2VAFW055A
2VAFW056A
2VAFW057A
2VAFW058A
2VAFW059A
2VAFW060A
2VAFW061A
2VAFW062A
2VAFW063A
2VAFW064A
2VAFW065A
2VAFW066A
2VAFW067A
2VAFW068A
2VAFW069A
2VAFW070A
2VAFW071A
2VAFW072A
2VAFW073A
2VAFW074A
2VAFW075A
2VAFW076A
2VAFW077A
2VAFW078A
2VAFW079A
2VAFW080A
2VAFW081A
2VAFW082A
2VAFW083A
2VAFW084A
2VAFW085A
2VAFW086A
2VAFW087A
2VAFW088A
2VAFW089A
2VAFW090A
2VAFW091A
2VAFW092A
2VAFW093A


REACTOR BLDG
AUXILIARY BLDG

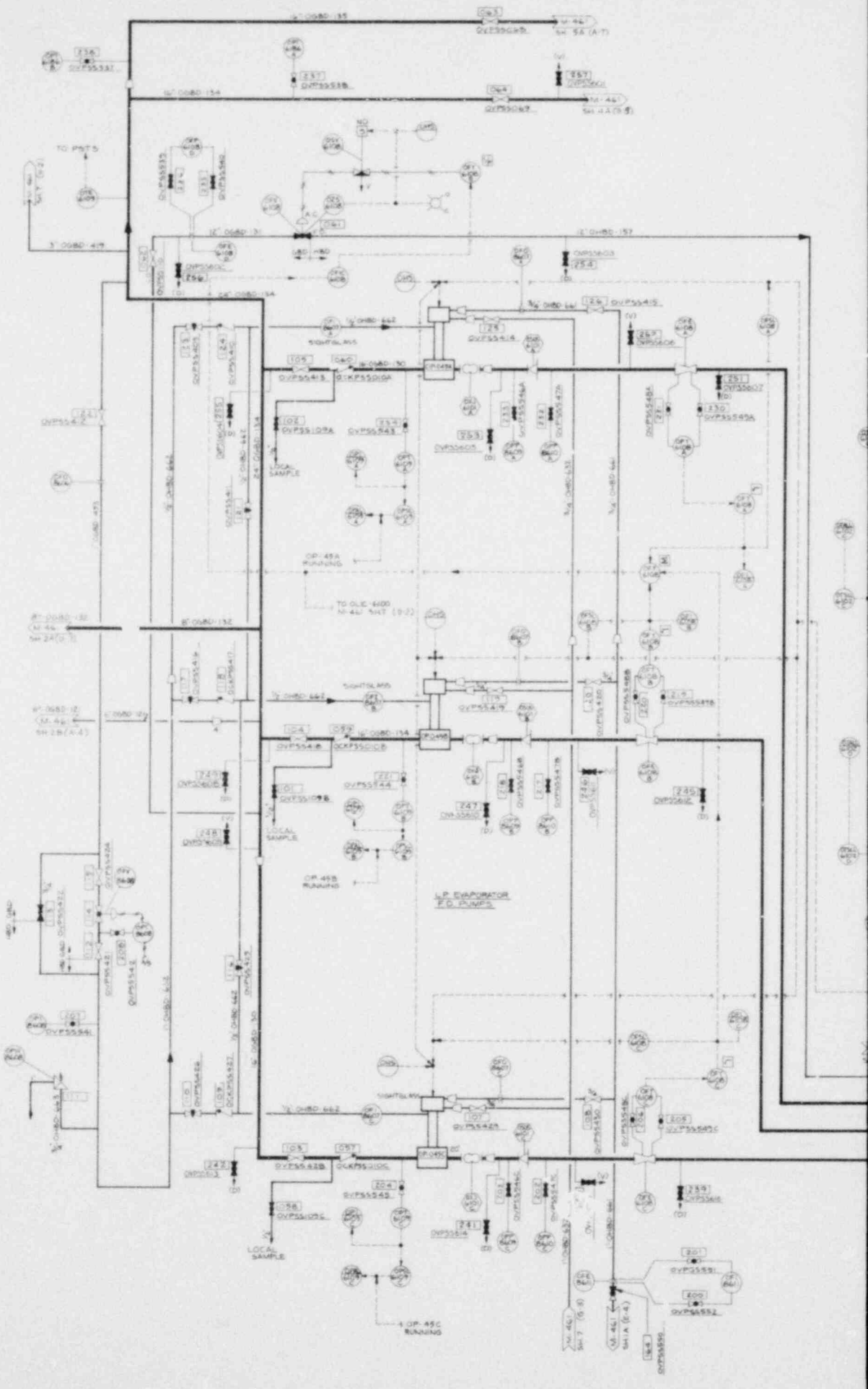


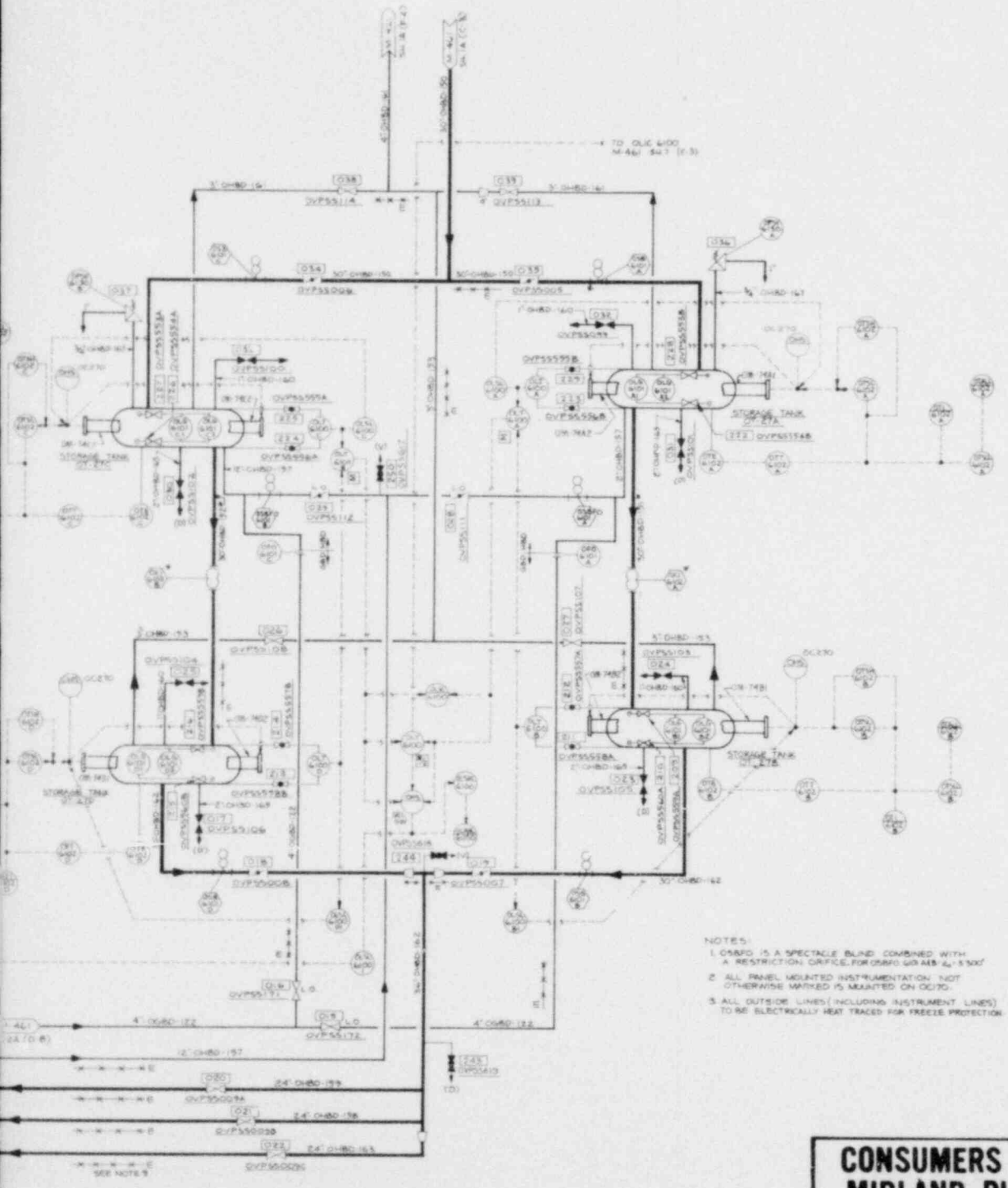
NOTES:
1. '2' ITEMS ARE CONTAINED ONLY ON SHEET 2.
2. FOR 2" AND SMALLER PIPING THERMOWELL CONNECTIONS REFER TO INSTRUMENTS INSTALLATION INSTRUCTIONS J-407.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Evaporator Process Steam to Dow
(M-461 sh 1A, Rev 0)

FSAR Figure 10.4-14, sh. 1

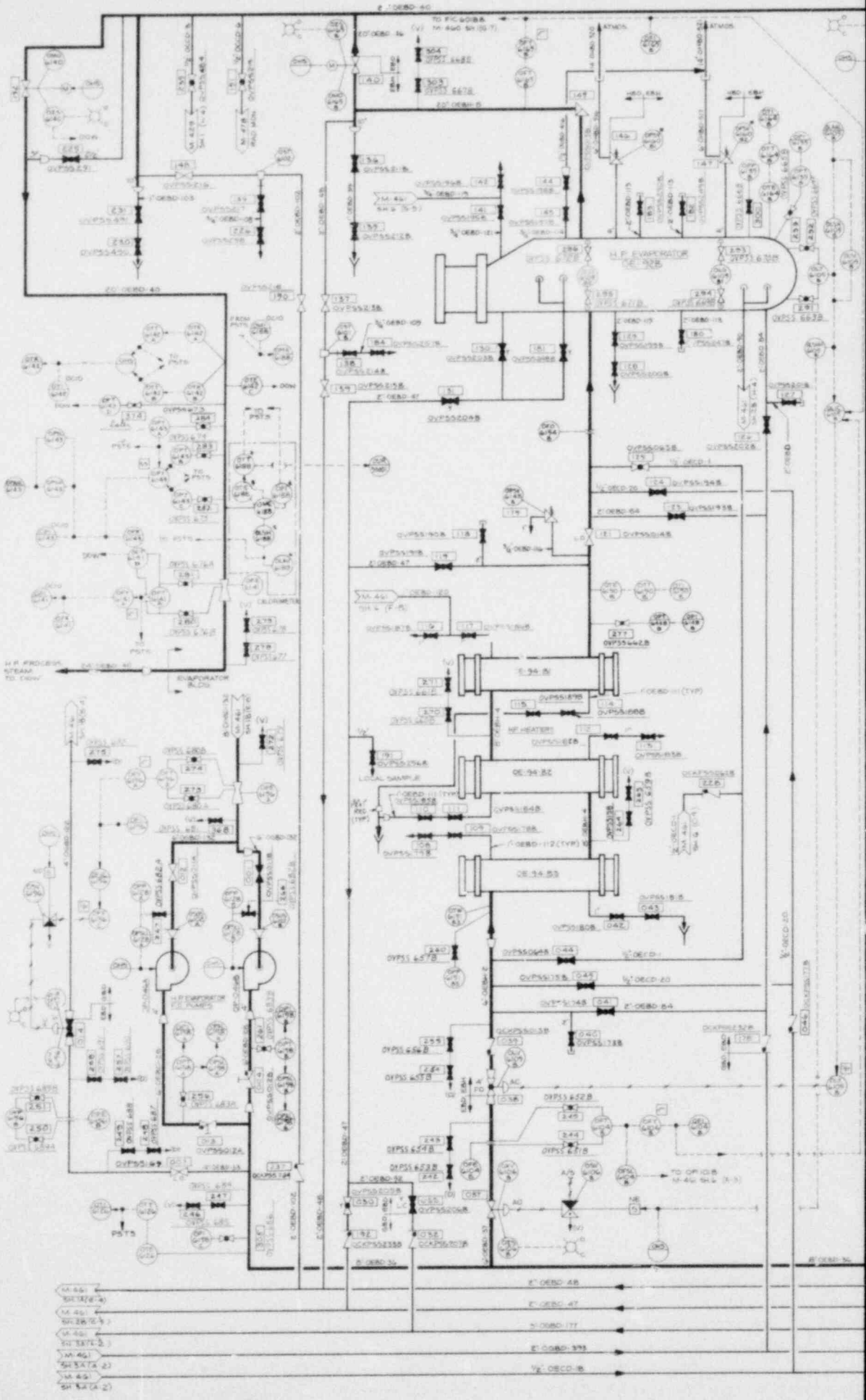

LP EVAPORATOR F.D. PUMPS
OP-49A RUNNING
OP-49B RUNNING
OP-49C RUNNING
LOCAL SAMPLE
TO PNTS
TO OLIC-6400

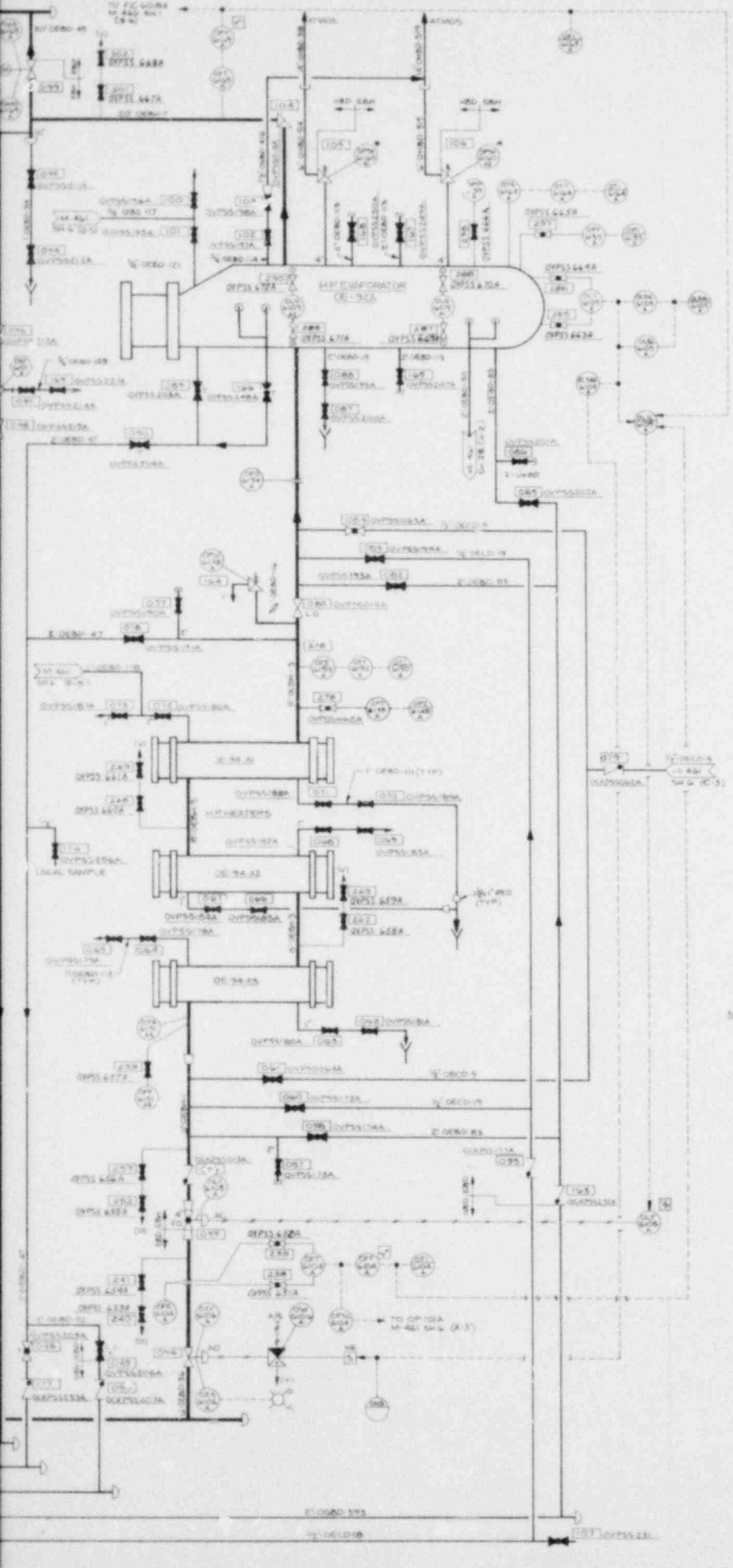


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Evaporator Process Steam to Dow
(M-461 sh 1B, Rev 0)

FSAR Figure 10.4-14, sh. 2





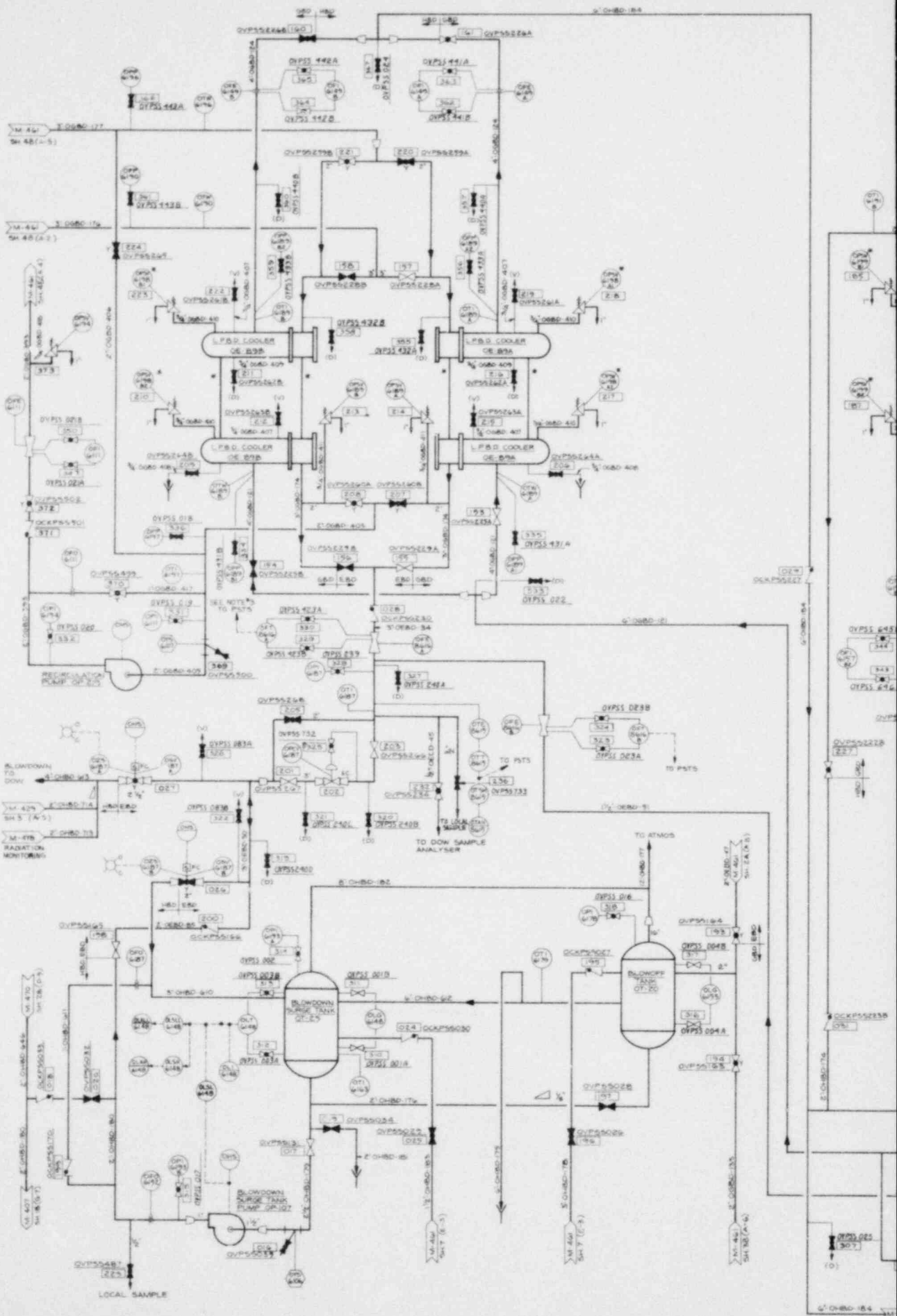
NOTES:

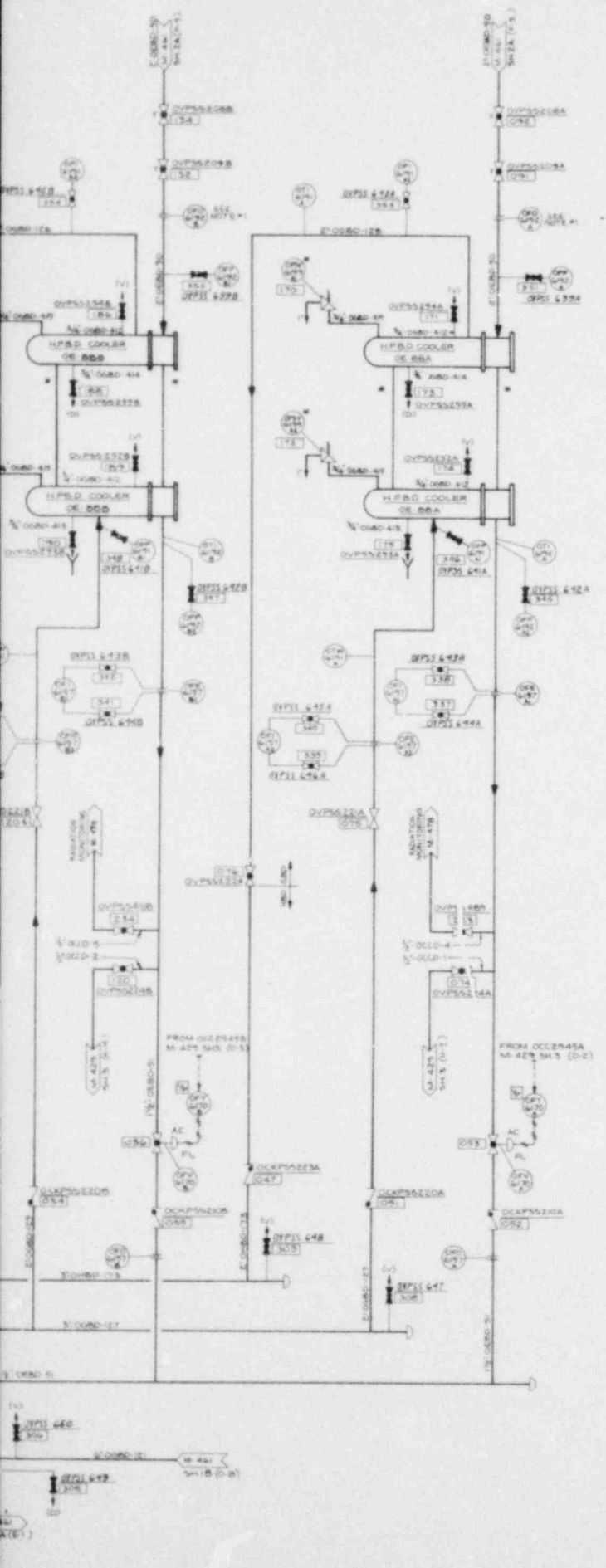
1. ALL VENT & DRAIN VALVES ON HP HEATERS ARE 1/2" CLASS 600 GLOBE VALVES. PIPING DOWNSTREAM OF GLOBE VALVES IS CLASS H&D.
2. DISCHARGE FROM DRAIN LINES OEBD 35 MUST BE VISIBLE TO OPERATOR OF DRAIN VALVES.
3. ELEVATION OF OFD-WPE TO BE 15 FT MIN. BELOW BOTTOM OF EVAPORATOR.
4. FOR IDENTIFICATION OF EVAPORATOR CONNECTIONS REFER TO DWG SK-M-1265.
5. ALL PANEL MOUNTED INSTRUMENTS ARE ON OC-170/OC-270 UNLESS OTHERWISE NOTED.
6. FOR DOW/BECHTEL INTERFACE SEE ADAPTER TABLE AND NOTE 6 ON M-461 SH 5.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Evaporator Process Steam to Dow
(M-461 sh 2A, Rev 0)

FSAR Figure 10.4-15, sh. 1


LPSD COOLER
LPSD COOLER
LPSD COOLER
LPSD COOLER
RECIRCULATION PUMP
BLOWDOWN SURGE TANK
BLOWDOWN SURGE TANK PUMP
ORIFICE TANK
TO ATMOS
TO PSTS
TO DOW SAMPLE ANALYSER
TO DOW
RADIATION MONITORING
LOCAL SAMPLE

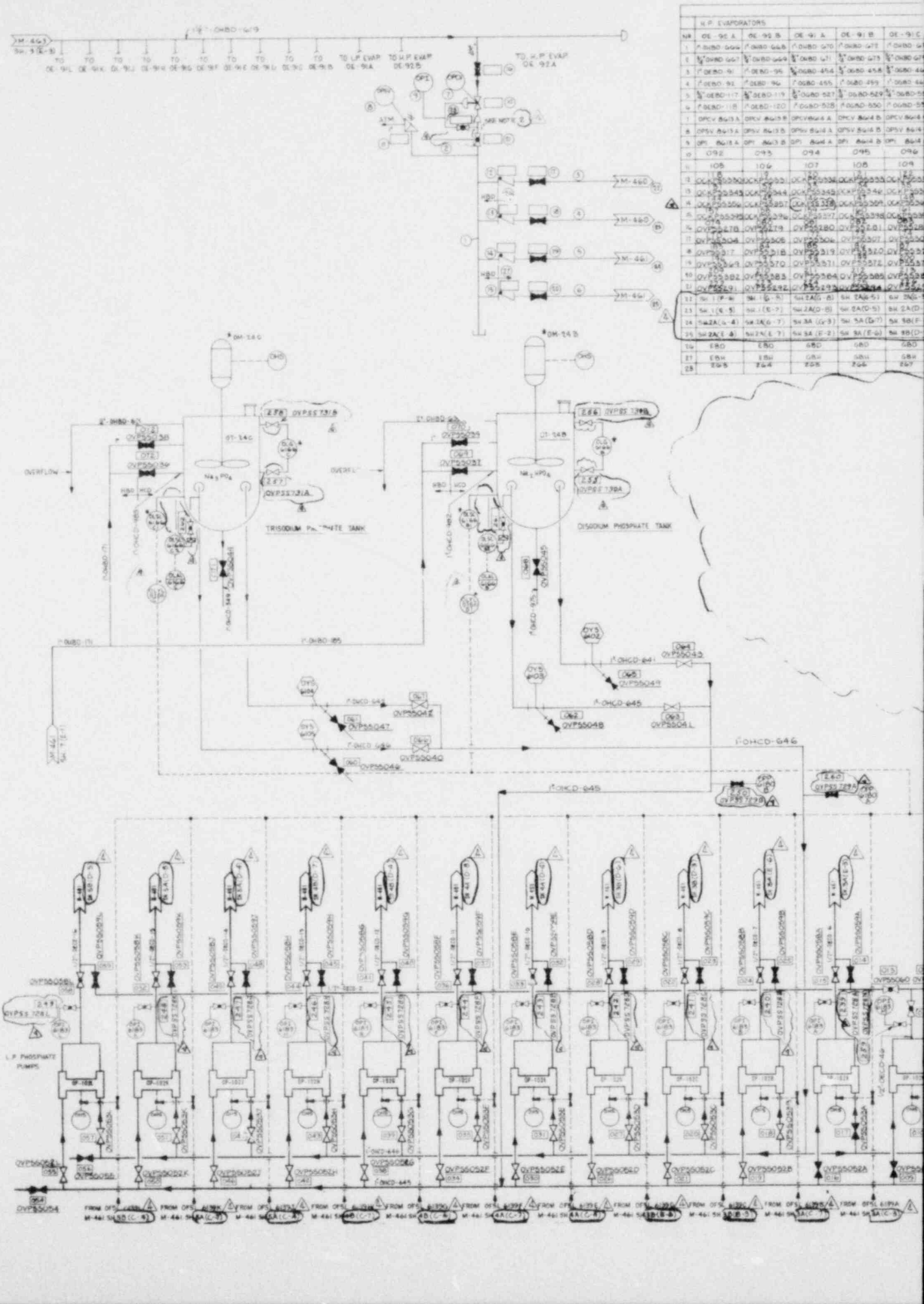


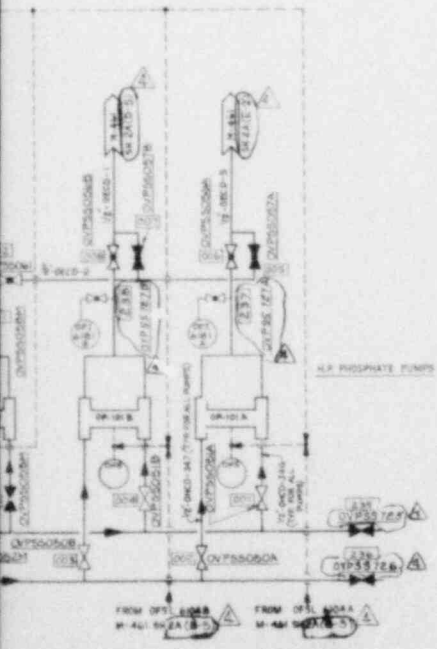
NOTES:
1. ELEVATION OF OPD-6492 TO BE 18FT. MIN. BELOW BOTTOM OF EVAPORATOR.
2. ALL PANEL MOUNTED INSTRUMENTS ARE ON OC-170/OC-270 UNLESS OTHERWISE NOTED.
3. DISTANCE FROM INLET OF PUMP OP-219 TO OGBD-405/407 BRANCH CONNECTION TO BE 5 FT. MIN.

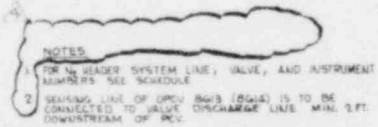
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Evaporator Process Steam to Dow
(M-461 sh 2B, Rev 0)

FSAR Figure 10.4-15, sh. 2


H.P. EVAPORATORS
TO L.P. EVAP OE-91A
TO H.P. EVAP OE-92B
TO H.P. EVAP OE-92A
TRISODIUM PHOSPHATE TANK
DISODIUM PHOSPHATE TANK
OVERFLOW
L.P. PHOSPHATE PUMPS
SEE NOTE 2

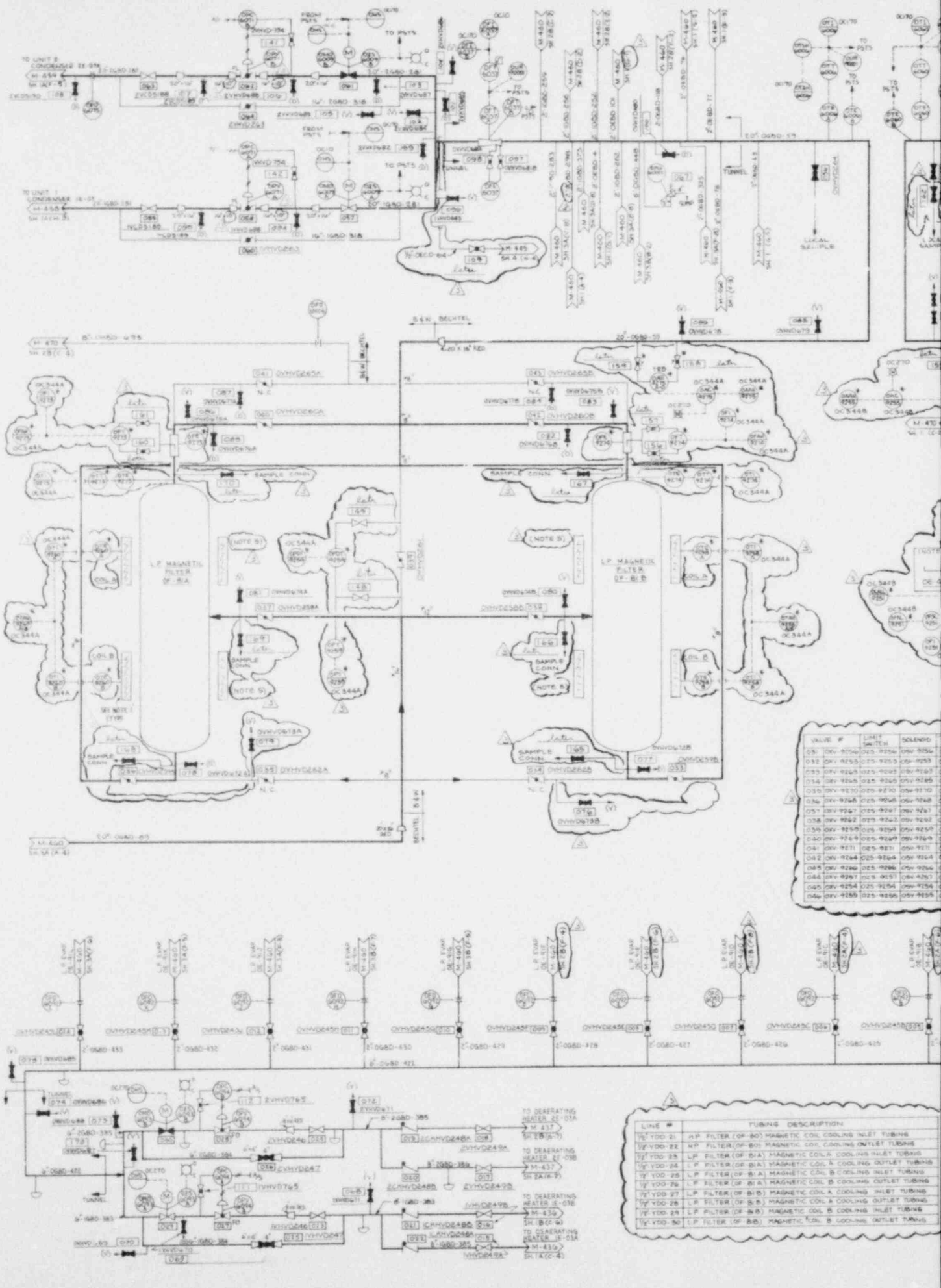




CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

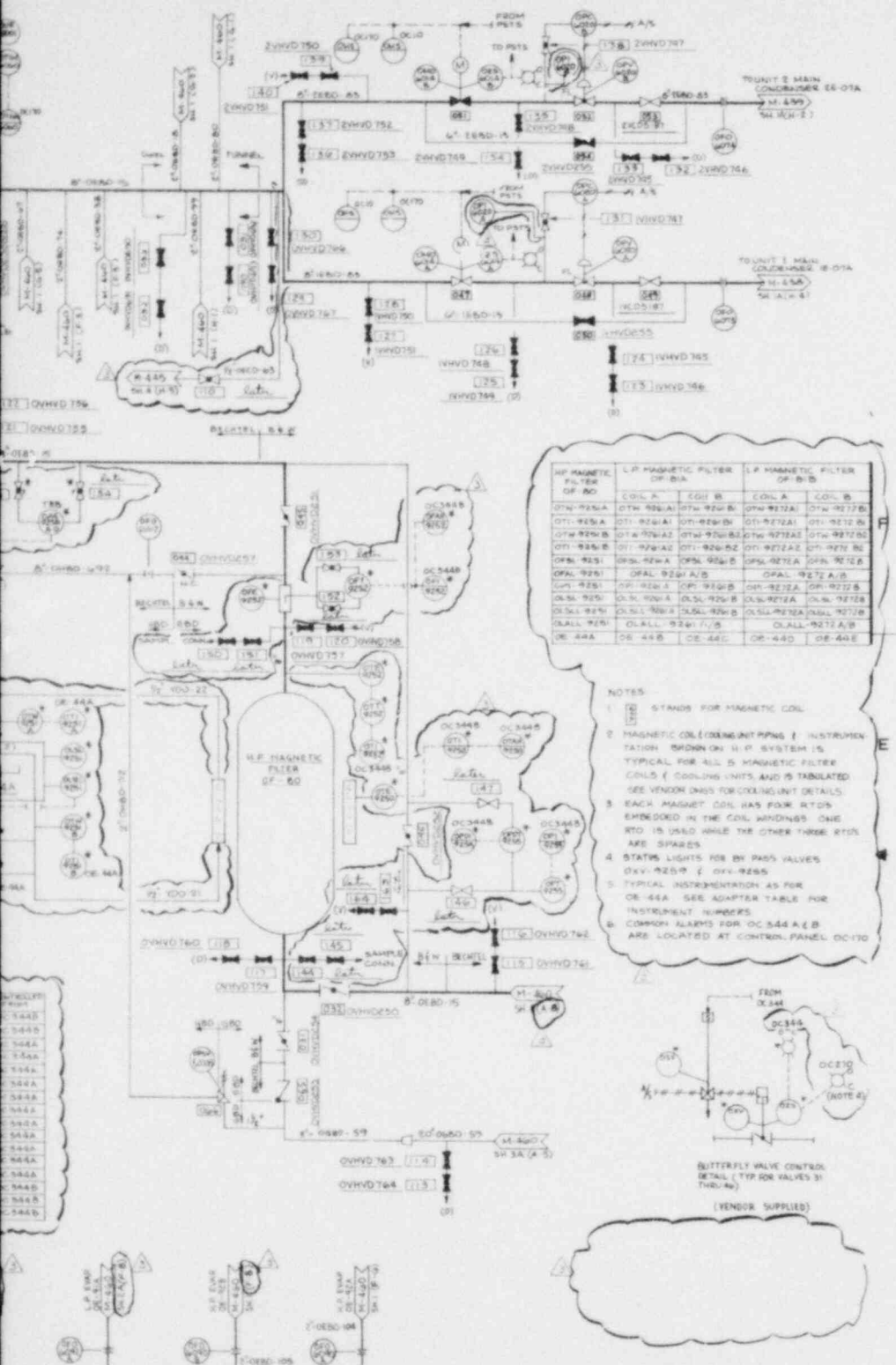
Evaporator Process Steam to Dow
(M-461 sh 6, Rev 4)

FSAR Figure 10.4-19

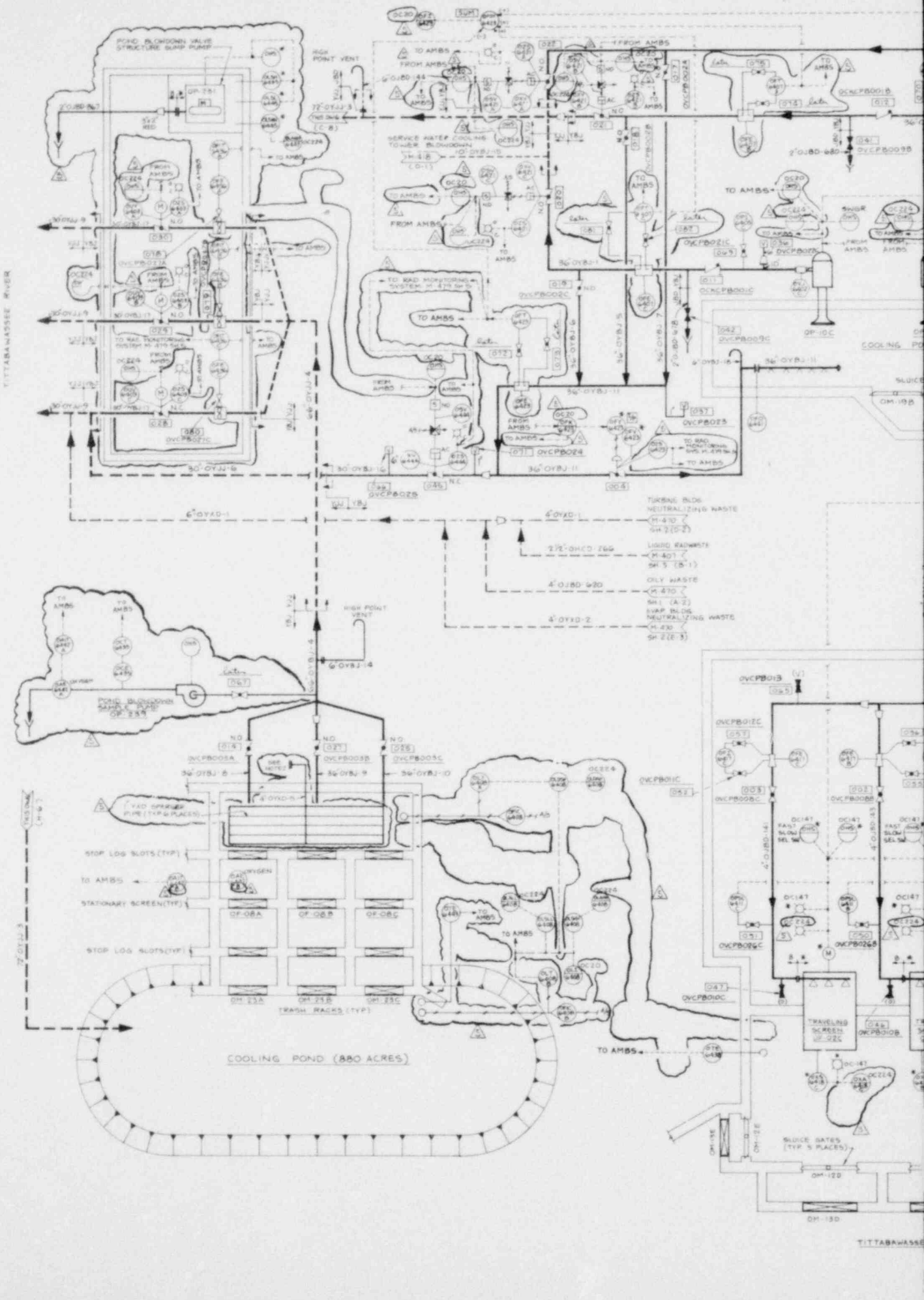


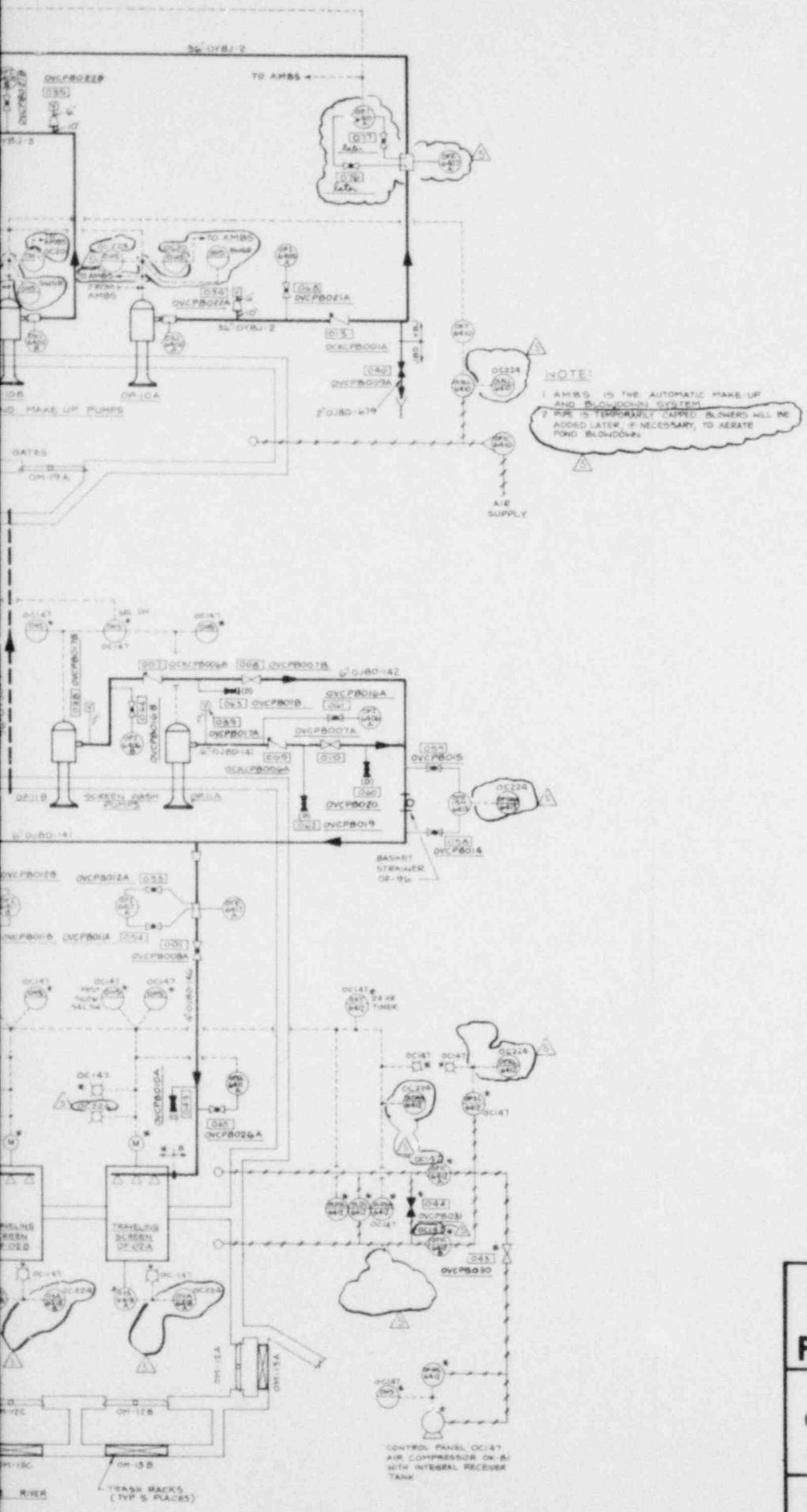
VALVE #	LIMIT SWITCH	SOLENOID
031	ZSV-9256	ZSV-9256	YSV-9256
032	ZSV-9253	ZSV-9253	YSV-9253
033	ZSV-9263	ZSV-9263	YSV-9263
034	ZSV-9265	ZSV-9265	YSV-9265
035	ZSV-9270	ZSV-9270	YSV-9270
036	ZSV-9268	ZSV-9268	YSV-9268
037	ZSV-9267	ZSV-9267	YSV-9267
038	ZSV-9262	ZSV-9262	YSV-9262
039	ZSV-9259	ZSV-9259	YSV-9259
040	ZSV-9269	ZSV-9269	YSV-9269
041	ZSV-9271	ZSV-9271	YSV-9271
042	ZSV-9264	ZSV-9264	YSV-9264
043	ZSV-9266	ZSV-9266	YSV-9266
044	ZSV-9257	ZSV-9257	YSV-9257
045	ZSV-9254	ZSV-9254	YSV-9254
046	ZSV-9255	ZSV-9255	YSV-9255

LINE #	TUBING DESCRIPTION
1½"-YDD-21	HP FILTER (OF-80) MAGNETIC COIL COOLING INLET TUBING
1½"-YDD-22	HP FILTER (OF-80) MAGNETIC COIL COOLING OUTLET TUBING
1½"-YDD-23	LP FILTER (OF-81A) MAGNETIC COIL A COOLING INLET TUBING
1½"-YDD-24	LP FILTER (OF-81A) MAGNETIC COIL A COOLING OUTLET TUBING
1½"-YDD-25	LP FILTER (OF-81A) MAGNETIC COIL B COOLING INLET TUBING
1½"-YDD-26	LP FILTER (OF-81A) MAGNETIC COIL B COOLING OUTLET TUBING
1½"-YDD-27	LP FILTER (OF-81B) MAGNETIC COIL A COOLING INLET TUBING
1½"-YDD-28	LP FILTER (OF-81B) MAGNETIC COIL A COOLING OUTLET TUBING
1½"-YDD-29	LP FILTER (OF-81B) MAGNETIC COIL B COOLING INLET TUBING
1½"-YDD-30	LP FILTER (OF-81B) MAGNETIC COIL B COOLING OUTLET TUBING



H.P. MAGNETIC FILTER OF-80	L.P. MAGNETIC FILTER OF-81A		L.P. MAGNETIC FILTER OF-81B	
	COIL A	COIL B	COIL A	COIL B
OTH-9256A	OTH-9256A1	OTH-9256B1	OTH-9272A1	OTH-9272B1
OTI-9256A	OTI-9256A1	OTI-9256B1	OTI-9272A1	OTI-9272B1
OTH-9256B	OTH-9256A2	OTH-9256B2	OTH-9272A2	OTH-9272B2
OTI-9256B	OTI-9256A2	OTI-9256B2	OTI-9272A2	OTI-9272B2
OPSL-9251	OPSL-9256A	OPSL-9256B	OPSL-9272A	OPSL-9272B
OPAL-9251	OPAL-9256 A/B		OPAL-9272 A/B	
OPI-9251	OPI-9256A	OPI-9256B	OPI-9272A	OPI-9272B
OLSL-9255	OLSL-9256A	OLSL-9256B	OLSL-9272A	OLSL-9272B
OLSLL-9255	OLSLL-9256A	OLSLL-9256B	OLSLL-9272A	OLSLL-9272B
OLALL-9251	OLALL-9256 A/B		OLALL-9272 A/B	
OE-44A	OE-44B	OE-44C	OE-44D	OE-44E

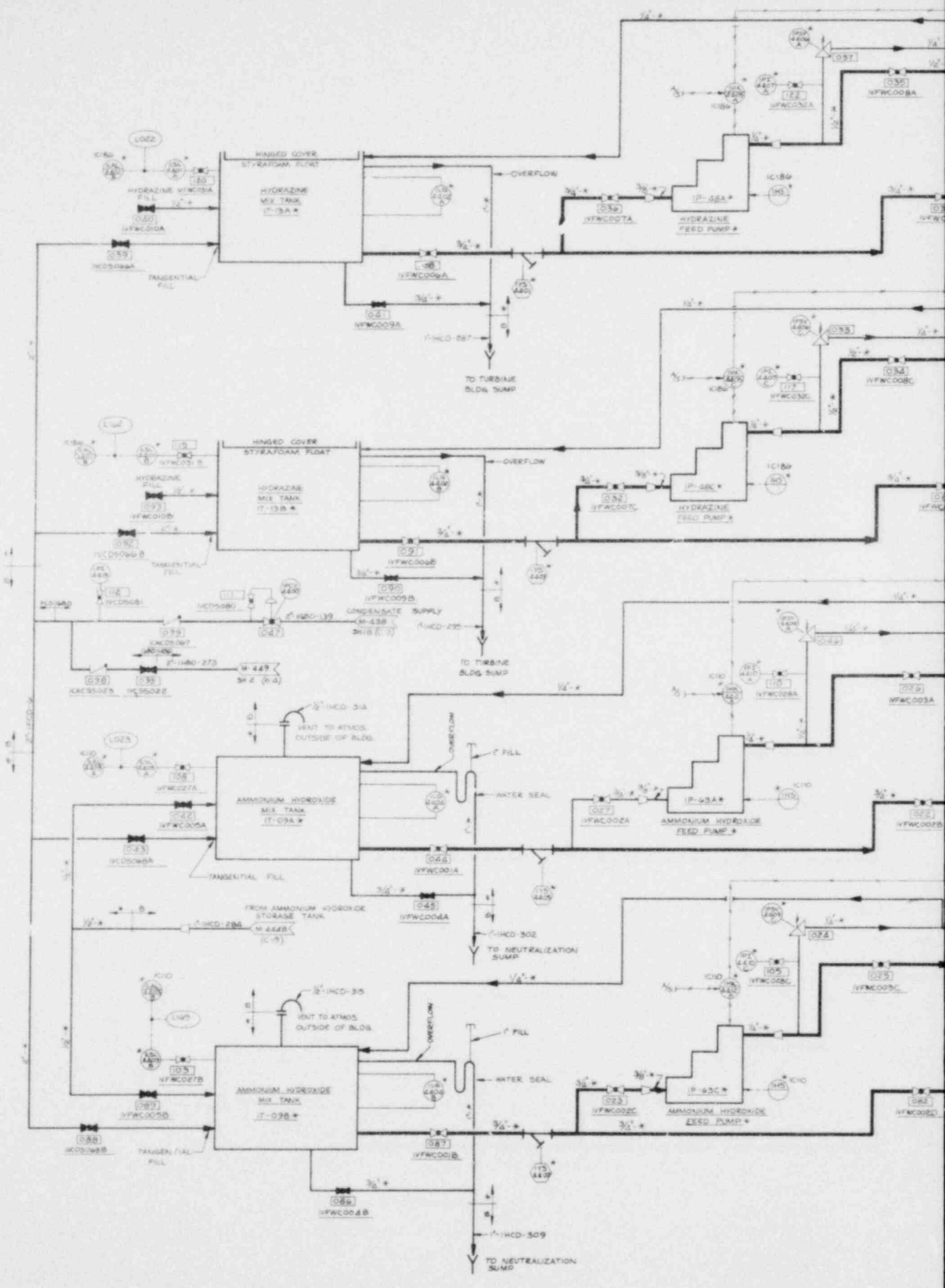

COOLING POND (880 ACRES)
TITTABAWASSEE RIVER
TO AMBS
FROM AMBS
HIGH POINT VENT
SERVICE WATER COOLING TOWER BLOWDOWN
TURBINE BLDG NEUTRALIZING WASTE
LIQUID RADWASTE
OILY WASTE
YARD SPRINKLER PIPE (TYP 6 PLACES)
STOP LOG SLOTS (TYP)
STATIONARY SCREEN (TYP)
TRASH RACKS (TYP)
TRAVELING SCREEN
SLUICE GATES (TYP 5 PLACES)
COOLING PO

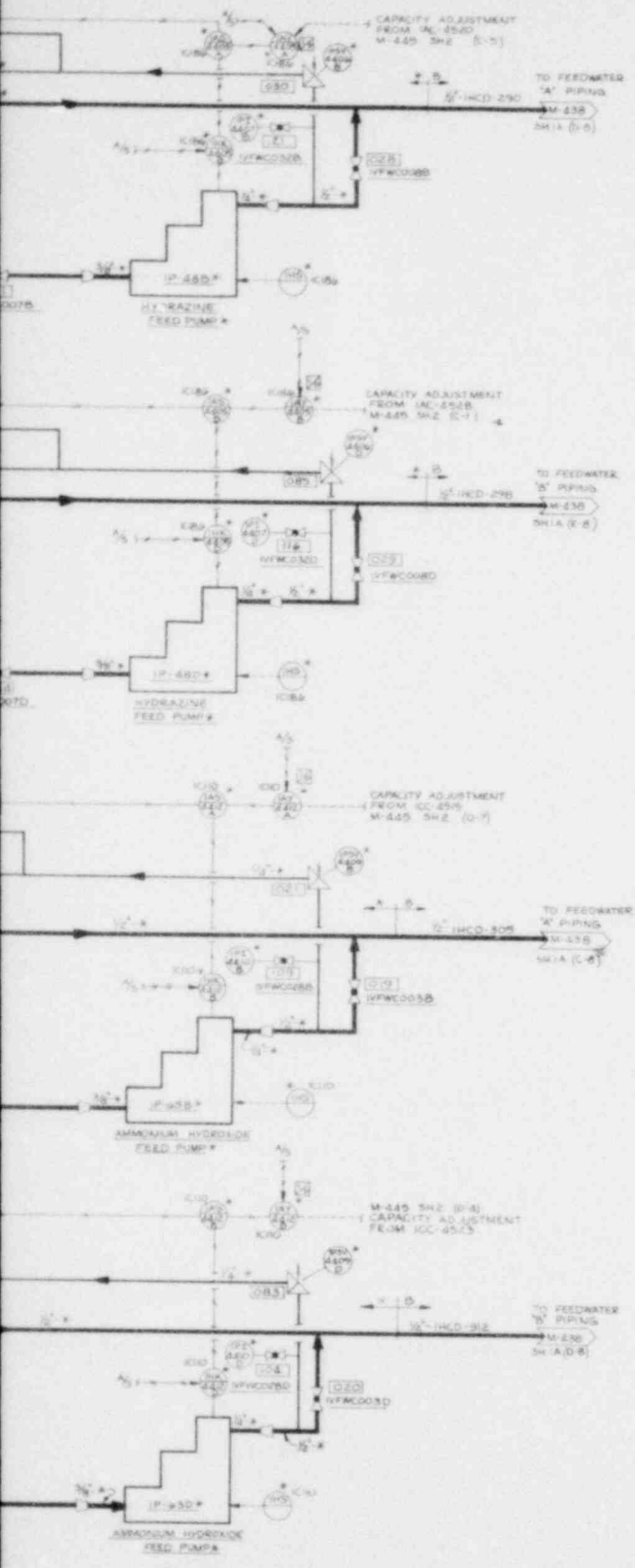


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Cooling Pond Blowdown & Makeup
(M-464, Rev 5)

FSAR Figure 10.4-24


HINGED COVER
STYROFOAM FLOAT
HYDRAZINE MIX TANK IT-13A
OVERFLOW
HYDRAZINE FEED PUMP
TANGENTIAL FILL
TO TURBINE BLDG SUMP
HINGED COVER
STYROFOAM FLOAT
HYDRAZINE MIX TANK IT-13B
OVERFLOW
HYDRAZINE FEED PUMP
TANGENTIAL FILL
TO TURBINE BLDG SUMP
CONDENSATE SUPPLY
VENT TO ATMOS. OUTSIDE OF BLDG.
AMMONIUM HYDROXIDE MIX TANK IT-09A
OVERFLOW
FILL
WATER SEAL
AMMONIUM HYDROXIDE FEED PUMP
TANGENTIAL FILL
FROM AMMONIUM HYDROXIDE STORAGE TANK
TO NEUTRALIZATION SUMP
VENT TO ATMOS. OUTSIDE OF BLDG.
AMMONIUM HYDROXIDE MIX TANK IT-09B
OVERFLOW
FILL
WATER SEAL
AMMONIUM HYDROXIDE FEED PUMP
TANGENTIAL FILL
TO NEUTRALIZATION SUMP

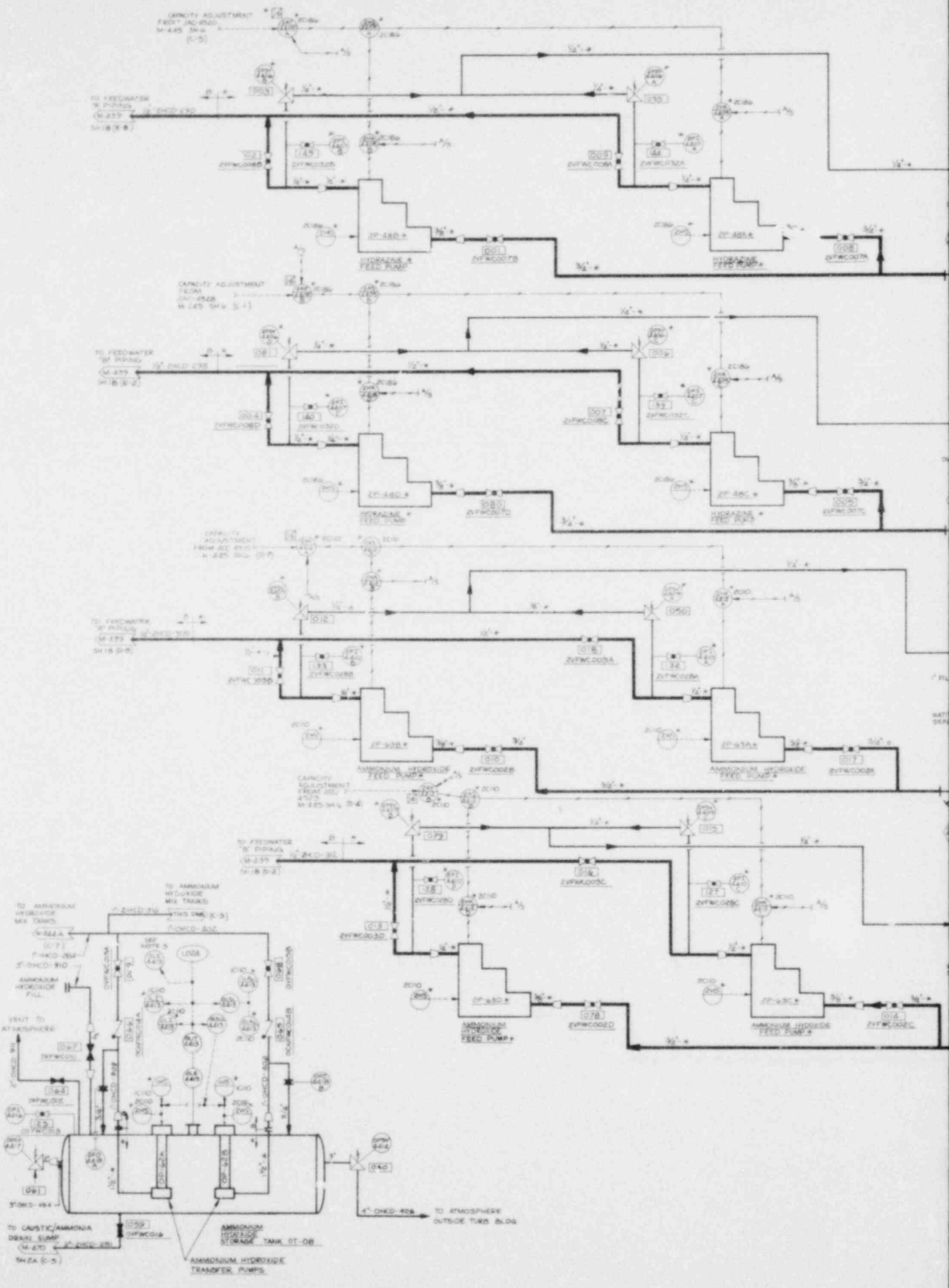


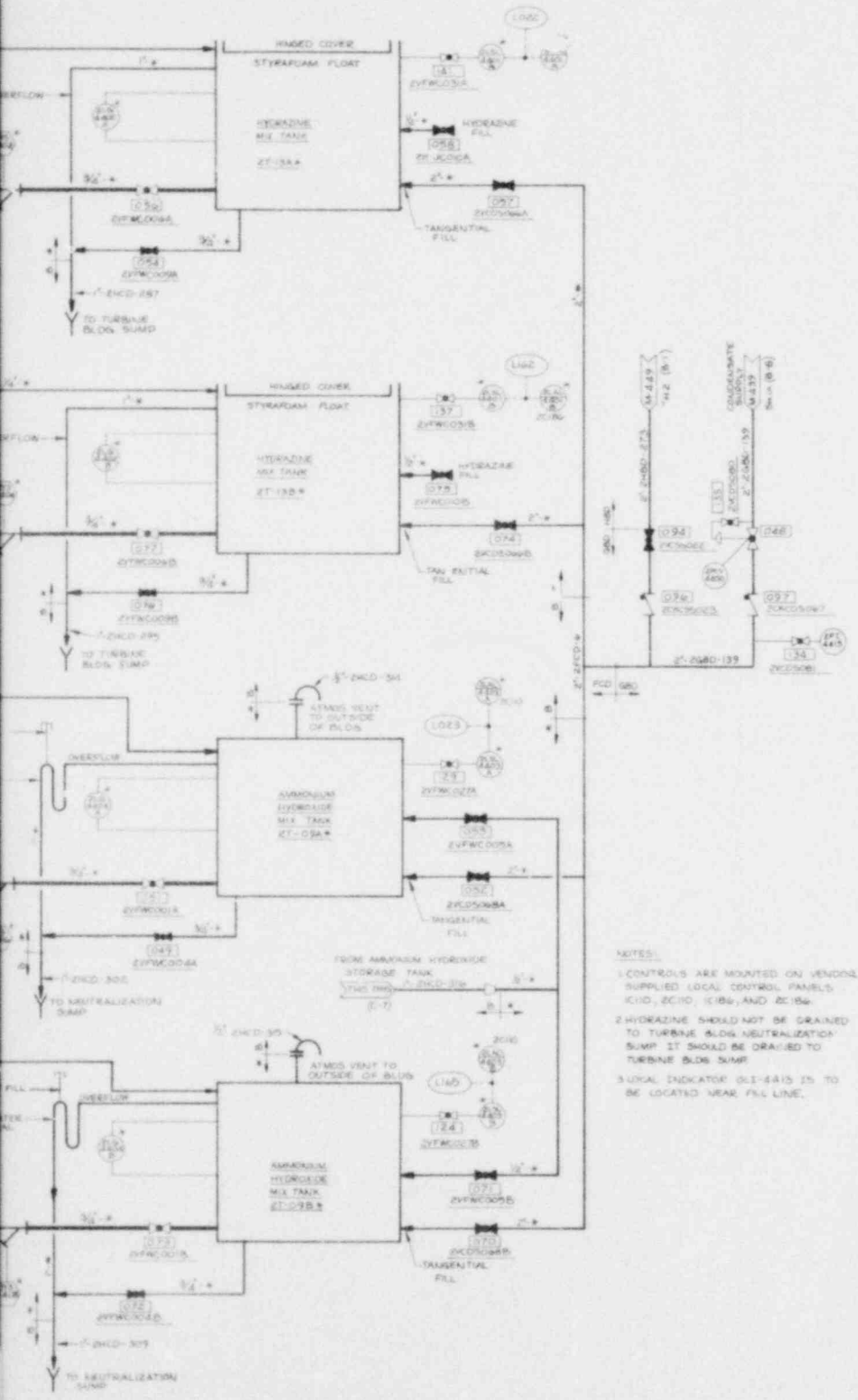
NOTES:
1. CONTROLS ARE MOUNTED ON VENDOR SUPPLIED LOCAL CONTROL PANELS K10, K10, IC186, AND IC186.
2. HYDRAZINE SHOULD NOT BE DRAINED TO TURBINE BLDG. NEUTRALIZATION SUMP. IT SHOULD BE DRAINED TO TURBINE BLDG. SUMP.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Feedwater Chemical Addition
Unit 1
(M-444A, Rev 0)

FSAR Figure 10.4-25, sh. 1

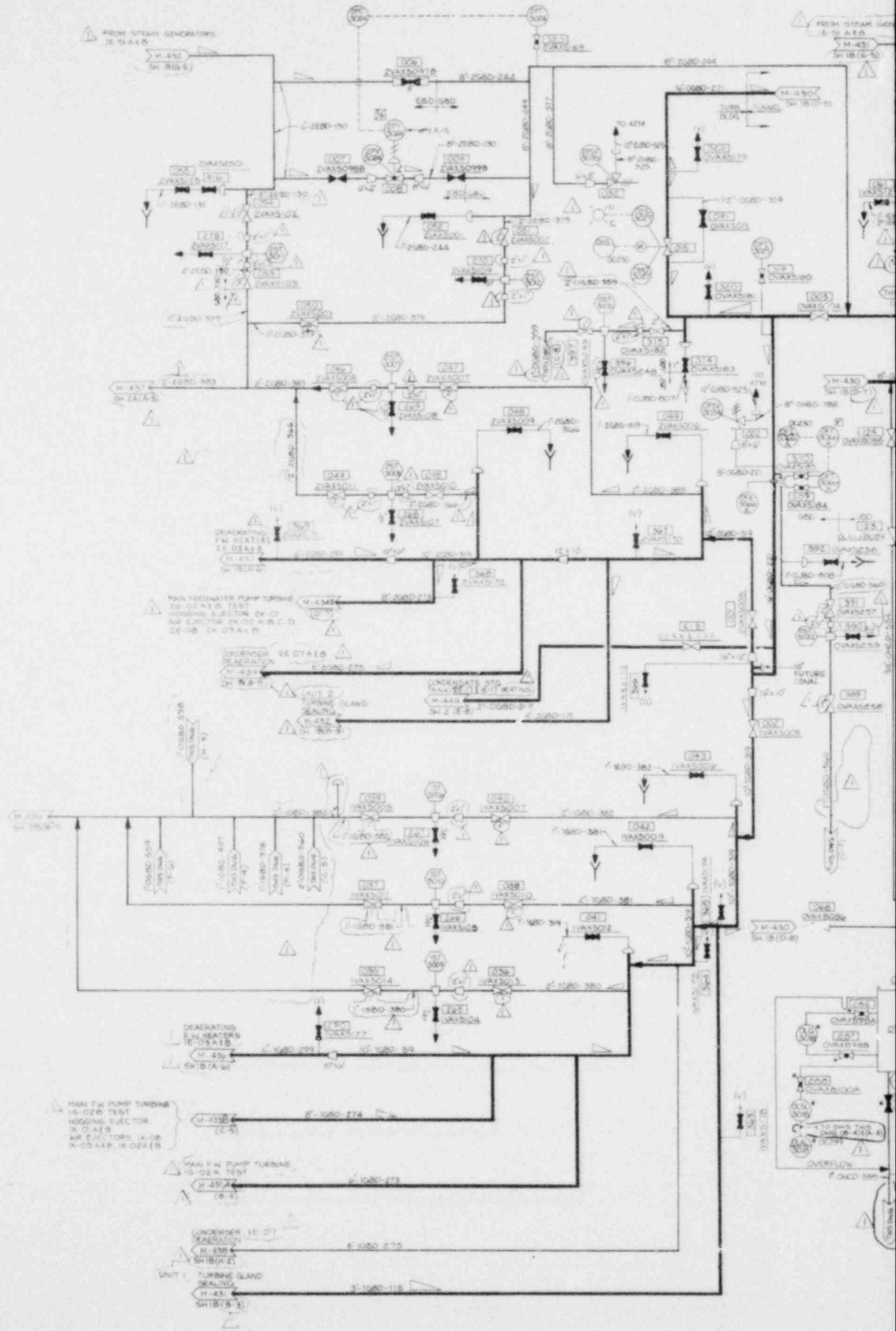

TO FEEDWATER "A" PUMPS
TO FEEDWATER "B" PUMPS
HYDRAZINE FEED PUMP A
HYDRAZINE FEED PUMP B
AMMONIUM HYDROXIDE FEED PUMP A
AMMONIUM HYDROXIDE FEED PUMP B
TO AMMONIUM HYDROXIDE MIX TANKS
VENT TO ATMOSPHERE
AMMONIUM HYDROXIDE FILL
TO CAUSTIC/AMMONIA DRAIN SUMP
AMMONIUM HYDROXIDE STORAGE TANK 0T-08
AMMONIUM HYDROXIDE TRANSFER PUMPS
TO ATMOSPHERE OUTSIDE TURB BLDG

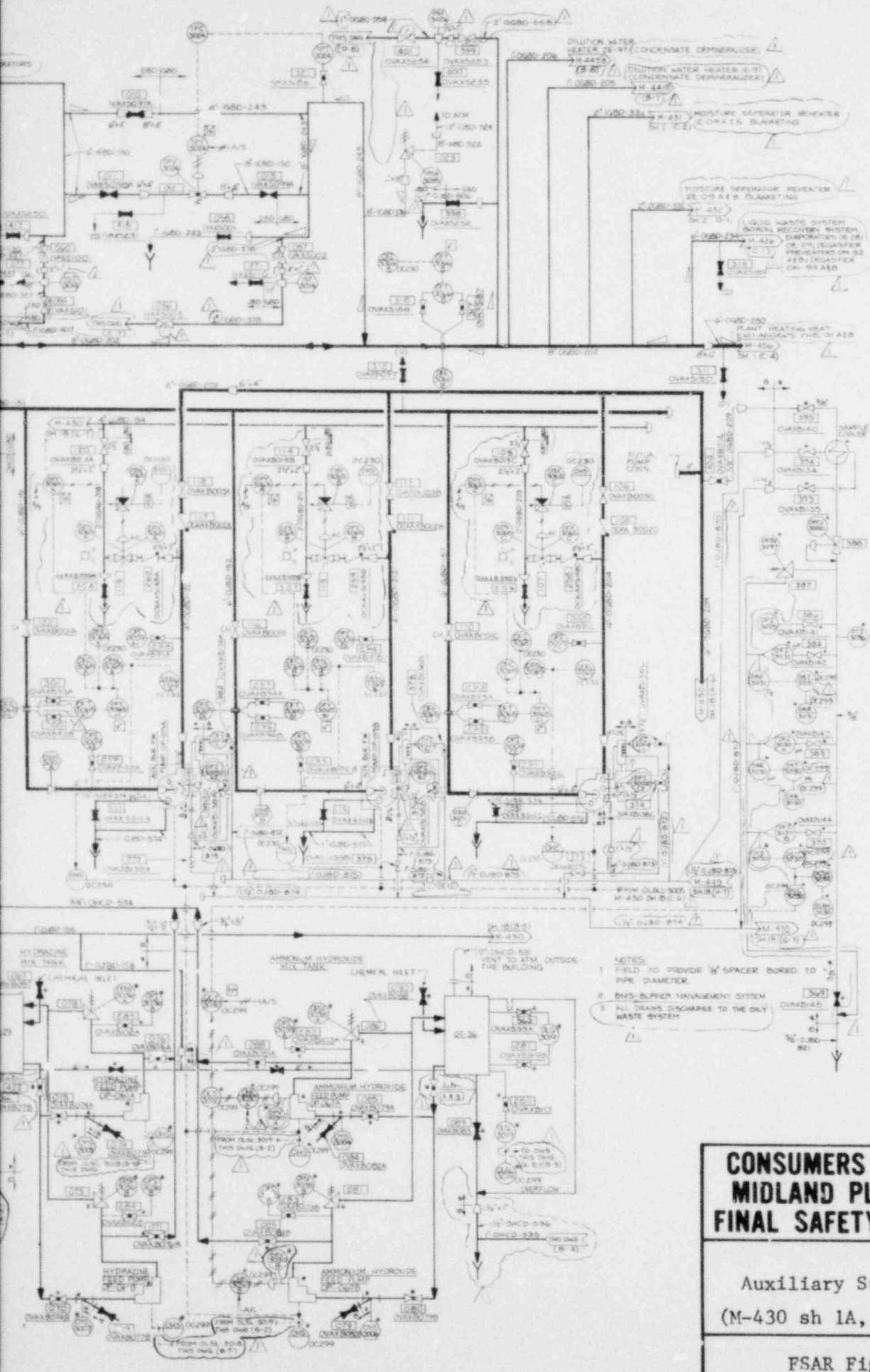


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Feedwater Chemical Addition
Unit 2
(M-444B, Rev 0)

FSAR Figure 10.4-25, sh. 2

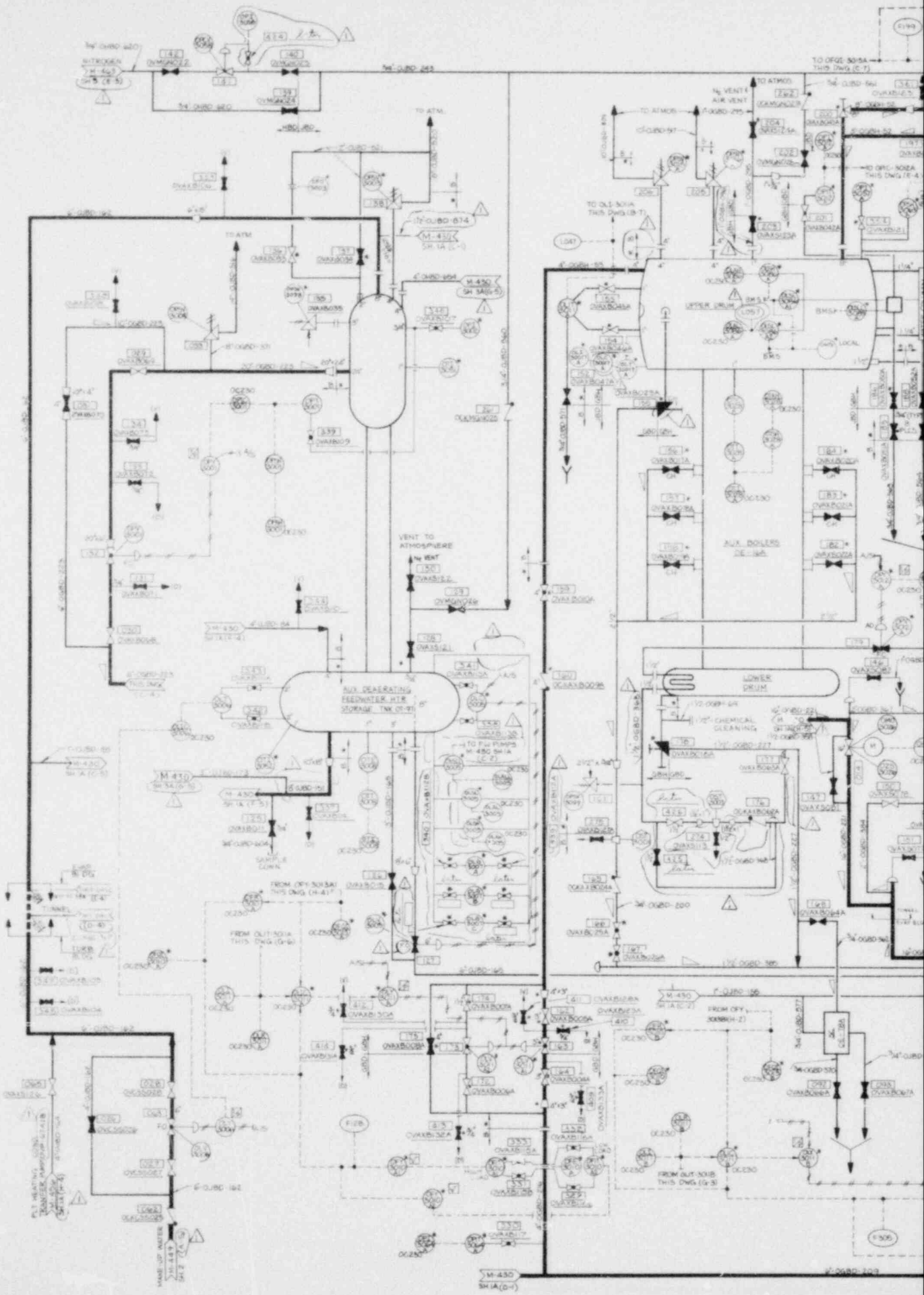

FROM STEAM GENERATORS 2E-15A,E,B
M-452
SH 1B(G-5)
8"-2580-244
12"-2580-359
TO ATM
M-430
SH 1B(D-1)
DEAERATING F.W. HEATERS 2E-05A,E,B
MAIN F.W. PUMP TURBINE 2E-02A,E,B TEST
HOGGING EJECTOR 2K-01
AIR EJECTOR 2K-02 A,B,C,D
2E-08 2K-05A,E,B
CONDENSER DEAERATION
M-434
SH 1B(B-1)
UNIT 2 TURBINE GLAND SEALING
M-45
SH 1B(B-3)
FUTURE (SPARE)
M-430
SH 1B(D-8)
MAIN F.W. PUMP TURBINE 1E-02B TEST
HOGGING EJECTOR 1K-01A,B
AIR EJECTORS 1K-02A,E,B
1K-05A,E,B
M-435
(C-5)
MAIN F.W. PUMP TURBINE 1E-02A TEST
M-434
(B-6)
CONDENSER 1E-01 DEAERATION
M-435
SH 1B(A-2)
UNIT 1 TURBINE GLAND SEALING
M-45
SH 1B(B-3)
OVERFLOW

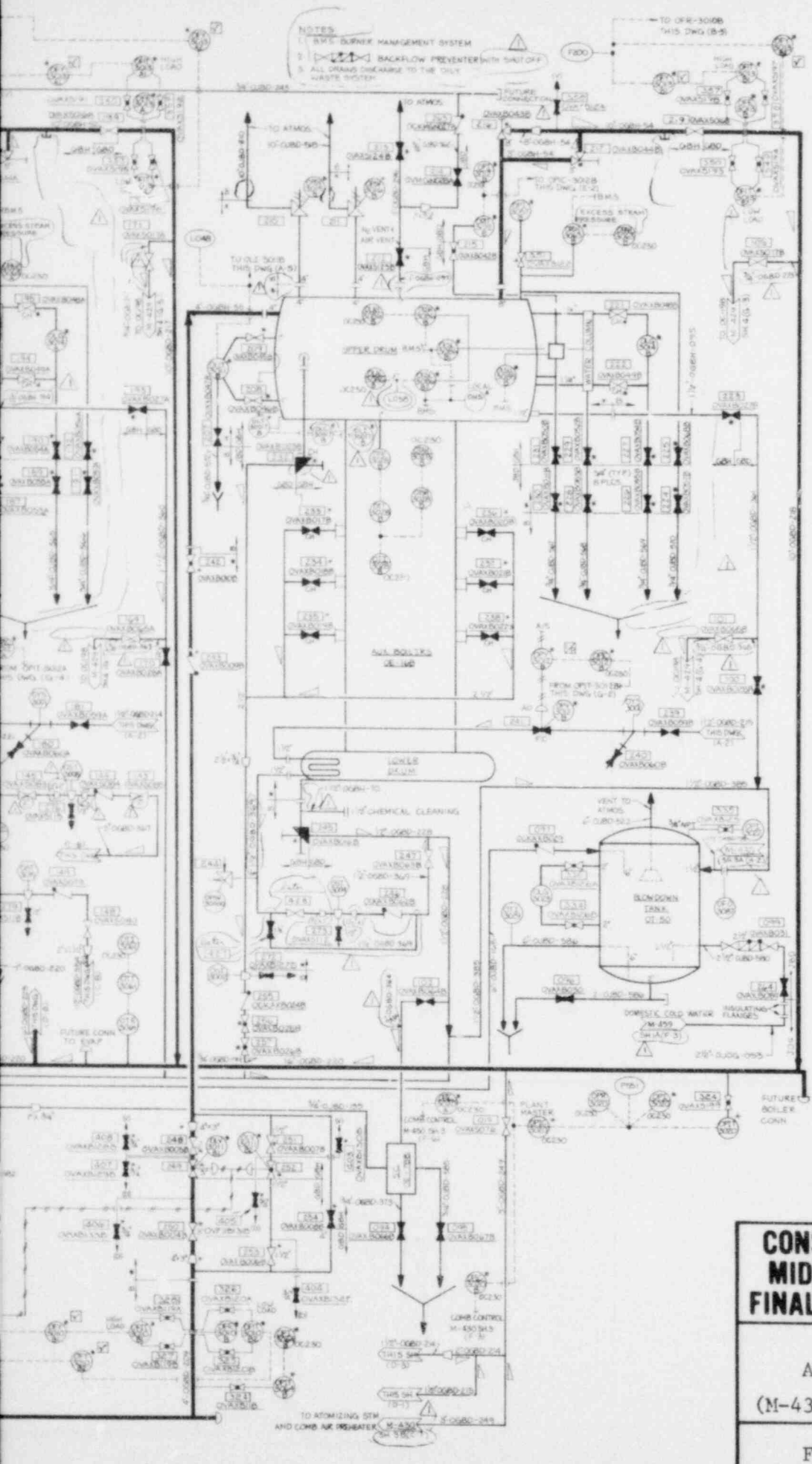


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Auxiliary Steam Boilers
(M-430 sh 1A, Rev 1)

FSAR Figure 10.4-26, sh. 1


AUX. DEAERATING FEEDWATER HTR STORAGE TNK (T-97)
AUX. BOILERS (E-94)
UPPER DRUM
LOWER DRUM
TO ATMOS
VENT TO ATMOSPHERE
FROM OFF SHEET
TO OFF SHEET
M-430 SH 1A (C-1)



CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Auxiliary Steam Boilers
(M-430 sh 1B, Rev 1)

FSAR Figure 10.4-26, sh. 2

generators, results in contamination of the condensate demineralizers which requires processing of the regenerative wastes by the LWS. Operation of the LWS in this mode may require offsite discharge of the turbine building waste liquid. It is therefore assumed that all turbine building drainage is released to the environs without treatment. Furthermore, it is assumed that the discharged laundry waste is released without treatment. The quantity and the concentration of tritium in the tritiated water assumed released is consistent with the aforementioned assumption that 10% of the liquid process stream is discharged.

The effluent activity levels in liquids processed by the liquid waste system are small. The discharge valves are interlocked to automatically close if high radiation is detected by the upstream radiation detector to minimize the release of radioactivity due to operator error. For these reasons an additional conservative adjustment to the release as recommended in NUREG 0017 is deemed not applicable. The radioisotopic concentrations in the effluent during all modes of plant operation are below the limits set forth in Paragraph 20.106 of 10 CFR 20.

Table 11.2-8 presents the expected average annual liquid releases for normal plant operation including anticipated operational occurrences. These releases are based on expected system parameters for the boron recovery system, given in Table 11.2-7, and for the LWS, given in Table 11.2-4. Expected primary coolant, secondary system, and regenerative solution concentrations are given in Tables 11.1-7, 11.1-14, and 11.2-6 respectively.

The radioactive liquid effluents from the plant are diluted with various plant discharges and subsequently discharged to the Tittabawassee River. The dilution water is normally provided by the cooling pond blowdown. However, during periods when there is no blowdown, dilution water can be drawn from the discharge of the cooling pond makeup pumps. The final cooling pond operation study [1] estimated that pond blowdown will occur intermittently with a long-term average flowrate of approximately 48.5 cfs. This average does not encompass periods of zero blowdown. If blowdown does not occur when liquid effluents are to be discharged, the effluents will be diluted with up to 67 cfs of makeup dilution water provided by one of the makeup pumps. In the computation of average annual radionuclide concentrations, 43 cfs was used for the plant discharge rate, corresponding to the average blowdown flowrate computed in the preliminary cooling pond operation study. Because this is a lower average discharge rate than that estimated from the final cooling pond operation study, and because a lower plant discharge rate produces higher radionuclide concentrations, 43 cfs is conservative. The estimated average annual concentrations of important radionuclides released into the Tittabawassee River are listed in Table 11.2-9 along with the concentration limits set forth in 10 CFR 20. The effluent discharge is further diluted by the Tittabawassee River. 27

For modeling purposes, an approximate 500-foot (152 m) stretch of the Tittabawassee River downstream from the blowdown discharge structure is defined as near field for the mixing of liquid radionuclide effluents with the river. Near field mixing of the effluent discharge into the Tittabawassee River depends mainly on turbulent jet mixing process. The extent of mixing can be related to discharge jet velocity. A relationship between the extent of mixing and jet velocity was established by employing the physical model described in Appendix 5.1B of the Midland Environmental Report - Operating License Stage. The plant discharge forms a shoreline-attached plume and radionuclide concentrations are not uniform across the river. As a result, dilution factors at the end of the near field are defined as the ratio of effluent concentration to the maximum concentration at the downstream end of the near field. Using an effluent discharge flowrate of 67 cfs, the average annual Tittabawassee River flowrate of 1584 cfs, and the experimentally determined jet mixing characteristics, an average annual near field dilution factor of 3 has been estimated. 27

To show that the design objectives of Appendix I to 10 CFR 50 have been met, the maximum individual total body and maximum organ doses have been calculated and found to be below the dose limits of 3 and 10 mrem/yr/unit respectively. Table 11.2-10 gives the doses which were calculated based on the equations and usage factors given in Regulatory Guide 1.109. The Tittabawassee River is not used as a potable water supply; therefore, only fish consumption and shoreline recreation pathways are expected to exist during the term of plant operation.

REFERENCES

1. Midland Power Plant Cooling Pond Operation Study, (March 1979) Bechtel Associates Professional Corporation | 27

TABLE 11.2-1 (continued)

6. Liquid Waste System Concentrates Pumps

Number	2
Type	Vertical, centrifugal
Design pressure, psig	300
Design temperature, °F	140
Design flow, gpm	50
Design head, ft	97
Fluid	Evaporator concentrates
Material	ASTM A 296 GR CF-8M
Design code	Hydraulic Institute
Motor	3hp/460V/3ph/3,550 rpm
Seal type	Double

7. Auxiliary Building Sump Pumps

Number	4
Type	Vertical, submerged
Design pressure, psig	150
Design temperature, °F	150
Design flow, gpm	75
Design head, ft	85
Fluid	Floor drain water
Material	SA-351 GR CF-8m
Design code	Hydraulic Institute
Motor	5hp/460V/3ph/1,750 rpm
Seal type	Single

8. Laundry Drain Tank Pump

Number	1
Type	Vertical, centrifugal
Design pressure, psig	300
Design temperature, °F	140
Design flow, gpm	50
Design head, ft	206
Fluid	Detergent water
Material	ASTM A 296 GR CF-8m
Design code	Hydraulic Institute
Motor	10hp/460V/3ph/3,550 rpm
Seal type	Double

FILTERS

1. Liquid Waste System Drain Tank Filters

Number	2
Type	Epoxy impregnated cellulose fiber cartridge
Design pressure, psig	150
Design temperature, °F	200

TABLE 11.2-1 (continued)

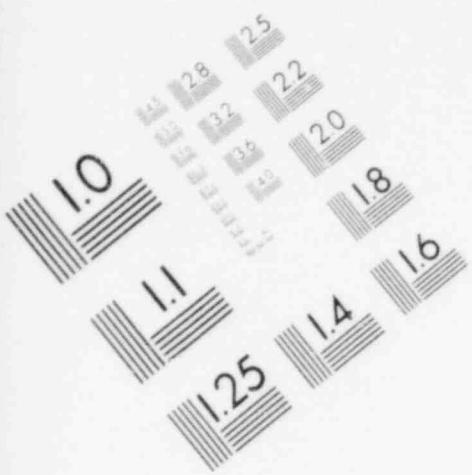
Design flow, gpm	150	
Particle retention		
3 micron	98%	27
23 micron	100%	
Pressure drop @ 150 gpm		
Clean, psi	5	
Dirty, psi	70	
Cartridge area, ft²	23	27
Material, vessel	Austenitic stainless steel	
Fluid	Floor drain water	
Design code	ASME Section III, Class 3(1)	

2. Liquid Waste System Receiver Tank Filters

Number	2	
Type	Epoxy impregnated cellulose fiber cartridge	
Design pressure, psig	150	
Design temperature, °F	200	
Design flow, gpm	150	
Particle retention		
1 micron	98%	
10 micron	100%	
Pressure drop @ 150 gpm		
Clean, psi	5	
Dirty, psi	70	
Cartridge area, ft²	23	27
Material, vessel	Austenitic stainless steel	
Fluid	Generally low and intermediate TDS wastes	
Design code	ASME Section III, Class 3(1)	

3. Monitor Tank Post-Filter

Number	1	
Type	Epoxy impregnated cellulose fiber cartridge	
Design pressure, psig	150	
Design temperature, °F	200	
Design flow, gpm	150 gpm	
Particle retention		
1 micron	98%	
10 micron	100%	
Pressure drop @ 150 gpm		
Clean, psi	5	
Dirty, psi	70	
Cartridge area, ft²	23	27
Material, vessel	Austenitic stainless steel	
Fluid	LWS effluent	
Design code	ASME Section III, Class 3(1)	



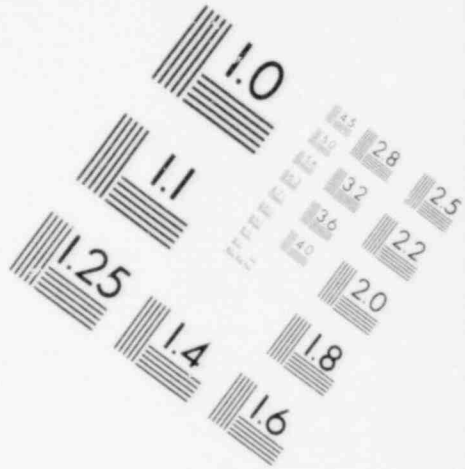
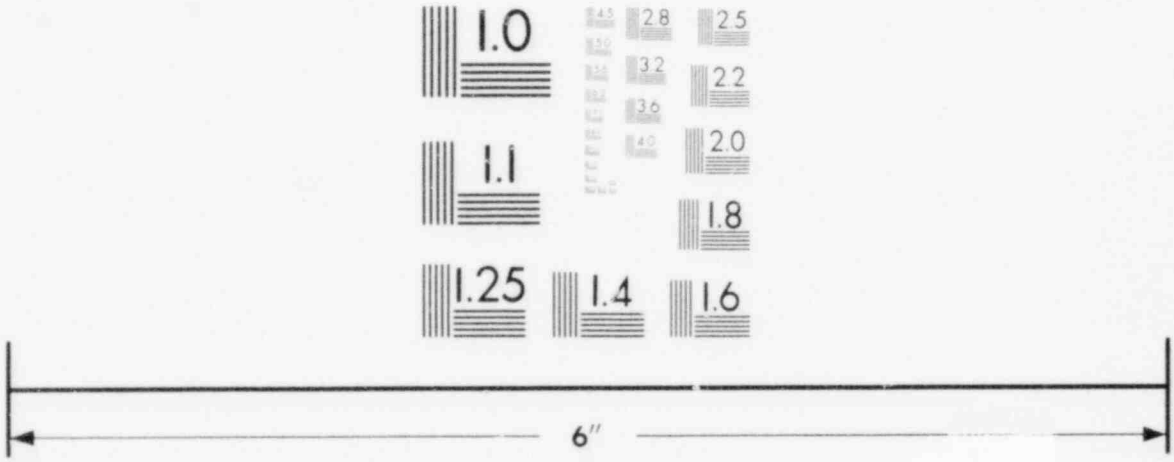
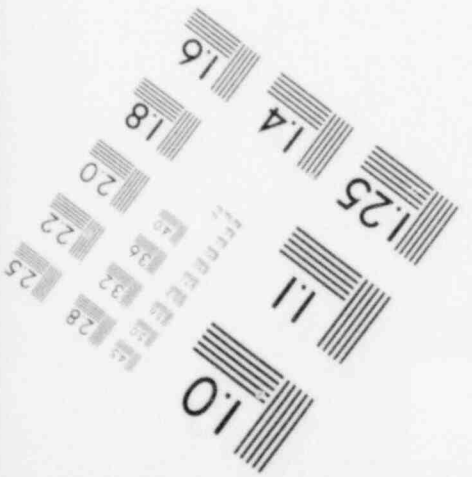


IMAGE EVALUATION
TEST TARGET (MT-3)



MICROCOPY RESOLUTION TEST CHART



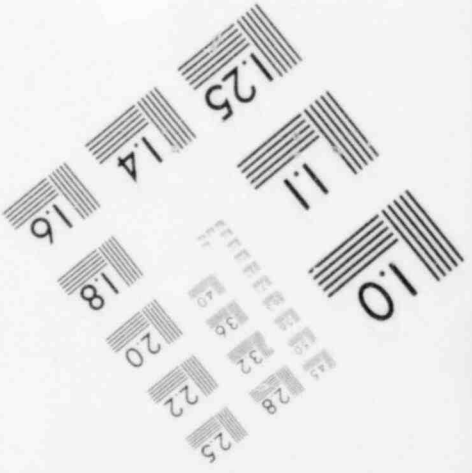


TABLE 11.2-1 (continued)

4. Chemical Waste Filter

Number	1	
Type	Epoxy impregnated cellulose fiber cartridge	
Design pressure, psig	150	
Design temperature, °F	200	
Design flow, gpm	50	27
Particle retention		
1 micron	98%	
23 micron	100%	27
Pressure drop @ 150 gpm		
Clean, psi	3	27
Dirty, psi	70	
Cartridge area, ft²	23	27
Material, vessel	Austenitic stainless steel	
Fluid	Generally high TDS wastes	
Design code	ASME Section III, Class 3(1)	

5. Laundry Drain Tank Filter

Number	4	22
Type	Epoxy, impregnated cellulose fiber cartridge	
Design pressure, psig	150	
Design temperature, °F	200	
Design flow, gpm	50	27
Particle retention		
3 micron	98%	
23 micron	100%	
Pressure drop @ 150 gpm		
Clean, psi	3	27
Dirty, psi	70	
Cartridge area, ft²	23	27
Material, vessel	Austenitic stainless steel	
Fluid	Detergent wastes	
Design code	ASME Section III, Class 3(1)	

TANKS

1. Liquid Waste System Drain Tanks

Number	1	
Type	Horizontal, two compartments	
Capacity, gallons	4,600/compartment	27
Design pressure	Atmospheric	
Design temperature, °F	200	
Fluid	Floor drain water	
Material	SA-240-T-316	
Design code	ASME Section VIII	

TABLE 11.2-1 (continued)

2. Liquid Waste System Receiver Tanks

Number	2
Type	Vertical, two compartments per tank
Capacity, gallons	17,500/compartment
Design pressure	Atmospheric
Design temperature, °F	200
Fluid	Floor drain water
Material	A-240 316 SS
Design code	API-650 (unstamped)

3. Liquid Waste System Monitor Tank

Number	1
Type	Vertical, two compartments
Capacity, gallons	20,000/compartment
Design pressure	Atmospheric
Design temperature, °F	200
Fluid	Demineralized water
Material	A-240 316 SS
Design code	API-650 (unstamped)

4. Chemical Waste Receiver Tanks

Number	1
Type	Horizontal, two compartments
Capacity, gallons	1,400/compartment | 27
Design pressure	Atmospheric
Design temperature, °F	200
Fluid	Sample, laboratory, decontamination drain water
Material	SA-240-T-316
Design code	ASME Section VIII | 27

5. Liquid Waste System Concentrate Monitor Tanks

Number	2
Type	Vertical, two compartments per tank
Capacity, gallons	2,500 per compartment
Design pressure	Atmospheric
Design temperature, °F	200
Fluid	Evaporator concentrates
Material	SA-240 T-316
Design code	ASME Section VIII

TABLE 11.2-1 (continued)

6. Laundry Drain Tank

Number	2
Type	Horizontal
Capacity, gallons	4,000
Design pressure	Atmospheric
Design temperature, °F	200
Fluid	Laundry waste water
Material	SA-240-T-316
Design code	ASME Section VIII

PACKAGED EQUIPMENT

1. Liquid Waste System Evaporator Package

Number	1
Type	Horizontal bowed tube
Fluid	Floor drain waste
Design decontamination factors	
Iodine	10^3
Others	10^4
Design flow, gpm	30
Cooling water	
Flow, lb/hr	620,000
Temperature, in/out, °F	105/127
Pressure, psig	85
Steam	
Flow, lb/hr	21,000
Temperature, in/out, °F	388/298
Pressure, psig	50
Material	
Shell	Incaloy 825
Tubes	Titanium
Design code	ASME Section VIII, Div. 1

2. Liquid Waste System Demineralizers

Number	2
Type	Mixed bed
Design pressure, psig	115
Design pressure drop, psi	20
Design temperature, °F	120
Design flow, gpm	150
Decontamination factors	
Cations	10
Anions	10
Cs, Rb	2
Resin Volume, ft^3	50
Fluid	Evaporator distillate/filtered floor drain water

27

TABLE 11.2-1 (continued)

Material	304 SS
Design code	ASME Section VIII

(1)Filter design code is ASME Section VIII; filter manufacturer elected to impose more stringent requirements.

TABLE 11.2-9

ESTIMATED LIQUID EFFLUENT CONCENTRATIONS[1]
(μCi/cc)

Radionuclide	Diluted by Plant Discharge	10 CFR 20 Table II, Col 2	Fraction of 10 CFR 20
Br-83	1.42E-13	3.0E-6	4.7E-8
I-130	2.84E-13	3.0E-6	9.5E-8
I-131	8.02E-11	3.0E-7	2.7E-4
I-132	2.76E-12	8.0E-6	3.5E-7
I-133	5.60E-11	1.0E-6	5.6E-5
I-134	4.79E-13	2.0E-5	2.4E-8
I-135	1.29E-11	4.0E-6	3.2E-6
Rb-86	4.30E-14	7.0E-5	6.1E-10
Cs-134	3.57E-10	9.0E-6	4.0E-5
Cs-136	5.62E-12	9.0E-5	6.2E-8
Cs-137	6.38E-10	2.0E-5	3.2E-5
Cr-51	3.49E-13	2.0E-3	1.8E-10
Mn-54	2.60E-11	1.0E-4	2.6E-7
Fe-55	3.23E-13	8.0E-4	4.1E-10
Fe-59	1.96E-13	6.0E-5	3.3E-9
Co-58	1.07E-10	1.0E-4	1.1E-6
Co-60	2.35E-10	5.0E-5	4.7E-6
Sr-89	7.79E-14	3.0E-6	2.6E-8
Sr-90	2.01E-15	3.0E-7	6.7E-9
Sr-91	8.10E-14	7.0E-5	1.2E-9
Y-91	3.57E-13	3.0E-5	1.2E-8
Y-93	1.64E-14	3.0E-5	5.5E-10
Zr-95	3.65E-11	6.0E-5	6.1E-7
Nb-95	5.21E-11	1.0E-4	5.2E-7
Mo-99	6.75E-11	2.0E-4	3.4E-7
Ru-103	3.65E-12	8.0E-5	4.6E-8
Ru-106	6.25E-11	1.0E-5	6.3E-6
Te-125m	4.09E-15	2.0E-4	2.1E-11
Te-127m	4.12E-14	6.0E-5	6.9E-10
Te-129m	2.73E-13	3.0E-5	9.1E-9
Te-131m	1.58E-13	6.0E-5	2.6E-9
Te-132	3.46E-12	3.0E-5	1.2E-7
Ba-140	3.78E-14	3.0E-5	1.3E-9
Ce-141	1.18E-14	9.0E-5	1.3E-10
Ce-143	6.30E-15	4.0E-5	1.6E-10
Ce-144	1.30E-10	1.0E-5	1.3E-5
Pr-143	7.60E-15	5.0E-5	1.5E-10
Np-239	2.00E-13	1.0E-4	2.0E-9
Ag-110m	1.15E-11	3.0E-5	3.8E-7
H-3	6.07E-6	3.0E-3	2.0E-3
TOTAL			2.5E-3

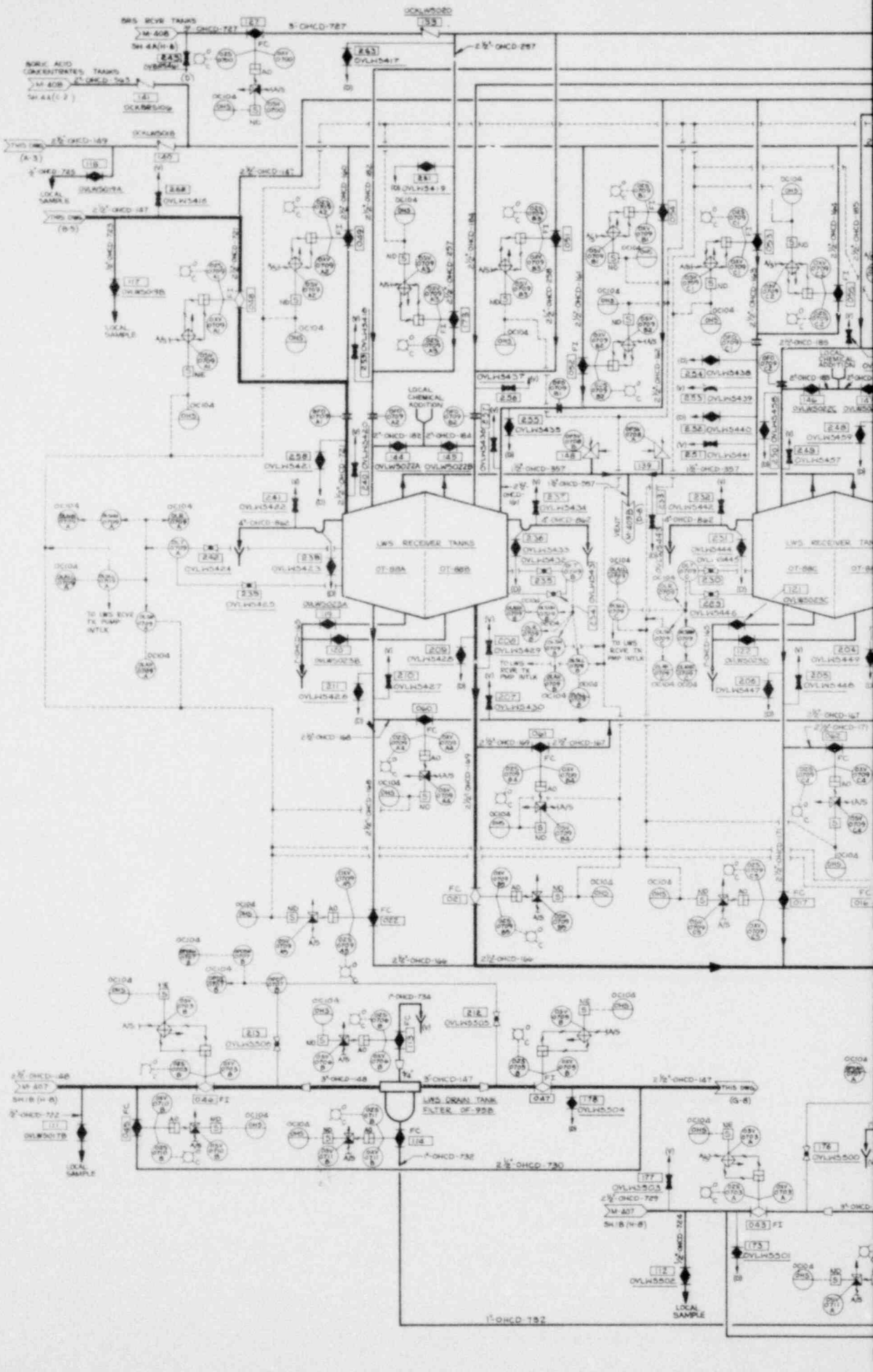
[1]These concentrations are conservatively calculated using a plant discharge flowrate of 43 cfs.

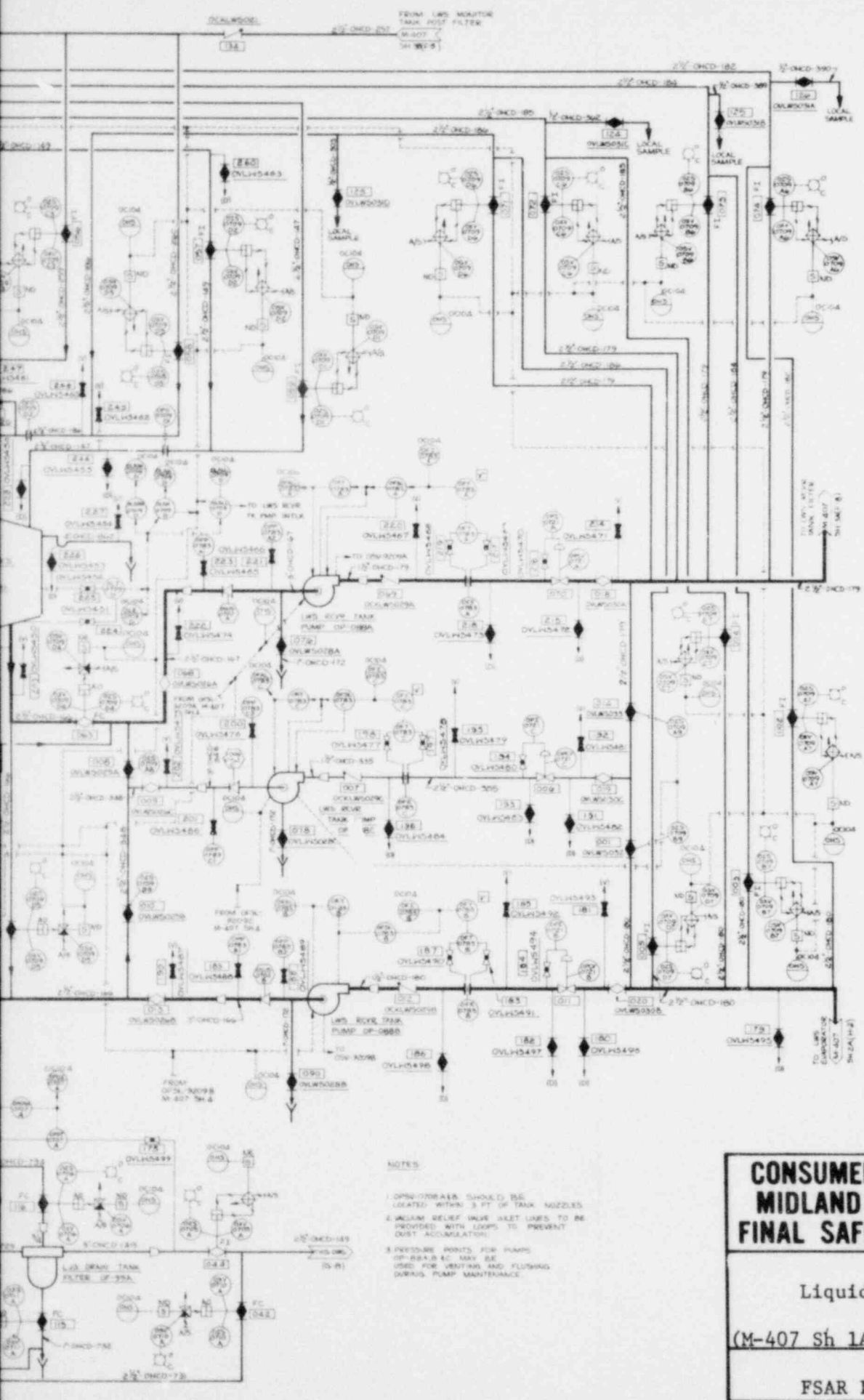
TABLE 11.2-10

MAXIMUM INDIVIDUAL DOSES FROM LIQUID EFFLUENTS (mrem/Yr/Unit)

Type of Dose	Pathway	Dose
Total body-adult	Fish consumption	1.25
	Shoreline recreation	.002
	TOTAL	1.252
Adult's liver	Fish consumption	1.72
	TOTAL	1.72

10


BRS RCVR TANKS
BORIC ACID CONCENTRATES TANKS
LWS RECEIVER TANKS
LWS DRAIN TANK FILTER OF-95B
LOCAL SAMPLE
LOCAL CHEMICAL ADDITION
TO LWS RCVR TK PMP INTLK

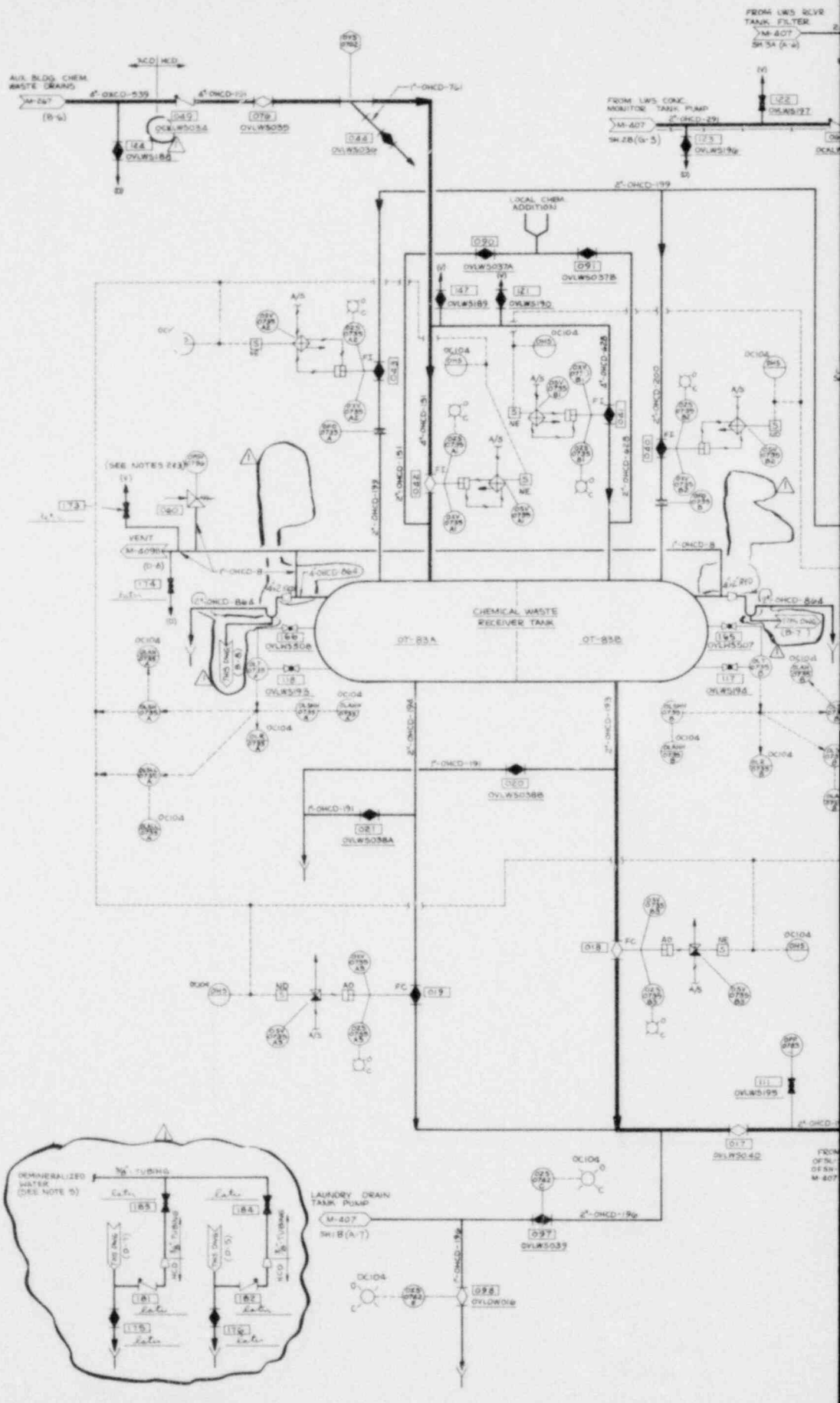


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Liquid Waste Unit 1 & 2

(M-407 Sh 1A Rev 0)

FSAR Figure 11.2-1 Sh 1


CHEMICAL WASTE RECEIVER TANK
OT-83A
OT-83B
LOCAL CHEM. ADDITION
AUX. BLDG. CHEM. WASTE DRAINS
FROM LWS RCVR TANK FILTER
FROM LWS CONC. MONITOR TANK PUMP
LAUNDRY DRAIN TANK PUMP
DEMINERALIZED WATER (SEE NOTE 5)
VENT
(SEE NOTES 2 & 3)
HCD
8"-OHCD-199
6"-OHCD-151
6"-OHCD-200
6"-OHCD-428
6"-OHCD-192
6"-OHCD-193
6"-OHCD-194
4"-OHCD-191
4"-OHCD-8
4"-OHCD-8a4
4"-OHCD-8b4
3"-OHCD-8a4
3"-OHCD-8b4
1"-OHCD-8
1"-OHCD-74
2"-OHCD-196
2"-OHCD-197
6"-OHCD-539
6"-OHCD-151
OVLW5037A
OVLW5037B
OVLW5189
OVLW5190
OVLW5506
OVLW5507
OVLW5193
OVLW5196
OVLW5038B
OVLW5038A
OVLW5034
OVLW5035
OVLW5036
OVLW5195
OVLW5040
OVLW5039
OVLW5196
OVLW5197
OVLW5198
OVLW5199
OVLW5200
OVLW5201
OVLW5202
OVLW5203
OVLW5204
OVLW5205
OVLW5206
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OVLW5211
OVLW5212
OVLW5213
OVLW5214
OVLW5215
OVLW5216
OVLW5217
OVLW5218
OVLW5219
OVLW5220
OVLW5221
OVLW5222
OVLW5223
OVLW5224
OVLW5225
OVLW5226
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OVLW5231
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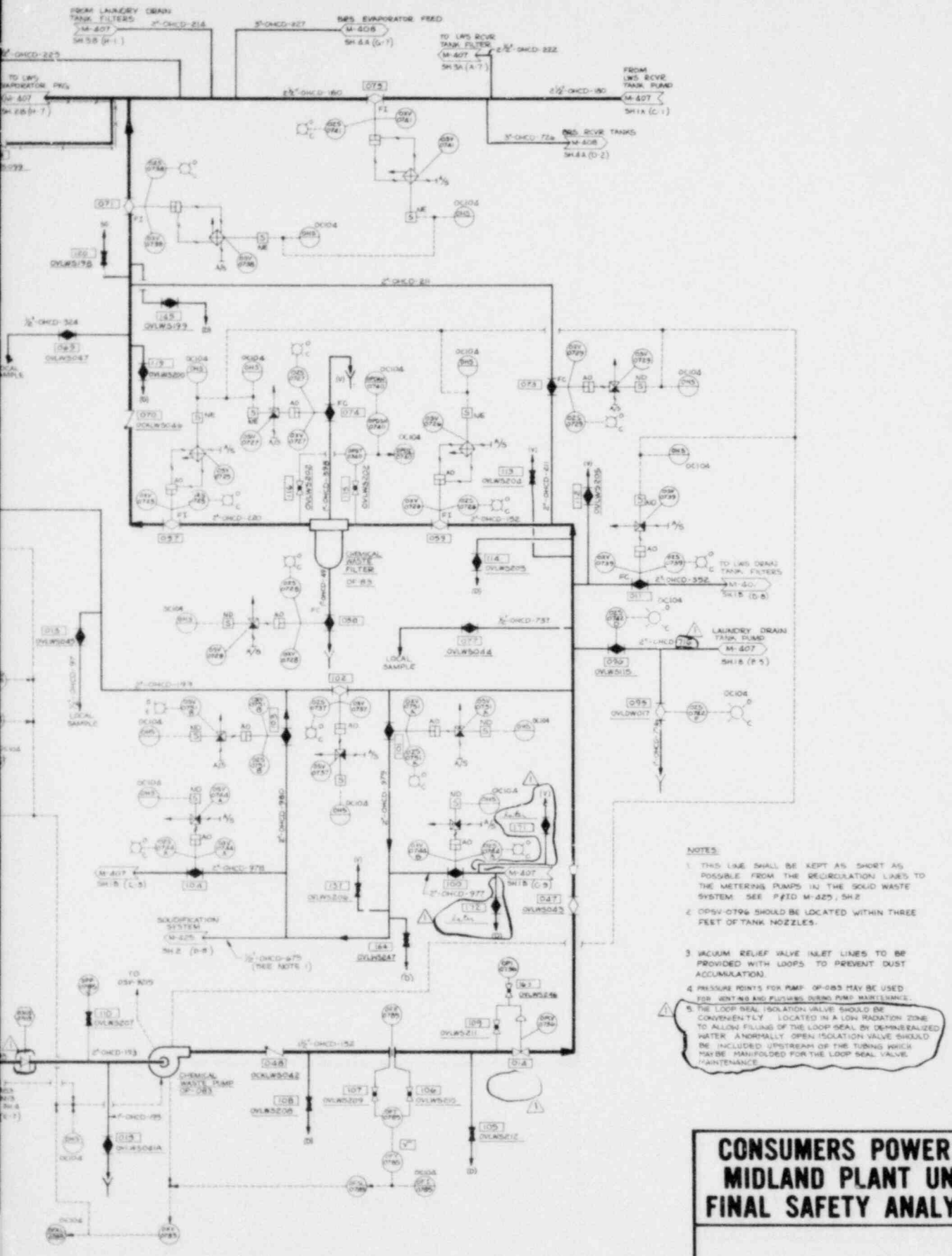
OVLW5233
OVLW5234
OVLW5235


FROM LAUNDRY DRAIN TANK FILTERS
M-407
SH 5B (H-1)
3"-OHCD-214
3"-OHCD-227
B&PS EVAPORATOR FEED
M-408
SH 4A (G-7)
TO LWS RCVR TANK FILTER
M-407
SH 5A (A-7)
2½"-OHCD-222
FROM LWS RCVR TANK PUMP
M-407
SH 1A (C-1)
2½"-OHCD-225
TO LWS EVAPORATOR PKG
M-407
SH 2B (H-7)
2½"-OHCD-180
075
2½"-OHCD-180
3"-OHCD-72a
B&PS RCVR TANKS
M-408
SH 4A (D-2)
FI
OSV 0736
OSV 0738
OSV 0740
OSV 0741
OSV 0742
OSV 0743
OSV 0744
OSV 0745
OSV 0746
OSV 0747
OSV 0748
OSV 0749
OSV 0750
OSV 0751
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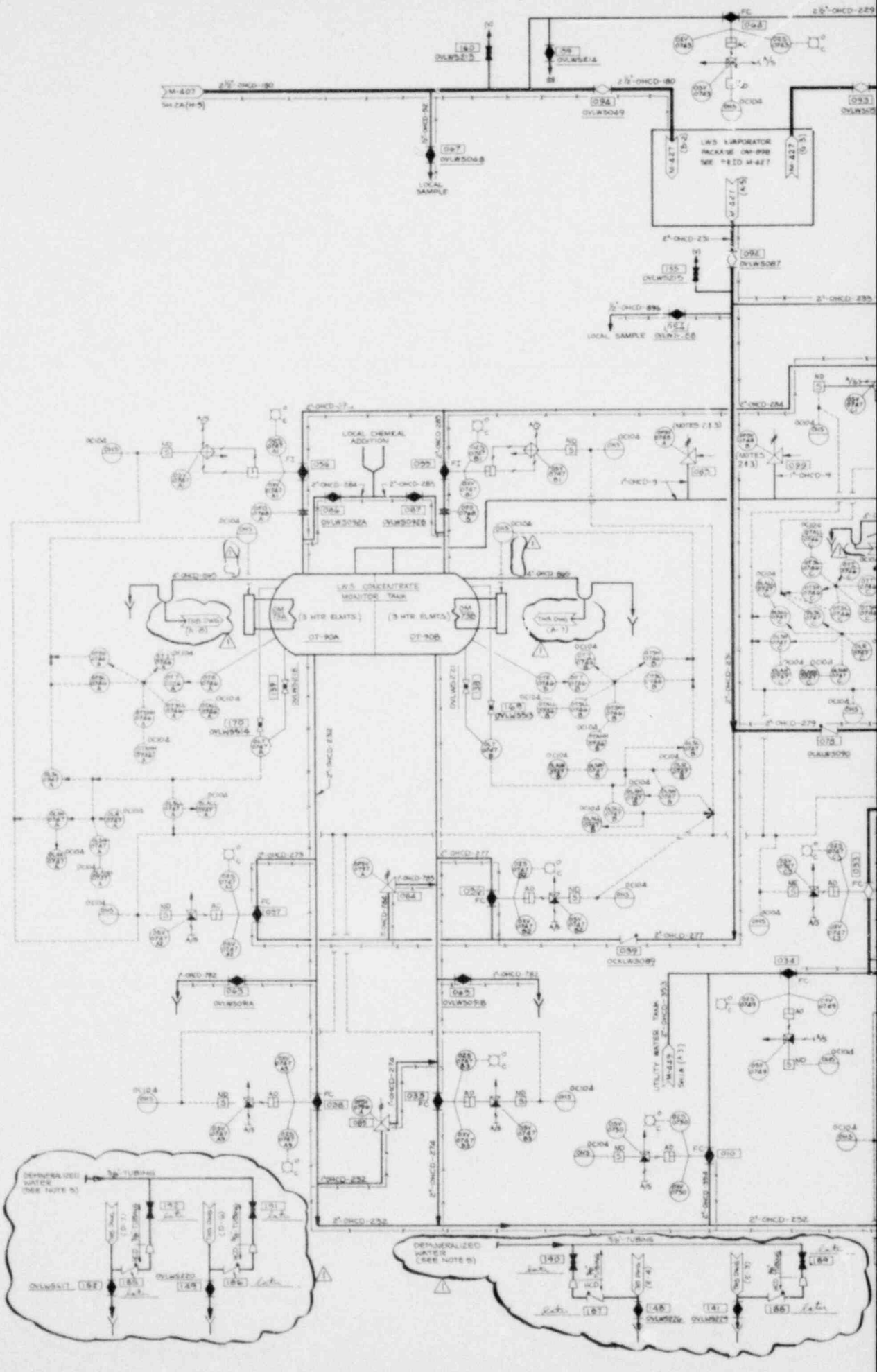
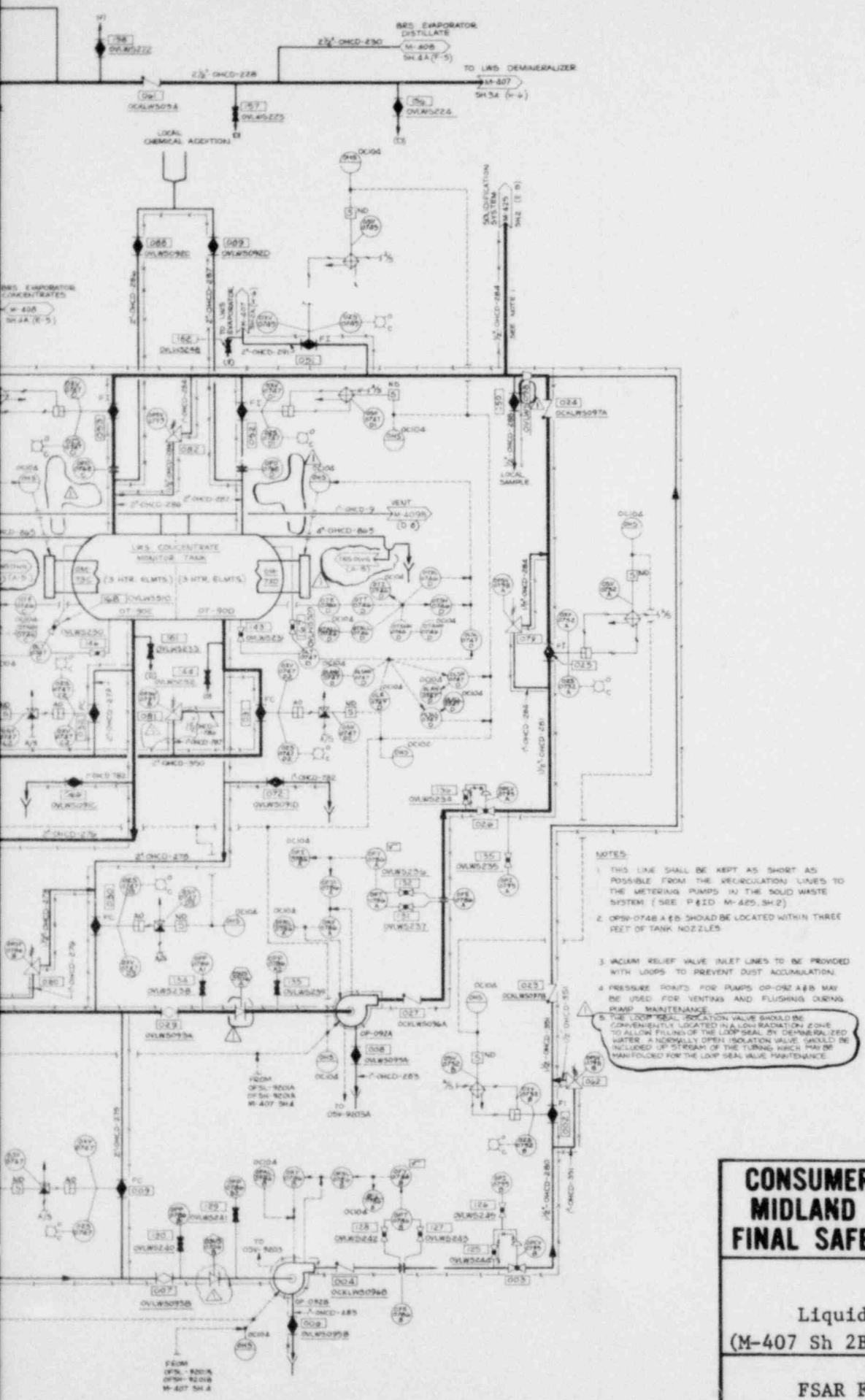
OSV 0759
OSV


LWS CONCENTRATE MONITOR TANK
(3 HTR ELMTS.)
(3 HTR ELMTS.)
OT-90A
OT-90B
LOCAL CHEMICAL ADDITION
LWS EVAPORATOR PACKAGE ON-89B SEE P&ID M-427
LOCAL SAMPLE
LOCAL SAMPLE
DEMINERALIZED WATER (SEE NOTE 15)
DEMINERALIZED WATER (SEE NOTE 15)
UTILITY WATER TANK
NOTES 2 & 3
NOTES 2 & 3



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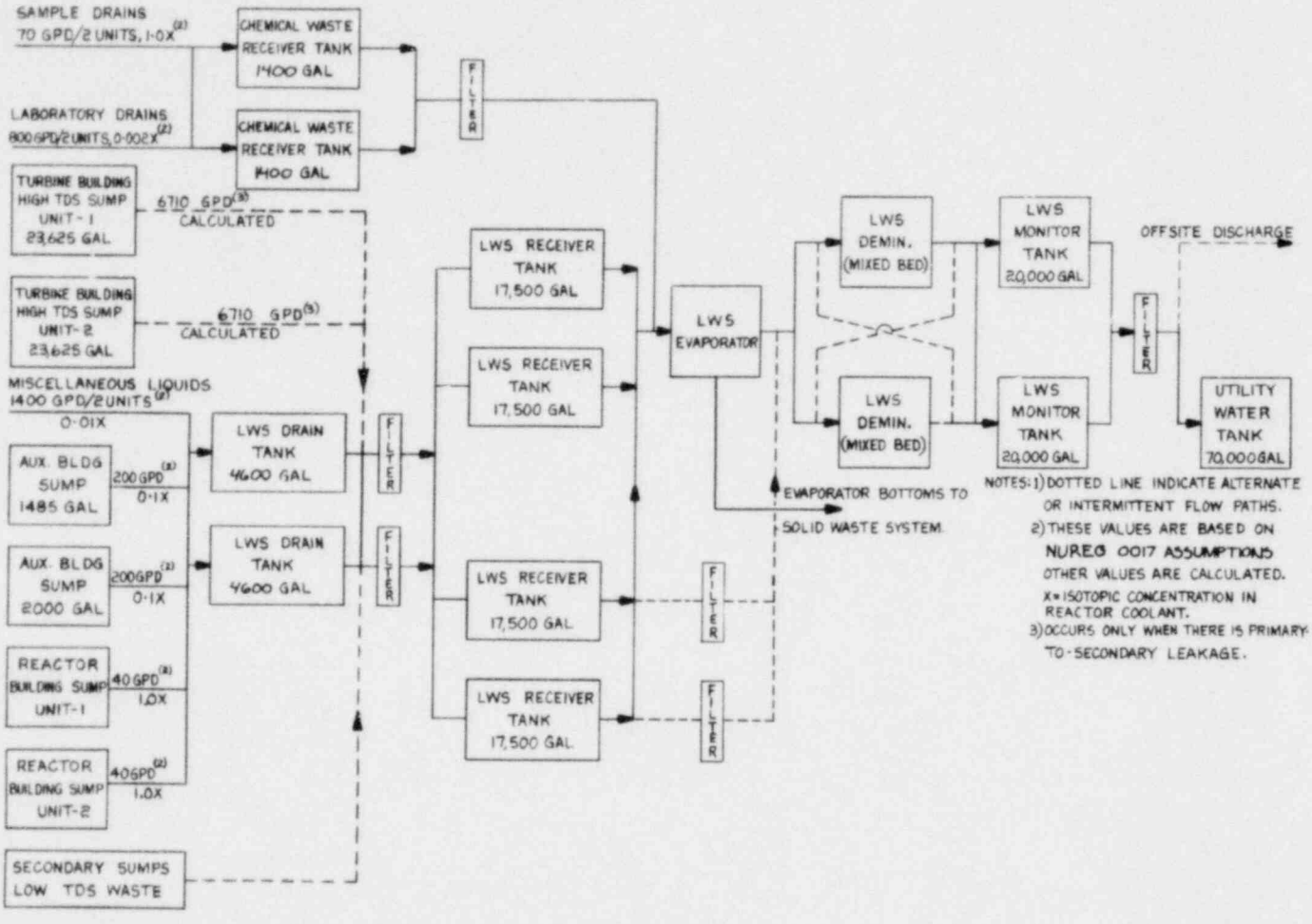
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Liquid Waste Unit 1 & 2
(M-407 Sh 2B Rev 1)

FSAR Figure 11.2-2 Sh 2



CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Liquid Waste System
Block Diagram

FSAR Figure 11.2-6

11.3 GASEOUS WASTE MANAGEMENT SYSTEM

The gaseous waste management system (GWMS) includes all subsystems that have the potential to release airborne radioactive materials into the environment during normal operation and anticipated operational occurrences. Included are the vent system of normally and potentially radioactive components, building ventilation systems, and the radwaste gas system (RGS).

The waste gases originating in the reactor coolant consist mainly of hydrogen and nitrogen with trace amounts of radioactive gases. The function of the RGS is to collect and isolate these radioactive noble gases, airborne halogens, and particulates, and to reduce their activity through decay.

The plant ventilation exhaust systems accommodate other potential release paths for gaseous radioactivity from miscellaneous leakages, aerated vents from systems containing radioactive fluids, and the removal of noncondensables from the secondary system. Potential sources of gaseous releases are discussed in Subsection 11.3.3 and illustrated in Figure 11.3-1. Systems which handle these gases are included here to the extent that they represent potential release paths for gaseous radioactivity and are discussed in detail in the following sections.

11.3.1 DESIGN BASES

The design objectives of the gaseous waste management system (GWMS) are:

a. To meet the processing requirements of the plant during normal operation and anticipated operational occurrences

b. To reduce the radioactivity concentrations of the gaseous wastes to levels acceptable for discharge

c. To protect both the public and plant personnel against exposure to radioactive material in accordance with the applicable design criteria

d. To have adequate available capability during periods of excessive waste generation

The GWMS is designed in accordance with the following criteria:

a. The GWMS processing capability is sufficient to ensure meeting the requirements of 10 CFR 20 and the dose design objectives specified in Appendix I to 10 CFR 50 during normal plant operation and anticipated operational occurrences. More specifically:

1. The calculated annual total quantity of all radioactive material released from each reactor at the site to the atmosphere will not result in an estimated annual air dose from gaseous effluents at any location near ground level which could be occupied by individuals in unrestricted areas in excess of 10 millirads for gamma radiation or 20 millirads for beta radiation.

2. The calculated annual total quantity of all radioactive material released from each reactor at the site to the atmosphere will not result in an estimated annual external dose from gaseous effluents to any individual in unrestricted areas in excess of 5 millirems to the total body or 15 millirems to the skin.

3. The calculated annual total quantity of all radioactive iodine and radioactive material in particulate form released from each reactor at the site in effluents to the atmosphere will not result in an estimated annual dose from such radioactive iodine and radioactive material in particulate form for any individual in an unrestricted area from all pathways of exposure in excess of 15 millirems to any orga .

4. The concentrations of radioactive materials in gaseous effluents released to an unrestricted area will not exceed the limits in 10 CFR 20, Appendix B, Table II, Column 1.

b. The GWMS is designed to meet the requirements of General Design Criteria 60 and 64 of Appendix A to 10 CFR 50.

11.3.1.1 Radwaste Gas System

The radwaste gas system (RGS) collects the radioactive noble gases, airborne halogens, and particulates generated during plant operation. These gases are then retained for radioactive decay before releasing to the atmosphere. The RGS is shared between the two units and is located in the auxiliary building.

Protection of the radwaste gas system from wind and tornado effects is discussed in Section 3.3. Flood design is discussed in Section 3.4 . Missile protection is discussed in Section 3.5. Protection against dynamic effects associated with the postulated rupture of piping is discussed in Section 3.6. Environmental design is discussed in Section 3.11. Piping and isolation valves in the areas of containment penetration are discussed in Subsection 6.2.4. 27

11.3.1.1.1 Safety Design Bases

SAFETY DESIGN BASIS ONE - The radwaste gas system is designed to limit the annual releases of radioactive noble gases, airborne halogens, and particulates to below the regulatory limits of 10 CFR 20 and 10 CFR 50.

SAFETY DESIGN BASIS TWO - The gas surge tank, gas decay tanks, and associated isolation valves and piping are designed to withstand the safe shutdown earthquake.

SAFETY DESIGN BASIS THREE - The RGS is designed to monitor combustible gas concentrations and take appropriate measures when necessary to prevent an explosion as discussed in Subsection 11.3.1.2.2 and 11.3.2.1.2.

11.3.1.1.2 Power Generation Design Bases

POWER GENERATION DESIGN BASIS ONE - The RGS is designed to compress and store waste gases. Adequate storage volume is provided so that a design basis holdup time of 60 days is available for the radioactive decay of the stored gases. Actual holdup time may be less than this value depending upon radionuclide content relative to 10 CFR 50, Appendix I criteria. System sizing incorporates provisions for degasification of one RC volume per day for one unit and load changes at 50, 100, 150, 200, and 250 days of the core equilibrium cycle, as well as two hot shutdowns and two cold shutdowns for the other unit. Gaseous waste generation estimates in Table 11.3-4 represent normal operation and not the system sizing basis.

POWER GENERATION DESIGN BASIS TWO - The RGS is designed to provide the facilities for sampling, monitoring, and controlling the release of waste gases.

POWER GENERATION DESIGN BASIS THREE - The system components and piping are shielded to minimize radiation exposure to plant operating personnel. Remotely operated valves and equipment are utilized in order to minimize radiation exposure during maintenance and normal operations.

POWER GENERATION DESIGN BASIS FOUR - The RGS is designed to accommodate normal gas volumes plus an abnormal gas volume resulting from degasification of one reactor coolant volume in a day.

POWER GENERATION DESIGN BASIS FIVE - The system includes drain lines and facilities to prevent moisture accumulation.

11.3.1.1.3 Codes and Standards

Codes and standards applicable to the radwaste gas system are listed in Table 3.2-1. Engineering and design of the RGS are in accordance with the criteria of Branch Technical Position (BTP) ETSB 11-1 Section B-II. The only exception to this BTP is that the documentation requirements of this position paper are not specified in design and procurement documents. At date of publication of Rev. 1 of BTP ETSB 11-1 the RGS was at a stage too far advanced in design and procurement for implementation of this requirement. Quality assurance requirements which were in effect are discussed in Chapter 17.

11.3.1.2 Radwaste Gas System Design

The components of the radwaste gas system are listed in Table 11.3-1. Included are equipment capacity, materials of construction, applicable design codes, and the design temperatures and pressures. All equipment is shared between Unit 1 and Unit 2. Equipment specified is of a design which has typically been used in a successful manner in operating radwaste gas systems. The components and interconnecting piping in the systems meet the requirements of Branch Technical Position ETSB 11-1. A piping and instrumentation diagram of the RGS is shown in Figure 11.3-2. The gaseous discharge radiation monitor is discussed in Subsection 11.5.2.2.4. | 27

The equipment layout of the RGS is presented as part of the auxiliary building equipment layout in Figure 1.2-5. The layout provides design features consistent with Regulatory Guide 8.8, Rev. 1, to minimize occupational radiation exposure to plant personnel. Compressors are located in separate shielded compartments so that radiation exposure is reduced to a minimum whenever it is necessary to do maintenance work on equipment. An installed spare compressor is provided in order to minimize the downtime of the system. All valves are located outside the rooms containing the tanks or compressors. | 27

The valves are described in Subsection 11.3.1.2.3. Piping runs are located in shielded pipe chases. Drain lines are routed such that liquid accumulation will not occur. Sampling lines are routed to a common centrally located sampling station.

The design and expected component activities for the RGS are listed in Tables 11.3-2 and 11.3-3 respectively.

Specific design considerations are discussed in the following sections.

11.3.2.1.3 Instrumentation Applications

The inlet line of the gas surge tank is connected to a gas analyzer with redundant channels which continuously monitor oxygen level. Nitrogen will be automatically injected into the surge tank to dilute the concentration if the explosion limit is approached. An alarm will notify the operator when nitrogen injection occurs. 27

The oxygen concentration alarms at 2% and 4% are annunciated at the radwaste system local control panel and at the main control room system alarm. 20

The oxygen monitors are designed such that their operation will not cause an explosion of hydrogen gas (non-sparking). 13

The oxygen monitoring system will have the capability for daily sensor checks, monthly functional checks, and quarterly calibrations.

The gas surge tank is equipped with a pressure switch which will start one compressor when the pressure reaches 5 psig and the second compressor when the pressure reaches 10 psig.

The pressure and temperature of each gas decay tank are monitored and recorded continuously to detect leakage. A pressure of 145 psig within any decay tank signals an alarm on the main control panel to alert the operator to go to the radwaste control room. A pressure of 160 psig within any decay tank signals an alarm on the radwaste control panel, automatically trips the

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TABLE 11.3-1

RADWASTE GAS SYSTEM
PROCESS EQUIPMENT DESCRIPTION

Equipment	Radwaste Gas Surge Tank	Radwaste Gas Decay Tanks	Radwaste Gas Compressors, Aftercoolers, and Moisture Separators	
Quantity	1	6	3	
Capacity	200 ft^3	390 ft^3 (each)	5 scfm (each)	
Material of construction	Stainless steel	Stainless steel	Stainless steel	
Design pressure, psig	50	250	240	27
Design temperature, ^oF	200	200	400	
Design code	III-3	III-3	VIII, Div. 1	27

TABLE 11.3-2

RGS COMPONENT ACTIVITY INVENTORY,(1) Ci
(DESIGN CONDITION)

Isotope	Surge Tank	Decay Tank (each)
Kr-83m	1.07E+1	1.37E-2
Kr-85m	8.81E+1	3.52E+0
Kr-85	4.74E+2	1.30E+3
Kr-87	1.59E+1	3.90E-4
Kr-88	1.12E+2	1.60E+0
Xe-131m	1.54E+2	4.01E+2
Xe-133m	2.30E+2	4.82E+2
Xe-133	2.20E+4	5.38E+4
Xe-135m	3.85E-2	6.25E-3
Xe-135	3.73E+2	2.05E+2
Xe-138	5.58E-2	1.8E-23
I-129	3.31E-9	9.09E-9
I-131	1.70E-1	4.34E-1
I-132	1.59E-2	6.47E-5
I-133	1.62E-2	2.15E-1
I-134	2.18E-3	2.5E-10
I-135	6.61E-2	2.00E-2

(1)Bases for design inventories are:

a. Reactor coolant concentration is based on 1% failed fuel.
b. Reactor coolant gas concentration is 20 scc/kg of reactor coolant.
c. All the gaseous activity in the reactor coolant is transferred to the waste gas decay tank within 24 hours after the reactor is shut down.
d. All the organic iodines reaching the degasifier are removed at the degasifier. Credit for ion exchangers in the makeup and purification system and boron recovery system is considered.

TABLE 11.3-11

NEAREST SITE BOUNDARY[1] - ESTIMATED ATMOSPHERIC DILUTION (X/Q) AND DEPOSITION (D/Q) FACTORS FOR ELEVATED (MIXED MODE) RELEASE WITHOUT OPEN TERRAIN CORRECTION FACTORS

Sector	Distance Miles	KM	6 Month X/Q(s/m³)	Annual X/Q(s/m³)	6 Month D/Q(1/m²)	
N	0.311	0.50	6.11E-7	6.12E-7	9.13E-9	10
NNE	0.311	0.50	6.41E-7	6.84E-7	1.06E-8	27
NE	0.311	0.50	5.60E-7	6.80E-7	9.17E-9	
ENE	0.311	0.50	6.19E-7	6.99E-7	1.02E-8	
E	0.36	0.58	4.23E-7	5.27E-7	7.43E-9	
ESE	0.55	0.88	2.78E-7	2.94E-7	4.74E-9	
SE	0.95	1.53	1.93E-7	1.81E-7	3.43E-9	
SSE	1.22	1.97	1.03E-7	1.11E-7	1.79E-9	
S	1.19	1.92	6.56E-8	6.27E-8	1.04E-9	10
SSW	1.22	1.97	6.72E-8	6.10E-8	1.08E-9	
SW	0.90	1.45	9.73E-8	8.68E-8	1.65E-9	
WSW	0.311	0.50	3.55E-7	2.99E-7	5.50E-9	
W	0.311	0.50	1.91E-7	1.64E-7	2.57E-9	
WNW	0.311	0.50	1.67E-7	1.65E-7	2.07E-9	
NW	0.311	0.50	3.39E-7	2.78E-7	4.52E-9	
NNW	0.311	0.50	3.95E-7	3.49E-7	4.72E-9	

[1] See Subsection 2.1.1.3 for description of site boundary.

TABLE 11.3-12

NEAREST SITE BOUNDARY [1] - ESTIMATED ATMOSPHERIC DILUTION (X/Q) AND DEPOSITION (D/Q) FACTORS FOR ELEVATED (MIXED-MODE) RELEASE WITH OPEN TERRAIN CORRECTION FACTORS

Sector	Distance Miles	KM	6 Month X/Q(s/m^3)	Annual X/Q(s/m^3)	6 Month D/Q(1/m^2)
N	0.311	0.50	2.44E-6	2.45E-6	3.65E-8
NNE	0.311	0.50	2.57E-6	2.74E-6	4.23E-8
NE	0.311	0.50	2.24E-6	2.72E-6	3.67E-8
ENE	0.311	0.50	2.48E-6	2.80E-6	4.09E-8
E	0.36	0.58	1.93E-6	2.11E-6	2.97E-8
ESE	0.55	0.88	1.11E-6	1.18E-6	1.90E-8
SE	0.95	1.53	6.50E-7	6.10E-7	1.15E-8
SSE	1.22	1.97	2.64E-7	2.83E-7	4.58E-9
S	1.19	1.92	1.72E-7	1.65E-7	2.73E-9
SSW	1.22	1.97	1.72E-7	1.56E-7	2.77E-9
SW	0.90	1.45	3.51E-7	3.13E-7	5.96E-9
WSW	0.311	0.50	.42E-6	1.20E-6	2.20E-8
W	0.311	0.50	7.62E-7	6.60E-7	1.03E-8
WNW	0.311	0.50	6.67E-7	6.62E-7	8.28E-9
NW	0.311	0.50	1.36E-6	1.11E-6	1.81E-8
NNW	0.311	0.50	1.58E-6	1.40E-6	2.29E-8

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[1]See Subsection 2.1.1.3 for description of site boundary.

TABLE 11.3-13

NEAREST VEGETABLE GARDENS[1] - ESTIMATED ATMOSPHERIC DILUTION (X/Q) AND DEPOSITION FACTORS FOR GROUND LEVEL RELEASE WITHOUT OPEN TERRAIN CORRECTION FACTORS

Sector	Distance Miles	Distance KM	6 Month $X/Q(s/m^3)$	Annual $X/Q(s/m^3)$	6 Month $D/Q(1/m^2)$
N	1.52	2.44	7.62E-7	6.44E-7	5.01E-9
NNE	1.40	2.26	7.35E-7	6.56E-7	5.71E-9
NE	1.29	2.07	7.25E-7	7.32E-7	6.14E-9
ENE	2.33	3.75	3.04E-7	2.91E-7	2.60E-9
E	1.72	2.77	4.69E-7	4.35E-7	4.15E-9
ESE	1.82	2.93	3.55E-7	3.09E-7	3.33E-9
SE	1.72	2.77	3.03E-7	2.59E-7	3.10E-9
SSE	2.5	4.02	9.88E-8	9.37E-8	1.08E-9
S	1.25	2.01	1.85E-7	1.57E-7	2.02E-9
SSW	1.29	2.07	1.89E-7	1.55E-7	1.94E-9
SW	1.02	1.64	3.09E-7	2.54E-7	3.14E-9
WSW	0.8	1.28	7.53E-7	6.46E-7	6.70E-9
W	0.87	1.40	5.89E-7	4.84E-7	4.21E-9
WNW	1.40	2.26	4.16E-7	3.54E-7	2.34E-9
NW	2.10	3.38	3.59E-7	2.70E-7	1.89E-9
WNW	1.86	2.99	5.00E-7	3.70E-7	2.76E-9

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[1] Nearest vegetable garden is assumed located at the nearest residence. See Subsection 2.1.1.3 for description of site boundary.

TABLE 11.3-14

NEAREST VEGETABLE GARDENS[1] - ESTIMATED ATMOSPHERIC DILUTION (X/Q) AND DEPOSITION (D/Q) FACTORS FOR GROUND LEVEL RELEASE WITH OPEN TERRAIN CORRECTION FACTORS

Sector	Distance Miles	Distance KM	6 Month X/Q(s/m³)	Annual X/Q(s/m³)	6 Month D/Q(1/m²)	
N	1.52	2.44	1.65E-6	1.39E-6	1.08E-8	
NNE	1.40	2.26	1.68E-6	1.50E-6	1.31E-8	
NE	1.29	2.07	1.78E-6	1.79E-6	1.50E-8	
ENE	2.33	3.75	4.90E-7	4.68E-7	4.19E-9	10
E	1.72	2.77	9.28E-7	8.61E-7	8.21E-9	
ESE	1.82	2.93	6.79E-7	5.91E-7	6.36E-9	
SE	1.72	2.77	5.99E-7	5.13E-7	6.13E-9	
SSE	2.5	4.02	1.59E-7	1.51E-7	1.75E-9	
S	1.25	2.01	4.67E-7	3.96E-7	5.10E-9	27
SSW	1.29	2.07	4.62E-7	3.79E-7	4.76E-9	
SW	1.02	1.64	9.54E-7	7.86E-7	9.70E-9	
WSW	0.8	1.28	2.94E-6	2.52E-6	2.61E-8	10
W	0.87	1.40	2.23E-6	1.83E-6	1.59E-8	
WNW	1.40	2.26	9.53E-7	8.10E-7	5.36E-9	
NW	2.10	3.38	6.31E-7	4.76E-7	3.33E-9	
NNW	1.86	2.99	9.44E-7	7.00E-7	5.22E-9	

[1]Nearest vegetable garden is assumed located at the nearest residence. See Subsection 2.1.1.3 for description of site boundary.

TABLE 11.3-17

NEAREST COWS AND/OR GOATS - ESTIMATED ATMOSPHERIC DILUTION (X/Q) AND DEPOSITION (D/Q) FACTORS FOR GROUND LEVEL RELEASE WITHOUT OPEN TERRAIN CORRECTION FACTORS

Sector	Distance Miles	Distance KM	6 Month X/Q(s/m^3)	Annual X/Q(s/m^3)	6 Month D/Q($1/m^2$)
NE	4.53	7.28	1.29E-7	1.29E-7	9.02E-10
ENE	3.96	6.37	1.46E-7	1.38E-7	1.16E-9
E	3.37	5.43	1.86E-7	1.70E-7	1.45E-9
ESE	3.85	6.19	1.22E-7	1.06E-7	1.01E-9
	5.00	8.05[1]	8.36E-8	7.23E-8	6.74E-10
SE	3.96	6.37	9.05E-8	7.72E-8	8.11E-10
WSW	4.65	7.49	5.63E-8	4.77E-8	4.00E-10
W	3.71	5.97	7.36E-8	5.90E-8	4.29E-10

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[1] There is a goat in this sector at this distance. There are no other sectors which have cows or goats within 5 miles of the plant.

TABLE 11.3-18

NEAREST COWS AND/OR GOATS - ESTIMATED ATMOSPHERIC DILUTION (X/Q) AND DEPOSITION (D/Q) FACTORS FOR GROUND LEVEL RELEASE WITH OPEN TERRAIN CORRECTION FACTORS

Sector	Distance Miles	Distance KM	6 Month X/Q(s/m^3)	Annual X/Q(s/m^3)	6 Month D/Q($1/m^2$)	
NE	4.53	7.28	1.58E-7	1.58E-7	1.10E-9	
ENE	3.96	6.37	1.90E-7	1.80E-7	1.50E-9	10
E	3.37	5.43	2.58E-7	2.36E-7	2.02E-9	
ESE	3.85	6.19	1.60E-7	1.38E-7	1.32E-9	27
	5.00	8.05[1]	9.73E-8	8.41E-8	7.84E-10	
SE	3.96	6.37	1.18E-7	1.00E-7	1.05E-9	10
WSW	4.65	7.49	6.76E-8	5.73E-8	4.80E-10	
W	3.71	5.97	9.86E-8	7.91E-8	5.75E-10	

[1] There is a goat in this sector at this distance. There are no other sectors which have cows or goats within 5 miles of the plant.

TABLE 11.3-19

NEAREST COWS AND/OR GOATS - ESTIMATED ATMOSPHERIC DILUTION (X/Q) AND DEPOSITION (D/Q) FACTORS FOR ELEVATED (MIXED MODE) RELEASE WITHOUT OPEN TERRAIN CORRECTION FACTORS

Sector	Distance Miles	KM	6 Month X/Q(s/m³)	Annual X/Q(s/m³)	6 Month D/Q(1/m²)	
NE	4.53	7.28	4.09E-8	4.68E-8	6.06E-10	
ENE	3.96	6.37	5.14E-8	5.63E-8	7.65E-10	
E	3.37	5.43	5.91E-8	6.47E-8	9.24E-10	
ESE	3.85	6.19	5.28E-8	4.95E-8	7.37E-10	10
	5.00	8.05[1]	3.85E-8	3.57E-8	5.16E-10	
SE	3.96	6.37	4.44E-8	3.93E-8	6.39E-10	
WSW	4.65	7.49	2.83E-8	2.49E-8	3.64E-10	27
W	3.71	5.97	2.78E-8	2.44E-8	2.83E-10	

[1] There is a goat in this sector at this distance. There are no other sectors which have cows or goats within 5 miles of the plant.

TABLE 11.3-20

NEAREST COWS AND/OR GOATS - ESTIMATED ATMOSPHERIC DILUTION (X/Q) AND DEPOSITION (D/Q) FACTORS FOR ELEVATED (MIXED MODE) RELEASE WITH OPEN TERRAIN CORRECTION FACTORS

Sector	Distance Miles	Distance KM	6 Month $X/Q(s/m^3)$	Annual $X/Q(s/m^3)$	6 Month $D/Q(1/m^2)$
NE	4.53	7.28	4.99E-8	5.71E-8	7.40E-10
ENE	3.96	6.37	6.68E-8	7.32E-8	9.95E-10
E	3.37	5.43	8.21E-8	8.99E-8	1.28E-9
ESE	3.85	6.19	6.92E-8	6.49E-8	9.65E-10
	5.00	8.05[1]	4.48E-8	4.15E-8	6.01E-10
SE	3.96	6.37	5.77E-8	5.10E-8	8.31E-10
WSW	4.65	7.49	3.40E-8	2.99E-8	4.37E-10
W	3.71	5.97	3.72E-8	3.27E-8	3.80E-10

10

[1] There is a goat in this sector at this distance. There are no other sectors which have cows or goats within 5 miles of the plant.

TABLE 11.3-21

NEAREST MEAT ANIMAL - ESTIMATED ATMOSPHERIC DILUTION (X/Q) AND DEPOSITION (D/Q) FACTORS FOR GROUND LEVEL RELEASE WITHOUT OPEN TERRAIN CORRECTION FACTORS

Sector	Distance Miles	Distance KM	6 Month X/Q(s/m³)	Annual X/Q(s/m³)	6 Month D/Q(1/m²)	
NNE	4.3	6.92	1.64E-7	1.44E-7	1.07E-9	
NE	4.3	6.92	1.39E-7	1.39E-7	9.74E-10	10
ENE	3.96	6.37	1.46E-7	1.38E-7	1.16E-9	27
E	3.37	5.43	1.86E-7	1.70E-7	1.45E-9	
ESE	4.89	7.86	8.63E-8	7.46E-8	6.97E-10	
WSW	3.03	4.88	1.06E-7	8.97E-8	7.83E-10	10
W	4.41	7.10	5.74E-8	4.60E-8	3.29E-10	

NOTE: There are no other sectors which have meat animals within 5 miles of the plant.

TABLE 11.3-22

NEAREST MEAT ANIMAL - ESTIMATED ATMOSPHERIC DILUTION (X/Q) AND DEPOSITION (D/Q) FACTORS FOR GROUND LEVEL RELEASE WITH OPEN TERRAIN CORRECTION FACTORS

Sector	Distance Miles	Distance KM	6 Month χ/Q (s/m^3)	Annual χ/Q (s/m^3)	6 Month D/Q ($1/m^2$)
NNE	4.3	6.92	2.05E-7	1.80E-7	1.34E-9
NE	4.3	6.92	1.74E-7	1.74E-7	1.22E-9
ENE	3.96	6.37	1.90E-7	1.80E-7	1.50E-9
E	3.37	5.43	2.58E-7	2.36E-7	2.02E-9
ESE	4.89	7.86	1.02E-7	8.81E-8	8.23E-10
WSW	3.03	4.88	1.54E-7	1.31E-7	1.14E-9
W	4.41	7.10	7.06E-8	5.65E-8	4.05E-10

10

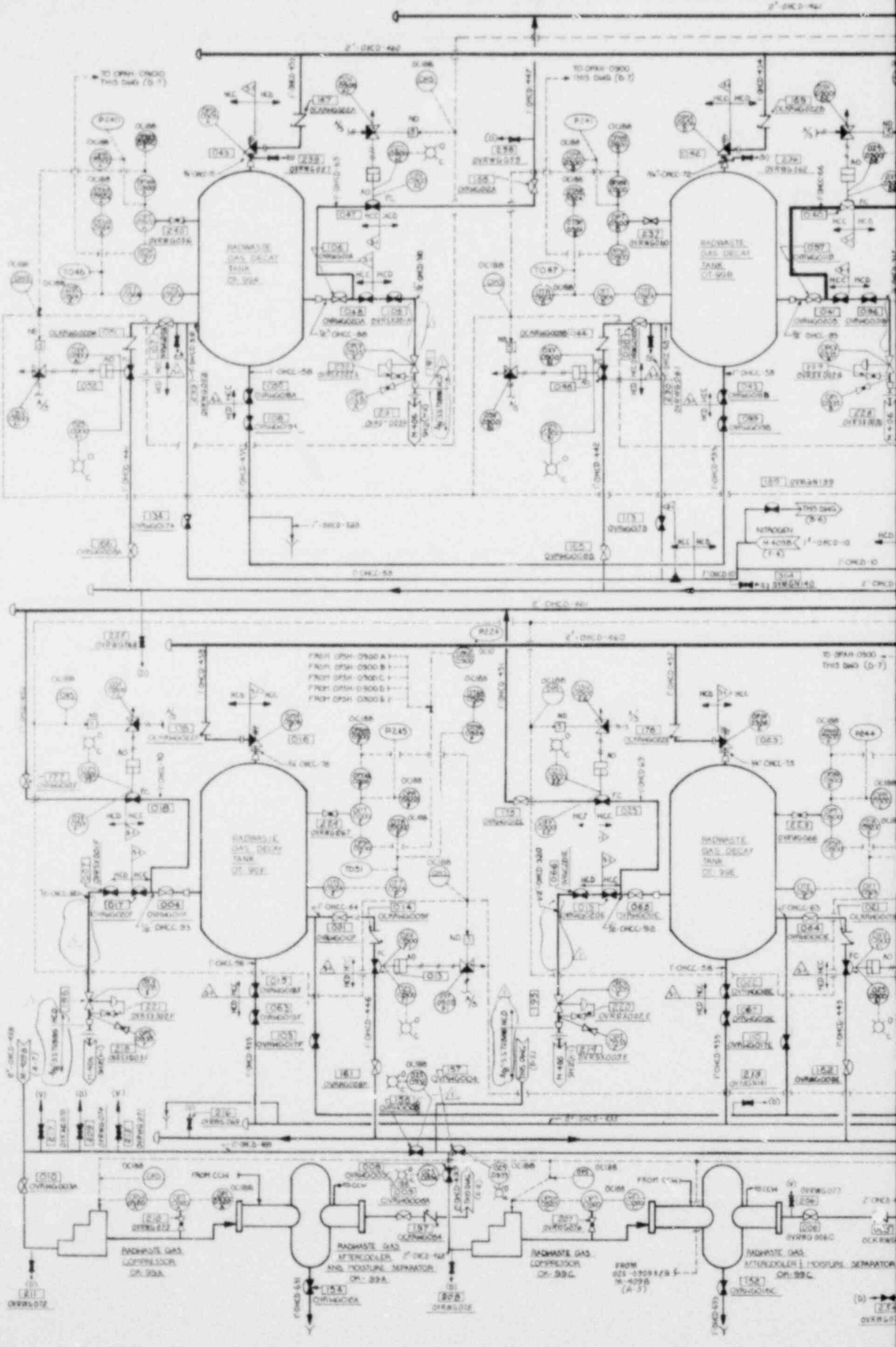
NOTE: There are no other sectors which have meat animals within 5 miles of the plant.

TABLE 11.3-25

POTENTIAL DOSES DUE TO GASEOUS EFFLUENTS

Dose Type	Location Sector	Location Distance (miles)	Pathway	Dose (mrem/yr) Per Unit: Without Open Terrain Correction Factor	With Open Terrain Correction Factor	10 CFR 50 Appendix I Limit	
Gamma air[1]	NNE[2]	0.311		0.034	0.14	10	
Beta air[1]	NNE[2]	0.311		0.094	0.38	20	
Total body	WSW[3]	0.311	Immersion[1]	0.007	0.03	5	
			Ground deposition	0.006	0.02		
Skin	WSW[3]	0.311	Immersion[1]	0.031	0.12	15	10
			Ground deposition	0.007	0.03		
Child's thyroid	WSW	0.8	Leafy[4] vegetables	0.084	0.33		
			Inhalation	0.008	0.03		
			Total	0.092	0.36		
Infant's thyroid	E	3.37	Cow milk[4]	0.19	0.26	15	27
	ESE	5	Goat[4]	0.43	0.50	15	10

[1] Noble gas effluents only
[2] Currently occupied by Dow Chemical Company
[3] Anticipating occupancy at WSW site boundary during plant lifetime
[4] The food pathway doses are based on the following site specific data: 0.26 kg/m² for pasture grass density, 1.2 kg/m² for vegetables, and 0.52 kg/m² for stored feed. The fraction of the daily feed that is pasture grass while grazing is 0.25 for cows and 1.00 for goats. Furthermore, it is assumed that the fraction of the area covered by vegetables is 0.5. 10


RADWASTE GAS DECAY TANK OT-90A
RADWASTE GAS DECAY TANK OT-90B
RADWASTE GAS DECAY TANK OT-90E
RADWASTE GAS DECAY TANK OT-90F
RADWASTE GAS COMPRESSOR OP-99A
RADWASTE GAS AFTERCOOLER AND MOISTURE SEPARATOR OP-99A
RADWASTE GAS COMPRESSOR OP-99C
RADWASTE GAS AFTERCOOLER AND MOISTURE SEPARATOR OP-99C
NITROGEN
TO OPSH-0900 THIS DWG (D-7)
FROM OPSH-0900 A THIS DWG (D-7)
FROM OPSH-0900 B THIS DWG (D-7)
FROM OPSH-0900 C THIS DWG (D-7)
FROM OPSH-0900 D THIS DWG (D-7)
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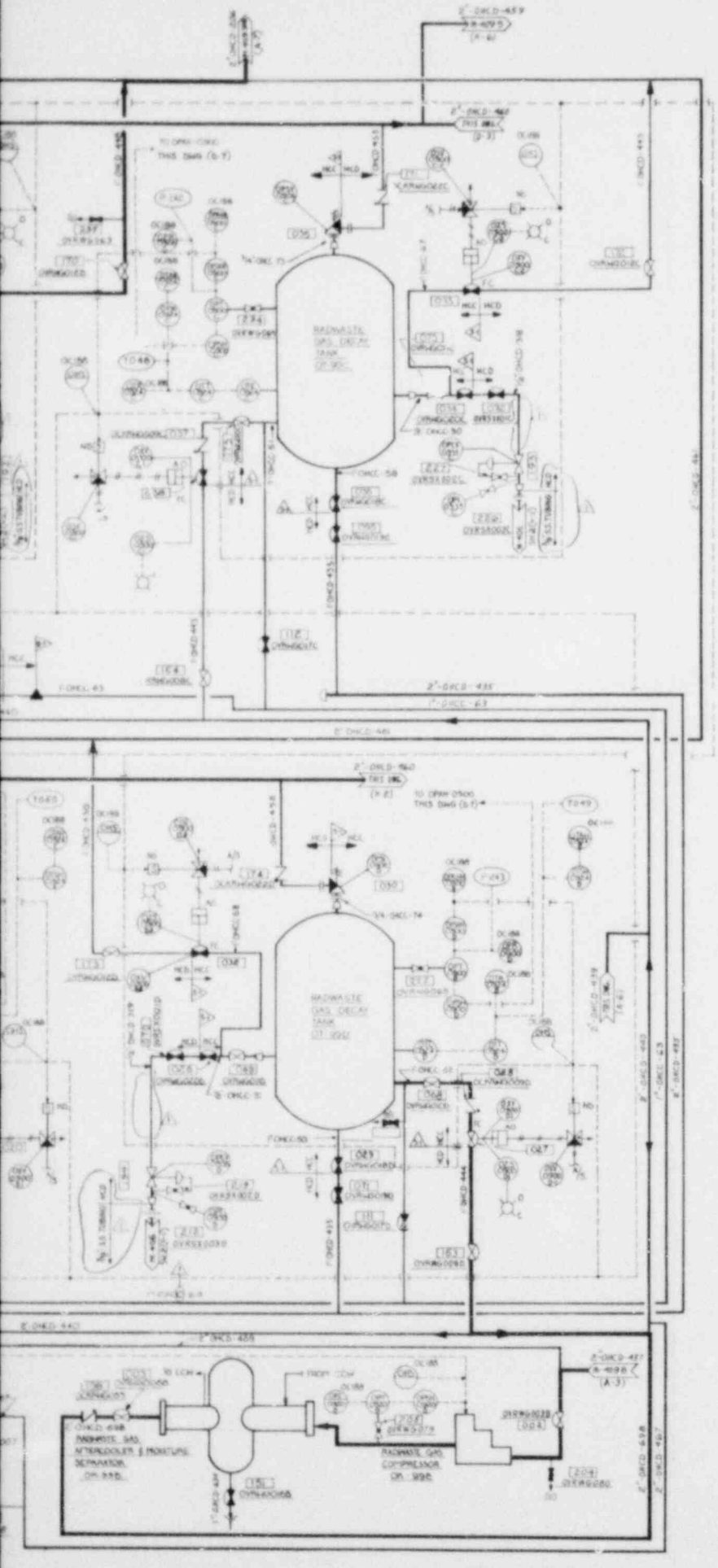
FROM CCW
TO CCW
FROM 025-0959 A/B (A-3)



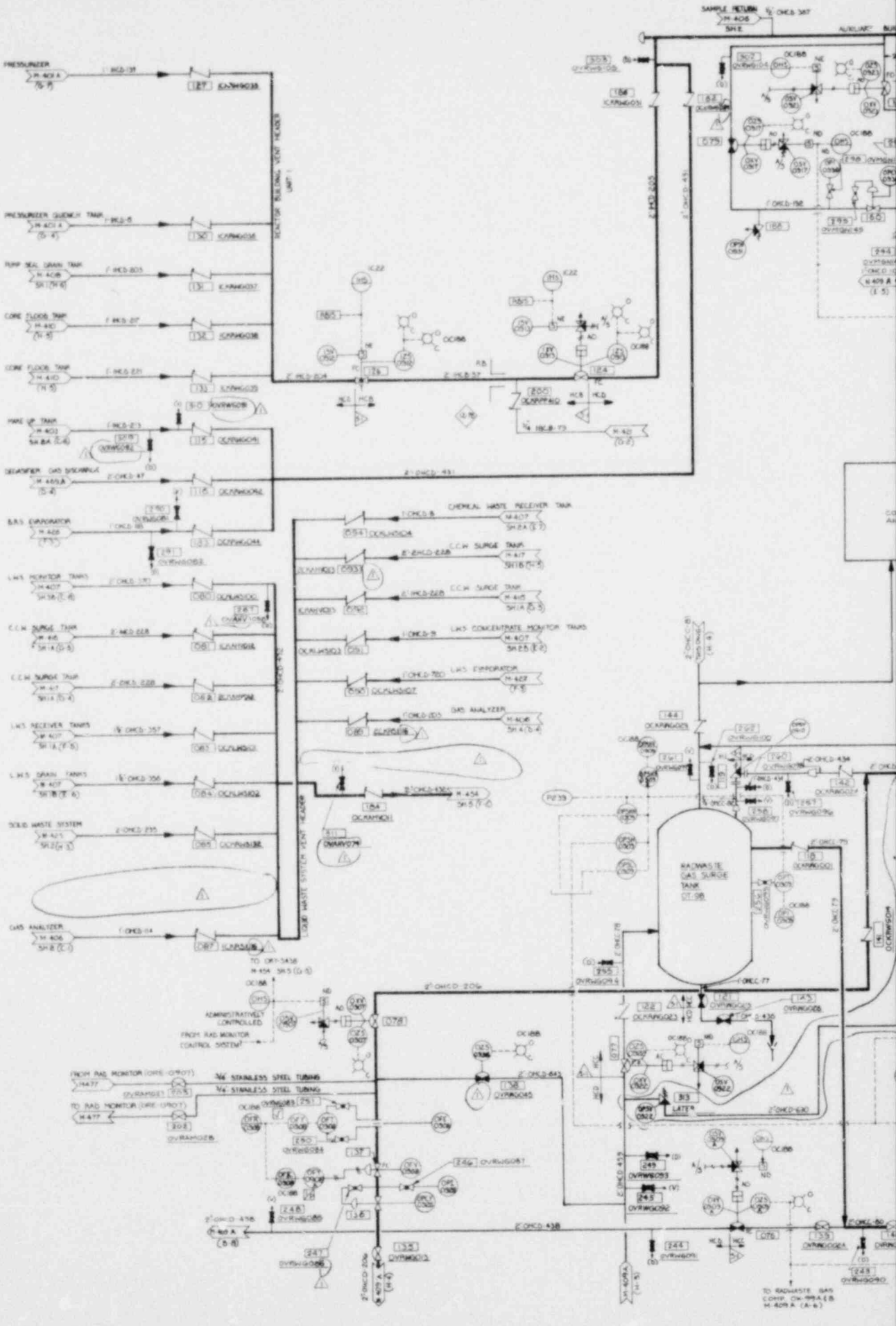
NOTES

1. RADWASTE GAS DELAY TANK AND SURGE TANK NITROGEN PURGE INLET VALVES, MOISTURE DRAIN VALVES, AND DRAIN PIPING SHALL BE LOCATED SO THAT DRAINAGE CAN BE TERMINATED BY VISUAL INSPECTION OF THE DRAIN LINE.
2. TANK DRAIN LINES SHALL SLOPE TO FLOOR DRAINS FOR GRAVITY DRAINAGE.
3. THE ORDER OF PIPING CONNECTIONS TO EACH VENT HEADER IS SHOWN AS A SCHEMATIC REPRESENTATION ONLY. ACTUAL CONSTRUCTION ORDER OF PIPING CONNECTION TO VENT HEADER IS NOT CRITICAL.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Radwaste Gas - Units 1 & 2
(M-409A, Rev 1)

FSAR Figure 11.[illegible]-2, sh. 1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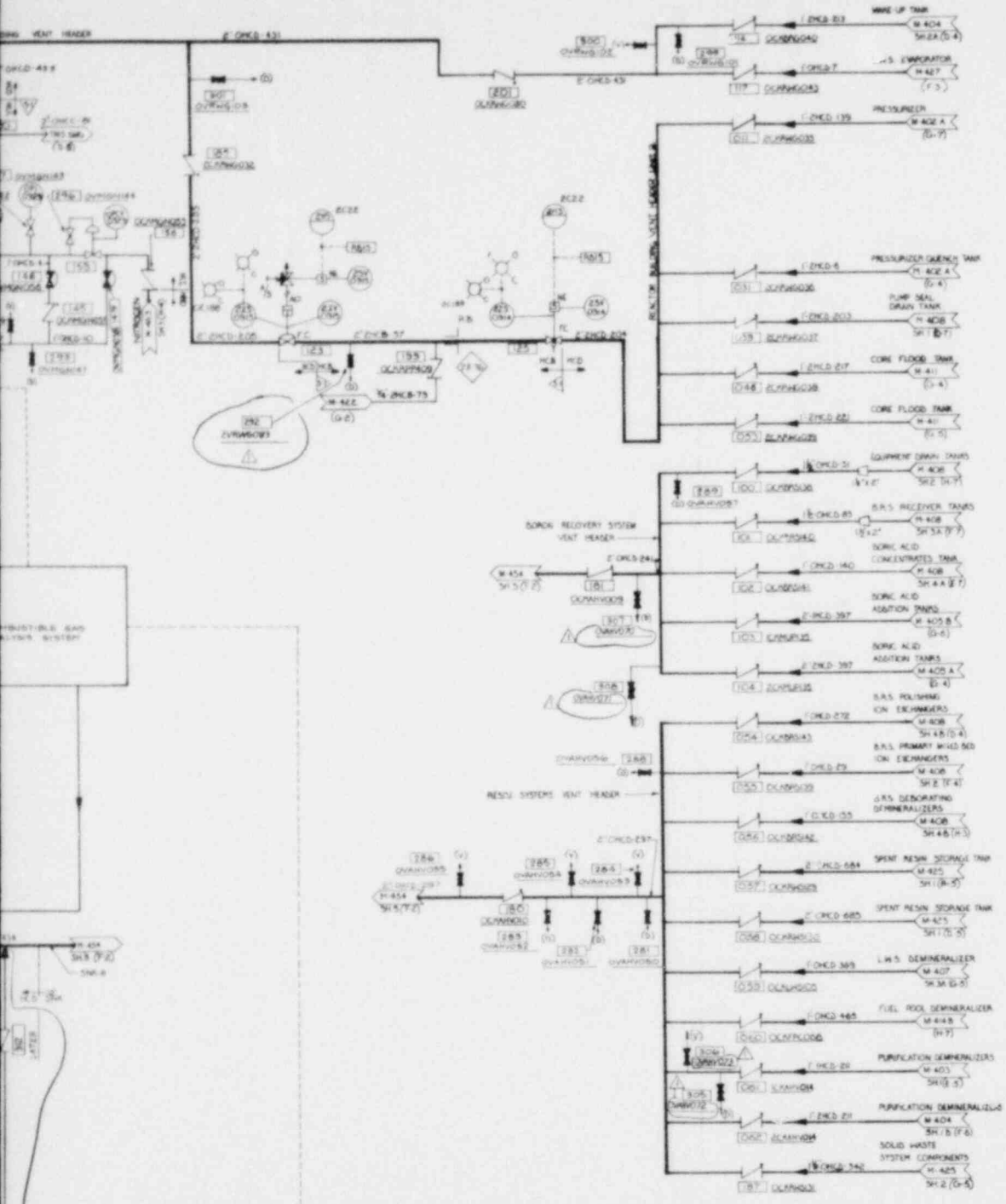
PRESSURIZER QUENCH TANK
PUMP SEAL DRAIN TANK
CORE FLOOD TANK
CORE FLOOD TANK
MAKE UP TANK
DEGASIFIER GAS DISCHARGE
B.W.S. EVAPORATOR
L.W.S. MONITOR TANKS
C.C.W. SURGE TANK
C.C.W. SURGE TANK
L.W.S. RECEIVER TANKS
L.W.S. DRAIN TANKS
SOLID WASTE SYSTEM
GAS ANALYZER
REACTOR BUILDING VENT HEADER
UNIT 1
SOLID WASTE SYSTEM VENT HEADER
CHEMICAL WASTE RECEIVER TANK
C.C.W. SURGE TANK
C.C.W. SURGE TANK
L.W.S. CONCENTRATE MONITOR TANKS
L.W.S. EVAPORATOR
GAS ANALYZER
SAMPLE RETURN
RADWASTE GAS SURGE TANK
ADMINISTRATIVELY CONTROLLED
FROM RAD MONITOR CONTROL SYSTEM?
FROM RAD MONITOR (DRYE-07907)
TO RAD MONITOR (DRYE-07907)
¼ STAINLESS STEEL TUBING
¼ STAINLESS STEEL TUBING
LATE*
TO RADWASTE GAS COMP (SM-499A&B M-409A (A-6)



CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Radwaste Gas - Units 1 & 2
(M-409B, Rev 1)

FSAR Figure 11.3-2, sh. 2

12.3 RADIATION PROTECTION DESIGN FEATURES

12.3.1 FACILITY DESIGN FEATURES

In this subsection specific design features for maintaining personnel exposures as low as reasonably achievable (ALARA) are discussed. The plant design features are generally in accordance with Regulatory Position C.3 of Regulatory Guide 8.8[13] with the exception of certain equipment items which are located in common shielded cubicles. These equipment items include small radwaste pumps, gas decay tanks, and boric acid addition tanks. The design will however accommodate placement of temporary shielding for additional personnel protection during maintenance.

12.3.1.1 Plant Design Description for as Low as is Reasonably Achievable

The equipment and plant design features employed to maintain radiation exposures ALARA are based upon the design considerations of Subsection 12.1.2 and are outlined in this subsection for several general classes of equipment (Subsection 12.3.1.1.1), and several typical plant layout situations (Subsection 12.3.1.1.2).

12.3.1.1.1 Common Equipment and Component Designs for ALARA

This subsection describes the design features utilized for several general classes of equipment or components. These classes of equipment are common to many of the plant systems; thus, the features employed for each system to maintain minimum exposures are similar and are discussed by equipment class in the following paragraphs.

FILTERS - Filters which accumulate radioactivity are supplied with the means to perform cartridge replacement remotely. Adequate space is provided to allow removing, cask loading, and transporting the cartridge to the solid radwaste area for remotely packaging into the shipping containers. The process is accomplished in such a manner that exposure to personnel and the possibility of inadvertent radioactive release to the environment is minimized. Each filter installation is contained in a shielded compartment, provided with external vent and drain valving, and compartment drainage capabilities. The filter handling system has also been designed with a minimum of components susceptible to malfunction.

DEMINERALIZERS - Demineralizers for radioactive systems are designed so that spent resins can be remotely hydraulically transferred to spent resin tanks prior to solidification and so that fresh resin can be loaded into the demineralizer remotely from the clean resin tank. Underdrains and downstream strainers are designed for full system pressure drop. The demineralizers

and piping are designed with provisions for being flushed with demineralized water.

EVAPORATORS - Evaporators are provided with chemical addition connections to allow the use of chemicals for descaling operations. Space is provided to allow uncomplicated removal of heating tube bundles. . more radioactive components are separated from those that are less radioactive by a shield wall. All instruments and controls are located on the low activity side of the shield wall. All valves in radioactive lines are located on the low activity side of the shield wall. Valves in nonradioactive lines are located outside of the room if practical.

PUMPS - Wherever practicable, pumps are purchased with mechanical seals to reduce seal servicing time. Pumps and associated piping are arranged to provide adequate space for access to the pumps for servicing. Small pumps are installed in a manner which allows easy removal if necessary. All pumps in radioactive waste systems are provided with flanged connections for ease in removal. Drain connections are provided on either the pump casing or the process line for maintenance. Pumps in radwaste service which pump liquids containing potentially high suspended solids have double mechanical seals with a separate seal flushing system. 27

TANKS - Whenever practicable, tanks are provided with sloped bottoms and bottom outlet connections. Overflow lines are directed to the waste collection system in order to control any contamination within plant structures. Excepting the condensate storage tanks, outside tanks as well as most inside tanks have provisions such as curbing or dikes to contain overflows on accidental spills.

HEAT EXCHANGERS - Heat exchangers are provided with corrosion resistant tubes of stainless steel or other suitable materials with tube-to-tube sheet joints welded to minimize leakage. Impact baffles are provided and tube side and shell side velocities are limited to minimize erosive effects.

INSTRUMENTS - Instrument devices are located in low radiation zones whenever practical. Primary instrument devices which, for functional reasons, are located in high radiation zones are designed for easy removal to a lower radiation zone for calibration. Transmitters and readout devices are located in low radiation zones, such as corridors or the control room, for servicing. Some instruments (such as thermocouples) in high radiation zones are provided in duplicate to reduce access and service time required.

Diaphragm seals are provided on instrument sensing lines on process piping which may contain highly radioactive solids to reduce the servicing time required to keep the lines free of solids. Instrument and sensing line connections are located in

c. To reduce potential equipment neutron activation and mitigate the possibility of radiation damage to materials

d. The control room will be sufficiently shielded such that the whole-body dose, or its equivalent to any part of the body (calculated using the method indicated in Appendix 15B), will not exceed the limits of 10 CFR 50, Appendix A, General Design Criterion 19.

12.3.2.2 General Shielding Design

Shielding is provided to attenuate direct radiation through walls and penetrations and scattered radiation to less than the upper limit of the radiation zone for each area shown in Figures 12.3-16 through 12.3-30 and Figure 12.3-43. The minimum shielding requirements for all plant areas are shown in Figures 12.3-1 through 12.3-15 and 12.3-42. General locations of the plant areas and equipment discussed in this subsection are shown in the general arrangement drawings of Section 1.2. The locations of the laboratory and the counting room are shown in Figure 1.2-28. Design criteria for penetrations comply with the intent of Regulatory Guide 8.8 and are discussed in Subsection 12.3.1.1.2 for ALARA. 27 4

The material used for most of the plant shielding is ordinary concrete with a minimum bulk density of 2.35 gm/cc. Whenever poured-in-place concrete has been replaced by concrete blocks or other material, design assures protection on an equivalent shielding basis as determined by the characteristics of the material selected. Compliance of concrete radiation shield design with Regulatory Guide 1.69[15] is discussed in Appendix 3A. Water is used as the primary shield material for areas above the spent fuel transfer and storage areas. 9

12.3.2.2.1 Containment Shielding Design

During reactor operation, the containment protects personnel occupying adjacent plant structures and yard areas from radiation originating in the reactor vessel and primary loop components. The concrete containment wall, together with the reactor vessel and steam generator compartment shield walls, reduces radiation levels outside the containment to less than 1.0 mrem/hr.

For design basis accidents, the containment reduces the plant radiation intensities from fission products inside the containment to acceptable emergency levels, as defined by 10 CFR 50 Appendix A, General Design Criterion 19, for the control room (see Subsection 12.3.2.2.5).

Where personnel and equipment hatches or penetrations pass through the containment wall, additional shielding is provided to

radiation zone during normal operation and shutdown and to acceptable emergency levels as defined by 10 CFR 50 during design basis accidents.

12.3.2.2.2 Containment Interior Shielding Design

During reactor operation, most areas inside the containment are Zone V and normally inaccessible. However, shielding is provided to reduce dose rates to less than 100 mrem/hr in the accessible areas of the containment. These are the Zone IV or lower areas shown in Figures 12.3-18 through 12.3-23.

The sources of radioactive materials are the fission products generated in the fuel rods, radioactive corrosion products generated by neutron bombardment of fuel rod cladding and reactor structural components, and the activation products in the reactor coolant. The fission products leaking from defective fuel rods and the corrosion and activation products are transported by the reactor coolant to the various primary loop components such as the steam generators, the pressurizer, the reactor coolant pumps, and the associated piping. The reactor vessel is shielded by the concrete primary shield, reactor cavity shield, and by the concrete secondary shield which also surrounds all other primary loop components. Air cooling is provided to prevent overheating, dehydration, and degradation of the shielding and structural properties of the primary shield.

Components of the letdown portion of the makeup and purification system are located in shielded compartments which are normally Zone V, restricted access areas. Shielding is provided for each piece of equipment in the letdown system consistent with its postulated maximum activity (Subsection 12.2.1) and with the access and zoning requirements of adjacent areas. This equipment includes the letdown coolers and letdown lines.

After shutdown, most of the containment is accessible for limited periods of time and all access is controlled. Areas are surveyed to establish allowable working periods. Dose rates are expected to range from 0.5 to 1,000 mrem/hr depending on the location inside the containment (excluding reactor cavity). These dose rates result from residual fission products, neutron activated materials, and corrosion products in the reactor coolant system.

Spent fuel is the primary source of radiation during refueling. Because of the extremely high activity of the fission products contained in the spent fuel elements and the proximity of Zone II areas, extensive shielding has been provided for areas surrounding the spent fuel pool and the fuel transfer canal to ensure that radiation levels remain below zone levels specified for adjacent areas. Water provides the shielding over the spent fuel assemblies during fuel handling.

12.3.2.2.3 Auxiliary Building and Solid Radwaste Building Shielding Design

During normal operation, the major components in the auxiliary building with potentially high radioactivity are:

a. The makeup and purification systems which include the letdown lines, the reactor makeup tank, purification filters and demineralizers, and the makeup pumps

b. The liquid waste systems which include liquid receiver tanks, drain tanks, filters, demineralizers, evaporators, and associated pumps and piping

c. The radwaste gas system, which includes radwaste gas decay tanks, radwaste gas surge tank, and associated piping

Shielding is provided for each piece of equipment consistent with its postulated maximum activity (Subsection 12.2.1) as discussed in Sections 11.1, 11.2, 11.3, and 11.4 and with the access and zoning requirements of adjacent areas (Figures 12.3-16 through 12.3-30 and 12.3-43). | 27

Depending on the equipment in the compartments, the access varies from Zones II through V. Corridors are shielded to allow Zone II access.

Removable sections of block shield walls and stepped concrete shield plugs are utilized to remove and replace equipment and spent filter cartridges respectively.

Following reactor shutdown, the decay heat removal system (DHRS) pumps and heat exchangers are in operation to remove heat from the reactor coolant system. The radiation levels in the vicinity of this equipment will temporarily reach Zone V levels due to corrosion and fission products in the reactor primary coolant. Shielding is provided to attenuate radiation from DHRS equipment during shutdown cooling operations to levels consistent with the radiation zoning requirements of adjacent areas.

The counting rooms of the auxiliary building are designed and shielded to give a dose rate limit of less than 0.01 mrem/hr from all external sources.

The concrete shield walls surrounding the spent fuel cask loading and storage area, as well as the shield walls surrounding the fuel transfer and storage areas, are sufficiently thick to limit radiation levels outside the shield walls in all accessible areas to less than the Zone II maximum dose rate of 2.5 mrem/hr.

Water in the spent fuel pool provides shielding above the spent fuel transfer and storage areas. Radiation levels at the fuel

handling equipment are limited to 2.5 mrem/hr during normal operations and 10 mrem/hr during fuel handling.

The fuel pool cooling and purification system (FPCPS) (Section 9.1) shielding is based on the maximum activity discussed in Subsection 12.2.1 and the access and zoning requirements of adjacent areas. Equipment in the FPCPS to be shielded includes the FPCPS heat exchangers, pumps, piping, filters, and demineralizers.

Shielding is provided as necessary around the following radwaste equipment to ensure that the radiation zone and access requirements are met for surrounding areas:

a. Liquid waste system (LWS) receiver tanks and pumps

b. LWS monitor tank and pumps

c. LWS drain tank and pumps

d. Chemical waste receiver tank and pumps

e. LWS evaporator

f. Waste solidification equipment

g. Waste drumming and storage areas

h. LWS concentrate monitor tanks and pumps

i. Liquid radwaste piping

j. LWS filters and demineralizers

k. Spent resin storage tanks and pumps

l. Boron recovery system degasifier

m. Radwaste gas surge tank, compressors, aftercoolers, and moisture separators

n. Radwaste gas decay tanks

o. Boron recovery system evaporator

12.3.2.2.4 Turbine Building Shielding Design

Radiation shielding is not required for any process equipment located in the turbine building except the condensate demineralizers. All areas in the turbine building are classified Zone I except the condensate demineralizer area which is classified Zone II. This area could become Zone V due to primary to secondary leakage.

TABLE 12.3-5

SPACE IDENTIFICATION

Building	Elevation	Room No.	Space Identification	
Containment 1	574'-0"	1	Tendon gallery	
Containment 1	574'-0"	2	Tendon gallery access shaft	
Auxiliary	568'-0"	8	Laundry process unit area	27
Auxiliary	568'-0"	9	Sump pump	
Auxiliary	568'-0"	10	Sump pump	
Auxiliary	562'-6"	11	Elevator shaft	
Auxiliary	568'-0"	12	Laundry drain tank room	
Auxiliary	568'-0"	13	Valve area	27
Auxiliary	568'-0"	14	Chemical waste receiver tank pump room	
Auxiliary	568'-0"	15	Laundry drain tank pump room	
Auxiliary	568'-0"	16	Chemical waste receiver tank room	
Auxiliary	568'-0"	17	Accessway	
Auxiliary	568'-0"	18	Corridor	
Auxiliary	574'-0"	19	Pipeway	
Auxiliary	574'-0"	20	Pipeway	
Auxiliary	574'-0"	21	Pipeway	
Auxiliary	574'-0"	22	Pipeway	
Auxiliary	574'-0"	23	Pipeway	
Auxiliary	574'-0"	24	Pipeway	
Auxiliary	568'-0"	25	RB spray pump and decay heat removal pump	

TABLE 12.3-5 (continued)

Building	Elevation	Room No.	Space Identification
Auxiliary	568'-0"	26	RB spray pump and decay heat removal pump
Auxiliary	568'-0"	27	RB spray pump and decay heat removal pump
Auxiliary	568'-0"	28	RB spray pump and decay heat removal pump
Auxiliary	568'-0"	29	Stair No. 2 enclosure
Auxiliary	568'-0"	30	Equipment area
Auxiliary	568'-0"	30A	Filter room | 27
Auxiliary	568'-0"	31	Equipment drain tank room
Auxiliary	568'-0"	32	Pump area
Auxiliary	568'-0"	33	Pump area
Auxiliary	568'-0"	34	LWS drain tank room
Auxiliary	568'-0"	35	Pump area
Auxiliary	568'-0"	36	Pump area
Auxiliary	568'-0"	37	Accessway
Auxiliary	568'-0"	37A	Accessway
Auxiliary	568'-0"	37B	Accessway
Auxiliary	568'-0"	38	Equipment drain tank room
Auxiliary	576'-6"	39	Pipeway
Containment 2	574'-0"	40	Tendon gallery
Containment 2	574'-0"	41	Tendon gallery access shaft
Containment 1	593'-6"	100	Piping area
Containment 1	593'-6"	101	Letdown cooler room

TABLE 12.3-5 (continued)

Building	Elevation	Room No.	Space Identification
Containment 1	593'-6"	102	Piping area
Containment 1	601'-3"	103	Incore instrument area
Containment 1	593'-6"	104	Piping area
Containment 1	593'-6"	105	Primary loop enclosure area
Containment 1	592'-2-1/4"	106	Reactor cavity area
Auxiliary	584'-0"	108	Accessway
Auxiliary	584'-0"	109	Accessway
Auxiliary	584'-0"	110	Pipeway
Auxiliary	584'-0"	111	Auxiliary feedwater pump room
Auxiliary	584'-0"	112	Corridor
Auxiliary	584'-0"	113	Auxiliary feedwater pump room
Auxiliary	584'-0"	114	Corridor
Auxiliary	584'-0"	115	Stair No. 3 enclosure
Auxiliary	584'-0"	116	Pipeway
Auxiliary	584'-0"	117	Auxiliary feedwater pump room
Auxiliary	584'-0"	118	Auxiliary feedwater pump room
Auxiliary	584'-0"	119	Corridor
Auxiliary	584'-0"	121	Decay heat removal heat exchanger room
Auxiliary	584'-0"	122	Decay heat removal heat exchanger room
Auxiliary	584'-0"	123	Corridor
Auxiliary	584'-0"	124	Decay heat removal heat exchanger room

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TABLE 12.3-5 (continued)

Building	Elevation	Room No.	Space Identification
Auxiliary	584'-0"	125	Decay heat removal heat exchanger room
Auxiliary	584'-0"	126	Component cooling water pump room
Auxiliary	584'-0"	127	Equipment area
Auxiliary	584'-0"	128	Equipment access area
Auxiliary	584'-0"	129	CRDM component cooling water booster pump and filter
Auxiliary	584'-0"	130	Pipeway
Auxiliary	584'-0"	131	Pipeway
Auxiliary	584'-0"	132	Component cooling water heat exchanger
Auxiliary	584'-0"	133	BRS receiver tank room
Auxiliary	584'-0"	134	BRS receiver tank room
Auxiliary	584'-0"	135A	BRS valve station
Auxiliary	584'-0"	135B	BRS receiver tank transfer pump room
Auxiliary	584'-0"	135C	BRS receiver tank transfer pump room
Auxiliary	584'-0"	136	Accessway
Auxiliary	593'-0"	137	Pipeway
Auxiliary	593'-0"	138	Pipeway
Auxiliary	593'-0"	139	Pipeway
Auxiliary	584'-0"	140	BRS receiver tank room
Auxiliary	584'-0"	141	BRS receiver tank room
Auxiliary	584'-0"	142	LWS receiver tank room

TABLE 12.3-5 (continued)

Building	Elevation	Room No.	Space Identification	
Auxiliary	584'-0"	146A	LWS receiver and monitor valve station	
Auxiliary	584'-0"	146B	LWS receiver and monitor tank pump room	
Auxiliary	584'-0"	146C	LWS receiver and monitor tank pump room	
Auxiliary	584'-0"	147	Accessway	27
Auxiliary	584'-0"	150	LWS monitor tank room	
Auxiliary	584'-0"	151	LWS receiver tank room	
Auxiliary	593'-0"	155	Pipe and cable chase	
Auxiliary	593'-0"	156	Pipe and cable chase	
Containment 2	593'-6"	158	RB sump area	27
Containment 2	593'-6"	159	Piping area	
Containment 2	593'-6"	160	Letdown cooler room	
Containment 2	593'-6"	161	Piping area	
Containment 2	601'-3"	162	Incore instrument area	
Containment 2	593'-6"	163	Piping area	
Containment 2	593'-6"	164	Primary loop enclosure area	
Containment 2	592'-2-1/4"	165	Reactor cavity area	
Auxiliary	599'-0"	200	Fuel pool heat exchanger room	
Auxiliary	591'-6"	201	Tendon service shaft	
Auxiliary	591'-6"	202	Tendon service shaft	
Auxiliary	614'-0"	203	Tendon service shaft	
Auxiliary	614'-0"	204	Tendon service shaft	27

TABLE 12.3-5 (continued)

Building	Elevation	Room No.	Space Identification	
Auxiliary	591'-6"	205	Tendon service shaft	
Auxiliary	591'-6"	206	Tendon service shaft	
Auxiliary	599'-0"	207	Access area	
Auxiliary	599'-0"	209	Corridor	
Auxiliary	599'-0"	210	Fuel pool cooling pump room	
Auxiliary	599'-0"	211	Fuel pool cooling valve station room	
Auxiliary	599'-0"	212	Makeup pump room	
Auxiliary	599'-0"	213	Makeup pump room	
Auxiliary	599'-0"	214	Makeup pump room	
Auxiliary	599'-0"	215	Makeup pump room	
Auxiliary	599'-0"	216	Makeup pump room	
Auxiliary	599'-0"	217	Makeup pump room	
Auxiliary	599'-0"	220	Component cooling water heat exchanger	
Auxiliary	599'-0"	221	Equipment access area	
Auxiliary	599'-0"	224	Accessway	
Auxiliary	599'-0"	225	Accessway	
Containment 1	619'-6"	300	Isolation valve chamber	27
Containment 1	619'-6"	301	Fuel transfer pit	
Containment 1	526'-0"	302	Electrical penetration area	
Auxiliary	614'-0"	303	Surge tank room	
Auxiliary	614'-0"	304	Pump room	
Auxiliary	614'-0"	305	Pipe chase	27

TABLE 12.3-5 (continued)

Building	Elevation	Room No.	Space Identification
Auxiliary	614'-0"	306	Pump room
Auxiliary	614'-0"	307	Sample station
Auxiliary	624'-0"	308	Pipeway
Auxiliary	614'-0"	309	Accessway
Auxiliary	614'-0"	310	Accessway
Auxiliary	614'-0"	311	Degasifier valve room
Auxiliary	614'-0"	312	Degasifier valve room
Auxiliary	624'-0"	313	Pipeway
Auxiliary	614'-0"	314	Corridor
Auxiliary	614'-0"	315	Makeup and purification letdown valve station
Auxiliary	614'-0"	316	Makeup and purification letdown valve station
Auxiliary	614'-0"	317	Control station
Auxiliary	614'-0"	318	Office
Auxiliary	614'-0"	319	Accessway
Auxiliary	616'-6"	320	Controlled laboratory
Auxiliary	616'-6"	321	Sample preparation station
Auxiliary	616'-6"	322	Counting room
Auxiliary	616'-6"	323	Storage room
Auxiliary	614'-0"	324	Stairway No. 8 enclosure
Auxiliary	614'-0"	326	Load center area
Auxiliary	614'-0"	327	Pipeway
Auxiliary	614'-0"	328	Piping penetration

27

TABLE 12.3-5 (continued)

Building	Elevation	Room No.	Space Identification
Auxiliary	614'-0"	329	Piping penetration
Auxiliary	614'-0"	330	Makeup tank room
Auxiliary	614'-0"	331	Makeup tank room
Auxiliary	614'-0"	332	Equipment access area
Auxiliary	614'-0"	333	Accessway
Auxiliary	614'-0"	334	Accessway
Auxiliary	614'-0"	335	Pipeway
Auxiliary	614'-0"	336	Radwaste gas decay tank room
Auxiliary	614'-0"	337	Waste gas compressor room
Auxiliary	614'-0"	338	Waste gas compressor room
Auxiliary	614'-0"	339	Waste gas compressor room
Auxiliary	614'-0"	340	Radwaste gas decay tank room
Auxiliary	614'-0"	341	Transfer tube alignment room
Auxiliary	614'-0"	342	Transfer tube alignment room
Auxiliary	614'-0"	343	Cask
Auxiliary	624'-8"	344	Fuel tilt pit
Auxiliary	619'-6"	345	Fuel tilt pit
Auxiliary	619'-6"	346	Spent fuel pool
Auxiliary	614'-0"	348	Corridor
Auxiliary	614'-0"	349	Stair No. 4 enclosure
Auxiliary	614'-0"	350	Battery room
Auxiliary	614'-0"	351	Battery room
Auxiliary	614'-0"	352	Battery room

TABLE 12.3-5 (continued)

Building	Elevation	Room No.	Space Identification	
Auxiliary	614'-0"	353	Battery room	
Auxiliary	614'-0"	354	Electrical penetration	
Auxiliary	614'-0"	355	Electrical penetration	
Auxiliary	614'-0"	356	Battery room	
Auxiliary	614'-0"	357	Battery room	
Auxiliary	614'-0"	358	Switchgear room	
Auxiliary	614'-0"	359	Switchgear room	
Auxiliary	614'-0"	360	Switchgear room	
Auxiliary	614'-0"	361	Switchgear room	
Containment 2	619'-6"	369	Isolation valve chamber	27
Containment 2	619'-6"	370	Fuel transfer pit	
Containment 2	626'-0"	371	Electrical penetration area	
Containment 1	640'-0"	400	Core flooding tanks area	
Containment 1	640'-0"	401	Core flooding tanks area	
Containment 1	634'-0"	402	Reactor vessel area	
Containment 1	640'-0"	403	Tank area	
Auxiliary	634'-6"	404	LWS concentrate monitor tank room	
Auxiliary	634'-6"	405	LWS concentrate monitor tank room	27
Auxiliary	634'-6"	406	Valve gallery	
Auxiliary	634'-6"	407	Accessway	
Auxiliary	634'-6"	408	Corridor	
Auxiliary	634'-6"	409	Boric acid concentrate tank room	

TABLE 12.3-5 (continued)

Building	Elevation	Room No.	Space Identification
Auxiliary	634'-6"	410	Railroad car loading area
Auxiliary	634'-6"	411	Decontamination room
Auxiliary	634'-6"	412A	Pump area
Auxiliary	634'-6"	412B	Pump area
Auxiliary	634'-6"	413	Hot machine shop
Auxiliary	634'-6"	414A	Spent resin storage tank room
Auxiliary	634'-6"	414B	Spent resin storage tank room
Auxiliary	634'-6"	415	Hot instrument shop
Auxiliary	634'-6"	416	Valve station
Auxiliary	634'-6"	417A	Pipeway
Auxiliary	634'-6"	417B	Pipeway
Auxiliary	634'-6"	418	Exit corridor
Auxiliary	634'-6"	419	H&V filter room
Auxiliary	634'-6"	420	Boric acid addition tank room
Auxiliary	634'-6"	421	Boric acid addition tank room
Auxiliary	634'-6"	422	Corridor
Auxiliary	634'-6"	423	Corridor
Auxiliary	634'-6"	424	Corridor
Auxiliary	634'-6"	425	Equipment access area
Auxiliary	634'-6"	426	Fuel pool skimmer pump area
Auxiliary	634'-6"	427	Accessway
Auxiliary	634'-6"	428	Degasifier room
Auxiliary	634'-6"	429	Degasifier room

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TABLE 12.3-5 (continued)

Building	Elevation	Room No.	Space Identification
Auxiliary	634'-6"	430	Pipeway
Auxiliary	634'-6"	431	Pipeway
Auxiliary	634'-6"	432	Boric acid addition pumps and filters
Auxiliary	634'-6"	433	Boric acid addition pumps and filters
Auxiliary	634'-6"	434	Demineralizer valves room
Auxiliary	634'-6"	435	Demineralizer valves room
Auxiliary	634'-6"	435A	Accessway
Auxiliary	634'-6"	435B	Demineralizer valves room
Auxiliary	634'-6"	435C	Demineralizer valves room
Auxiliary	630'10"	436	Cask wash-down space
Auxiliary	613'-6"	437	Cask head space
Auxiliary	634'-6"	438	Demineralizer valves room
Auxiliary	634'-6"	439A	Accessway
Auxiliary	634'-6"	439B	Demineralizer control area
Auxiliary	628'-6"	440A	Electrical penetration
Auxiliary	628'-6"	440B	Electrical penetration
Auxiliary	628'-6"	441A	Electrical penetration
Auxiliary	628'-6"	441B	Electrical penetration
Auxiliary	634'-6"	442A	Auxiliary access control and change area
Auxiliary	628'-6"	442B	Storage area
Auxiliary	634'-6"	443A	Auxiliary access control and change area

TABLE 12.3-5 (continued)

Building	Elevation	Room No.	Space Identification
Auxiliary	628'-6"	443B	Storage area
Auxiliary	633'-4"	444	Corridor
Auxiliary	632'-6"	445	Shower
Auxiliary	632'-6"	445A	Drying area
Auxiliary	632'-6"	446	Janitors closet
Auxiliary	632'-6"	447	Toilet area
Auxiliary	632'-6"	448	Health physicist office
Auxiliary	632'-6"	448A	Health physicist work area
Auxiliary	632'-6"	449	First aid area
Auxiliary	632'-6"	450	Corridor
Auxiliary	632'-6"	451	Access control area
Auxiliary	632'-6"	452	Decontamination area
Auxiliary	632'-6"	453	Sorting area
Auxiliary	632'-6"	454	Laundry area
Auxiliary	632'-6"	455	Clothing storage
Auxiliary	632'-6"	456	Cable chase
Auxiliary	632'-6"	457	Cable chase
Auxiliary	632'-6"	458	Controlled laboratory
Auxiliary	632'-6"	459	Counting room
Auxiliary	632'-6"	460	Locker room
Auxiliary	632'-6"	460A	Entrance
Auxiliary	632'-6"	461	Change area
Auxiliary	632'-6"	462A	H&V chase

27

TABLE 12.3-5 (continued)

Building	Elevation	Room No.	Space Identification
Auxiliary	632'-6"	462B	Cable chase
Auxiliary	632'-6"	463A	Cable chase
Auxiliary	632'-6"	463B	H&V chase
Auxiliary	632'-6"	464A	Cable chase
Auxiliary	632'-6"	464B	H&V chase
Auxiliary	632'-6"	465	Corridor
Containment 2	640'-0"	466	Core flooding tanks area
Containment 2	640'-0"	467	Core flooding tanks area
Containment 2	634'-0"	468	Reactor vessel area
Containment 2	640'-0"	469	Tank area
Containment 2	640'-0"	470	Charcoal cleanup unit area
Containment 1	640'-6"	500	Emergency lock
Containment 1	640'-6"	501	Emergency lock access platform
Containment 1	642'-7"	502	Personnel access lock
Containment 1	636'-0"	503	Head storage stand area
Auxiliary	648'-6"	504	Radwaste area
Auxiliary	645'-0"	505	Valve gallery area
Auxiliary	645'-0"	506	Chiller area
Auxiliary	645'-0"	507	Chiller area
Auxiliary	645'-0"	508	Valve gallery
Auxiliary	645'-0"	509	H&V filter room
Auxiliary	652'-6"	509A	Filter
Auxiliary	652'-6"	509B	Filter

27

TABLE 12.3-5 (continued)

Building	Elevation	Room No.	Space Identification
Auxiliary	652'-6"	509C	Filter
Auxiliary	652'-6"	509D	Filter
Auxiliary	652'-6"	509E	Filter
Auxiliary	652'-6"	509F	Filter
Auxiliary	645'-0"	510	Access area
Auxiliary	652'-6"	511A	Filter
Auxiliary	652'-6"	511B	Filter
Auxiliary	652'-6"	511C	Filter
Auxiliary	652'-6"	511D	Filter
Auxiliary	652'-6"	511E	Filter
Auxiliary	652'-6"	511F	Filter
Auxiliary	652'-6"	511G	Filter
Auxiliary	652'-6"	511H	Filter
Auxiliary	652'-6"	511J	Filter
Auxiliary	652'-6"	511K	Filter
Auxiliary	652'-6"	511L	Filter
Auxiliary	652'-6"	511M	Filter
Auxiliary	652'-6"	511N	Filter
Auxiliary	652'-6"	511P	Filter
Auxiliary	652'-6"	511R	Filter
Auxiliary	652'-6"	511S	Filter
Auxiliary	652'-6"	511T	Filter
Auxiliary	652'-6"	511V	Filter

TABLE 12.3-5 (continued)

Building	Elevation	Room No.	Space Identification
Auxiliary	645'-0"	512A	Demineralizer
Auxiliary	645'-0"	512B	Demineralizer
Auxiliary	645'-0"	512C	Demineralizer
Auxiliary	645'-0"	512D	Demineralizer
Auxiliary	645'-0"	512E	Demineralizer
Auxiliary	645'-0"	513A	Demineralizer
Auxiliary	645'-0"	513B	Demineralizer
Auxiliary	645'-0"	513C	Demineralizer
Auxiliary	645'-0"	513D	Demineralizer
Auxiliary	645'-0"	513E	Demineralizer
Auxiliary	645'-0"	513F	Demineralizer
Auxiliary	645'-0"	513G	Demineralizer
Auxiliary	645'-0"	513H	Demineralizer
Auxiliary	645'-0"	514	Equipment access area
Auxiliary	645'-0"	515	Valve gallery
Auxiliary	643'-0"	516	New fuel storage
Auxiliary	643'-0"	517	New fuel storage
Auxiliary	645'-0"	518	Access area
Auxiliary	645'-0"	519	Access area
Auxiliary	642'-7"	522	Electrical equipment room
Auxiliary	642'-7"	523	Electrical equipment room
Auxiliary	642'-7"	526	Access platform
Auxiliary	642'-7"	527	Access platform

TABLE 12.3-5 (continued)

Building	Elevation	Room No.	Space Identification	
Auxiliary	646'-0"	528	Lower cable spreading room	
Auxiliary	646'-0"	529	Lower cable spreading room	
Auxiliary	646'-0"	530	Process instrument room	
Containment 2	640'-6"	536	Emergency lock	
Containment 2	640'-6"	537	Emergency lock access platform	
Containment 2	642'-7"	538	Personnel access lock	
Containment 2	636'-0"	539	Head storage stand area	
Containment 1	659'-0"	601	Piping penetration	
Containment 1	659'-0"	602	Reactor head storage	
Containment 1	659'-0"	603	Piping penetration	
Auxiliary	659'-0"	604	H&V equipment room	27
Auxiliary	659'-0"	605	Operating area	
Auxiliary	659'-0"	606	Boric acid mixing tank area	
Auxiliary	659'-0"	607	Boric acid and clean resin tank area	
Auxiliary	659'-0"	608	H&V filter room	
Auxiliary	659'-0"	610	Corridor	
Auxiliary	659'-0"	611	H&V equipment room	27
Auxiliary	659'-0"	612	Auxiliary equipment room	
Auxiliary	659'-0"	613	Auxiliary equipment room	
Auxiliary	659'-0"	614	Main control instrument rack room	
Auxiliary	659'-0"	615	Electrical equipment room	
Auxiliary	659'-0"	616	Pump room	

TABLE 12.3-5 (continued)

Building	Elevation	Room No.	Space Identification
Auxiliary	659'-0"	617	Office
Auxiliary	659'-0"	619	Kitchenette
Auxiliary	659'-0"	621	Toilet
Auxiliary	659'-0"	622	Air lock area
Auxiliary	659'-0"	623	Accessway
Auxiliary	659'-0"	624	Safety equipment room
Auxiliary	659'-0"	625	Control room
Auxiliary	659'-0"	626	Safety equipment room
Auxiliary	659'-0"	627	Liquid waste evaporator area
Auxiliary	659'-0"	628	Liquid waste evaporator area
Auxiliary	659'-0"	629	Liquid waste evaporator area
Auxiliary	659'-0"	630	Liquid waste evaporator area
Auxiliary	659'-0"	631	Pump room
Auxiliary	659'-0"	632	Valve gallery
Auxiliary	659'-0"	633	Valve gallery
Auxiliary	659'-0"	634	Pump room
Containment 2	659'-0"	635	Piping penetration
Containment 2	659'-0"	636	Reactor head storage
Containment 2	659'-0"	637	Piping penetration
Auxiliary	659'-0"	638A	Valve gallery
Auxiliary	659'-0"	638B	Valve gallery
Auxiliary	659'-0"	639A	Pump area
Auxiliary	659'-0"	639B	Pump area

27

TABLE 12.3-5 (continued)

Building	Elevation	Room No.	Space Identification	
Auxiliary	674'-6"	700	Electrical equipment room	
Auxiliary	674'-6"	701	Electrical equipment room	
Auxiliary	674'-6"	702	Containment purge room	
Auxiliary	674'-6"	703	Containment purge room	
Auxiliary	673'-6"	704	Accessway	
Auxiliary	673'-6"	705	Accessway	
Auxiliary	673'-6"	707	H&V chase	27
Auxiliary	673'-6"	708	H&V equipment room	
Auxiliary	674'-6"	709	Upper cable spreading room	
Auxiliary	674'-6"	710	Upper cable spreading room	27
Auxiliary	673'-0"	711	Component cooling water storage tank room	
Auxiliary	673'-0"	712	Component cooling water storage tank room	
Containment 1	685'-0"	725	RB operating area	
Containment 1	685'-0"	726	RB operating area	
Containment 1	688'-0"	727	Reactor cavity cover	
Auxiliary	690'-6"	730	Air intake area	
Auxiliary	690'-6"	731	Air intake area	
Auxiliary	685'-0"	732	H&V equipment area	
Auxiliary	685'-0"	733	H&V equipment area	
Auxiliary	685'-0"	734	H&V equipment area	
Auxiliary	689'-6"	735	Elevator machine room	
Auxiliary	685'-0"	737	H&V equipment area	

TABLE 12 3-5 (continued)

Building	Elevation	Room No.	Space Identification
Auxiliary	685'-0"	738	H&V equipment area
Auxiliary	685'-0"	739	H&V control room
Containment 2	685'-0"	740	RB operating area
Containment 2	685'-0"	741	RB operating area
Containment 2	688'-0"	742	Reactor cavity cover
Turbine	614'-0"	380	Tank area - Unit 1
Turbine	614'-0"	381	Tank area - Unit 2
Turbine	614'-0"	382	Operator area - Unit 1
Turbine	614'-0"	383	Operator area - Unit 2
Turbine	614'-0"	384	Condensate demineralizer - Unit 1
Turbine	614'-0"	385	Condensate demineralizer - Unit 2
Turbine	614'-0"	386	Battery room - Unit 1
Turbine	614'-0"	387	Battery room - Unit 2
Turbine	614'-0"	388	Switchgear area - Unit 1
Turbine	614'-0"	389	Switchgear area - Unit 2
Turbine	614'-0"	390	Condenser - Unit 1
Turbine	614'-0"	391	Condenser - Unit 2
Turbine	593'-7"	392	Condensate pump pit - Unit 1
Turbine	593'-7"	393	Condensate pump pit - Unit 2
Turbine	614'-0"	394	Electrohydraulic control unit
Turbine	614'-0"	395	Electrohydraulic control unit
Turbine	614'-0"	396	Stair No. 20 enclosure

TABLE 12.3-5 (continued)

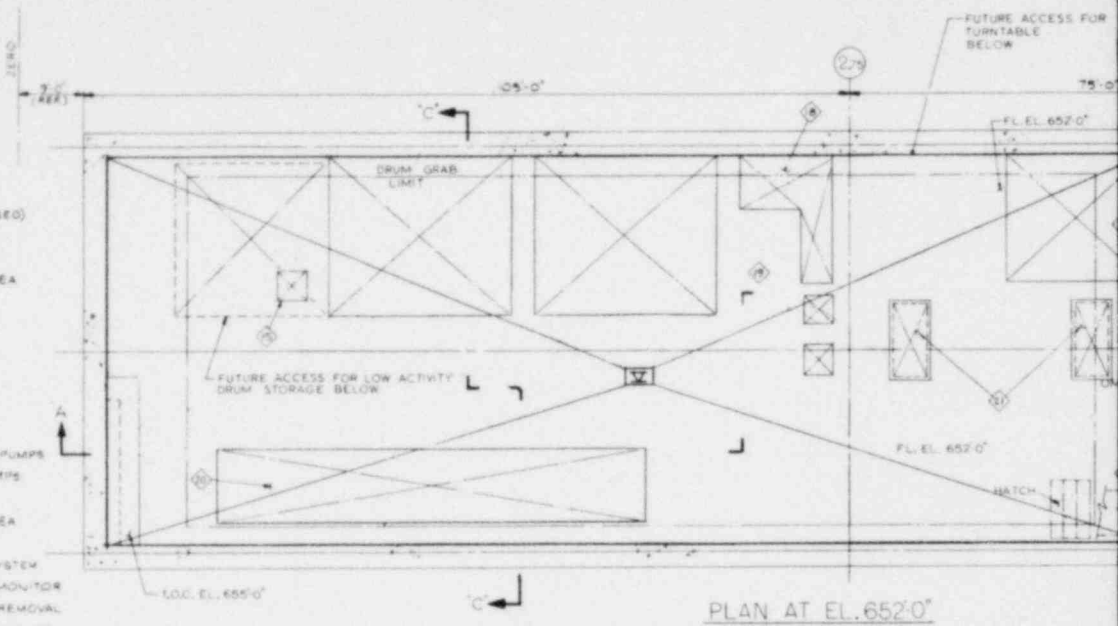
Building	Elevation	Room No.	Space Identification
Turbine	614'-0"	397	Stair No. 21 enclosure
Turbine	614'-0"	398	Stair No. 22 enclosure
Turbine	634'-6"	470	Feedwater heater - Unit 1
Turbine	634'-6"	471	Feedwater heater - Unit 2
Turbine	634'-6"	472	Load center area - Unit 1
Turbine	634'-6"	473	Load center area - Unit 2
Turbine	634'-6"	474	Switchgear - Unit 1
Turbine	634'-6"	475	Switchgear and load center area - Unit 2
Turbine	634'-6"	476	Feedwater pump - Unit 1
Turbine	634'-6"	477	Feedwater pump - Unit 2
Turbine	634'-6"	478	Turbine stop valves - Unit 1
Turbine	634'-6"	479	Turbine stop valves - Unit 2
Turbine	631'-0"	480	Lube oil room - Unit 1
Turbine	631'-0"	481	Lube oil room - Unit 2
Turbine	634'-6"	482	Toilet area
Turbine	634'-6"	483	Locker room
Turbine	634'-6"	484	Shower area
Turbine	634'-6"	485	Entry
Turbine	634'-6"	486	Uncontrolled laboratory
Turbine	634'-6"	487	Entry
Turbine	634'-6"	488	Entry
Turbine	634'-6"	489	Corridor

TABLE 12.3-5 (continued)

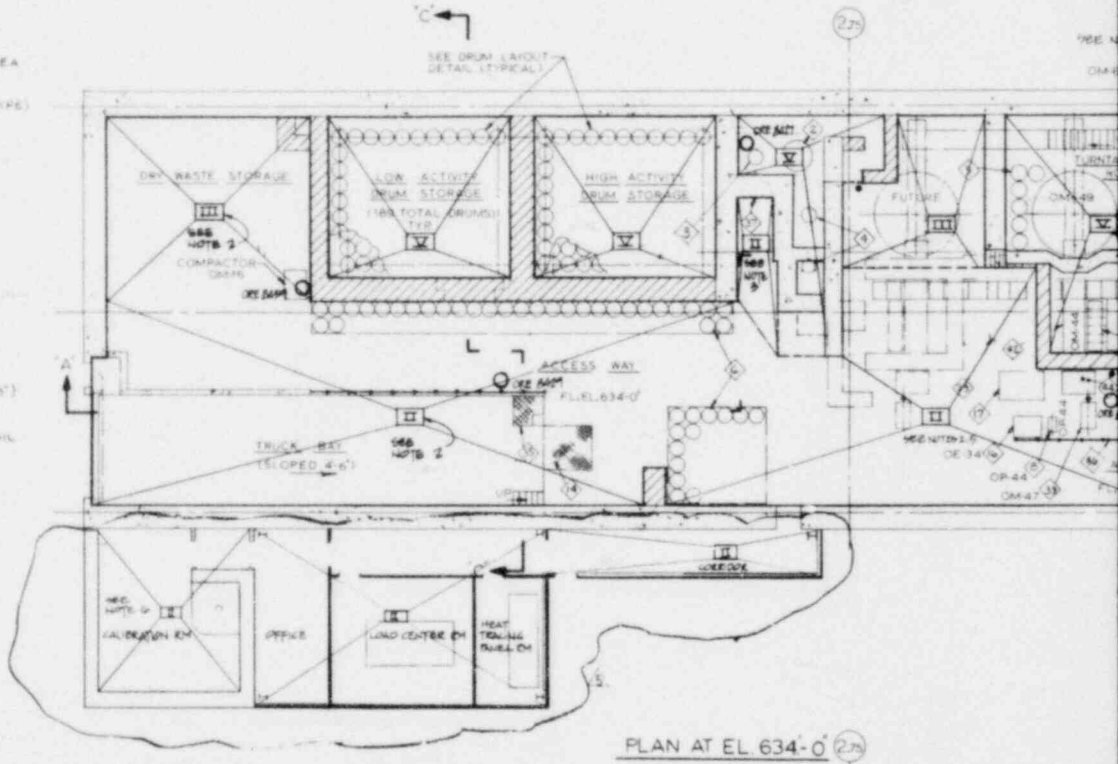
Building	Elevation	Room No.	Space Identification
Turbine	634'-6"	490	Load center area - Unit 1
Turbine	634'-6"	491	Air compressors and after-cooler
Turbine	660'-0"	639	Programming room
Turbine	659'-0"	640	Deaerating feedwater heater
Turbine	659'-0"	641	Deaerating feedwater heater
Turbine	659'-0"	642	Turbine-generator operating area
Turbine	659'-0"	643	Turbine-generator operating area
Turbine	695'-0-5/16"	750	H&V chiller and service area
Turbine	695'-0-5/16"	751	H&V chiller and service area
Turbine	675'-0"	752	Computer room

◇ EQUIPMENT LEGEND

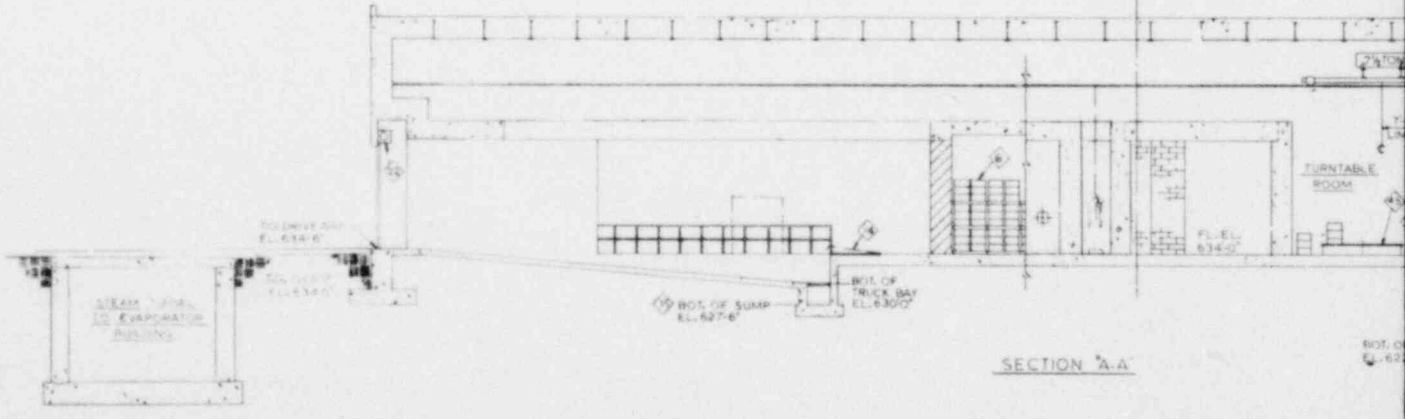
1. EMPTY DRUM CONVEYOR (GRAVITY FEED)
2. DECONTAMINATION STATION
3. CAPPING & MONITOR STATION
4. FILTER CARTRIDGE REMOVAL AREA
5. 6 DRUM COOLING AREA
6. EMPTY DRUM STORAGE AREA
7. WASTE METERING PUMPS
8. ASPHALT METERING PUMP
9. RESIN DECANT TANK
10. RESIN TRANSFER PUMP
11. RESIN DECANT PUMP
12. LIQUID WASTE 31% CONCENTRATE PUMPS
13. BORIC ACID CONCENTRATE PUMPS
14. TRUCK LOADING DOCK RAMP
15. CRANE ACCESS TO DRY WASTE AREA
16. LUBE OIL COOLER
17. DISTILLATE COLLECTION & FILTER SYSTEM
18. OPENING FOR DECON./E CAPPING/MONITOR
19. OPENING FOR FILTER CARTRIDGE REMOVAL
20. OPENING FOR OVERHEAD TRUCK LOADING
21. REMOVABLE PANELS (EL 652'-0") FOR EQUIPMENT REMOVAL BELOW
22. MOTOR OPERATED 8'-0" x 14'-0" STEEL ROLLING DOOR
23. EXTRUDER VALVE MAINTENANCE AREA
24. CRANE MAINTENANCE AREA
25. T.V. & CRANE PANEL (CONSOLE TYPE)
26. PROCESS CONTROL PANEL
27. TRANSFORMER
28. MOTOR CONTROL CENTER
29. ASPHALT STORAGE TANK
30. ASPHALT RECIRCULATION PUMPS
31. PIPE TRENCH
32. ELECTRIC AUXILIARY BOILER
33. DRAINAGE SUMP
34. FUTURE PROCESS CONTROL PANEL
35. TRUCK BAY DRAINAGE SUMP
36. HANDRAIL (REMOVABLE)
37. AIR CONDITIONING UNIT (EL 663'-5")
38. EXTRUDER MOTOR
40. EMPTY DRUM TRANSPORT MONORAIL
41. SCR DRIVE CABINET
42. EVAPORATOR (EVAPORATOR)
43. TURNTABLE
44. EXTRUDER GEARBOX
45. BRIDGE CRANE



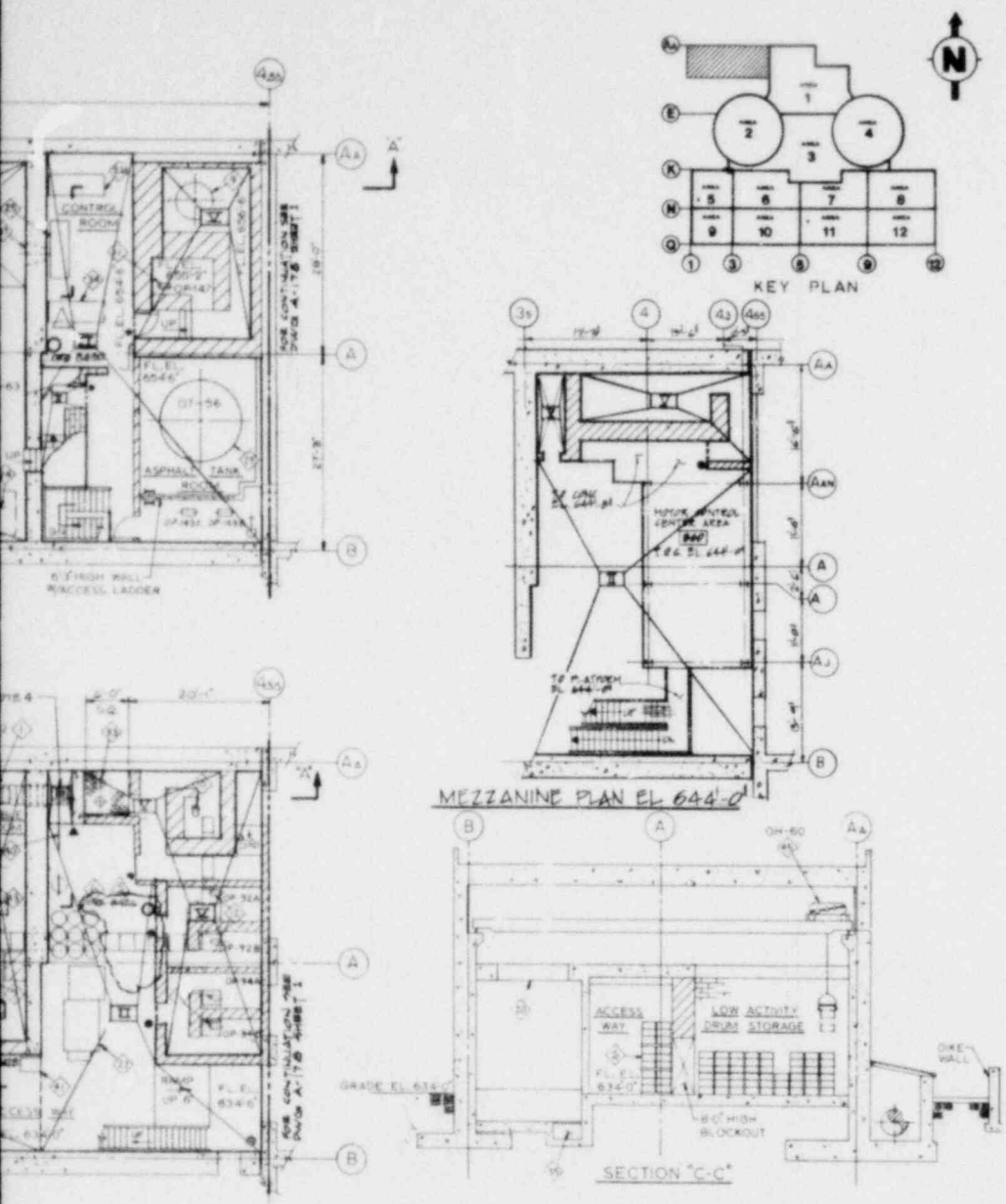
PLAN AT EL. 652'-0"



PLAN AT EL. 634'-0"



SECTION "A-A"



NOTES:

1. SEE GENERAL NOTES ON DWG A-170
2. DURING RADWASTE DRUM TRUCK LOADING THIS AREA IS A ZONE IV
3. DURING THE FILTER HANDLING OPERATION, THIS AREA IS A ZONE IV.
4. ▲ MAY BE LOWERED WHEN LIFTING DRUMS FROM TURNTABLE AREA THIS AREA MAY BE ZONE V DURING DRUM TRANSFER.
5. DURING TRUCK LOADING THIS AREA CAN BE ZONE V IF THE HIGH ACTIVITY BARRELS TRAVEL DIRECTLY OVER THE CENTER OF THIS AREA.
6. LOWER GRADE IN CAMED SUMP AREA IS A ZONE V, COULD BE AS HIGH AS 500 MR/HR.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Radiation Zoning
Solid Radwaste Building
Plan of El. 634'-0" & 652'-0"
(A-178 Sh 2 of 2, Rev 5)

FSAR Figure 12.3-43

Plant Technical Engineer	a.	Graduate in engineering, a related physical science, or equivalent (minimum of 4 years experience)	8
	b.	Minimum of 1 year nuclear power plant experience	
	c.	Minimum of 3 years of professional level experience in nuclear services, nuclear plant operation, or nuclear engineering	23
Staff Health Physicist	a.	Graduate in health physics, engineering, a physical science, or equivalent experience (minimum of 4 years)	8
Staff Chemist	a.	Graduate in engineering, a physical science, or equivalent in experience (minimum of 4 years)	
Instrument and Control Engineer	a.	Graduate in engineering, a related physical science, or equivalent (4 years college education creditable on a 1-for-1 basis towards total power plant experience)	
	b.	Minimum of 5 years experience in instrumentation and control, of which a minimum of 6 months must be in nuclear instrumentation and control	27
Instrument and Control Supervisor	a.	High school diploma or equivalent	
	b.	Minimum of 4 years of responsible power plant experience in the craft or discipline he supervises	
Reactor Engineer	a.	Graduate in engineering or a related physical science	
	b.	Minimum of 2 years of experience in areas of reactor physics, core measurements, core heat transfer, and core physics testing programs	23
General/Associate Engineers	a.	Graduate in engineering or a related physical science	

Plant Supervisor/ Shift Supervisors	a.	High school diploma or equivalent
	b.	Minimum of 4 years of responsible power plant experience, 1 year of which is in nuclear power. A maximum of 2 years of academic training may be substituted for the 4 years of power plant experience
	c.	Shall be qualified for, acquire, and hold an active senior reactor operator license
Control Operator I	a.	High school diploma or equivalent
	b.	Minimum of 2 years of power plant experience, of which a minimum of 1 year is nuclear power plant experience
	c.	Shall be qualified for, acquire, and hold an active reactor operator's license
Control Operator II Licensed Auxiliary Operator	a.	High school diploma or equivalent
	b.	Minimum of 2 years power plant experience of which a minimum of 1 year is nuclear power plant experience
	c.	Shall be qualified for, acquire, and hold an active reactor operator's license

| 20

14A.1.25 CHILLED WATER AND SAFEGUARDS CHILLED WATER SYSTEMS

1. Purpose

To demonstrate that the safeguards chilled water system will function properly and to demonstrate proper component response following receipt of simulated ESFAS signals.

2. Prerequisites

2.1 Construction activities complete on items to be tested

2.2 Appropriate system instrumentation calibrated and operational

2.3 Appropriate power sources available

2.4 Service water system available

2.5 Control logic and alarm circuitry functional checks complete

3. Test Method

3.1 Verify that the chiller units supply chilled water at rated flow and temperature conditions.

3.2 Verify chilled water flow to all supplied components.

3.3 Demonstrate proper component response and water flows upon receipt of simulated ESFAS signals. | 27

4. Acceptance Criteria

The chilled water and safeguards chilled water systems function as described in Subsections 9.2.9 and 9.2.10.

14A.1.26 VENTILATION SYSTEMS

1. Purpose

1.1 To demonstrate proper operation of the following ventilation systems:

a. Control room area ventilation system

b. Spent fuel pool area ventilation system

c. Auxiliary and radwaste area ventilation system

d. Turbine building area ventilation system

e. Engineered safety features ventilation system

f. Reactor building ventilation system

g. Diesel generator building ventilation system

h. Service water pump structure ventilation system

i. Reactor building air purification and cleanup system

1.2 To demonstrate proper system component response to simulated ESFAS signals where applicable

1.3 Demonstrate the control room pressurization system operates as required by design. | 20

2. Prerequisites

2.1 Construction activities complete on items to be tested

2.2 System instrumentation calibrated and operational

2.3 Appropriate power sources available

2.4 Control logic and alarm circuitry functional checks complete | 27

3. Test Method

3.1 Demonstrate proper operation of system fans and verify air flow, distribution, and pressure control are within specification. | 20

3.2 For applicable systems, demonstrate proper system component response and air flow following receipt of simulated ESFAS signals. | 27

4. Acceptance Criteria

The ventilation systems operate as described in Section 9.4. ESFAS actuated components function as described in Chapter 6.

14A.1.27 HEPA FILTER AND CHARCOAL ADSORBER TEST

1. Purpose

To demonstrate leaktightness and particle removal ability of HEPA filter banks and charcoal adsorber units in the control room ventilation system, spent fuel pool area ventilation system, auxiliary and radwaste area ventilation system, ESF ventilation system, and reactor building air purification and cleanup system. 20

2. Prerequisites

Ventilation systems associated with filters are operational

3. Test Method

3.1 Inject an aerosol of DOP (dioctylphthalate) upstream of HEPA filters. Take a sample downstream of HEPA filter and determine concentrations.

3.2 Inject gaseous freon 112 (or equivalent) upstream of charcoal adsorbers. Obtain upstream and downstream samples and determine concentrations.

4. Acceptance Criteria

The HEPA filter and charcoal adsorber units meet or exceed the filter efficiencies given in Regulatory Guide 1.52.

14A.1.32 BORON RECOVERY SYSTEM

1. Purpose

To demonstrate the capability of the boron recovery system to recover boric acid from reactor coolant.

2. Prerequisites

2.1 Construction activities complete on items to be tested

2.2 Appropriate system instrumentation calibrated and operational

2.3 Appropriate power sources available

2.4 Steam supply available for running evaporator and degassifier | 27

2.5 Control logic and alarm circuitry functional checks complete

2.6 Component cooling water supply available

2.7 Primary water and demineralized water available to fill loop seals | 27

2.8 Nitrogen available for blanketing the tanks

3. Test Method

3.1 Demonstrate operability of system design flowpaths

3.2 Demonstrate design head and flow curve for system pumps | 27

3.3 Demonstrate ability to recover boric acid and produce demineralized water of specified quality

3.4 Demonstrate the system interlocks and controls function as designed

3.5 Demonstrate operability of system degasifiers | 27

4. Acceptance Criteria

The boron recovery system performs as specified in Subsection 9.3.7.

14A.1.33 EMERGENCY DIESEL FUEL OIL STORAGE TRANSFER SYSTEM

1. Purpose

To demonstrate proper operation of the emergency diesel fuel oil storage and transfer system.

2. Prerequisites

2.1 Construction activities complete on items to be tested

2.2 Appropriate system instrumentation calibrated and operational

2.3 Control logic and alarm circuitry functional checks complete

3. Test Method

3.1 Verify design head and flow of transfer pumps.

3.2 Demonstrate all flowpaths of the fuel oil storage system.

3.3 Demonstrate proper load group assignments for electrically powered equipment and instrumentation. | 20

4. Acceptance Criteria

The emergency diesel fuel oil storage and transfer system functions as specified in Subsection 9.5.4.

14A.1.70 RCS LOW-PRESSURE OVERPROTECTION FEATURES

1. Purpose

To verify proper operation of relief and alarm actuation of the low temperature overpressure protection features.

2. Prerequisites

2.1 The DHRS suction from RCS relief valves has been satisfactorily tested in accordance with ASTM Section XI, Subsection 1WV3510.

2.2 The RCS is operating in the DHR mode with a pressurizer steam bubble above 35 psig and below 220F. 21

3. Test Method

3.1 Simulate, in turn, each DHRS suction isolation valve from the RCS not open.

3.2 Simulate pressurizer pressure above the power operated relief valve (PORV) setpoint.

4.0 Acceptance Criteria

4.1 Alarms on each DHRS suction isolation valve function properly.

4.2 PORV opens and closes at the required setpoints.

14A.1.71 PROCESS DRAINAGE

1. Purpose

To demonstrate the operability of the floor drainage system for potentially radioactive drains.

2. Prerequisites

Construction activities complete on items to be tested.

3. Test Method

27

3.1 Bench test valves located in drain lines from rooms housing critical equipment to demonstrate leak tightness.

3.2 Demonstrate that the radioactive waste drainage system is independent from nonradioactive drainage systems.

3.3 Demonstrate proper flowpaths.

4. Acceptance Criteria

Equipment and floor drainage system operate as described in FSAR Subsection 9.3.3.

APPENDIX 15B

MATHEMATICAL MODELS FOR RADIOLOGICAL CONSEQUENCES

15B.1 ACTIVITY RELEASE MODELS

15B.1.1 PATHWAYS

The release pathways for the major accidents are shown schematically in Figure 15B-1. The accidents and their respective pathways are given below with the letters (A-E, A-F-E, etc) referring to the labels used in Figure 15B-1.

Secondary system releases (SSR): S→E

Radwaste gas system failure (RGSF): A→E

Liquid waste system component failure (LWSCF): A→E

Fuel handling accident (FHA): A→F→E

Control rod ejection accident (CREA): S→E + C→E

Loss-of-coolant accident (LOCA)

Containment release - C→E→CR
Hydrogen purge - C→F→E
ESF pump and line leakage - A→E

15B.1.2 MATHEMATICAL MODELS

15B.1.2.1 Activity Release to Atmosphere

The activity of isotope i in the confining structure prior to release to the atmosphere is described by:

$$A_i(t) = A_i(0)\, e^{-\lambda_i t} \quad \text{curies} \qquad (1)$$

where

$A_i(t)$ = activity of isotope i in the structure at time t, curies

$A_i(0)$ = initial activity of isotope i released to the structure, curies

λ_i = removal constant of isotope i in the structure, s^{-1}

$$\lambda_i = \lambda_{di} + \lambda_{ri} + \iota$$

where

λ_{di} = decay constant of isotope i, s^{-1}

λ_{ri} = removal constant for sprays on isotope i, s^{-1} (used only in LOCA analysis)

L = leakage or release rate of structure atmosphere, s^{-1}

The rate of activity released to the atmosphere for isotope i is:

$$\frac{dR_i(t)}{dt} = f \cdot L \cdot A_i(t) \quad \text{curies/s} \qquad (2)$$ | 27

which solving yields:

$$R_i(t) = \frac{f \cdot L \cdot A_i(0)}{\lambda_i} (1-e^{-\lambda_i t}) \quad \text{curies} \qquad (3)$$

where

$R_i(t)$ = activity released to the atmosphere for isotope i, curies

f = fraction of isotope i which is not removed by filtration

All other symbols are previously defined.

For cases of direct release to the atmosphere, decay and holdup are not considered (i.e., $\lambda_{di} = 0$ and L is very large). Equation 3 becomes:

$$R_i(t) = f \cdot A_i(0) \quad \text{curies} \qquad (4)$$

and if there is no filtration, then

$$R_i(t) = A_i(0) \quad \text{curies} \qquad (5)$$

The activity released to the atmosphere for isotope i during time interval j is:

$$R_{ij} = R_i(t_2) - R_i(t_1) \qquad \text{curies} \qquad (6)$$

where

t_1, t_2 = endpoints of time interval j, s

15B.1.2.2 Activity Released to Control Room

Referring to Figure 15B-2, the rate of change of activity of isotope i during time interval j inside the control room is:

$$\frac{VdC_i(t)}{dt} = \left[KF_1(1-\eta_1) + F_2\right] B_i(t) + K\left[F_5 + F_4(1-\eta \cdot \right. C_i(t) - \left[F_3 + F_L + \lambda_{di}V\right] C_i(t) \qquad (7)$$

where

V = control room volume, m^3

$C_i(t)$ = control room concentration of isotope i at time t, curies/m^3

$K = \frac{F_T - F_B}{F_T}$

$F_T = F_3 + F_1$, m^3/s

F_1 = intake rate of outside air, m^3/s

F_3 = total recirculation flow, m^3/s

F_B = flow to battery room, m^3/s

η_1 = intake filter efficiency

F_2 = unfiltered inleakage of outside air into control room, m^3/s

$B_i(t)$ = activity concentration of isotope i in the outside atmosphere at time t, curies/m^3

$= L \cdot A_i(t) \cdot (\chi/Q)_j$

$A_i(t)$ = activity of isotope i in containment volume at time t, curies

$(x/Q)_j$ = atmospheric dispersion factor between containment and control room intake vent during time interval j, s/m^3

η_2 = recirculation filter efficiency

F_4 = recirculation flow that passes through the recirculation filter, m^3/s

F_5 = recirculation flow that does not pass through recirculation filter, m^3/s

F_L = control room leakage to atmosphere, m^3/s

Substituting Equation 1 for A (t) and rearranging yields:

$$\frac{dC_i(t)}{dt} = X_i \cdot L \cdot A_i(o)e^{-\lambda_i t} - Y_i C_i(t) \quad \frac{\text{curie}}{m^3\text{-s}} \qquad (8)$$ | 27

where

$$X_i = \left[K(1-\eta_1)F_1 + F_2\right](X/Q)_j/V \qquad m^{-3}$$

$$Y_i = \left[F_3 + F_L + \lambda_{di}V - K(F_5 + F_4(1-\eta_2))\right]/V \qquad s^{-1}$$

Solving Equation 8 yields the control room concentration: | 27

$$C_i(t) = \frac{X_i \cdot L \cdot A_i(o)}{Y_i - \lambda_i}(e^{-\lambda_i t} - e^{-Y_i t}) + C_i(o)e^{-Y_i t} \quad \text{curie}/m^3 \qquad (9)$$

The integrated activity of isotope i during time interval j inside the control room is:

$$IC_{ij} = \int_{t_1}^{t_2} V\,C_i(t)\,dt \quad \text{curie - s} \qquad (10)$$

where

t_1, t_2 = endpoints of time interval j, s

15B.2 DOSE MODELS

15B.2.1 THYROID DOSE VIA INHALATION

The thyroid dose is calculated based on the method outlined in TID 14844.(1) The following breathing rates, taken from Reference 2, are used in the dose analysis.

Time Interval	Breathing Rate
0 to 8 hours	3.47×10^{-4} m^3/s
8 to 24 hours	1.75×10^{-4} m^3/s
1 to 30 days	2.32×10^{-4} m^3/s

The dose conversion factors used in the dose analysis are taken from Reference 1 and presented below.

Isotope	Dose Conversion Factor (rem/Ci-inhaled)
I-131	1.48×10^6
I-132	5.35×10^4
I-133	4.00×10^5
I-134	2.50×10^4
I-135	1.24×10^5

15B.2.1.1 Doses to Offsite Personnel

The dose to the thyroid due to inhalation during time interval j at distance x from release is described by:

$$D_{th}(x)_j = BR_j \cdot \frac{X}{Q}(x)_j \cdot \sum_i DCF_i R_{ij} \text{ rem} \qquad (11)$$

where

$D_{th}(x)_j$ = thyroid inhalation dose at distance x from release during time interval j, rem

DCF_i = dose conversion factor for iodine isotope i, rem/curies-inhaled

BR_j = breathing rate during time interval j, m^3/s

$\frac{X}{Q}(x)_j$ = atmospheric dispersion factor at distance x during time interval j, s/m^3 | 27

R_{ij} = activity released for iodine isotope i during time interval j, curies

15B.2.1.2 Doses to Control Room Personnel

The dose to the thyroid due to inhalation during time interval j - inside the control room is:

$$D_{th}^{cr_j} = OF_j BR_j \sum_i DCF_i IC_{ij}/V \quad rem \qquad (12)$$

where

OF_j = occupancy factor, fraction of time personnel are in control room during time interval j

All other symbols as previously defined.

The occupancy factors used are taken from Reference 3 and presented below.

Time Interval	Occupancy Factor
0-1 day	1.0
1-4 days	0.6
4-30 days	0.4

15B.2.2 WHOLE-BODY GAMMA DOSE

The whole-body gamma dose model is taken from References 2 and 4 with credit taken for the absorption of the gamma radiation afforded by the first 5 centimeters of tissue. The whole-body gamma dose is calculated assuming the individual is located at the center of the hemispherical radioactive cloud.

15B.2.2.1 Doses to Offsite Personnel

The whole-body gamma dose to any individual at distance x from the release during time interval j is:

$$D_\gamma(x)_j = \frac{\chi}{Q}(x)_j \sum_i IGDF_i R_{ij} \quad rem \qquad (13)$$

where

$D_\gamma(x)_j$ = whole-body gamma dose during time interval j at distance x, rem

$IGDF_i$ = "semi-infinite" cloud gamma dose conversion factor for isotope i, $\frac{rem\text{-}m^3}{curies\text{-}s}$ | 27

All other symbols as previously defined.

$$IGDF_i = 0.25 \sum_l e^{-\mu^T_{al} d} E_l F_{il} \quad \frac{rem - m^3}{curie - s} \qquad (14)$$

where

0.25 = dose conversion constant

μ^T_{al} = energy absorption coefficient in tissue for gamma energy l, cm^{-1} (Reference 5)

d = tissue depth, 5 cm

E_l = gamma energy l, MeV (References 6, 7, and 8)

F_{il} = fraction of occurrence that the decay of isotope i gives off energy l (References 6, 7, and 8)

Table 15B-1 gives the semi-infinite cloud whole-body gamma dose conversion factors used in the analyses.

15B.2.2.2 Doses to Control Room Personnel

The whole-body gamma dose to control room personnel is described by:

$$(D_\gamma^{cr})_j = OF_j \sum_i IC_{ij} FGDF_i/V \quad \text{rem} \tag{15}$$

where

$(D_\gamma^{cr})_j$ = whole-body gamma dose to control room personnel during time interval j, rem

$FGDF_i$ = finite cloud gamma dose conversion factor for isotope i, $\frac{\text{rem-m}^3}{\text{curies-s}}$

FGDF is calculated based on the model given in Reference 9, with credit taken for the attenuation of the gammas through the first 5 centimeters of tissue and integrated over the volume of the finite cloud of radius R.

$$FGDF_i = 0.25 \sum_l e^{-\mu_{al} d} E_l F_{il} \frac{\mu_{al}}{\mu_l} \left\{ \left[1 - e^{-\mu_l R}\right] - K_l \left[e^{-\mu_l R} (\mu_l R + 1) - 1\right] \right\} \quad \frac{\text{rem-m}^3}{\text{curies-s}} \tag{16}$$

where

μ_{al} = energy absorption coefficient in air for gamma energy l, m^{-1}

μ_l = total absorption coefficient in air for gamma energy l, m^{-1}

K_l = "correction" factor for scatter for gamma energy $l = \frac{\mu_l - \mu_{al}}{\mu_{al}}$ | 27

R = radius or hemisphere with volume equal to control room volume, m

All other symbols as previously defined.

Table 15B-1 gives the whole-body gamma dose factors for the 81,851 cubic foot control room (R = 10.4 m).

b. Alternative equivalent zone designations and requirements may be utilized to cover those situations not included in the subject standard. For example, there are situations in which shoe covers and/or coveralls are required but material accountability is not.

Positions a and b were previously accepted by the NRC on May 30, 1975, as a part of Revision 1A of Bechtel Topical Report BQ-TOP-1.

c. Section 2.1, Planning - The project will use four cleanliness zones instead of the five zones listed in this paragraph. These zones will provide the necessary cleanliness and will provide less confusion in the field. The requirements of Zones I and II in the standard will be included in Zones A and B of the field procedure. The requirements of Zone III of the standard will be covered by including these items into Zone B or upgrading Zone C for the particular item. Zone IV will be included in Zone C, except the restrictions on tobacco or eating are not required. This zone can be upgraded to include these restrictions for particular items if necessary. Zone V will be incorporated into Zones C or D as required. 16

(Note: Zone C provides no restriction except that the areas will be maintained free of detrimental scrap materials and will be swept regularly.) Protective coverings will be utilized in work areas to minimize grease and oil spillage on finished surfaces. Zone D areas will be heavy construction areas without cleanliness restrictions and will be upgraded to Zone C when the heavy construction is completed.

	Zones			
Restriction List	A	B	C	D
Clothing changes	Yes	No	No	No
Clean gloves, shoe covers, head covering	Yes	Yes	No	No
Filtered air	Yes	No	No	No
Material precleaning	Yes	No	No	No
Material accountability	Yes	Yes	No	No
Personnel accountability	Yes	Yes	No	No
No use of tobacco/eating	Yes	Yes	No	No

d. Paragraph 2.2, Procedures and Instruction - This paragraph requires procedures for safety and fire regulations. The project will use procedures which describe existing national, state, and local codes and regulations to control safety and fire. The National Fire Protection Association is the national fire code followed at the site.

Positions c and d were reviewed and found acceptable by the NRC. This evaluation is in the NRC's letter to CPCo dated August 12, 1977, dealing with regulatory guides in the quality assurance category.

17.1.1.9 Alternatives to and Interpretations of Regulatory Guide 1.54 - 6/73 (ANSI N101.4-1972) 16

ANSI N101.4-1972:

a. The painting requirements for the Midland project are specified in five project painting specifications, most of which were developed prior to the issuance of Regulatory Guide 1.54. ANSI N101.4 was used extensively in the development of these specifications and compliance to ANSI N45.2 is required by Consumers Power Company for equipment procured for the Midland project. Although not specifically required in all four specifications, ANSI N101.4 and ANSI N101.2 are generally referenced and used in evaluation and approval of vendor painting procedures. 27

b. In instances where non-LOCA qualified paint is used on small components with a limited painted surface such as valve operators, instrumentation, small accessory components, and equipment trim, the FSAR provided the total surface area painted with these non-LOCA qualified paints to substantiate their limited application and therefore acceptable use. It is the applicant's position that, upon completing the tabulation of the amount of non-LOCA qualified paint used inside the Midland containment, if this amount is below 100 kg, the amount is acceptable. In the calculation of this total weight, only components exposed to the LOCA environment will be considered. If, upon completion of the tabulation of the amount of non-LOCA qualified paint used inside containment, this amount exceeds 100 kg, it is the applicant's position that the following will be considered in conjunction with system characteristics (sump screen size and spray nozzle openings) to determine acceptability or necessity of any corrective actions: 16

1. The areas of paint exposed to the containment LOCA atmosphere

2. The mode of paint failure (i.e., flaking or solubility)

3. The potential of the paint reactants reaching the containment sump, considering possible surrounding traps such as insulation, etc

LIST OF EFFECTIVE PAGES

This List of Effective Pages identifies those text pages and figures that are currently effective in the Responses to NRC Questions.

Page or Figure No.	Issue
VOLUME I	
Q&R LOEP-1	Rev. 27
Q&R LOEP-2	Rev. 27
Q&R LOEP-3	Rev. 27
Q&R LOEP-4	Rev. 27
Q&R LOEP-5	Rev. 27
Q&R LOEP-6	Rev. 27
Q&R LOEP-7	Rev. 27
Q&R LOEP-8	Rev. 27
Q&R LOEP-9	Rev. 27
Q&R LOEP-10	Rev. 27
Q&R LOEP-11	Rev. 27
Q&R LOEP-12	Rev. 27
Q&R LOEP-13	Rev. 27
Q&R LOEP-14	Rev. 27
Q&R LOEP-15	Rev. 27
Q&R LOEP-16	Rev. 27
Q&R LOEP-17	Rev. 27
Q&R LOEP-18	Rev. 27
Q&R LOEP-19	Rev. 27
Q&R LOEP-20	Rev. 27
Q&R LOEP-21	Rev. 27
Q&R LOEP-22	Rev. 27
Q&R LOEP-23	Rev. 27
Q&R LOEP-27	Rev. 27
Q&R LOEP-25	Rev. 27
Q&R LOEP-26	Rev. 27
Q&R LOEP-27	Rev. 27
Q&R LOEP-28	Rev. 27
Q&R LOEP-29	Rev. 27
Q&R LOEP-30	Rev. 27
Q&R LOEP-31	Rev. 27
Q&R LOEP-32	Rev. 27
Q&R CR-1	Rev. 16
Q&R CR-2	Rev. 17
Q&R CR-3	Rev. 17
Q&R CR-4	Rev. 26
Q&R CR-5	Rev. 16
Q&R CR-6	Rev. 27
Q&R CR-7	Rev. 16
Q&R CR-8	Rev. 16
Q&R CR-9	Rev. 16

Q&R CR-10	**Rev. 20**
Q&R CR-10a	**Rev. 27**
Q&R CR-10b	**Rev. 27**
Q&R CR-11	Rev. 17
Q&R CR-12	Rev. 17
Q&R CR-13	Rev. 21
Q&R CR-14	Rev. 21
Q&R CR-14a	Rev. 21
Q7R CR-14b	Rev. 21
Q&R CR-15	Rev. 19
Q&R CR-16	Rev. 17
Q&R CR-17	Rev. 17
Q&R CR-18	Rev. 20
Q&R CR-19	Rev. 17
Q&R CR-20	Rev. 21
Q&R CR-21	Rev. 21
Q&R CR-22	Rev. 21
Q&R CR-22a	Rev. 17
Q&R CR-22b	Rev. 17
Q&R CR-23	Rev. 21
Q&R CR-24	Rev. 18
Q&R CR-25	Rev. 17
Q&R CR-26	Rev. 17
Q&R CR-27	Rev. 19
Q&R CR-28	Rev. 17
Q&R CR-29	Rev. 18
Q&R CR-30	Rev. 18
Q&R CR-31	Rev. 18
Q&R CR-32	Rev. 20
Q&R CR-33	Rev. 17
Q&R CR-34	Rev. 18
Q&R CR-35	Rev. 26
Q&R CR-36	Rev. 16
Q&R CR-37	Rev. 19
Q&R CR-38	Rev. 19
Q&R CR-39	Rev. 19
Q&R CR-40	Rev. 19
Q&R CR-41	Rev. 19
Chapter 1 Tab	
Q&R 1-i	Rev. 18
1.1 Tab	Rev. 2
1.2 Tab	Rev. 2
Q&R 1.2-1	Rev. 18
Q&R 1.2-2	Rev. 18
Q&R 1.2-3	Rev. 18
1.3 Tab	Rev. 2
1.4 Tab	Rev. 2
1.5 Tab	Rev. 2
Q&R 1.5-1	Rev. 18
Q&R 1.5-2	Rev. 18
1.6 Tab	Rev. 2
Q&R 1.6-1	Rev. 12
1.7 Tab	Rev. 2
Chapter 2 Tab	

Q&R 2-i	Rev. 22
Q&R 2-ii	Rev. 24
Q&R 2-iii	Rev. 20
Q&R 2-iv	Rev. 24
2.1 Tab	Rev. 2
Q&R 2.1-1	Rev. 3
Q&R 2.1-2	Rev. 3
Q&R 2.1-3	Rev. 3
2.2 Tab	Rev. 2
Q&R 2.2-1	Rev. 3
Q&R 2.2-2	Rev. 3
Q&R 2.2-3	Rev. 11
Q&R 2.2-4	Rev. 3
2.3 Tab	Rev. 2
Q&R 2.3-1	Rev. 13
Q&R 2.3-2	Rev. 13
Q&R 2.3-3	Rev. 11
Q&R 2.3-4	Rev. 3
Q&R 2.3-5	Rev. 8
Q&R 2.3-6	Rev. 8
Q&R 2.3-7	Rev. 8
Q&R 2.3-8	Rev. 14
Q&R 2.3-9	Rev. 8
Q&R 2.3-10	Rev. 8
Q&R 2.3-11	Rev. 8
Q&R 2.3-12	Rev. 11
Q&R 2.3-13	Rev. 8
Q&R 2.3-14	Rev. 8
Q&R 2.3-15	Rev. 8
Q&R 2.3-16	Rev. 8
Q&R 2.3-17	Rev. 8
Q&R 2.3-18	Rev. 14
Q&R 2.3-19	Rev. 14
Q&R 2.3-20	Rev. 14
Q&R 2.3-21	Rev. 17
Q&R 2.3-22	Rev. 17
2.4 Tab	Rev. 2
Q&R 2.4-1	Rev. 3
Q&R 2.4-2	Rev. 7
Q&R 2.4-3	Rev. 7
Q&R 2.4-4	Rev. 8
Q&R 2.4-5	Rev. 12
Q&R 2.4-6	Rev. 26
Q&R 2.4-7	Rev. 8
Q&R 2.4-8	Rev. 8
Q&R 2.4-9	Rev. 8
Q&R 2.4-10	Rev. 20
Q&R 2.4-11	Rev. 20
Q&R 2.4-12	Rev. 26
Q&R 2.4-13	Rev. 26
Q&R 2.4-14	Rev. 26
Q&R 2.4-15	Rev. 22

Q&R 2.4-16	Rev. 22
Q&R 2.4-17	Rev. 22
Q&R 2.4-18	Rev. 22
Q&R 2.4-19	Rev. 22
Q&R Tbl. 2.4-1	Rev. 19
Q&R Tbl. 2.4-2	Rev. 22
Q&R Tbl. 2.4-3	Rev. 20
Q&R Fig. 2.4-1	Rev. 19
Q&R Fig. 2.4-2	Rev. 26
Q&R Fig. 2.4-3	Rev. 22
Q&R Fig. 2.4-4	Rev. 22
2.5 Tab	Rev. 2
Q&R 2.5-1	Rev. 3
Q&R 2.5-2	Rev. 5
Q&R 2.5-3	Rev. 18
Q&R 2.5-4	Rev. 18
Q&R 2.5-4a	Rev. 18
Q&R 2.5-4b	Rev. 18
Q&R 2.5-5	Rev. 8
Q&R 2.5-6	Rev. 8
Q&R 2.5-7	Rev. 8
Q&R 2.5-8	Rev. 8
Q&R 2.5-9	Rev. 8
Q&R 2.5-10	Rev. 22
Q&R 2.5-11	Rev. 15
Q&R 2.5-12	Rev. 14
Q&R 2.5-13	Rev. 14
Q&R 2.5-14	Rev. 14
Q&R 2.5-15	Rev. 14
Q&R 2.5-16	Rev. 26
Q&R 2.5-17	Rev. 15
Q&R 2.5-18	Rev. 26
Q&R 2.5-19	Rev. 26
Q&R 2.5-20	Rev. 21
Q&R 2.5-21	Rev. 20
Q&R 2.5-22	Rev. 26
Q&R 2.5-23	Rev. 20
Q&R 2.5-24	Rev. 20
Q&R 2.5-25	Rev. 24
Q&R 2.5-26	Rev. 24
Q&R 2.5-27	Rev. 24
Q&R 2.5-28	Rev. 24
Q&R 2.5-29	Rev. 24
Q&R 2.5-30	Rev. 24
Q&R 2.5-31	Rev. 26
Q&R 2.5-32	Rev. 24
Q&R 2.5-33	Rev. 26
Q&R 2.5-34	Rev. 26
Q&R Tbl. 2.5-1	
Sheet 1	Rev. 18
Sheet 2	Rev. 18
Q&R Tbl. 2.5-2	

Sheet 1	Rev. 18
Sheet 2	Rev. 18
Sheet 3	Rev. 18
Q&R Tbl. 2.5-3	
Sheet 1	Rev. 18
Sheet 2	Rev. 18
Sheet 3	Rev. 18
Q&R Tbl. 2.5-4	
Sheet 1	Rev. 18
Sheet 2	Rev. 18
Sheet 3	Rev. 18
Sheet 4	Rev. 18
Sheet 5	Rev. 18
Sheet 6	Rev. 18
Q&R Fig. 2.5-1	Rev. 22
Q&R Fig. 2.5-2	Rev. 22
Q&R Fig. 2.5-3	Rev. 24
Appendix 2A Tab	Rev. 5
Appendix 2B Tab	Rev. 5
Appendix 2C Tab	Rev. 5
Chapter 3 Tab	
Q&R 3-i	Rev. 20
Q&R 3-ii	Rev. 27
Q&R 3-iii	Rev. 27
Q&R 3-iv	Rev. 21
Q&R 3-v	Rev. 21
Q&R 3-vi	Rev. 21
Q&R 3-vii	Rev. 21
Q&R 3-viii	Rev. 21
Q&R 3-ix	Rev. 21
Q&R 3-x	Rev. 21
Q&R 3-xi	Rev. 21
Q&R 3-xii	Rev. 24
Q&R 3-xiii	Rev. 24
Q&R 3-xiv	Rev. 24
Q&R 3-xv	Rev. 24
3.1 Tab	Rev. 2
3.2 Tab	Rev. 2
Q&R 3.2-1	Rev. 8
Q&R 3.2-2	Rev. 9
Q&R 3.2-3	Rev. 9
Q&R 3.2-4	Rev. 9
Q&R 3.2-5	Rev. 16
Q&R 3.2-6	Rev. 16
Q&R 3.2-7	Rev. 16
3.3 Tab	Rev. 2
Q&R 3.3-1	Rev. 3
Q&R 3.3-2	Rev. 3
3.4 Tab	Rev. 2
Q&R 3.4-1	Rev. 8
Q&R 3.4-2	Rev. 3
Q&R 3.4-3	Rev. 3

Q&R 3.4-4	Rev. 3
3.5 Tab	Rev. 2
Q&R 3.5-1	Rev. 3
Q&R 3.5-2	Rev. 3
Q&R 3.5-3	Rev. 14
Q&R 3.5-4	Rev. 8
Q&R 3.5-5	Rev. 8
Q&R 3.5-6	Rev. 8
Q&R 3.5-7	Rev. 8
Q&R 3.5-8	Rev. 8
Q&R 3.5-9	Rev. 8
Q&R 3.5-10	Rev. 9
Q&R 3.5-11	Rev. 9
Q&R 3.5-12	Rev. 9
Q&R 3.5-13	Rev. 15
Q&R 3.5-14	Rev. 15
Q&R 3.5-15	Rev. 18
Q&R 3.5-16	Rev. 15
Q&R 3.5-17	Rev. 15
Q&R 3.5-18	Rev. 15
Q&R 3.5-19	Rev. 15
Q&R 3.5-20	Rev. 17
Q&R 3.5-20a	Rev. 17
Q&R 3.5-20b	Rev. 17
Q&R 3.5-21	Rev. 15
Q&R 3.5-22	Rev. 18
Q&R 3.5-23	Rev. 18
Q&R 3.5-24	Rev. 19
3.6 Tab	Rev. 2
Q&R 3.6-1	Rev. 3
Q&R 3.6-2	Rev. 9
Q&R 3.6-3	Rev. 8
Q&R 3.6-4	Rev. 8
Q&R 3.6-5	Rev. 8
Q&R 3.6-6	Rev. 8
Q&R 3.6-7	Rev. 8
Q&R 3.6-8	Rev. 8
Q&R 3.6-9	Rev. 8
Q&R 3.6-10	Rev. 8
Q&R 3.6-11	Rev. 8
Q&R 3.6-12	Rev. 8
Q&R 3.6-13	Rev. 18
Q&R 3.6-14	Rev. 18
Q&R 3.6-15	Rev. 14
Q&R 3.6-16	Rev. 14
Q&R 3.6-17	Rev. 14
Q&R 3.6-18	Rev. 14
Q&R 3.6-19	Rev. 14
Q&R 3.6-20	Rev. 15
Q&R 3.6-21	Rev. 14
Q&R 3.6-22	Rev. 26
Q&R 3.6-23	Rev. 14

Q&R 3.6-24	Rev. 18
Q&R Fig. 3.6-1	Rev. 18
3.7 Tab	Rev. 2
Q&R 3.7-1	Rev. 3
Q&R 3.7-2	Rev. 3
Q&R 3.7-3	Rev. 15
Q&R 3.7-4	Rev. 8
Q&R 3.7-5	Rev. 8
Q&R 3.7-6	Rev. 8
Q&R 3.7-7	Rev. 26
Q&R 3.7-8	Rev. 15
Q&R 3.7-9	Rev. 15
Q&R 3.7-10	Rev. 15
Q&R 3.7-11	Rev. 16
Q&R 3.7-12	Rev. 16
Q&R 3.7-13	Rev. 26
Q&R 3.7-14	Rev. 24
Q&R 3.7-15	Rev. 21
Q&R 3.7-16	Rev. 21
Q&R Fig. 3.7-1	Rev. 21
Q&R Fig. 3.7-2	Rev. 21
Q&R Fig. 3.7-3	Rev. 21
Q&R Fig. 3.7-4	Rev. 21
Q&R Fig. 3.7-5	Rev. 21
Q&R Fig. 3.7-6	Rev. 21
Q&R Fig. 3.7-7	Rev. 21
Q&R Fig. 3.7-8	Rev. 21
Q&R Fig. 3.7-9	Rev. 21
Q&R Fig. 3.7-10	Rev. 21
Q&R Fig. 3.7-11	Rev. 21
Q&R Fig. 3.7-12	Rev. 21
Q&R Fig. 3.7-13	Rev. 21
Q&R Fig. 3.7-14	Rev. 21
Q&R Fig. 3.7-15	Rev. 21
Q&R Fig. 3.7-16	Rev. 21
Q&R Fig. 3.7-17	Rev. 21
Q&R Fig. 3.7-18	Rev. 21
Q&R Fig. 3.7-19	Rev. 21
Q&R Fig. 3.7-20	Rev. 21
Q&R Fig. 3.7-21	Rev. 21
Q&R Fig. 3.7-22	Rev. 21
Q&R Fig. 3.7-23	Rev. 21
Q&R Fig. 3.7-24	Rev. 21
Q&R Fig. 3.7-25	Rev. 21
Q&R Fig. 3.7-26	Rev. 21
Q&R Fig. 3.7-27	Rev. 21
Q&R Fig. 3.7-28	Rev. 21
Q&R Fig. 3.7-29	Rev. 21
Q&R Fig. 3.7-30	Rev. 21
Q&R Fig. 3.7-31	Rev. 21
Q&R Fig. 3.7-32	Rev. 21
Q&R Fig. 3.7-33	Rev. 21

Q&R Fig. 3.7-34	Rev. 21
Q&R Fig. 3.7-35	Rev. 21
Q&R Fig. 3.7-36	Rev. 21
Q&R Fig. 3.7-37	Rev. 21
Q&R Fig. 3.7-38	Rev. 21
Q&R Fig. 3.7-39	Rev. 21
Q&R Fig. 3.7-40	Rev. 21
Q&R Fig. 3.7-41	Rev. 21
Q&R Fig. 3.7-42	Rev. 21
Q&R Fig. 3.7-43	Rev. 21
Q&R Fig. 3.7-44	Rev. 21
Q&R Fig. 3.7-45	Rev. 21
Q&R Fig. 3.7-46	Rev. 21
Q&R Fig. 3.7-47	Rev. 21
Q&R Fig. 3.7-48	Rev. 21
Q&R Fig. 3.7-49	Rev. 21
Q&R Fig. 3.7-50	Rev. 21
Q&R Fig. 3.7-51	Rev. 21
Q&R Fig. 3.7-52	Rev. 21
Q&R Fig. 3.7-53	Rev. 21
Q&R Fig. 3.7-54	Rev. 21
Q&R Fig. 3.7-55	Rev. 21
Q&R Fig. 3.7-56	Rev. 21
Q&R Fig. 3.7-57	Rev. 21
Q&R Fig. 3.7-58	Rev. 21
Q&R Fig. 3.7-59	Rev. 21
Q&R Fig. 3.7-60	Rev. 21
Q&R Fig. 3.7-61	Rev. 21
Q&R Fig. 3.7-62	Rev. 21
Q&R Fig. 3.7-63	Rev. 21
Q&R Fig. 3.7-64	Rev. 21
Q&R Fig. 3.7-65	Rev. 21
Q&R Fig. 3.7-66	Rev. 21
Q&R Fig. 3.7-67	Rev. 21
Q&R Fig. 3.7-68	Rev. 21
Q&R Fig. 3.7-69	Rev. 21
Q&R Fig. 3.7-70	Rev. 21
Q&R Fig. 3.7-71	Rev. 21
Q&R Fig. 3.7-72	Rev. 21
Q&R Fig. 3.7-73	Rev. 21
Q&R Fig. 3.7-74	Rev. 21
Q&R Fig. 3.7-75	Rev. 21
Q&R Fig. 3.7-76	Rev. 21
Q&R Fig. 3.7-77	Rev. 21
Q&R Fig. 3.7-78	Rev. 21
Q&R Fig. 3.7-79	Rev. 21
Q&R Fig. 3.7-80	Rev. 21
Q&R Fig. 3.7-81	Rev. 21
Q&R Fig. 3.7-82	Rev. 21
Q&R Fig. 3.7-83	Rev. 21
Q&R Fig. 3.7-84	Rev. 21
Q&R Fig. 3.7-85	Rev. 21

Q&R Fig. 3.7-86	Rev. 21
Q&R Fig. 3.7-87	Rev. 21
Q&R Fig. 3.7-88	Rev. 21
Q&R Fig. 3.7-89	Rev. 21
Q&R Fig. 3.7-90	Rev. 21
Q&R Fig. 3.7-91	Rev. 21
Q&R Fig. 3.7-92	Rev. 21
Q&R Fig. 3.7-93	Rev. 21
Q&R Fig. 3.7-94	Rev. 21
Q&R Fig. 3.7-95	Rev. 21
Q&R Fig. 3.7-96	Rev. 21
Q&R Fig. 3.7-97	Rev. 24
Q&R Fig. 3.7-98	Rev. 24
Q&R Fig. 3.7-99	Rev. 24
Q&R Fig. 3.7-100	Rev. 24
Q&R Fig. 3.7-101	Rev. 24
Q&R Fig. 3.7-102	Rev. 24
Q&R Fig. 3.7-103	Rev. 24
Q&R Fig. 3.7-104	Rev. 24
Q&R Fig. 3.7-105	Rev. 24
Q&R Fig. 3.7-106	Rev. 24
Q&R Fig. 3.7-107	Rev. 24
Q&R Fig. 3.7-108	Rev. 24
Q&R Fig. 3.7-109	Rev. 24
Q&R Fig. 3.7-110	Rev. 24
Q&R Fig. 3.7-111	Rev. 24
Q&R Fig. 3.7-112	Rev. 24
Q&R Fig. 3.7-113	Rev. 24
Q&R Fig. 3.7-114	Rev. 24
Q&R Fig. 3.7-115	Rev. 24
Q&R Fig. 3.7-116	Rev. 24
Q&R Fig. 3.7-117	Rev. 24
Q&R Fig. 3.7-118	Rev. 24
Q&R Fig. 3.7-119	Rev. 24
Q&R Fig. 3.7-120	Rev. 24
Q&R Fig. 3.7-121	Rev. 24
Q&R Fig. 3.7-122	Rev. 24
Q&R Fig. 3.7-123	Rev. 24
Q&R Fig. 3.7-124	Rev. 24
Q&R Fig. 3.7-125	Rev. 24
Q&R Fig. 3.7-126	Rev. 24
Q&R Fig. 3.7-127	Rev. 24
Q&R Fig. 3.7-128	Rev. 24
Q&R Fig. 3.7-129	Rev. 24
Q&R Fig. 3.7-130	Rev. 24
Q&R Fig. 3.7-131	Rev. 24
Q&R Fig. 3.7-132	Rev. 24
Q&R Fig. 3.7-133	Rev. 24
Q&R Fig. 3.7-134	Rev. 24
Q&R Fig. 3.7-135	Rev. 24
Q&R Fig. 3.7-136	Rev. 24
Q&R Fig. 3.7-137	Rev. 24

Q&R Fig. 3.7-138	Rev. 24
Q&R Fig. 3.7-139	Rev. 24
Q&R Fig. 3.7-140	Rev. 24
Q&R Fig. 3.7-141	Rev. 24
Q&R Fig. 3.7-142	Rev. 24
Q&R Fig. 3.7-143	Rev. 24
Q&R Fig. 3.7-144	Rev. 24
3.8 Tab	
Q&R 3.8-1	Rev. 8
Q&R 3.8-2	Rev. 14
Q&R 3.8-3	Rev. 8
Q&R 3.8-4	Rev. 8
Q&R 3.8-5	Rev. 8
Q&R 3.8-6	Rev. 14
Q&R 3.8-7	Rev. 14
Q&R 3.8-8	Rev. 15
Q&R 3.8-9	Rev. 15
Q&R 3.8-10	Rev. 27
Q&R 3.8-11	Rev. 20
Q&R 3.8-12	Rev. 20
Q&R 3.8-13	Rev. 27
Q&R Tbl. 3.8-1	
Sheet 1	Rev. 21
Sheet 2	Rev. 19
Q&R Tbl 3.8-2	Rev. 19
Q&R Tbl 3.8-3	Rev. 19
Q&R Tbl 3.8-4	Rev. 19
Q&R Tbl 3.8-5	Rev. 19
Q&R Tbl 3.8-6	Rev. 21
Q&R Tbl 3.8-7	Rev. 21
Q&R Tbl 3.8-8	Rev. 19
Q&R Tbl 3.8-9	Rev. 19
Q&R Tbl 3.8-10	Rev. 19
Q&R Tbl 3.8-11	Rev. 19
Q&R Tbl. 3.8-12	
Sheet 1	Rev. 20
Sheet 2	Rev. 20
Q&R Tbl. 3.8-13	
Sheet 1	Rev. 20
Sheet 2	Rev. 20
Q&R Tbl. 3.8-14	
Sheet 1	Rev. 20
Sheet 2	Rev. 20
Q&R Tbl. 3.8-15	Rev. 20
3.9 Tab	
Q&R 3.9-1	Rev. 8
Q&R 3.9-2	Rev. 19
Q&R 3.9-3	Rev. 8
Q&R 3.9-4	Rev. 8
Q&R 3.9-5	Rev. 8
Q&R 3.9-6	Rev. 14
Q&R 3.9-7	Rev. 8

Q&R 3.9-8	Rev. 9
Q&R 3.9-8a	Rev. 17
Q&R 3.9-8b	Rev. 9
Q&R 3.9-9	Rev. 14
Q&R 3.9-10	Rev. 8
Q&R 3.9-11	Rev. 8
Q&R 3.9-12	Rev. 8
Q&R 3.9-13	Rev. 8
Q&R 3.9-14	Rev. 25
Q&R 3.9-15	Rev. 17
Q&R 3.9-16	Rev. 14
Q&R 3.9-17	Rev. 8
Q&R 3.9-18	Rev. 8
Q&R 3.9-19	Rev. 8
Q&R 3.9-20	Rev. 15
Q&R 3.9-21	Rev. 15
Q&R 3.9-22	Rev. 19
Q&R 3.9-23	Rev. 17
Q&R 3.9-24	Rev. 15
Q&R 3.9-25	Rev. 14
Q&R 3.9-26	Rev. 14
Q&R 3.9-27	Rev. 14
Q&R 3.9-28	Rev. 14
Q&R 3.9-29	Rev. 14
Q&R 3.9-30	Rev. 16
Q&R 3.9-31	Rev. 17
Q&R 3.9-32	Rev. 15
Q&R 3.9-33	Rev. 15
Q&R 3.9-34	Rev. 15
Q&R 3.9-35	Rev. 15
Q&R 3.9-36	Rev. 15
Q&R 3.9-37	Rev. 27
Q&R 3.9-38	Rev. 27
Q&R 3.9-39	Rev. 16
Q&R 3.9-40	Rev. 16
Q&R 3.9-41	Rev. 16
Q&R 3.9-42	Rev. 16
Q&R 3.9-43	Rev. 16
Q&R 3.9-44	Rev. 26
Q&R 3.9-45	Rev. 16
Q&R 3.9-46	Rev. 16
Q&R 3.9-47	Rev. 16
Q&R 3.9-48	Rev. 27
Q&R 3.9-49	Rev. 17
Q&R 3.9-50	Rev. 17
Q&R 3.9-51	Rev. 18
Q&R 3.9-52	Rev. 17
Q&R Tbl. 3.9-1	
Sheet 1	Rev. 8
Sheet 2	Rev. 8
Q&R Tbl. 3.9-2	
Sheet 1	Rev. 19

Sheet 2	Rev. 19
Sheet 3	Rev. 20
Sheet 4	Rev. 19
Sheet 5	Rev. 19
Sheet 6	Rev. 19
Sheet 7	Rev. 19
3.10 Tab	
Q&R 3.10-1	Rev. 2
Q&R 3.10-2	Rev. 24
Q&R 3.10-3	Rev. 14
Q&R 3.10-4	Rev. 10
Q&R 3.10-5	Rev. 14
Q&R 3.10-6	Rev. 15
3.11 Tab	
Q&R 3.11-1	Rev. 24
Q&R 3.11-2	Rev. 16
Q&R 3.11-3	Rev. 15
Q&R 3.11-4	Rev. 15
Q&R 3.11-5	Rev. 24
Q&R 3.11-6	Rev. 15
Q&R 3.11-7	Rev. 20
Q&R 3.11-8	Rev. 26
Q&R 3.11-9	Rev. 19
Q&R 3.11-10	Rev. 21
Q&R 3.11-11	Rev. 21
Q&R 3.11-12	Rev. 21
Q&R 3.11-13	Rev. 19
Q&R 3.11-14	Rev. 19
Q&R 3.11-15	Rev. 19
Q&R 3.11-16	Rev. 19
Q&R 3.11-17	Rev. 19
Q&R 3.11-18	Rev. 26
Q&R 3.11-19	Rev. 19
Q&R 3.11-20	Rev. 19
Q&R 3.11-21	Rev. 19
Q&R 3.11-22	Rev. 19
Q&R 3.11-23	Rev. 19
Q&R 3.11-24	Rev. 22
Q&R 3.11-24a	Rev. 22
Q&R 3.11-24b	Rev. 22
Q&R 3.11-24c	Rev. 22
Q&R 3.11-24d	Rev. 22
Q&R 3.11-25	Rev. 19
Q&R 3.11-26	Rev. 19
Q&R 3.11-27	Rev. 19
Q&R 3.11-28	Rev. 21
Q&R 3.11-29	Rev. 26
Q&R 3.11-30	Rev. 25
Q&R 3.11-30a	Rev. 21
Q&R 3.11-30b	Rev. 21
Q&R 3.11-31	Rev. 19
Q&R 3.11-32	Rev. 19

Q&R 3.11-33	Rev. 19
Q&R 3.11-34	Rev. 26
Q&R 3.11-35	Rev. 19
Q&R 3.11-36	Rev. 21
Q&R 3.11-37	Rev. 26
Q&R 3.11-38	Rev. 21
Q&R 3.11-38a	Rev. 21
Q&R 3.11-38b	Rev. 21
Q&R 3.11-39	Rev. 26
Q&R 3.11-40	Rev. 26
Q&R 3.11-41	Rev. 20
Appendix 3A Tab	
Q&R 3A-1	Rev. 21
Q&R 3A-2	Rev. 8
Q&R 3A-3	Rev. 8
Q&R 3A-4	Rev. 9
Q&R 3A-5	Rev. 9
Q&R 3A-6	Rev. 10
Q&R 3A-7	Rev. 21
Q&R 3A-8	Rev. 18
Q&R 3A-9	Rev. 15
Q&R 3A-10	Rev. 18
Q&R 3A-11	Rev. 18
Q&R 3A-12	Rev. 18
Q&R 3A-13	Rev. 19
Q&R 3A-14	Rev. 26
Appendix 3B Tab	
Q&R 3B-1	Rev. 19
Appendix 3C Tab	
Chapter 4 Tab	
Q&R 4-	Rev. 19
Q&R 4-ii	Rev. 20
Q&R 4-iii	Rev. 19
Q&R 4-iv	Rev. 19
4.1 Tab	
Q&R 4.1-1	Rev. 9
4.2 Tab	
Q&R 4.2-1	Rev. 8
Q&R 4.2-2	Rev. 9
Q&R 4.2-3	Rev. 9
Q&R 4.2-4	Rev. 9
Q&R 4.2-5	Rev. 10
Q&R 4.2-6	Rev. 9
Q&R 4.2-7	Rev. 9
Q&R 4.2-8	Rev. 9
Q&R 4.2-9	Rev. 9
Q&R 4.2-10	Rev. 26
Q&R 4.2-11	Rev. 9
Q&R 4.2-12	Rev. 18
Q&R 4.2-12a	Rev. 18
Q&R 4.2-12b	Rev. 18
Q&R 4.2-13	Rev. 26

Q&R 4.2-14	Rev. 9
Q&R 4.2-15	Rev. 18
Q&R 4.2-16	Rev. 18
Q&R 4.2-16a	Rev. 18
Q&R 4.2-16b	Rev. 18
Q&R 4.2-17	Rev. 9
Q&R 4.2-18	Rev. 9
Q&R 4.2-19	Rev. 9
Q&R 4.2-20	Rev. 9
Q&R 4.2-21	Rev. 9
Q&R 4.2-22	Rev. 9
Q&R 4.2-23	Rev. 14
Q&R 4.2-24	Rev. 14
Q&R 4.2-25	Rev. 14
Q&R 4.2-26	Rev. 14
Q&R 4.2-27	Rev. 15
Q&R 4.2-28	Rev. 14
Q&R 4.2-29	Rev. 14
Q&R 4.2-30	Rev. 19
Q&R 4.2-31	Rev. 14
Q&R 4.2-32	Rev. 14
Q&R 4.2-33	Rev. 14
Q&R 4.2-34	Rev. 14
Q&R 4.2-35	Rev. 14
Q&R 4.2-36	Rev. 17
Q&R 4.2-37	Rev. 17
Q&R 4.2-38	Rev. 19
4.3 Tab	
Q&R 4.3-1	Rev. 8
Q&R 4.3-2	Rev. 8
Q&R 4.3-3	Rev. 18
Q&R 4.3-4	Rev. 18
Q&R Fig. 4.3-1	Rev. 18
Q&R Fig. 4.3-2	Rev. 18
Q&R Fig. 4.3-3	Rev. 18
4.4 Tab	
Q&R 4.4-1	Rev. 15
Q&R 4.4-2	Rev. 10
Q&R 4.4-3	Rev. 8
Q&R 4.4-4	Rev. 8
Q&R 4.4-5	Rev. 9
Q&R 4.4-6	Rev. 9
Q&R 4.4-7	Rev. 15
Q&R 4.4-8	Rev. 16
Q&R 4.4-9	Rev. 15
Q&R 4.4-10	Rev. 15
Q&R 4.4-11	Rev. 15
Q&R 4.4-12	Rev. 15
Q&R 4.4-13	Rev. 20
4.5 Tab	
Q&R 4.5-1	Rev. 9
Q&R 4.5-2	Rev. 9

Q&R 4.5-3	Rev. 9
4.6 Tab	
Q&R 4.6-1	Rev. 9
Q&R 4A-1	Rev. 19
Q&R 4A-2	Rev. 19
Q&R 4A-3	Rev. 19
Q&R 4A-4	Rev. 19
Q&R 4A-5	Rev. 19
Q&R 4A-6	Rev. 19
Q&R 4A-7	Rev. 19
Q&R 4A-8	Rev. 19
Q&R 4A-9	Rev. 19
Q&R 4A-10	Rev. 19
Q&R 4A-11	Rev. 19
Q&R 4A-12	Rev. 19
Q&R 4A-13	Rev. 19
Q&R 4A-14	Rev. 19
Q&R Tbl 4A-1	Rev. 19
Q&R Tbl 4A-2	Rev. 19
Q&R Tbl 4A-3	Rev. 19
Q&R Tbl 4A-4	
Sheet 1	Rev. 19
Sheet 2	Rev. 19
Q&R Tbl 4A-5	Rev. 19
Q&R Tbl 4A-6	Rev. 19
Q&R Tbl 4A-7	
Sheet 1	Rev. 19
Sheet 2	Rev. 19
Q&R Fig. 4A-1	Rev. 19
Q&R Fig. 4A-2	Rev. 19
Q&R Fig. 4A-3	Rev. 19
Q&R Fig. 4A-4	Rev. 19
Q&R Fig. 4A-5	Rev. 19
Q&R Fig. 4A-6	Rev. 19
Q&R Fig. 4A-7	Rev. 19
Q&R Fig. 4A-8	Rev. 19

VOLUME 2

Chapter 5 Tab	
Q&R 5-i	Rev. 25
Q&R 5-ii	Rev. 25
Q&R 5-iii	Rev. 24
Q&R 5-iv	Rev. 17
5.1 Tab	
5.2 Tab	
Q&R 5.2-1	Rev. 3
Q&R 5.2-2	Rev. 21

Q&R 5.2-3	Rev. 8
Q&R 5.2-4	Rev. 8
Q&R 5.2-5	Rev. 8
Q&R 5.2-6	Rev. 8
Q&R 5.2-7	Rev. 26
Q&R 5.2-8	Rev. 26
Q&R 5.2-9	Rev. 9
Q&R 5.2-10	Rev. 9
Q&R 5.2-11	Rev. 17
Q&R 5.2-12	Rev. 10
Q&R 5.2-13	Rev. 9
Q&R 5.2-14	Rev. 10
Q&R 5.2-15	Rev. 9
Q&R 5.2-16	Rev. 21
Q&R 5.2-17	Rev. 9
Q&R 5.2-18	Rev. 9
Q&R 5.2-19	Rev. 9
Q&R 5.2-20	Rev. 9
Q&R 5.2-21	Rev. 9
Q&R 5.2-22	Rev. 9
Q&R 5.2-23	Rev. 9
Q&R 5.2-24	Rev. 9
Q&R 5.2-25	Rev. 9
Q&R 5.2-26	Rev. 9
Q&R 5.2-27	Rev. 9
Q&R 5.2-28	Rev. 15
Q&R 5.2-29	Rev. 15
Q&R 5.2-30	Rev. 17
Q&R 5.2-31	Rev. 17
Q&R 5.2-32	Rev. 17
Q&R 5.2-33	Rev. 17
Q&R 5.2-34	Rev. 17
Q&R 5.2-35	Rev. 17
Q&R 5.2-36	Rev. 17
Q&R 5.2-37	Rev. 17
Q&R 5.2-38	Rev. 17
Q&R 5.2-38a	Rev. 18
Q&R 5.2-38b	Rev. 18
Q&R 5.2-38c	Rev. 19
Q&R 5.2-38d	Rev. 19
Q&R 5.2-38e	Rev. 19
Q&R 5.2-38f	Rev. 21
Q&R 5.2-39	Rev. 15
Q&R 5.2-40	Rev. 15
Q&R 5.2-41	Rev. 15
Q&R 5.2-42	Rev. 18
Q&R 5.2-43	Rev. 21
Q&R 5.2-44	Rev. 25
Q&R 5.2-45	Rev. 21
Q&R 5.2-46	Rev. 26
Q&R Fig. 5.2-1	Rev. 17
Q&R Fig. 5.2-2	Rev. 17

5.3 Tab	
Q&R 5.3-1	Rev. 3
Q&R 5.3-2	Rev. 8
Q&R 5.3-3	Rev. 8
Q&R 5.3-4	Rev. 8
Q&R 5.3-5	Rev. 8
Q&R 5.3-6	Rev. 8
Q&R 5.3-7	Rev. 15
Q&R 5.3-8	Rev. 15
Q&R 5.3-9	Rev. 16
Q&R 5.3-10	Rev. 17
Q&R 5.3-11	Rev. 17
Q&R 5.3-12	Rev. 24
Q&R 5.3-13	Rev. 21
Q&R 5.3-14	Rev. 22
Q&R 5.3-15	Rev. 22
Q&R 5.3-16	Rev. 21
Q&R Tbl. 5.3-1	Rev. 8
Q&R Tbl. 5.3-2	Rev. 8
Q&R Tbl 5.3-3	
Sheet 1	Rev. 24
Sheet 2	Rev. 24
Q&R Fig. 5.3-1	Rev. 8
Q&R Fig. 5.3-2	Rev. 8
5.4 Tab	
Q&R 5.4-1	Rev. 12
Q&R 5.4-2	Rev. 12
Q&R 5.4-3	Rev. 8
Q&R 5.4-4	Rev. 8
Q&R 5.4-5	Rev. 24
Q&R 5.4-6	Rev. 8
Q&R 5.4-7	Rev. 8
Q&R 5.4-8	Rev. 9
Q&R 5.4-9	Rev. 18
Q&R 5.4-10	Rev. 18
Q&R 5.4-11	Rev. 14
Q&R 5.4-12	Rev. 19
Q&R 5.4-13	Rev. 19
Q&R 5.4-14	Rev. 19
Q&R 5.4-15	Rev. 19
Q&R 5.4-16	Rev. 19
Q&R 5.4-17	Rev. 14
Q&R 5.4-18	Rev. 14
Q&R 5.4-19	Rev. 15
Q&R 5.4-20	Rev. 15
Q&R 5.4-21	Rev. 15
Q&R 5.4-22	Rev. 15
Q&R 5.4-23	Rev. 15
Q&R 5.4-24	Rev. 15
Q&R 5.4-25	Rev. 15
Q&R 5.4-26	Rev. 18
Q&R 5.4-27	Rev. 15

Q&R 5.4-28	Rev. 15
Q&R 5.4-29	Rev. 18
Q&R 5.4-30	Rev. 24
Chapter 6 Tab	
Q&R 6-i	Rev. 27
Q&R 6-ii	Rev. 27
Q&R 6-iii	Rev. 23
Q&R 6-iv	Rev. 18
6.1 Tab	
Q&R 6.1-1	Rev. 8
Q&R 6.1-2	Rev. 8
Q&R 6.1-3	Rev. 13
6.2 Tab	
Q&R 6.2-1	Rev. 3
Q&R 6.2-2	Rev. 16
Q&R 6.2-3	Rev. 15
Q&R 6.2-4	Rev. 15
Q&R 6.2-5	Rev. 9
Q&R 6.2-6	Rev. 9
Q&R 6.2-7	Rev. 17
Q&R 6.2-8	Rev. 17
Q&R 6.2-8a	Rev. 9
Q&R 6.2-8b	Rev. 9
Q&R 6.2-9	Rev. 3
Q&R 6.2-10	Rev. 3
Q&R 6.2-11	Rev. 8
Q&R 6.2-12	Rev. 8
Q&R 6.2-13	Rev. 8
Q&R 6.2-14	Rev. 8
Q&R 6.2-15	Rev. 8
Q&R 6.2-16	Rev. 17
Q&R 6.2-17	Rev. 13
Q&R 6.2-18	Rev. 11
Q&R 6.2-19	Rev. 8
Q&R 6.2-20	Rev. 8
Q&R 6.2-21	Rev. 8
Q&R 6.2-22	Rev. 11
Q&R 6.2-23	Rev. 8
Q&R 6.2-24	Rev. 8
Q&R 6.2-25	Rev. 8
Q&R 6.2-26	Rev. 8
Q&R 6.2-27	Rev. 17
Q&R 6.2-28	Rev. 17
Q&R 6.2-29	Rev. 17
Q&R 6.2-30	Rev. 17
Q&R 6.2-31	Rev. 17
Q&R 6.2-32	Rev. 18
Q&R 6.2-33	Rev. 17
Q&R 6.2-34	Rev. 17
Q&R 6.2-35	Rev. 17
Q&R 6.2-36	Rev. 17
Q&R 6.2-37	Rev. 17

Q&R 6.2-38	Rev. 17
Q&R 6.2-39	Rev. 17
Q&R 6.2-40	Rev. 17
Q&R 6.2-41	Rev. 17
Q&R 6.2-42	Rev. 17
Q&R 6.2-43	Rev. 17
Q&R 6.2-44	Rev. 17
Q&R 6.2-45	Rev. 17
Q&R 6.2-46	Rev. 18
Q&R 6.2-47	Rev. 27
Q&R 6.2-48	Rev. 17
Q&R 6.2-49	Rev. 24
Q&R 6.2-50	Rev. 24
Q&R 6.2-51	Rev. 23
Q&R 6.2-52	Rev. 23
Q&R 6.2-53	Rev. 26
Q&R 6.2-54	Rev. 27
6.3 Tab	
Q&R 6.3-1	Rev. 3
Q&R 6.3-2	Rev. 3
Q&R 6.3-3	Rev. 3
Q&R 6.3-4	Rev. 3
Q&R 6.3-5	Rev. 3
Q&R 6.3-6	Rev. 21
Q&R 6.3-7	Rev. 8
Q&R 6.3-8	Rev. 9
Q&R 6.3-9	Rev. 9
Q&R 6.3-10	Rev. 9
Q&R 6.3-11	Rev. 9
Q&R 6.3-12	Rev. 9
Q&R 6.3-13	Rev. 9
Q&R 6.3-14	Rev. 15
Q&R 6.3-14a	Rev. 15
Q&R 6.3-14b	Rev. 15
Q&R 6.3-15	Rev. 9
Q&r 6.3-16	Rev. 9
Q&R 6.3-17	Rev. 21
Q&R 6.3-18	Rev. 21
Q&R 6.3-19	Rev. 9
Q&R 6.3-20	Rev. 9
Q&R 6.3-21	Rev. 9
Q&R 6.3-22	Rev. 9
Q&R 6.3-23	Rev. 9
Q&R 6.3-24	Rev. 9
Q&R 6.3-25	Rev. 9
Q&R 6.3-26	Rev. 9
Q&R 6.3-27	Rev. 9
Q&r 6.3-28	Rev. 9
Q&R 6.3-29	Rev. 9
Q&R 6.3-30	Rev. 9
Q&R 6.3-31	Rev. 9
Q&R 6.3-32	Rev. 15

Q&R 6.3-33	Rev. 15
Q&R 6.3-34	Rev. 9
Q&R 6.3-35	Rev. 10
Q&R 6.3-36	Rev. 15
Q&R 6.3-37	Rev. 15
Q&R 6.3-38	Rev. 15
Q&R 6.3-39	Rev. 15
Q&R 6.3-40	Rev. 15
Q&R 6.3-41	Rev. 15
Q&R 6.3-42	Rev. 15
Q&R 6.3-43	Rev. 18
Q&R 6.3-44	Rev. 18
Q&R 6.3-44a	Rev. 18
Q&R 6.3-44b	Rev. 18
Q&R 6.3-45	Rev. 15
Q&R 6.3-46	Rev. 16
Q&R 6.3-46a	Rev. 16
Q&R 6.3-46b	Rev. 16
Q&R 6.3-47	Rev. 15
Q&R 6.3-48	Rev. 15
Q&R 6.3-49	Rev. 26
Q&R 6.3-50	Rev. 15
Q&R 6.3-51	Rev. 15
Q&R 6.3-52	Rev. 20
Q&R 6.3-53	Rev. 15
Q&R 6.3-54	Rev. 21
Q&R 6.3-55	Rev. 21
Q&R 6.3-56	Rev. 15
Q&R 6.3-57	Rev. 15
Q&R 6.3-58	Rev. 21
Q&R 6.3-59	Rev. 15
Q&R 6.3-60	Rev. 16
Q&R 6.3-61	Rev. 15
Q&R 6.3-62	Rev. 15
Q&R 6.3-63	Rev. 15
Q&R 6.3-64	Rev. 15
Q&R 6.3-65	Rev. 15
Q&R 6.3-66	Rev. 17
Q&R 6.3-67	Rev. 21
Q&R 6.3-68	Rev. 26
Q&R 6.3-69	Rev. 19
Q&R 6.3-70	Rev. 19
Q&R 6.3-71	Rev. 19
Q&R 6.3-72	Rev. 23
Q&R 6.3-73	Rev. 26
Q&R 6.3-74	Rev. 26
Q&R Fig. 6.3-1	Rev. 9
Q&R Fig. 6.3-2	Rev. 18
6.4 Tab	
Q&R 6.4-1	Rev. 3
Q&R 6.4-2	Rev. 9
Q&R 6.4-3	Rev. 3

Q&R 6.4-4	Rev. 3
Q&R 6.4-5	Rev. 8
Q&R 6.4-6	Rev. 26
Q&R 6.4-7	Rev. 18
Q&R 6.4-8	Rev. 18
6.5 Tab	
Q&R 6.5-1	Rev. 3
Q&R 6.5-2	Rev. 8
Q&R 6.5-3	Rev. 17
6.6 Tab	
Q&R 6.6-1	Rev. 3
Q&R 6.6-2	Rev. 8
6.7 Tab	
6.8 Tab	
Q&R 6.8-1	Rev. 9
Q&R 6.8-2	Rev. 9
Q&R 6.8-3	Rev. 9
Q&R 6.8-4	Rev. 9
Q&R 6.8-5	Rev. 16
Q&R 6.8-6	Rev. 15
Q&R 6.8-7	Rev. 15
Q&R 6.8-8	Rev. 17
Appendix 6A Tab	
Appendix 6B Tab	
Appendix 6C Tab	

Chapter 7 Tab

Q&R 7-i	Rev. 27
Q&R 7-ii	Rev. 24
Q&R 7.0-1	Rev. 10
Q&R 7.0-2	Rev. 15
7.1 Tab	
Q&R 7.1-1	Rev. 2
Q&R 7.1-2	Rev. 2
Q&R 7.1-3	Rev. 2
Q&R 7.1-4	Rev. 15
Q&R 7.1-5	Rev. 15
Q&R 7.1-6	Rev. 15
Q&R 7.1-7	Rev. 15
Q&R 7.1-8	Rev. 17
Q&R 7.1-9	Rev. 16
Q&R 7.1-10	Rev. 16
Q&R 7.1-11	Rev. 15
Q&R 7.1-12	Rev. 18
Q&R 7.1-13	Rev. 15
Q&R 7.1-14	Rev. 15
Q&R 7.1-15	Rev. 15
Q&R 7.1-16	Rev. 15
Q&R 7.1-17	Rev. 26
Q&R 7.1-18	Rev. 26

Q&R 7.1-19	Rev. 26
Q&R 7.1-20	Rev. 21
Q&R 7.1-21	Rev. 21
Q&R 7.1-22	Rev. 26
Q&R 7.1-23	Rev. 26
7.2 Tab	
Q&R 7.2-1	Rev. 2
Q&R 7.2-2	Rev. 2
Q&R 7.2-3	Rev. 2
Q&R 7.2-4	Rev. 15
7.3 Tab	
Q&R 7.3-1	Rev. 10
Q&R 7.3-2	Rev. 15
Q&R 7.3-3	Rev. 16
Q&R 7.3-4	Rev. 21
Q&R 7.3-5	Rev. 15
Q&R 7.3-6	Rev. 15
Q&R 7.3-7	Rev. 21
Q&R 7.3-8	Rev. 20
Q&R 7.3-9	Rev. 24
Q&R 7.3-10	Rev. 26
7.4 Tab	
Q&R 7.4-1	Rev. 27
Q&R 7.4-2	Rev. 15
Q&R 7.4-3	Rev. 27
Q&R 7.4-4	Rev. 15
Q&R Fig. 7.4-1	Rev. 20
Q&R Fig. 7.4-2	Rev. 20
Q&R Fig. 7.4-3	Rev. 24
Q&R Fig. 7.4-4	Rev. 24
Q&R Fig. 7.4-5	Rev. 24
Q&R Fig. 7.4-6	Rev. 24
Q&R Fig. 7.4-7	Rev. 24
Q&R Fig. 7.4-8	Rev. 24
Q&R Fig. 7.4-9	Rev. 24
Q&R Fig. 7.4-10	Rev. 24
7.5 Tab	
Q&R 7.5-1	Rev. 18
Q&R 7.5-2	Rev. 16
Q&R 7.5-3	Rev. 10
Q&R 7.5-4	Rev. 27
Q&R 7.5-5	Rev. 27
Q&R 7.5-6	Rev. 20
Q&R 7.5-7	Rev. 26
7.6 Tab	
7.7 Tab	
Q&R 7.7-1	Rev. 15
Q&R 7.7-2	Rev. 15
Q&R 7.7-3	Rev. 15
7.8 Tab	
Chapter 8 Tab	
Q&R 8-i	Rev. 27

Q&R 8-ii	Rev. 19
Q&R 8-iii	Rev. 19
Q&R 8.0-1	Rev. 14
Q&R 8.0-2	Rev. 15
8.1 Tab	
Q&R 8.1-1	Rev. 15
Q&R 8.1-2	Rev. 18
Q&R 8.1-3	Rev. 26
8.2 Tab	
Q&R 8.2-1	Rev. 3
Q&R 8.2-2	Rev. 3
Q&R 8.2-3	Rev. 3
Q&R 8.2-4	Rev. 3
Q&R 8.2-5	Rev. 21
Q&R 8.2-6	Rev. 10
Q&R 8.2-7	Rev. 10
Q&R 8.2-8	Rev. 10
Q&R 8.2-9	Rev. 19
Q&R 8.2-10	Rev. 16
Q&R 8.2-11	Rev. 18
Q&R 8.2-12	Rev. 19
Q&R 8.2-13	Rev. 19
Q&R Tbl 8.2-1	
Sheet 1	Rev. 19
Sheet 2	Rev. 19
Sheet 3	Rev. 19
Sheet 4	Rev. 19
Sheet 5	Rev. 19
Sheet 6	Rev. 19
Sheet 7	Rev. 19
Sheet 8	Rev. 19
Q&R Fig. 8.2-1	Rev. 19
8.3 Tab	
Q&R 8.3-1	Rev. 18
Q&R 8.3-2	Rev. 16
Q&R 8.3-3	Rev. 18
Q&R 8.3-4	Rev. 8
Q&R 8.3-5	Rev. 8
Q&R 8.3-6	Rev. 21
Q&R 8.3-7	Rev. 8
Q&R 8.3-8	Rev. 15
Q&R 8.3-9	Rev. 10
Q&R 8.3-10	Rev. 15
Q&R 8.3-11	Rev. 10
Q&R 8.3-12	Rev. 16
Q&R 8.3-13	Rev. 10
Q&R 8.3-14	Rev. 10
Q&R 8.3-15	Rev. 15
Q&R 8.3-16	Rev. 15
Q&R 8.3-17	Rev. 15
Q&R 8.3-18	Rev. 21
Q&R 8.3-18a	Rev. 21

O&R 8.3-18b	Rev. 21
O&R 8.3-19	Rev. 15
O&R 8.3-20	Rev. 15
O&R 8.3-21	Rev. 15
O&R 8.3-22	Rev. 15
O&R 8.3-23	Rev. 15
O&R 8.3-24	Rev. 19
O&R 8.3-25	Rev. 18
O&R 8.3-26	Rev. 27
O&R 8.3-27	Rev. 27
O&R 8.3-28	Rev. 27
O&R 8.3-29	Rev. 27
O&R 8.3-30	Rev. 27
O&R 8.3-31	Rev. 27
O&R 8.3-32	Rev. 27
O&R 8.3-33	Rev. 27
O&R 8.3-34	Rev. 27
Appendix 8A Tab	
O&R 8A-1	Rev. 19
O&R 8A-2	Rev. 19
O&R 8A-3	Rev. 19
Chapter 9 Tab	
O&R 9-I	Rev. 24
O&R 9-ii	Rev. 27
O&R 9.0-1	Rev. 13
O&R 9.0-2	Rev. 24
O&R 9.0-3	Rev. 8
9.1 Tab	
O&R 9.1-1	Rev. 19
O&R 9.1-2	Rev. 3
O&R 9.1-3	Rev. 21
O&R 9.1-4	Rev. 21
O&R 9.1-5	Rev. 14
O&R 9.1-6	Rev. 18
O&R 9.1-7	Rev. 14
O&R 9.1-8	Rev. 14
O&R 9.1-9	Rev. 16
O&R 9.1-10	Rev. 18
O&R 9.1-11	Rev. 17
O&R 9.1-12	Rev. 19
9.2 Tab	
O&R 9.2-1	Rev. 3
O&R 9.2-2	Rev. 8
O&R 9.2-3	Rev. 8
O&R 9.2-4	Rev. 8
O&R 9.2-5	Rev. 8
O&R 9.2-6	Rev. 21
O&R 9.2-7	Rev. 21
O&R 9.2-8	Rev. 8
O&R 9.2-9	Rev. 8
O&R 9.2-10	Rev. 21
O&R 9.2-11	Rev. 8
O&R 9.2-12	Rev. 8

Q&R 9.2-13	Rev. 18
9.3 Tab	
Q&R 9.3-1	Rev. 22
Q&R 9.3-2	Rev. 7
Q&R 9.3-3	Rev. 8
Q&R 9.3-4	Rev. 8
Q&R 9.3-5	Rev. 14
Q&R 9.3-6	Rev. 19
9.4 Tab	
Q&R 9.4-1	Rev. 3
Q&R 9.4-2	Rev. 8
Q&R 9.4-3	Rev. 8
Q&R 9.4-4	Rev. 8
Q&R 9.4-5	Rev. 16
Q&R 9.4-6	Rev. 15
Q&R 9.4-7	Rev. 18
9.5 Tab	
Q&R 9.5-1	Rev. 3
Q&R 9.5-2	Rev. 3
Q&R 9.5-3	Rev. 12
Q&R 9.5-4	Rev. 27
Q&R 9.5-5	Rev. 10
Q&R 9.5-6	Rev. 11
Q&R 9.5-7	Rev. 10
Q&R 9.5-8	Rev. 13
Q&R 9.5-9	Rev. 10
Q&R 9.5-10	Rev. 10
Q&R 9.5-11	Rev. 10
Q&R 9.5-12	Rev. 10
Q&R 9.5-13	Rev. 10
Q&R 9.5-14	Rev. 10
Q&R 9.5-15	Rev. 10
Q&R 9.5-16	Rev. 10
Q&R 9.5-17	Rev. 10
Q&R 9.5-18	Rev. 10
Q&R 9.5-19	Rev. 10
Q&R 9.5-20	Rev. 10
Q&R 9.5-21	Rev. 10
Q&R 9.5-22	Rev. 10
Q&R 9.5-23	Rev. 10
Q&R 9.5-24	Rev. 10
Q&R 9.5-25	Rev. 10
Q&R 9.5-26	Rev. 10
Q&R 9.5-27	Rev. 10
Q&R 9.5-28	Rev. 13
Q&R 9.5-29	Rev. 10
Q&R 9.5-30	Rev. 10
Q&R 9.5-31	Rev. 15
Q&R 9.5-32	Rev. 15
Q&R 9.5-33	Rev. 15
Q&R 9.5-34	Rev. 15
Q&R 9.5-35	Rev. 15
Q&R 9.5-36	Rev. 15
Q&R 9.5-37	Rev. 15
Q&R 9.5-38	Rev. 15
Q&R 9.5-39	Rev. 15

O&R 9.5-40	Rev. 15
O&R 9.5-41	Rev. 15
O&R 9.5-42	Rev. 18
O&R 9.5-43	Rev. 26
O&R 9.5-44	Rev. 21
O&R 9.5-45	Rev. 27
O&R 9.5-46	Rev. 27
O&R 9.5-47	Rev. 27
O&R 9.5-48	Rev. 27
O&R 9.5-49	Rev. 27
Appendix 9A Tab	
O&R 9A-1	Rev. 11
O&R 9A-2	Rev. 10
O&R 9A-3	Rev. 12
O&R 9A-4	Rev. 12
O&R 9A-5	Rev. 10
O&R 9A-6	Rev. 14
O&R 9A-7	Rev. 14
O&R Fig 9A-1	Rev. 11

VOLUME 3

Chapter 10 Tab	
O&R 10-i	Rev. 18
10.1 Tab	
10.2 Tab	
O&R 10.2-1	Rev. 12
O&R 10.2-2	Rev. 3
O&R 10.2-3	Rev. 3
O&R 10.2-4	Rev. 8
O&R 10.2-5	Rev. 11
O&R 10.2-6	Rev. 14
O&R 10.2-7	Rev. 14
O&R 10.2-8	Rev. 11
O&R 10.2-9	Rev. 15
10.3 Tab	
O&R 10.3-1	Rev. 12
O&R 10.3-2	Rev. 15
O&R 10.3-3	Rev. 10
O&R 10.3-4	Rev. 15
O&R 10.3-5	Rev. 18
O&R 10.3-6	Rev. 18
10.4 Tab	
O&R 10.4-1	Rev. 3

Q&R 10.4-2	Rev. 8
Q&R 10.4-3	Rev. 8
Q&R 10.4-4	Rev. 16
Q&R 10.4-5	Rev. 8
Q&R 10.4-6	Rev. 8
Q&R 10.4-7	Rev. 8
Q&R 10.4-8	Rev. 10
Q&R 10.4-9	Rev. 10
Q&R 10.4-10	Rev. 10
Q&R 10.4-11	Rev. 15
Q&R 10.4-12	Rev. 10
Q&R 10.4-13	Rev. 10
Q&R 10.4-14	Rev. 10
Q&R 10.4-15	Rev. 16
Q&R 10.4-16	Rev. 10
Q&R 10.4-17	Rev. 16
Q&R 10.4-18	Rev. 14
Q&R 10.4-19	Rev. 14
Q&R 10.4-20	Rev. 15
Q&R 10.4-21	Rev. 15
Q&R 10.4-22	Rev. 15
Chapter 11 Tab	
Q&R 11-i	Rev. 20
11.1 Tab	
11.2 Tab	
11.3 Tab	
Q&R 11.3-1	Rev. 3
Q&R 11.3-2	Rev. 20
Q&R 11.3-3	Rev. 20
11.4 Tab	
Q&R 11.4-1	Rev. 4
Q&R 11.4-2	Rev. 17
11.5 Tab	
Q&R 11.5-1	Rev. 19
Q&R 11.5-2	Rev. 19
11.6 Tab	
Chapter 12 Tab	
Q&R 12-i	Rev. 20
12.1 Tab	
Q&R 12.1-1	Rev. 20
12.2 Tab	
12.3 Tab	
Q&R 12.3-1	Rev. 8
Q&R 12.3-2	Rev. 8
Q&R 12.3-3	Rev. 8
Q&R 12.3-4	Rev. 15
Q&R 12.3-5	Rev. 17
12.4 Tab	
Q&R 12.4-1	Rev. 17
12.5 Tab	
Q&R 12.5-1	Rev. 3
Q&R 12.5-2	Rev. 8

Q&R 12.5-3	Rev. 14
Q&R 12.5-4	Rev. 14
Chapter 13 Tab	
Q&R 13-i	Rev. 19
13.1 Tab	
Q&R 13.1-1	Rev. 3
Q&R 13.1-2	Rev. 3
Q&R 13.1-3	Rev. 8
Q&R 13.1-4	Rev. 8
Q&R 13.1-5	Rev. 8
Q&R 13.1-6	Rev. 8
Q&R 13.1-7	Rev. 18
Q&R 13.1-8	Rev. 18
Q&R 13.1-9	Rev. 15
Q&R 13.1-10	Rev. 14
13.2 Tab	
Q&R 13.2-1	Rev. 8
Q&R 13.2-2	Rev. 8
Q&R 13.2-3	Rev. 11
Q&R 13.2-4	Rev. 8
Q&R 13.2-5	Rev. 8
Q&R 13.2-6	Rev. 8
Q&R 13.2-7	Rev. 8
Q&R 13.2-8	Rev. 14
13.3 Tab	
Q&R 13.3-1	Rev. 18
13.4 Tab	
Q&R 13.4-1	Rev. 9
Q&R 13.4-2	Rev. 18
Q&R 13.4-3	Rev. 19
Q&R 13.4-4	Rev. 18
13.5 Tab	
Q&R 13.5-1	Rev. 8
Q&R 13.5-2	Rev. 8
13.6 Tab	
Appendix 13A Tab	
Chapter 14 Tab	
Q&R 14-i	Rev. 27
14.1 Tab	
14.2 Tab	
Q&R 14.2-1	Rev. 26
Q&R 14.2-2	Rev. 19
Q&R 14.2-3	Rev. 19
Q&R 14.2-4	Rev. 21
Q&R 14.2-5	Rev. 27
Q&R 14.2-6	Rev. 21
Q&R 14.2-7	Rev. 19
Q&R 14.2-8	Rev. 19
Q&R 14.2-9	Rev. 19
Q&R 14.2-10	Rev. 19
Q&R 14.2-11	Rev. 19
Q&R 14.2-12	Rev. 19

Q&R 14.2-13	Rev. 23
Q&R 14.2-14	Rev. 21
Q&R 14.2-15	Rev. 21
Q&R 14.2-16	Rev. 21
Q&R 14.2-16a	Rev. 27
Q&R 14.2-16b	Rev. 21
Q&R 14.2-17	Rev. 27
Q&R 14.2-18	Rev. 19
Q&R 14.2-19	Rev. 19
Q&R 14.2-20	Rev. 19
Q&R 14.2-21	Rev. 19
Q&R 14.2-22	Rev. 19
Q&R 14.2-23	Rev. 27
Q&R 14.2-24	Rev. 26
Q&R 14.2-25	Rev. 19
Q&R 14.2-26	Rev. 19
Q&R 14.2-27	Rev. 20
Appendix 14A Tab	
Chapter 15 Tab	
Q&R 15-i	Rev. 18
Q&R 15-ii	Rev. 21
Q&R 15-iii	Rev. 27
Q&R 15-iv	Rev. 19
Q&R 15.0-1	Rev. 7
Q&R 15.0-2	Rev. 11
Q&R 15.0-3	Rev. 3
Q&R 15.0-4	Rev. 11
Q&R 15.0-5	Rev. 3
Q&R 15.0-6	Rev. 3
Q&R 15.0-7	Rev. 3
Q&R 15.0-8	Rev. 8
Q&R 15.0-9	Rev. 8
Q&R 15.0-10	Rev. 9
Q&R 15.0-11	Rev. 9
Q&R 15.0-12	Rev. 9
Q&R 15.0-13	Rev. 13
Q&R 15.0-14	Rev. 9
Q&R 15.0-15	Rev. 14
Q&R 15.0-16	Rev. 9
Q&R 15.0-17	Rev. 15
Q&R 15.0-18	Rev. 15
Q&R 15.0-19	Rev. 15
Q&R 15.0-20	Rev. 15
Q&R 15.0-21	Rev. 18
Q&R 15.0-22	Rev. 15
Q&R 15.0-23	Rev. 15
Q&R 15.0-24	Rev. 15
Q&R 15.0-25	Rev. 15
Q&R 15.0-26	Rev. 15
Q&R 15.0-27	Rev. 15
Q&R 15.0-28	Rev. 15
15.1 Tab	

Q&R 15.1-1	Rev. 3
Q&R 15.1-2	Rev. 9
Q&R 15.1-3	Rev. 9
Q&R 15.1-4	Rev. 9
Q&R 15.1-5	Rev. 9
Q&R 15.1-6	Rev. 11
Q&R 15.1-7	Rev. 11
Q&R 15.1-8	Rev. 11
Q&R 15.1-9	Rev. 16
Q&R 15.1-10	Rev. 15
Q&R 15.1-11	Rev. 15
Q&R 15.1-12	Rev. 15
Q&R 15.1-13	Rev. 15
Q&R 15.1-14	Rev. 15
Q&R 15.1-15	Rev. 16
Q&R 15.1-16	Rev. 15
15.2 Tab	
Q&R 15.2-1	Rev. 8
Q&R 15.2-2	Rev. 12
Q&R 15.2-3	Rev. 9
Q&R 15.2-4	Rev. 10
Q&R 15.2-5	Rev. 9
Q&R 15.2-6	Rev. 9
Q&R 15.2-7	Rev. 9
Q&R 15.2-8	Rev. 12
Q&R 15.2-9	Rev. 9
Q&R 15.2-10	Rev. 9
Q&R 15.2-11	Rev. 15
Q&R 15.2-12	Rev. 19
Q&R 15.2-13	Rev. 19
Q&R 15.2-14	Rev. 19
Q&R 15.2-15	Rev. 19
Q&R 15.2-16	Rev. 19
Q&R 15.2-17	Rev. 19
Q&R 15.2-18	Rev. 19
Q&R 15.2-19	Rev. 19
Q&R 15.2-20	Rev. 19
Q&R 15.2-21	Rev. 21
Q&R Fig. 15.2-1	Rev. 17
Q&R Fig. 15.2-2	Rev. 17
Q&R Fig. 15.2-3	Rev. 19
Q&R Fig. 15.2-4	Rev. 19
Q&R Fig. 15.2-5	Rev. 19
Q&R Fig. 15.2-6	Rev. 19
Q&R Fig. 15.2-7	Rev. 19
Q&R Fig. 15.2-8	Rev. 19
Q&R Fig. 15.2-9	Rev. 19
Q&R Fig. 15.2-10	Rev. 19
15.3 Tab	
Q&R 15.3-1	Rev. 15
Q&R 15.3-2	Rev. 16
Q&R 15.3-3	Rev. 16

15.4 Tab	
Q&R 15.4-1	Rev. 8
Q&R 15.4-2	Rev. 8
Q&R 15.4-3	Rev. 8
Q&R 15.4-4	Rev. 8
Q&R 15.4-5	Rev. 8
Q&R 15.4-6	Rev. 8
Q&R 15.4-7	Rev. 8
Q&R 15.4-8	Rev. 8
Q&R 15.4-9	Rev. 11
Q&R 15.4-10	Rev. 11
Q&R 15.4-10a	Rev. 11
Q&R 15.4-10b	Rev. 8
Q&R 15.4-11	Rev. 8
Q&R 15.4-12	Rev. 9
Q&R 15.4-13	Rev. 12
Q&R 15.4-14	Rev. 9
Q&R 15.4-15	Rev. 12
Q&R 15.4-16	Rev. 12
Q&R 15.4-17	Rev. 9
Q&R 15.4-18	Rev. 9
Q&R 15.4-19	Rev. 15
Q&R 15.4-20	Rev. 15
Q&R 15.4-21	Rev. 21
Q&R 15.4-22	Rev. 26
Q&R 15.4-23	Rev. 26
Q&R 15.4-24	Rev. 21
15.5 Tab	
Q&R 15.5-1	Rev. 9
15.6 Tab	
Q&R 15.6-1	Rev. 3
Q&R 15.6-2	Rev. 3
Q&R 15.6-3	Rev. 8
Q&R 15.6-4	Rev. 8
Q&R 15.6-5	Rev. 8
Q&R 15.6-6	Rev. 10
Q&R 15.6-7	Rev. 12
Q&R 15.6-8	Rev. 15
Q&R 15.6-9	Rev. 18
Q&R Fig 15.6-1	Rev. 10
Q&R Fig 15.6-2	Rev. 10
15.7 Tab	
Q&R 15.7-1	Rev. 3
Q&R 15.7-2	Rev. 14
Q&R 15.7-3	Rev. 17
Q&R 15.7-4	Rev. 16
Q&R 15.7-5	Rev. 18
15.8 Tab	
Appendix 15A Tab	
Appendix 15B Tab	
Appendix 15C Tab	
Q&R 15C-1	Rev. 17

Appendix 15D Tab	
Q&R 15D-1	Rev. 15
Q&R 15D-2	Rev. 16
Q&R 15D-3	Rev. 15
Q&R 15D-4	Rev. 15
Q&R 15D-5	Rev. 15
Q&R 15D-6	Rev. 16
Q&R 15D-7	Rev. 17
Q&R 15D-8	Rev. 26
Q&R 15D-9	Rev. 26
Q&R 15D-10	Rev. 17
Q&R 15D-11	Rev. 27
Q&R 15D-12	Rev. 19
Q&R 15D-13	Rev. 17
Q&R 15D-14	Rev. 17
Q&R 15D-15	Rev. 26
Q&R 15D-16	Rev. 19
Q&R 15D-17	Rev. 19
Q&R 15D-18	Rev. 18
Appendix 15E Tab	
Q&R 15E-1	Rev. 18
Q&R 15E-2	Rev. 18
Q&R 15E-3	Rev. 18
Q&R 15E-4	Rev. 18
Q&R 15E-5	Rev. 18
Chapter 16 Tab	
Q&R 16-i	Rev. 22
Q&R 16.0-1	Rev. 26
16.1 Tab	
16.2 Tab	
16.3 Tab	
16.4 Tab	
16.5 Tab	
16.6 Tab	
16.7 Tab	
16.3/4A Tab	
Q&R 16.3/4A-1	Rev. 15
Chapter 17 Tab	
Q&R 17-i	Rev. 20
17.1 Tab	
17.2 Tab	
Q&R 17.2-1	Rev. 8
Q&R 17.2-2	Rev. 8
Q&R 17.2-3	Rev. 18
Q&R 17.2-4	Rev. 20

NRC Question	Title	Affected FSAR Sections	Location of Response
031.0	INSTRUMENTATION AND CONTROL BRANCH		
031.1	Listing and Qualification of Seismic Equipment	3.10	Q&R 3.10-1
031.2	Identification and Qualification	3.11	Q&R 3.11-1
031.3	Regulatory Guides 100, 106, and 108	App 3A	Q&R 3A-1
031.4	Correlation of Safety Systems	7.1	Q&R 7.1-1
031.5	Identification of Safety Systems	7.1.1	Q&R 7.1-2
031.6	Identification of Safety Systems	7.1.2	Q&R 7.1-3
031.7	Drawing Correlation	7.2, 1.7	Q&R 7.2-1
031.8	Pressurizer Heaters	7.4.1	Q&R 7.4-1
031.9	Safety Classification of RPS Display	7.5.1, 7.2	Q&R 7.5-2
031.10	NI and RPS	7.2, 7.8	Q&R 7.2-2
031.11	Identify Design Changes	1.2.2	Q&R 1.2-1
031.12	Regulatory Guide 1.70	3.11	Q&R 3.11-3
031.13	Class 1E Equipment Testing	3.11	Q&R 3.11-6
031.14	Independence, Redundancy, Isolation of Safety-Related Instrumentation and Control Systems	7.1.22, 8.3.1.4, 3.11	Q&R 7.1-14
031.15	Environmental Qualification for Pressurizer Heater Controls	7.1.1	Q&R 7.1-12
031.16	Midland Versus Other Plants	7.1.1	Q&R 7.1-13
031.17	Core Flood System	7.1.2	Q&R 7.1-16
031.18	Regulatory Guide 1.52	7.1, App 3A	Q&R 7.1-4
031.19	Compliance with ICSB BTP-24	7.1	Q&R 7.1-5
031.20	Class 1E and Non-Class 1E Isolation	7.1, App 3A	Q&R 7.1-6
031.21	Regulatory Guide 1.105	7.1, App 3A	Q&R 7.1-11
031.22	RPS Power Range Detector Inputs	7.2, 7.8	Q&R 7.2-4
031.23	MSLIS and AFWAS	7.3, 15.2	Q&R 7.3-2
031.24	Description of MSLIV	7.3, 10.3.2.2	Q&R 7.3-3
031.25	Radiation and Gas Monitors	7.3, 3.11, 12.3.3	Q&R 7.3-4
031.26	ESFAS Subsystem	7.3	Q&R 7.3-5
031.27	Pressurizer Heater Control System	7.4.1	Q&R 7.4-3
031.28	Cold Shutdown	7.4	Q&R 7.4-2
031.29	CRDCS - Trip Portion	7.4.2	Q&R 7.4-4

NRC Question	Title	Affected FSAR Sections	Location of Response
031.30	Safety-Related Display Instrumentation	7.5	Q&R 7.5-4
031.31	Terminating Dilution Flow	15.4.6, 7.5	Q&R 15.4-19
031.32	Makeup System Low Level Alarm	7.3.4, 7.5	Q&R 7.3-6
031.33	Alarms Requiring Operator Actions	15.0, 7.5	Q&R 15.0-17
031.34	DHR Dropline Design	5.4, 7.6	Q&R 5.4-19
031.35	Mitigation of Blowdown	7.7	Q&R 7.7-1
031.36	RF Interference	9.5.2	Q&R 9.5-32
031.37	Failure Modes of ICS	7.7.2.2	Q&R 7.7-3
031.38	Pressurizer Heaters	7.1, 7.4.1	Q&R 7.1-17
031.39	Regulatory Guide 1.118	7.1, 3A	Q&R 7.1-18
031.40	Qualification of Isolators (031.20, Part 3)	7.1, 3A	Q&R 7.1-20
031.41	Qualification of Control Room Air Monitors (031.25)	7.3, 3.11, 12.3.3 (RSP)	Q&R 7.3-7
031.42	Dilution Flow Alarm (031.31)	15.4.6, 7.5	Q&R 15.4-24
031.43	Regulatory Guide 1.95	3A	Q&R 3A-14
031.44	Environmental Qualification	3.11	Q&R 3.11-39
031.45	Use of Service Water as Backup to Condensate Storage Tank	7.3	Q&R 7.3-8
031.46	Radio Frequency Interference (031.36)	9.5.2	Q&R 9.5-58
031.47	Chemical Qualification Parameters	3.11	Q&R 3.11-41
031.48	Terminal Block Qualification (031.13)	3.11	Q&R 3.11-42
031.49	Hermetic Seals	7.1	Q&R 7.1-21
031.50	Post-Accident Monitoring (031.30)	7.5 (RSP)	Q&R 7.5-6
031.51	Ultrasonic Flow Transmitters (031.23)	7.3	Q&R 7.3-9
031.52	Branch Technical Position ICSB-4 (031.17)	7.1.2 (RSP)	Q&R 7.1-22
031.53	Bypass of Safety Features	7.3,7.4,7.6	Q&R 7.3-10

NRC Question	Title	Affected FSAR Sections	Location of Response
040.60	Effect of Hazardous Gases on Diesel Operation	9.5.8	Q&R 9.5-31
040.61	Turbine Overspeed Protection System	10.2	Q&R 10.2-5
040.62	Exercising Main Steam Stop and Control Valves	10.2	Q&R 10.2-6
040.63	Bulk Hydrogen Storage	10.2	Q&R 10.2-7
040.64	Equalizer Pipe Explanation	10.2	Q&R 10.2-8
040.65	Manifolding the Steam Generators	10.3	Q&R 10.3-1
040.66	Consequences of Unit 1 Intertie Valve Closure	10.3	Q&R 10.3-2
040.67	Stop/Control Valve Intertie	10.3	Q&R 10.3-3
040.68	Exhaust Steam Flow	10.4.1	Q&R 10.4-9
040.69	Inspection Tests	10.4.1	Q&R 10.4-10
040.70	Condenser Degradation	10.4.1	Q&R 10.4-11
040.71	Hydrogen Production on Secondary Water	10.4.1	Q&R 10.4-12
040.72	Condenser Tubes Corrision/ Erosion Measures	10.4.1	Q&R 10.4-13
040.73	Design Provisions for Condenser Tube Failure	10.4.1	Q&R 10.4-14
040.74	Effect of Turbine Bypass System Failure on Overspeed Protection Systems	10.4.4	Q&R 10.4-15
040.75	Effect of Turbine Bypass System Malfunction	10.4.4	Q&R 10.4-16
040.76	Tertiary Feedwater Information	10.4.10	Q&R 10.4-17
040.77	Regulatory Guide 1.63	8.0, App 3A	Q&R 8.0-2
040.78	Power Lockout for Valves	8.3	Q&R 8.3-15
040.79	Grid Voltage Effects	8.2	Q&R 8.2-9
040.80	DHR System Overpressurization	5.4, 8.3	Q&R 5.4-22
040.81	Penetration Overload Protection	8.3	Q&R 8.3-16
040.82	Regulatory Guide 1.108, Diesel Generator Testing	8.3, App 3A	Q&R 8.3-17
040.83	IEEE Std 336-1971	8.1	Q&R 8.1-1
040.84	Grid Frequency Transients	8.2	Q&R 8.2-10
040.85	Sequencing Safety Loads	8.3	Q&R 8.3-18
040.86	Inoperability of Diesel Generator	8.3	Q&R 8.3-19
040.87	Class 1E dc Battery Charger	8.3	Q&R 8.3-20
040.88	Spare Makeup Pump	6.3, 8.3	Q&R 6.3-36
040.89	Single Failures in AFW System	10.4, 8.3	Q&R 10.4-20
040.90	AC and DC Power to AFW System	10.4, 8.3	Q&R 10.4-21

NRC Question	Title	Affected FSAR Sections	Location of Response
040.91	Color Coding	8.3	Q&R 8.3-21
040.92	Class 1E Cable Separation	8.3	Q&R 8.3-22
040.93	Class 1E Swing Loads	8.3	Q&R 8.3-23
040.94	Diesel Generator and Auxiliaries Conformance to Regulatory Guides	9.5.4, 9.5.5, 9.5.6, 9.5.7, 9.5.8	Q&R 9.5-33
040.95	DP Switches Across Duplex Strainer	9.5.4	Q&R 9.5-34
040.96	Diesel Generator Fuel Oil System	9.5.4	Q&R 9.5-35
040.97	Diesel Generator Fuel Oil Storage	9.5.4	Q&R 9.5-36
040.98	Transportation of Fuel Oil	9.5.4	Q&R 9.5-37
040.99	Diesel Fuel Oil Storage/ Day Tanks	9.5.4	Q&R 9.5-38
040.100	Diesel Generator Starting System	9.5.4	Q&R 9.5-39
040.101	Symbols in Figure Q&R 9.5-28	9.5.7	Q&R 9.5-40
040.102	Diesel Generator Exhaust Clogging	9.5.8	Q&R 9.5-41
040.103	Single Valve Failure	10.2	Q&R 10.2-9
040.104	Hydrogen Production	10.4.1	Q&R 10.4-22
040.106	Effect of Diesel Generator Settlement on Fuel Oil Piping	9.5.4	Q&R 9.5-42
040.107	MSLIV Performance in Limiting Blowdown	10.3	Q&R 10.3-5
040.108	Exceptions to Regulatory Guide 1.63	8.1	Q&R 8.1-2
040.109	Regulatory Guide 1.108 Compliance	8.1	Q&R 8.1-3
040.110	Load Shedding During Sequencing	8.2	Q&R 8.2-11
040.111	Diesel Generator Qualification	8.3	Q&R 8.3-24
040.112	Separate Sequencers	8.3	Q&R 8.3-25
040.113	Underfrequency Events (Grid Disturbances)	8.2	Q&R 8.2-12
040.114	Diesel Generator Dust Protection	9.5.8	Q&R 9.5-48
040.115	Diesel Generator Air Dryer Design	9.5.6(RSP)	Q&R 9.5-45
040.116	Diesel Generator Operator and Maintenance Personnel	8.3	Q&R 8.3-26
040.117	Diesel Generator Prelube Time	9.5.7(RSP)	Q&R 9.5-47

Responses to NRC Questions
Midland 1&2

NRC Question	Title	Affected FSAR Sections	Location o Response
040.118	Diesel Generator Electric Prelube Oil Pump	9.5.7(RSP)	Q&R 9.5-48
040.119	Diesel Generator Testing, Surveillance, Maintenance, and Final Check	8.3(RSP)	Q&R 8.3-29
040.120	Diesel Generator Vibration of Instrumentation	8.3 (RSP)	Q&R 8.3-34

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CHAPTER 3

CONTENTS

NRC Question No.	Revision No.	Q&R Page No.
010.19	8	3.2-1
010.36	9	3.2-2
010.37	9	3.2-4
121.17	16	3.2-5
372.11	3	3.3-1
130.1	3	3.3-2
010.1	8	3.4-1
010.2	3	3.4-2
130.2	3	3.4-4
010.3	3	3.5-1
312.8	3	3.5-2
312.29	14	3.5-3
312.30	8	3.5-4
312.31	8	3.5-5
312.32	8	3.5-6
312.9	8	3.5-7
312.10	8	3.5-8
130.6	8	3.5-9
211.16	9	3.5-10
211.85	9	3.5-11
211.86	9	3.5-12
010.39	15	3.5-13
010.40	15	3.5-14
211.95	18	3.5-15
211.96	15	3.5-16
211.98	15	3.5-18
211.99	15	3.5-19
211.100	17	3.5-20
211.97	15	3.5-21
312.47	18	3.5-22
312.48	18	3.5-23
312.46	19	3.5-24
010.4	3	3.6-1
010.5	9	3.6-2
010.20	8	3.6-3
110.7	8	3.6-4
110.10	8	3.6-5
110.1	8	3.6-6
110.13	8	3.6-8
110.8	8	3.6-9
110.11	8	3.6-10
110.12	8	3.6-11

CHAPTER 3

CONTENTS

NRC Question No.	Revision No.	Q&R Page No.
110.2	14	3.6-12
110.3	8	3.6-13
110.9	14	3.6-15
010.41	14	3.6-16
010.42	14	3.6-17
010.43	14	3.6-18
010.44	14	3.6-19
110.32	15	3.6-20
110.33	14	3.6-21
110.35	15	3.6-22
110.45	16	3.6-23
130.3	3	3.7-1
130.4	3	3.7-2
130.7	15	3.7-3
130.8	8	3.7-4
130.9	8	3.7-5
130.10	8	3.7-6
361.3	15	3.7-7
130.18	15	3.7-9
130.20	15	3.7-10
130.19	16	3.7-11
130.24	24	3.7-13
361.6	21	3.7-15
130.25	21	3.7-16
130.11	8	3.8-1
130.13	14	3.8-2
130.14	8	3.8-3
130.5	8	3.8-4
130.12	8	3.8-5
130.15	14	3.8-6
130.17	15	3.8-8
130.16	15	3.8-9
130.21	27	3.8-10
130.22	20	3.8-11
130.23	27	3.8-12
110.28	19	3.9-1
110.14	8	3.9-3
110.4	8	3.9-4
110.15	14	3.9-6
110.16	17	3.9-7
110.17	8	3.9-9
110.18	9	3.9-11

CHAPTER 3

CONTENTS

NRC Question No.	Revision No.	Q&R Page No.
110.19	8	3.9-12
110.20	8	3.9-13
110.21	25	3.9-14
110.23	17	3.9-15
110.24	9	3.9-16
110.22	8	3.9-17
121.15	8	3.9-18
110.5	8	3.9-19
110.6	15	3.9-20
110.25	15	3.9-21
110.31	19	3.9-22
110.34	15	3.9-24
110.36	14	3.9-25
110.37	14	3.9-26
110.38	14	3.9-27
110.39	14	3.9-28
110.41	14	3.9-29
110.43	16	3.9-30
110.44	16	3.9-31
110.50	15	3.9-32
110.47	15	3.9-33
110.46	27	3.9-34
110.51	16	3.9-45
110.48	27	3.9-46
110.56	17	3.9-49
110.53	17	3.9-50
110.54	18	3.9-51
110.57	17	3.9-52
031.1	24	3.10-1
110.26	9	3.10-3
040.17	10	3.10-4
110.40	14	3.10-5
110.49	15	3.10-6
031.2	24	3.11-1
040.18	16	3.11-2
031.12	24	3.11-3
031.13	25	3.11-6
031.44	21	3.11-38a
031.47	20	3.11-40
031.48	20	3.11-41
031.3	21	3A-1
110.27	8	3A-2

CHAPTER 3

CONTENTS

NRC Question No.	Revision No.	Q&R Page No.
122.1	8	3A-3
121.4	9	3A-4
121.13	9	3A-5
400.2	10	3A-6
121.18	21	3A-7
400.3	18	3A-8
232.13	15	3A-9
110.55	17	3A-10
121.21	18	3A-11
400.4	19	3A-12
031.43	21	3A-14

Question 130.16 (3.8.6)

The answer to Question 130.15 is not acceptable. Based on our review, it appears that the margins of safety required by the load combinations of SRP 3.8.3 and 3.8.4 are greater than those required by your criteria. For the critical section of Seismic Category I concrete structures, both inside and outside containment, which may be governed by these load combinations, we require that you provide an assessment of the extent to which these structures can meet the following criteria.

1. $U = 1.4D + 1.7L + 1.9E$

2. $U = 1.4D + 1.7L + 1.7W$

3. $U = D + L + Ta + Ra + 1.5Pa$

4. $U = D + L + Ta + Ra + 1.25Pa + 1.0 (Y_y + Y_J + Y_M) + 1.25E$

The terms above are as defined on Pages 3.8.4-5 and 6 of the SRP 3.8.4. For this assessment, actual material properties may be used if properly justified.

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Response

It is CPCo's position that this request is not justified. Refer to the CPCo position provided by Revision 14 to Question 130.15.

Question 130.21 (3.8,2.5)

Provide an evaluation of the ability of those seismic Category I structures which are located upon backfill and which are experiencing settlement in excess of that predicted to withstand appropriate loading combinations, including SSE, throughout plant life. Describe how stresses associated with differential settlement of the structural foundations and any corrective preloading activities have been or will be factored into these evaluations. Also provide a comparison of the stresses predicted due to settlement to those allowable stresses permitted by the ACI Code. 17

Response

The diesel generator building is the only seismic Category I structure located on plant fill which is experiencing settlement in excess of the values predicted in FSAR Figure 2.5-48. The structure is a heavily reinforced concrete structure which is described in FSAR Section 3.5.

A preload program is in progress to consolidate the underlying foundation material. This program has been described in the response to FSAR Question 362.12. The settlement survey program described in FSAR Subsection 2.5.4.13 has been expanded to provide additional information on how the structure is reacting to the soil settlement. The settlement survey program for the building was expanded from 3 survey points to 12 survey points and the recording increment was decreased from 60 to 7 days. The additional data are to be used to evaluate the effects the settlement has on the structure. 18

The FSAR does not contain load combinations which address stresses due to differential settlement. This information will be addressed in CPCo's response to Mr. H.R. Denton's March 21, 1979, letter to Mr. S.H. Howell regarding plant fill. The response will be submitted for staff review by letter to Mr. Denton by April 25, 1979. Following completion of staff review, the information will be placed into the FSAR by amendment. Furthermore, the stress evaluation is dependent upon the settlement data from the preload program. The stress evaluation will be provided along with the results of the preload program by amendment. 20 27 18 26

2,3,4. Auxiliary and Diesel Generator Buildings and Service Water Pump Structure

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A similar comparison will be provided for the auxiliary building, diesel generator building, and service water pump structure by amendment.

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restraints, and nozzle collars are shown in Figures 3.8-32, 3.8-33, 3.8-34, and 3.8-38, respectively. Additional RCS pipe restraint detail drawings and reactor vessel, steam generator, and pressurizer arrangement are shown in Figures 3.8-66 through 3.8-80. 15 16

2. Postulated pipe breaks for cavity pressurization analyses are given in FSAR Table 6.2-1. Breaks at the reactor vessel hot and cold leg nozzle to piping terminal ends were postulated for the reactor cavity analyses. Hot leg, cold leg, pump suction, and pump discharge breaks were assumed for the steam generator cavity analysis. Secondary system breaks should not be controlling. Because the pressurizer is not in a separate cavity, primary system breaks are assumed to be controlling for steam generator cavity pressurization. 15

   Steam generator inlet and outlet nozzles' mass and energy releases are found in FSAR Tables 15.c-12 and 15.1-15, respectively. The assessments of the effect of asymmetric pressure differentials for the following items will be provided by amendment: 16

   a) Reactor pressure vessel

   b) Reactor vessel internals

   c) Control rod drives

   d) ECCS piping attached to the primary coolant piping 27

   e) Primary coolant piping

   f) Reactor vessel, steam generator, pressurizer, and pump supports

   g) Reactor internals

   h) Biological shield wall

   i) Steam generator, pressurizer, and pump compartment walls

3. This evaluation will be provided by amendment, if necessary, following assessment of the effects of the asymmetric pressure differentials.

4. The COPDA computer code was used for all pressurization analyses. Subsection 6.2.1.2.3.1, Item b, provides a description of this computer code. Schematic drawings of nodalization used for reactor vessel cavity and steam 15

generator cavity pressurization analyses are provided in Figures 6.2-74 and 6.2-23. A comparison of the calculated to allowable stresses and strains or deflections with a basis for the alowable values will be provided by amendment. | 27

5. This description will be provided by amendment following a review of the schedule on the effects of asymmetric pressure differentials (Question 110.46.1, item 2). | 27

6. The response to this question was previously given as the response to Question 110.28.

7. The response to this question was previously given as the response to Question 110.17 and further qualified by the response to Question 110.37.

derived seismic loads to assess the structural adequacy of the Midland RV internals.

An existing 177-FA reactor vessel internals model will be utilized to develop dynamic loads on the internal structures. The model will represent the reactor vessel internals. The loads will be developed as described below:

1. Reactor vessel internal differential pressures which are calculated using actual Midland break opening areas and times will be integrated over the appropriate areas to obtain forces.

2. These forces will then be compared to those developed previously for a similar 177-FA plant to determine load ratios.

3. The load ratios will be made available for use as scale factors in the existing 177-FA internals stress analysis.

Another comparison will be made to determine the seismic loads acting on the internals. It should be noted that seismic loads contribute very little (approximately 5%) to the faulted condition stresses on internal structures. Approximate seismic loads will be obtained by applying a scale factor to the existing and comparable 177-FA plant seismic analysis. Conservative scale factors will be obtained from response sepctra comparisons. 15

Core support assembly (CSA) stresses will be calculated for the worst case postulated pipe breaks. These stresses will be based on the Toledo Edison Company's Davis-Besse Units 2 and 3 faulted condition stress analysis. The results of this baseline analysis will be scaled by lateral and vertical load ratios for both hydrodynamic and seismic loads to determine the stresses in the critical areas of Midland CSA.

The Davis-Besse analysis was chosen as the baseline because it is the most recent B&W 177-FA CSA stress analysis. As such, it reflects the state-of-the-art methods, including large scale finite element analyses. In addition, stress classifications and allowable stresses are in accordance with Subsection NG of the 1974 edition of the ASME Boiler and Pressure Vessel Code. Thus, the resulting Midland analysis will reflect up-to-date stress methods.

The Davis-Besse and Midland CSA structures are similar with the exception of the plenum assembly. The Davis-Besse Units 2 and 3 are unique among B&W 177-FA plants in that they are designed for a B&W Mark C (17 x 17) fuel assembly instead of the Mark B (15 x 15) fuel assembly. This necessitated changes in the plenum cover, plenum cylinder, and column weldments. Therefore, the

baseline analysis of these components will be modified to reflect the Midland configuration.

The baseline analysis includes lateral loads from the system dynamics analysis, vertical loads from the core bounce analysis, and seismic loads. These first two loads, which are time dependent, are phased to determine the critical load on a component. The maximum seismic load is then added directly to determine the maximum load on a component. The ratio of the Midland plant to baseline loads will be determined for each of these three major loading types. The lateral load ratios will be determined from the system dynamics analysis pressure inputs for the core support shield, thermal shield, and plenum cylinder. The vertical load ratios will be determined from the core bounce analysis pressure inputs for the upper internals and lower internals. For the seismic loads, which include lateral and vertical forces, one seismic ratio factor will be determined. 15

These loading ratios will be used in conjunction with the baseline stress analysis to determine the maximum stress in the critical components. For those components differing from the baseline design, the original analysis will be modified to conservatively reflect the Midland configuration. The results will be summarized in a table showing the components and their critical margins of safety for the worst case cold leg and hot leg pipe ruptures. The results of this analysis will be provided by amendment. 27

5. Test Procedure

Functional testing will be performed prior to and after each environmental test as outlined above. The purpose of this testing is to determine the ability of the governor to control engine speed at the desired setpoint.

Radiation Exposure - All components are exposed to 4×10^4 rad gamma, total integrated dose.

a. Aging Simulations (Thermal and Cyclic)

As determined by IEEE Std P-650/P6 for certain types of electrical and nonelectrical components, thermal aging is not a failure mechanism. Components not in this category are subjected to aging tests. Thermal aging per IEEE Std 101 is performed for an equivalent 40 year life by aging for 14.26 days at 280F. Based on manufacturer's recommendation for 10 year replacement interval on all gaskets or o-rings, seals shall be subjected to accelerated temperature aging equivalent to 10 years of installed life. The seals will then be reassembled with the component and subjected to the component's functional acceptance criterion testing. Alternately, components containing seals which are thermally aged as a unit to the 40 year life may have the seals thermally aged to the same 40 year life and will not be subjected to separate external 10 year equivalent aging. 22

EBG-35 Actuator - Thermal aging was performed on seals and on the two coil polarized solenoid with wear aging accounted for by subjecting the actuator to 5,905 startup cycles.

EGA Control Box - Terminal strips were subjected to wear aging while the transformer was subjected to an alternative procedure consisting of a series of elevated temperature/humidity tests (48 hour) followed by induced and high potential tests. Following 10 cycles of testing, the transformer was subjected to a 1.5G sinusoidal 60Hz vibration test for 1×10^5 cycles.

Motor Operated Potentiometer - The terminal strip and motor were subjected to thermal aging followed by cyclic aging of the entire unit.

Booster Servo Motor - This component was subjected to cyclic wear aging. This is a pneumatic (hydraulic) device manufactured with all metallic

components. Therefore, with the exception of elastomeric seals, aging was not performed.

EG Resistor Box - The resistor box consists primarily of electronic parts which are exempted from aging as having no aging mechanisms in the 40 year life of the nuclear plant (P-650/D6). There is a terminal strip of organic composition on the outside of the box. The terminal strip will be subjected to accelerated temperature aging with t_A = 15 days, T_A = 138C. The terminal strip should have its dielectric strength tested before and after aging. No cyclic aging is considered necessary for the resistor box.

a. Seismic testing

Response spectra will be determined and plotted for one OBE and one SSE. A total of five OBE and three SSE tests will be performed in a random seismic test from 1.25 to 35Hz. 22

1. Acceptability Goals and and Requirements

Acceptance criteria are based upon the capability of governor components to control at desired speed settings as determined by functional tests.

2. Test Results

The test procedure for qualification of this equipment by Wylie Laboratories is in the stages of final approval. Complete testing as described above will require 8 months, with an additional 3 months for analysis of the results and preparation of the final report. Therefore, it is estimated that final test results will be added to the FSAR by amendment. 27

3. Identification of Documents

a. Item 1: Wylie Laboratories Qualification Plan dated March 29, 1978 (Bechtel Vendor Print 7220-M18-334) and Addendum 1, Rev 2 22

Ih. Sensors

1. Identification of Equipment 19

a. Manufacturer: Rosemount Inc., Eden Prairie, Minnesota

CHAPTER 6

CONTENTS

NRC Question No.	Revision No.	Q&R Page No.
312.33	8	6.1-1
312.34	8	6.1-2
312.11	13	6.1-3
022.1	16	6.2-1
022.2	17	6.2-5
022.3	9	6.2-8a
022.4	3	6.2-9
022.5	3	6.2-10
022.17	8	6.2-11
022.18	8	6.2-12
022.20	8	6.2-13
022.7	8	6.2-14
022.8	8	6.2-15
022.19	17	6.2-16
312.12	13	6.2-17
312.13	11	6.2-18
312.14	8	6.2-19
312.15	8	6.2-20
312.16	8	6.2-21
312.17	11	6.2-22
022.9	8	6.2-23
022.11	8	6.2-24
022.12	8	6.2-25
022.10	8	6.2-26
022.13	17	6.2-27
022.14	17	6.2-28
022.15	17	6.2-29
022.16	17	6.2-30
110.30	17	6.2-31
022.21	17	6.2-32
110.42	17	6.2-33
022.27	17	6.2-34
022.28	17	6.2-35
022.29	17	6.2-36
022.30	17	6.2-37
022.34	17	6.2-39
022.35	17	6.2-40
022.36	17	6.2-41
022.37	17	6.2-42
022.38	17	6.2-43
022.39	18	6.2-46
022.40	27	6.2-47

CHAPTER 6

CONTENTS

NRC Question No.	Revision No.	Q&R Page No.
222.3	17	6.2-48
022.41	24	6.2-49
022.43	23	6.2-51
022.44	20	6.2-53
022.46	27	6.2-54
211.5	3	6.3-1
211.6	3	6.3-2
211.10	3	6.3-5
211.58	21	6.3-6
122.8	8	6.3-7
211.39	9	6.3-8
211.49	9	6.3-9
211.50	9	6.3-10
211.51	9	6.3-11
211.52	9	6.3-12
211.53	9	6.3-13
211.54	15	6.3-14
211.55	9	6.3-15
211.56	21	6.3-16
211.57	9	6.3-19
211.89	9	6.3-20
211.90	9	6.3-21
211.93	9	6.3-22
211.40	9	6.3-23
211.91	9	6.3-24
211.92	9	6.3-25
211.41	9	6.3-26
211.42	9	6.3-27
211.43	9	6.3-28
211.48	9	6.3-29
211.44	9	6.3-30
211.45	9	6.3-31
211.46	15	6.3-32
211.47	9	6.3-34
040.26	10	6.3-35
040.88	15	6.3-36
211.114	15	6.3-37
211.115	15	6.3-40
211.116	18	6.3-42
211.117	18	6.3-44
211.118	15	6.3-45
211.119	16	6.3-46

Question 022.40 (6.2)

Your response to request 022.16 regarding local Type C testing of containment isolation valves is incomplete and unacceptable. We disagree with your assumption that penetrations associated with the secondary system (main steam, feedwater, auxiliary feedwater, etc) do not provide credible leak paths for the leakage of containment atmosphere out of containment. Primary-to-secondary steam generator tube leakage provides a potential leak path for containment atmosphere out of containment following a loss-of-coolant accident. Therefore, justify not performing local Type-C tests on secondary system containment isolation valves by either:

1. Showing a water seal exists which precludes containment atmospheric leakage as discussed in request 022.16; or

2. Providing a calculation which conservatively predicts the offsite dose attributed to containment atmospheric leakage through the steam generator tubes. Identify the dose contribution due to leakage and show that the dose contribution in addition to the offsite accident dose does not exceed the exposure guidelines of 10 CFR 100. 15

Response

During the time following LOCA that the internal pressure of the secondary side of the steam generator is above containment pressure, leakage of containment atmosphere into the secondary side of the steam generator is not possible. It is believed that the above condition would exist for a sufficient time to ensure that the offsite dose attributed to containment atmosphere leakage through the steam generator tube after the containment pressure exceeds the shell side steam generator pressure does not exceed 10 CFR 100 requirements for the Midland plant. 19
Verification of this position will be provided by amendment. 27

Question 222.3 (6.2.1)

Long term mass and energy releases for postulated breaks in the primary system are calculated using the CRAFT, REFLOOD, and CONTEMPT codes. Provide a comparison of the use of these codes for Midland to their use in Appendix 6A of BSAR-205 which we have approved. 15

Response

The computer codes CRAFT, REFLOOD, and CONTEMPT used in generating long-term mass and energy releases are the same as those used in Appendix 6A of BSAR-205.

Question 022.44 (6.2) (RSP)

Your response to request 022.39 concerning environmental qualification of safety-related equipment is incomplete. We will require that any thermal analysis to verify environmental qualification be based on the CSB Interim Evaluation Model. All applicants for operating licenses are being required to use this model pending the completion of Generic Task A-21, Main Steam Line Break Inside Containment - Evaluation of Environmental Conditions for Equipment Qualification, and Generic Task A-24, Qualification of Class 1E Safety-Related Equipment. (See NUREG-0371, Task Action Plans for Generic Activities.) Therefore, provide the analyses previously requested. 17

Response

Environmental qualification of safety-related equipment will be verified by analysis based on the CSB Interim Evaluation Model. Results of the analysis will be provided by amendment. 18 26

Question 022.46 (6.2)

The response to 022.29 concerning the maximum external containment pressure due to inadvertent actuation of the spray systems is not acceptable. It is our position that this calculation should assume that the containment, which is initially at 14.7 psia, 120F, and 100% relative humidity, becomes saturated at the minimum BWST temperature of 40F. Therefore, revise your external containment pressure analysis using these assumptions or provide sufficient justification which shows that the resulting structural loads and load combinations (using our assumptions) are with the current stress allowables. 17

Response

The transient analysis in FSAR Subsection 6.2.1.1.3.6 provides a conservative estimate of the containment response to an inadvertent spray actuation. This analysis, which includes the effect of heat stored in the internal concrete and steel structure, produces a maximum external loading of -2.85 psid. Ignoring the sensible heat in this structure would be unrealistically conservative. 18

Using the methodology required by NRC Questions 022.29 and 022.46 results in loading of -3.4 psid. This analysis neglects all sensible heat stored in the internal structures and is a bounding calculation.

The resulting structural loads and load combinations using the methodology of Questions 022.29 and 022.46 are within stress allowables with the design margin based on a 3 psid external pressure. The equipment hatch bolts are the limiting structural components in the analysis, and the stresses in these bolts remain within stress allowables. Therefore, even using the extreme conservatism of this calculational method, no breach of containment integrity will result from an inadvertent spray system actuation. 27 18

CHAPTER 7

CONTENTS

NRC Question No.	Revision No.	Q&R Page No.
040.23	10	7.0-1
040.24	15	7.0-2
031.4	2	7.1-1
031.5	2	7.1-2
031.6	2	7.1-3
031.18	15	7.1-4
031.19	15	7.1-5
031.20	17	7.1-6
031.21	15	7.1-11
031.15	18	7.1.12
031.16	15	7.1-13
031.14	16	7.1-14
031.17	15	7.1-16
031.38	20	7.1-17
031.39	21	7.1-19
031.40	21	7.1-20
031.49	21	7.1-22
031.52	21	7.1-23
031.7	2	7.2-1
031.10	16	7.2-2
031.22	15	7.2-4
040.25	10	7.3-1
031.23	15	7.3-2
031.24	16	7.3-3
031.25	21	7.3-4
031.26	15	7.3-5
031.32	15	7.3-6
031.41	21	7.3-7
031.45	20	7.3-8
031.51	24	7.3-9
031.53	24	7.3-10
031.8	27	7.4-1
031.28	15	7.4-2
031.27	27	7.4-3
031.29	15	7.4-4
022.6	18	7.5-1
031.9	16	7.5-2
040.30	10	7.5-3
031.30	27	7.5-4
031.50	20	7.5-6
031.35	15	7.7-1
031.37	15	7.7-3

CHAPTER 7

FIGURES

Figure No.	Title	
7.4-1	Class 1E Controls for Pressurizer Heater Banks 5&6 for Unit 1	19
7.4-2	Class 1E Controls for Pressurizer Heater Banks 5&6 for Unit 2	20
7.4-3	Pressurizer Heater Banks 5 & 6 Control Logic	
7.4-4	Pressurizer Heater Bank 5 Loop Diagram	
7.4-5	Pressurizer Heater Bank 5 Schematic	
7.4-6	Pressurizer Heater Bank 5 Cable Connections	24
7.4-7	Pressurizer Heater Bank 5 & 6 Adapter Table	
7.4-8	Pressurizer Heater Bank 5 Control Circuit	
7.4-9	Pressurizer Heater Bank 5 Annunciator Circuit	
7.4-10	Pressurizer Heater Single-Line Diagram	

Question 031.8 (7.4.1)

Item C of section 7.4.1.1.6 states, "Control of the pressurizer heaters is required to ensure the capability of maintaining reactor coolant pressure during safe shutdown." However, your pressurizer heater controls have been classified as non-safety and are discussed in section 7.7.1.8. Since the function of the pressurizer heaters is safety-related, it is inconsistent that their controls could be non-safety related.

Expand the appropriate subsections of Section 7.4 to address this subject as required by Section 7.4.1 of R.G. 1.70 and justify the conflict of safety category between the heaters and their controls.

Response

Subsection 7.4.1.1.6 and 7.4.2.7 have been revised to clarify the safety classification and adequacy of the pressurizer heater control system. | 27

Question 031.28 (7.4)

Criterion 19 of the General Design Criteria requires, in part, that equipment at appropriate locations outside the control room be provided with a potential capability for subsequent cold shutdown of the reactor through the use of suitable procedures. The staff interprets this to mean that the equipment is required for safety and should meet all requirements for a safety-related system. These systems should be identified in FSAR Section 7.4 as systems required for safe shutdown. 15

Modify your description in FSAR Section 7.4 to include all systems required to achieve and maintain safe shutdown of the reactor. This description should include all information specified in Section 7.4 of Regulatory Guide 1.70, and should identify and justify all exceptions.

Response

As indicated in the response to Question 211.35, the Midland design provides the ability to achieve, by safety grade means, the hot shutdown condition. In order to satisfy NRC General Design Criteria 19, the Midland plant design provides for nonsafety grade cooldown of the plant from outside the control room as discussed in FSAR Subsection 7.4.3.1.2.

Question 031.27 (7.4.1)

FSAR Section 7.4.1 identifies the pressurizer heater controls as a system required for safe shutdown. Yet Section 7.4.1.1.6(e) indicates that this system does not meet all requirements of IEEE Standard 279-1971 and discusses your basis for not meeting our requirement.

Identify the worst case events which would result from failure of this system while attempting to achieve and maintain hot shutdown. Also demonstrate that each of these conditions will not violate the commission's requirements. 15

Identify and justify all sections of IEEE 279-1971 which are not met in the design of the pressurizer heater control system. Coordinate the response of this request with the response to request 211.35.

Response

The Midland plant design will be revised to include Class 1E redundant pressurizer heater controls and power supplies. The redundant power supplies will be backed by a diesel generator in the event of a loss of normal power. 16 18

The following FSAR sections will be revised by amendment to reflect these changes.

	Sections
Control board drawings	1.7[2]
Mechanical, control system, and electrical description	5.0[1]
Equipment qualification	3.0

27

FSAR Sections 7.1, 7.4, 7.5, 7.7, and 15.0 have been revised in response to this question. 18

(1) Q&R Figures 7.4-1 and 7.4-2 show the Class 1E controls for pressurizer heater banks 5 and 6 for Units 1 and 2, respectively. FSAR Figures 5.1-1 and 5.1-2 will be revised by amendment to include this design change of Class 1E controls for pressurizer heater banks 5 and 6. 20 19

(2) The loop diagram, logic diagram, and electrical schematics for Class 1E control of pressurizer heater banks 5 and 6 are provided as Q&R Figures 7.4-3 through 7.4-10. Section 1.7 will be revised by amendment to include these drawings. 24

Question 031.29 (7.4.2)

The discussion of Regulatory Guide 1.53 in FSAR Section 7.4.2.3 states that "a failure modes and effects analysis of the control rod drive control system (CRDCS) trip position will be performed and submitted at a later date." This section also states that the discussion of conformance to Regulatory Guide 1.75 for the trip portion of the control rod drive control system will be submitted later. Please expedite these submittals consistent with our established review schedule.

15

Response

Regarding Regulatory Guide 1.53:

Revision 13 of the FSAR includes a failure modes and effects analysis of the control rod drive control system (CRDCS) trip portion.

Regarding Regulatory Guide 1.75:

Refer to the response to Question 031.20 for discussion of conformance to Regulatory Guide 1.75.

Question 040.30 (7.5, 8.3)

The transfer of manual control for safety-related equipment shows that in some cases, the switches used to effect the transfer also remove the automatic actuation capability as well as transferring the manual control from the main control room to another location. Identify all safety-related components (such as motors) for which the above applies and provide the bases and design criteria for this design. Also, state any design features (such as keylock switches or enclosures) which are provided to add assurance that these transfer or alternate control switches are in the current position during plant operations.

Response

The following safety-related components have been identified as having manual transfer controls which remove the automatic actuation capability and prevent manual control from the control room.

Component	Component Description	FSAR Subsection
1G11 1G12 2G11 2G12	Emergency diesel generators	8.3.1.1.3
1LV-3875A 1LV-3875B 2LV-3975A 2LV-3975B	Auxiliary feedwater steam generator level control valve	7.4.1.1.1
1SCV-3831 2SCV-3931	Auxiliary feedwater pump turbine driver speed control valve	10.4.9.5

The listed sections have been revised in response to this question.

10

Question 031.30 (7.5)

Provide the following information regarding FSAR Section 7.5.2.2.1:

1. By omission, this FSAR section takes exception to several sections of IEEE 279-1971. Describe how your design of the safety-related display instrumenation satisfies the missing sections of IEEE 279-1971 or provide justification for each omission.

2. Justify not including any safety-related recorders in this design as required by Branch Technical Position ISCB (sic) 23.

3. This FSAR section includes design criteria for only the engineered safety features actuation system (ESFAS). Identify all other safety-related display instrumentation and describe how it satisfies Branch Technical Position ICSB 23. Also include the information requested by Parts 1 and 2 above. 15

4. Justify not including control rod position indication as safety-related display instrumentation.

Response

In response to this question:

1. Compliance with IEEE Std 279-1971 for ESFAS (including indication channels) is discussed in Subsections 7.3.3.3.1 and 7.3.3.4.1. Compliance of pressurizer heater control system displays is discussed in Subsections 7.4.1.1.6 and 7.4.2.7. 27 18 27

2. Protective actions are not required to be initiated by recorded information. Therefore, no safety-related recorders are provided. However, in many cases, nonsafety-related recorders are provided as identified in Tables 7.5-1 and 7.5-2. 15

3. Tables 7.5-1 and 7.5-2 show the safety-related display information for ESF systems and safe shutdown (Class 1E designated by a # symbol). In addition to ESFAS displays, safety-related display instrumentation is provided for the following systems: 27

   a. Reactor building radiation monitors 15

   b. Reactor building sump level monitoring

   c. Reactor building hydrogen concentration detectors

d. Reactor coolant system pressure indication | 18

e. Dump to sump line flow indication | 23

These safety-related display instrumentation systems comply with EICSB Branch Technical Position 23, dated November 24, 1975, as discussed below:

a. The monitoring syste .e redundant with at least two channels of indication provided. Indicators are provided in the main control room. Safety grade reactor building radiation indicators are also provided outside the main control room on the local panel. Protective actions are not required to be initiated based on recorded information. Therefore, no Class 1E recorders are provided. | 27 However, in many cases (refer to Tables 7.5-1 and 7.5-2) nonsafety grade recorders are provided. | 15

b. The above systems are energized from onsite emergency power supplies.

c. Class 1E redundant indications are provided in accordance with IEEE Std 279-1971 such that no single active failure will cause a loss of the indication to the operator. | 15

d. These monitoring systems will be qualified in accordance with IEEE Std 323-1974 and IEEE Std 344-1975.

4. Justification for not including control rod position indication as safety-related display instrumentation is provided in Subsection 7.5.2.3.

Question 031.50 (7.5) (RSP)

The response to Question 031.30 is not acceptable for the following reasons:

(a) It is a staff position that all recorders required for post accident monitoring must be qualified to operate within acceptable limits before ard after a seismic event. This is a requirement to satisfy IEEE Standard 279-1971 specified in Branch Technical Position No. 23 listed in Appendix 7A of the Standard Review Plan. Provide a commitment to this position.

(b) Listed below are key parameters which should be included for post accident monitoring:

(1) Condensate storage tank level

(2) High pressure injection flow

(3) Low pressure injection flow

(4) Pressurizer pressure 20

(5) Pressurizer level

(6) Reactor coolant temperature

(7) Reactor building emergency sump level

(8) The enabling alarm and the transient pressure alarm for the overpressure protection system for low temperature operations indication

(9) Post-LOCA "Dump-to-Sump" flow

(10) Reactor building temperature

(11) Reactor building emerge :' sump water temperature

(12) Fan cooler flow rate and associated cooling water flow rate; and

(13) Valve position for all power operated containment isolation valves (See FSAR Table 6.2-28)

It is the staff's position that these parameters be included for post accident monitoring. Provide this information. If parameters have been excluded, provide the basis for not including them.

CHAPTER 8

CONTENTS

NRC Question No.	Revision No.	Q&R Page No.
040.19	14	8.0-1
040.77	15	8.0-2
040.83	15	8.1-1
040.108	18	8.1-2
040.109	18	8.1-3
040.1	3	8.2-1
040.2	3	8.2-2
040.3	3	8.2-3
040.4	3	8.2-4
040.14	21	8.2-5
040.20	10	8.2-6
040.21	10	8.2-7
040.22	10	8.2-8
040.79	19	8.2-9
040.84	16	8.2-10
040.110	18	8.2-11
040.113	19	8.2-12
040.13	18	8.3-1
040.15	8	8.3-4
040.16	21	8.3-6
040.5	8	8.3-7
040.27	10	8.3-8
040.28	15	8.3-9
040.29	10	8.3-11
040.31	16	8.3-12
040.32	10	8.3-13
040.78	15	8.3-15
040.81	15	8.3-16
040.82	15	8.3-17
040.85	21	8.3-18
040.86	15	8.3-19
040.87	15	8.3-20
040.91	15	8.3-21
040.92	15	8.3-22
040.93	15	8.3-23
040.111	19	8.3-24
040.112	18	8.3-25
040.116	27	8.3-26
040.119	27	8.3-29
040.120	27	8.3-34

CHAPTER 8

TABLES

19

Table No.	Title
8.2-1	Characteristics of Electrical Islands Containing the Midland Plant

Question 040.112 (8.3)

Your response to Q040.85 is incomplete. The use of a single load sequencer in your design for the connection of emergency safety features loads to the emergency buses when power is being supplied either from offsite or from the diesel generators is unacceptable as documented because it does not provide independence between the offsite power source and the onsite power sources to meet the requirements of GDC 17. Therefore, we require that you either provide a separate sequencer for offsite and onsite power or a detailed analysis to demonstrate that there are no credible sneak circuits or common failure modes in the sequencer design that could render both onsite and offsite power sources unavailable. In addition, provide information concerning the reliability of your sequencer and reference design detailed drawings.

Response

Subsection 8.3.1.1.3 has been revised to provide reliability data for the sequencer. The following is provided to support the existing system design,which utilizes one sequencer per the ESFAS channel. 18

After an accident signal, the sequencer is enabled upon the receipt of a power-available signal from the undervoltage relays located at the safety-related buses. The relay, bus, and sequencer are all part of the same safety-related redundant load group. The power source to this load group may be either offsite or onsite.

If a separate sequencer were provided so that one could be used to sequence the safety-related loads on offsite power and the other could be used to sequence safety-related loads on onsite power, it would be incorporated as an integral part of the same redundant load group of the existing sequencer. As a result, the power supplies for the separate sequencing systems would be derived from the same load group power source, and the sequencers would be electrically interconnected. As such, no independence or significant increase in reliability would be achieved by the addition of another sequencer.

It is our position that the existing design implements all applicable criteria with more than sufficient assurance of proper operation and independence.

Question 040.116 (8.3)

Provide a detailed discussion or plan of the level of training proposed for your operators, maintenance crew, quality assurance, and supervisory personnel responsible for the operation and maintenance of the emergency diesel generators. Identify the number and type of personnel that will be dedicated to the operations and maintenance of the emergency diesel generators and the number and type that will be assigned from your general plant operations and maintenance groups to assist when needed.

In your discussion identify the amount and kind of training that will be received by each of the above categories and the type of ongoing training program planned to assure a high level of availability of the emergency generators.

Also discuss the level of education and minimum experience requirements for the various categories of operations and maintenance personnel associated with the emergency diesel generators.

Response

Educational and minimum experience requirements for all categories of operations and maintenance personnel are in accordance with the recommendations of ANSI N18.1-1971. FSAR Subsection 13.2.1a provides further information. 27

Personnel from the Midland plant operations and maintenance departments will be performing the operations and maintenance functions associated with the emergency diesel generators. It is not anticipated that any assistance will be required or requested of nonplant operating or maintenance personnel. Vendor assistance will be requested if needed. These functions will be performed on a nondedicated basis. The number and type of personnel utilized for operations and maintenance of the diesel generator will be based on the complexity and requirements of the task being performed. In all cases, plant personnel utilized will possess the qualifications and training discussed in this response. Supervisors of these functions will be from the respective department.

Training will be provided for the operations and maintenance department personnel including respective supervisors of these groups. The projected training time, directly associated with emergency diesel generators, for each department is approximately 80 hours.

Due to the plant staff organization, the quality assurance department is not responsible for ensuring the proper operation and maintenance of the emergency diesel generators. Quality control personnel have this responsibility and are assigned to

individual departments. These personnel receive the departmental training as described below.

The proposed training to be received by the Midland plant staff is as follows:

1. Operations Department Personnel

    a. Basic diesel engines: This segment of training includes theory of operation, application, and basic controls.

    b. Emergency diesel generator, related systems training: This segment of training consists of instruction on mechanical, electrical, and instrumentation systems such as diesel fuel oil storage and transfer, intermediate ac distribution, emergency safety features actuation, and air start systems.

    c. Emergency diesel generators: This segment of the training provides the specific information concerning the diesel generator sets installed at the Midland plant. This instruction includes related plant procedures and technical specifications associated with the emergency diesel generators.

2. Maintenance Department Personnel 27

    a. Basic diesel engines: This segment of training includes theory of operation, application, and basic controls.

    b. Emergency diesel generator, related systems training: This segment of training consists of instruction on mechanical, electrical, and instrumentation systems such as diesel fuel oil storage and transfer, intermediate ac distribution, emergency safety features actuation, and air start systems.

    c. Emergency diesel generators: This segment of the training provides the specific information concerning the diesel generator sets installed at the Midland plant. The instruction includes related plant procedures and technical specifications associated with the emergency diesel generators.

In addition to the above training, it is proposed that vendor instruction will be obtained for installation, operation, and maintenance of the diesel generators. The proposed format of this course is:

1. Operations Department Personnel

    a. Theory of operation

b. Installation and testing

c. Engine and generator controls

d. General maintenance

2. Maintenance Department Personnel

a. Theory of operation

b. Installation and testing

c. Basic controls

d. Specific maintenance

e. Troubleshooting techniques

27

It is projected that the vendor instruction will occur during the installation and testing of the emergency diesel generators.

The Midland training department provides for requalification and replacement training to ensure maintenance of proficiency for the operating organization consistent with the recommendations of ANSI N18.1-1971.

Question 040.119 (8.3) (RSP)

Preiodic [sic] testing and test loading of an emergency diesel generator in a nuclear power plant is a necessary function to demonstrate the operability, capability and availability of the unit upon demand. Periodic testing coupled with good preventive maintenance practices will assure a high level of equipment readiness and availability upon demand.

To achieve an acceptable level of equipment readiness status, the following requirements shall be met:

1. The equipment shall be tested with a minimum loading of 25 percent of rated load. No-load or light-load operation tends to cause incomplete combustion of fuel, resulting in the formation of gum and varnish desposits on the cylinder walls, intake and exhause [sic] valves, pistons and piston rings, etc., and accumulation of unburned fuel in the turbocharger and exhaust system. The consequences of no-load or light-load operation are potential equipment failure due to the gum and varnish deposits and fire in the engine exhaust system.

2. Periodic surveillance testing shall be performed in accordance with the Regulatory Guide 1.108 or an acceptable alternative, and with the recommendations of the engine manufacturer. Conflicts between any such recommendations and NRC guidelines, particularly with respect to test frequency, loading and duration, should be identified and justified. 27

3. Preventive maintenance should go beyond the normal routine adjustments, servicing and repair of components when a malfunction occurs. Preventative maintenance shall encompass investigative testing of components which have a history of repeated manfunctioning and require constant attention and repair. In such cases consideration should be given to replacement of those components with other products which have a record of demonstrated reliability, rather than repetitive repair and maintenance of the existing components. Testing of the unit after adjustments or repairs have been made only confirms that the equipment is operable and does not necessarily mean that the root cause of the problem has been eliminated or alleviated.

4. Upon completion of repairs or maintenance and prior to an actual start, run, and load test, a final equipment check shall be made to assure that all electrical circuits are functional, i.e., fuses are in place, switches and circuit breakers are in their proper position, no loose wires exist, all test leads have been removed, and all valves are in the proper position to permit a manual start of the equipment. The unit shall be satisfactorily started and load tested before being returned to automatic standby service and shall

be confirmed to be under the control of the control room operator.

Discuss how the above requirements have been implemented in your emergency diesel generator system design, and how their implementation will be assured when the plant is in commercial operation.

Response

1. Periodic testing of the emergency diesel generators is accomplished in accordance with the technical specification as given in FSAR Subsection 16.3/4.8. The test specifications identify the criteria for the test including load requirements which generally are greater than 25%. However, some tests as described in the B&W Standard Technical Specifications (NUREG-0103), 16.4.8.1.1.2.c.5 require the diesel to operate at no-load conditions for short periods of time. These tests are performed at 18-month intervals and will be incorporated into the technical specifications for Midland. The tests are designed to demonstrate the operability, capability, and availability of the diesel generator upon demand and will be used to verify diesel generator status following maintenance activities which could affect operation. 27

2. There are no engine manufacturer recommendations regarding periodic surveillance testing which conflict with Regulatory Guide 1.108. The Midland position with respect to periodic testing and Regulatory Guide 1.108 is addressed in FSAR Appendix 3A.

3. The plant maintenance department uses the CPCo maintenance management system (MMS). One aspect of the MMS is to accumulate equipment maintenance history and utilize it to identify repetitive failures. When components are identified as repeatedly malfunctioning, investigations will be made in an attempt to find and eliminate the root cause. The specific actions taken to eliminate the root cause would depend on the results of the investigation and could include any of the following actions:

   a. Increasing the frequency and/or expanding the scope of an existing preventive maintenance program.

   b. Establishing a new preventive maintenance program.

   c. Replacement of the components with other products which have a demonstrated record of reliability. (It should be pointed out that a demonstrated record of reliability may not always be available for the replacement component.)

The preventive maintenance program established for the emergency diesel generators far exceeds normal routine adjustments, servicing, and repair of malfunctioning components. The major aspects of the program include the following:

Electrical

Item	Frequency[1]
Clean and inspection exterior of generator	18 months
Clean and inspect interior rotor and stator components	18 months
Clean and inspect slip-ring housing internal components	18 months
Clean and inspect ventilation (generator)	18 months
Clean and inspect regulator components	18 months
Check connections and measure insulation resistance	18 months

27

Mechanical

Inspection of jacket water cooler	
Engine inspection	Each refueling
Lube oil system Engine internals Connecting rods and bearings Crankshaft deflections Lube oil jets Cams, rollers, roller arms, push rods, etc Valve lifters Fuel injectors Foundation Drive coupling Air and oil filter Compression ratio, firing pressure	
Engine inspection	Every second refueling
Replace fuel injection pumps Check main bearings **Inspect gears, gear backlash**	

Starting air distributor filter	Monthly
Starting air compressor	Quarterly
Starting air compressor valves	Semi-annually
Starting air compressor bearings and bushings	Annually

(1) Frequencies shown are currently planned and could change based on experience and/or manufacturers recommendations.

Also, the supplier's service department receives reports of failed engine parts through its servicemen or through owner/operators. The service department determines if the failure is due to normal wear or exceptional causes. Those parts failed due to normal wear are replaced as a matter of routine maintenance. Exceptional failures are investigated. A history of component failures is maintained by the service department. When this history indicates a significant problem with a component, the component is submitted to the engineering department for redesign.

In the case of the diesel generators, and in compliance with 10 CFR 21, the vendor notifies the operator of any component deficiency directly and works closely with the operator to correct the deficiency. 27

4. Plant maintenance procedures invoke closeout inspection requirements. These requirements include provisions for sign-offs by the mechanic or technician and an additonal "witness or hold point" sign-off by an independent inspector or maintenance supervisor for critical inspection points. Installation and removal of test leads or jumpers is controlled either within the maintenance procedure itself or by reference to an administrative procedure which provides controls by requiring logging installation and removal. Further control is established by requiring that jumpers be orange in color and, therefore, easily identified. In addition, all jumpers are tagged. The required lineup of switches, valves, breakers, etc, is provided within applicable operating procedures. These procedures are utilized by operating personnel to establish proper electrical/mechanical lineups prior to operating the equipment.

   Administrative procedures require that applicable technical specification surveillance requirements, which are implemented by plant surveillance test procedures, be specified on the maintenance order which controls the work. These tests must be completed prior to the return of the equipment to service. The diesel generator will be load tested in accordance with the requirements of Technical

Specification 4.8.1.1.2.a. Testing will be performed from the control room, thereby insuring that the control room operator does have the diesel generator under his control. 27

Question 040.120 (8.3) (RSP)

The availability of an emergency diesel generator upon demand is dependent upon, among other things, the proper functioning of its controls and monitoring instrumentation. This instrumentation is generally panel mounted and in some instances the panels are mounted directly on the diesel generator skid. Major diesel engine damage has occurred at some operating plants from vibration-induced wear on skid-mounted control and monitoring instrumentation. This sensitive instrumentation is not made to withstand and function accurately for prolonged periods under continuous vibrational stresses normally encountered with internal combustion engines. Operation of sensitive instrumentation under this environment rapidly deteriorates calibration, accuracy and control signal output.

Therefore, except for sensors and other equipment that must be directly mounted on the engine or associated piping, the controls and monitoring instrumentation shall be installed on a free-standing, floor-mounted panel which is separate from the engine skids. This panel shall be located on a vibration-free floor area unless equipped with vibration mounts. 27

Confirm and describe your compliance with our above requirement, or provide justification for noncompliance in view of these expressed concerns and experiences.

Response

Except for sensors that must be engine-mounted due to their function, all instruments are mounted in panels which are on a foundation structurally isolated from the diesel generator pedestals.

CHAPTER 9

CONTENTS

NRC Question No.	Revision No.	Q&R Page No.
010.6	13	9.0-1
010.7	24	9.0-2
010.21	8	9.0-3
010.8	19	9.1-1
010.9	3	9.1-2
010.10	21	9.1-3
010.22	21	9.1-4
010.45	14	9.1-5
010.46	18	9.1-6
010.47	14	9.1-7
010.53	14	9.1-8
010.54	16	9.1-9
010.55	18	9.1-10
010.56	17	9.1-11
010.57	19	9.1-12
010.11	3	9.2-1
010.23	8	9.2-2
010.24	8	9.2-3
010.25	8	9.2-4
010.12	21	9.2-5
010.26	21	9.2-7
010.13	8	9.2-8
010.14	21	9.2-10
010.27	8	9.2-11
010.28	8	9.2-12
010.48	18	9.2-13
010.15	22	9.3-1
010.17	7	9.3-2
010.29	8	9.3-3
010.16	8	9.3-4
010.49	14	9.3-5
010.50	19	9.3-6
312.20	3	9.4-1
010.30	8	9.4-2
010.31	8	9.4-3
010.32	8	9.4-4
022.31	16	9.4-5
022.42	18	9.4-7
040.6	3	9.5-1
040.7	3	9.5-2
040.33	14	9.5-3
040.34	10	9.5-5
040.35	11	9.5-6

CHAPTER 9

CONTENTS

NRC Question No.	Revision No.	Q&R Page No.
040.36	10	9.5-7
040.37	13	9.5-8
040.38	10	9.5-9
040.39	10	9.5-10
040.40	10	9.5-11
040.41	10	9.5-12
040.42	10	9.5-13
040.43	10	9.5-14
040.44	10	9.5-15
040.45	10	9.5-16
040.46	10	9.5-17
040.47	10	9.5-18
040.48	10	9.5-19
040.49	10	9.5-20
040.50	10	9.5-21
040.51	10	9.5-22
040.52	10	9.5-23
040.53	10	9.5-24
040.54	10	9.5-25
040.55	10	9.5-26
040.56	10	9.5-27
040.57	13	9.5-28
040.58	10	9.5-29
040.59	10	9.5-30
040.60	15	9.5-31
031.36	15	9.5-32
040.94	15	9.5-33
040.95	15	9.5-34
040.96	15	9.5-35
040.97	15	9.5-36
040.98	15	9.5-37
040.99	15	9.5-38
040.100	15	9.5-39
040.101	15	9.5-40
040.102	15	9.5-41
040.106	24	9.5-42
031.46	20	9.5-44
040.114	27	9.5-49
040.115	27	9.5-45
040.117	27	9.5-47
040.118	27	9.5-48
421.3	12	9A-1
422.7	11	9A-6

Question 040.33 (9.5.2)

The information regarding the onsite communications system (Subsection 9.5.2) does not adequately cover the system capabilities during transients and accidents. Provide the following information:

a. Identify all working stations in the standard plant design 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 that will be 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

   2. Any other additional communication system provided that working station

e. Describe the performance requirements and tests that the above inplant 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. 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

a. Various work stations throughout the auxiliary building will be utilized to attain a safe cold plant shutdown. Access to the communication systems from these areas is

provided at strategic locations throughout the auxiliary building as shown in the drawings referenced in Table 1.7-8a. | 10 | 27

b. The prediction of maximum sound levels under transient and accident conditions is unfeasible. However, the maximum sound levels for normal plant operation will be measured once the plant is in operation. | 14

c. The types of communication systems available throughout the auxiliary building are shown in the drawings referenced in Table 1.7-8a. | 10 | 27

d. The page party system can be expected to effectively operate with a maximum background noise level of 85-95dBA.

The maximum background noise level that the sound powered phone system can be expected to effectively operate with will be provided by amendment when available from the vendor. | 14

The maximum background noise level that the public telephone system can be expected to effectively operate with will be provided by amendment when available.

e. Test Abstract 14A.1.47 has been revised in response to this question.

f. The protective measures taken to assure a functionally operable onsite communication system are discussed in Subsections 9.5.2.1.2 and 9.5.2.2.5. | 10

Question 040.115 (9.5.6) (RSP)

Operating experience has shown that accumulation of water in the starting air system has been one of the most frequent causes of diesel engine failure to start on demand. Condensation of entrained moisture in compressed air lines leading to control and starting air valves, air start motors, and condensation of moisture on the working surfaces of these components has caused rust, scale and water itself to build up and score and jam the internal working parts of these vital components, thereby preventing starting of the diesel generators.

As reported in NUREG/CR-0660, failure of diesel engines to start from the effects of moisture condensation in air starting systems and from other causes have lowered their operational reliability to less than the desired reliability goal of 0.99 specified in Branch Technical Position ICSB (PSB) 2 "Diesel Generator Reliability Testing" and Regulatory Guide 1.108 "Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants."

To improve diesel engine starting reliability, we require that compressed air starting system designs include air dryers for the removal of entrained moisture. The two air dryers most commonly used are the dessicant (sic) and refrigerant types . NUREG/CR-0060 finds that of these two types, the refrigerant type is better suited for nuclear power plant application and its selection is highly advisable. Midland FSAR Figure 9.5-27, "Emergency Diesel Generator Starting System," shows an air dryer and FSAR Section 9.5.6 states that an air dryer is used in the starting system. However, the type is not specified and there is no further description of the air dryer. Starting air should be dried to a dew point of not more than 50°F when installed in a normally controlled 70°F environment, otherwise the starting air dew point should be controlled to at least 10°F less than the lowest expected ambient temperature. 27

Describe the type of air dryer used in the diesel engine air starting system and revise your design if needed based on the information above.

Response

The system has a desiccant air dryer designed to dry the air to a dewpoint of -40F at 250 psi. This far exceeds the 10F below minimum expected ambient (50F) requirement recommended by the NRC. FSAR Subsection 9.5.6.2 has been revised in response to this question.

Features of the starting air system are as follows:

a. The air dryer, air receiver, and system piping and components are stainless steel.

b. Automatic drain traps are provided on the air receivers, and lines are sloped to low-point drain traps.

c. A drip leg with blowoff connection is provided upstream of air valves. Strainers are provided immediately upstream of the two starting air valves and filters are provided downstream of the valves in each starting train. Filters are also provided on the air dryer discharge just ahead of the air receiver tanks. Inlet strainers/separators are provided on the inlet to the air dryers (refer to Figure 9.5-27). 27

The position of the diesel generator supplier is that the reliability and performance of the desiccant dryer units furnished for the Midland project are superior to refrigerated units. Furthermore, the supplier's nuclear standby engines have never experienced a failure to start due to moisture in the starting air, nor do they expect this to happen.

Question 040.117 (9.5.7) (RSP)

Several fires have occurred at some operating plants in the area of the diesel engine exhaust manifold and inside the turbocharger housing. The fires started from lube oil leaking and accumulating on the engine exhaust manifold and accumulating and igniting inside the turbocharger housing. Accumulation of lube oil in these areas, on some engines, is apparently caused from an excessively long prelube period, generally longer than five minutes, prior to manual starting of a diesel generator. This condition does not occur on an emergeny start since the prelube period is minimal.

When manually starting the diesel generators for any reason, to minimize the potential fire hazard and to improve equipment availability, the prelube period should be limited to a maximum of three to five minutes unless otherwise recommended by the diesel generators. Specify the maximum prelube time interval to which your diesel engine will be exposed prior to manual start.

Response

27

The diesel generators for the Midland plant do not have the type of prelubrication system addressed in this question. The supplier utilizes a "lube oil keepwarm system" instead. This system consists of near operating temperature oil continuously circulating through the lower half of the engine to maintain critical component temperatures and lubrication (i.e., pistons, rods, bearings, crankshaft and gear train). However, the upper half of the engine (valve mechanisms) and the turbocharger are isolated from the keepwarm system circulation. These areas are kept warm by the circulation of heated jacket water in the block and in the turbocharger exhaust casing. Except for the turbochargers, a lubricant film is maintained in the upper half of the engine by a priming line (see the response to Question 040.118 for more details). Because oil does not circulate through the turbochargers, no prelube oil leakage would be expected in these areas which would present a potential fire hazard. The supplier has stated that it has never experienced leakage such as described in the question.

Standby conditions of the diesel generators are further discussed in FSAR Subsection 9.5.7.2.2.

Question 040.118 (9.5.7) (RSP)

An emergency diesel generator unit in a nuclear power plant is normally in the ready standby mode unless there is a loss of offsite power, an accident, or the diesel generator is under test. Long periods on standby have a tendency to drain or nearly empty the engine lube oil piping system. On an emergency start of the engine as much as 5 seconds to 14 or more seconds may elapse from the start of cranking until full lube oil pressure is attained even though full engine speed is generally reached in about five seconds after start of cranking. With an essentially dry engine, the momentary lack of lubrication at the various moving parts may damage bearing surfaces, producing incipient or actual component failure with resultant equipment unavailability.

The emergency condition of readiness requires this equipment to attain full rated speed and enable automatic sequencing of electric load within ten seconds. For this reason, and to improve upon the availability of this equipment upon demand, it is necessary to establish as quickly as possible an oil film in the wearing parts of the diesel engine. Lubricating oil is normally delivered to the engine wearing parts by one or more engine-driven pumps. During the starting cycle the pumps accelerate slowly with the engine and may not supply the required quantity of lubricating oil where needed fast enough. To remedy this condition we require that, as a minimum, an electrically driven lubricating oil pump, powered from a reliable DC power supply, be installed in the lube oil system to operate in parallel with the engine-driven main lube pump. The electric-driven prelube pump should operate only during the engine cranking cycle or until satisfactory lube oil pressure is established in the engine main lube distribution header. The installation of this prelube pump should be coordinated with the respective engine manufacturer. Some diesel engines include a lube oil circulating pump as an intregal part of the lube oil preheating system which is in use while the diesel engine is in the standby mode. In this case, an additional prelube oil pump may not be needed. 27

Confirm your compliance with our above requirement or provide your justification for not installing an electric prelube oil pump.

Response

The lower half of the diesel generator is continuously lubricated as described in the response to Question 040.117. For the upper half of the unit, except the turbochargers, a film of lubrication is provided by a priming line. Consequently, oil flow and pressure are instantaneously available upon engine start. Should the keepwarm system fail, the engine is designed to, and is capable of, starting and accepting load with residual oil film.

Question 040.114 (9.5.8)

Experience at some operating plants has shown that diesel engines have failed to start due to accumulation of dust and other deliterious material on electrical equipment associated with starting of the diesel generators (e.g., auxiliary relay contacts, control switches - etc.). Describe the provisions that have been made in your diesel generator building design, electrical starting system, and combustion air and ventilation air intake design(s) to preclude this condition to assure availability of the diesel generator upon demand.

Also describe what procedure will be used under normal plant operation tc minimize accumulation of dust in the diesel generator room. Your response should also identify and address any special conditions, construction or maintenance activities during operation of either unit which may result in abnormal generation of dust.

27

Response

The response to this question will be provided by amendment.

CHAPTER 14

CONTENTS

NRC Question No.	Revision No.	Q&R Page No.
211.175	18	14.2-1
423.1	27	14.2-2
423.2	27	14.2-7
423.3	19	14.2-18
423.4	27	14.2-20
423.5	19	14.2-25
423.6	19	14.2-26
423.7	20	14.2-27

Position A.7.d - The reactor building spray system tests are addressed in Test Abstract 14A.1.16 and the reactor building recirculating air cooling unit tests are discussed in Test Abstracts 14A.1.64 and 14A.1.60. 19

Position A.10.c - Test Abstract 14A.1.23 has been modified to address this testing requirement. 20

Position A.10.e - This position is addressed in Test Abstract 14A.1.54.

(5) Regulatory Guide 1.108 19

FSAR Subsection 14.2.7 has been modified to reference our position on Regulatory Guide 1.108 in Appendix 3A. The Regulatory Guide 1.108 position was modified by Revision 20 to address the requests of the Power Systems Branch. 20

19

Item (2)

(1) Test Abstract 14A.1.17 has been modified to include safety-related tank auxiliaries. 20

(2) The ECCS and containment spray system test abstracts have been modified to include a leakage test to determine the baseline total leakage rate from these systems.

The systems themselves have no integral leakage detection systems. However, the DHR and containment spray rooms are equipped with airborne radiation monitoring equipment and flooding alarms. The flooding alarms will be tested as described in FSAR Subsection 14.2.1.1 and the airborne monitors are covered by Test Abstract 14A.1.54, Area Radiation Monitoring System. 21

(3) Test Abstract 14A.1.71 has been provided to ensure leaktightness and correct failure mode of valves located in drain lines from rooms housing critical equipment. 27

(4) A test abstract for the auxiliary building crane will be provided by amendment when the design is finalized.

(5) As indicated in Subsection 6.4.4.2, toxic gas protection for the control room operator during a chlorine release at Dow is conservatively evaluated based on assumptions given in Regulatory Guide 1.95. In this analysis, no credit is taken for the caustic soda scrubbing system provided at the chlorine storage tank or the lower 21

predicted chlorine release rate (see Subsection 2.2.2.2.6 and Figure 2.2-8). This analysis establishes that the control room isolation system will detect the chlorine gas and isolate the control room in adequate time to ensure that chlorine concentration does not exceed the toxicity limit specified in Regulatory Guides 1.78 and 1.95. 21

Because control room habitability is not based on the use of Dow's systems, preoperational testing of Dow's ventilation systems, caustic scrubbers, and pumps is not required.

(6) FSAR Subsection 6.2.6.2 has been modified to add testing of the guard pipe. 20

(7) The cooling tower and auxiliaries are not safety-related. However, the safety-related interface will be tested as described in Test Abstract 14A.1.22. 19

(8) The prerequisites for Test Abstract 14A.1.12 have been modified to address this position.

(9) Test Abstract 14A.1.70 has been added to address this testing. 21

(22)14A.1.27- Appendix 3A, Regulatory Guide 1.52 provides response to this request. The test abstract has been expanded to identify systems to be tested. 20

(23)14A.1.28- The test abstract has been modified to address this testing.

(24)14A.1.29- Test Abstract 14A.1.29 has been modified to incorporate this testing. 21

(25)14A.1.33- Test Abstract 14A.1.33 has been modified to incorporate testing.

(26)14A.1.40- Test Abstract 14A.1.43 provides this testing. 20

(27)14A.1.42- Test Abstract 14A.1.42 has been modified to address this testing.

(28)14A.1.43 19

(1) Test Abstract 14A.1.43 has been modified to address the dc distribution system.

(2) Test Abstract 14A.1.43 has been modified to include this testing. 21

(29)14A.1.44- Test Abstract 14A.1.44 has been revised to include testing of the control and instrument buses. It is not the purpose of this test to verify the failure modes of the supplied loads upon loss of preferred or control and instrument power. Should a safety-related action occur as a result of loss of 120Vac power, such an occurrence will be verified in the preoperational test of the system in which the equipment performing the action is contained. 20

(30)14A.1.45

(1) Section 3.3 of Test Abstract 14A.1.45 has been broadened to specify that a discharge test will be conducted to verify battery capacity.

(2) The preoperational battery test will not measure actual system loads because they will not be available at the time. Actual electrical system loads will be measured as part of the power ascension program after core load.

(3) Response to this position will be provided by amendment. 27

(31)14A.1.48 - Test Abstract 14A.1.48 has been modified to address this testing. 20

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(32)14A.1.49- The steam portion of the plant sample system does not have excess flow check valves. The primary portion of the plant sampling system has excess flow check valves. Testing will be incorporated by amendment. 20 27

(33)14A.1.52 19

(1) Test Abstract 14A.1.42 has been modified to address this testing. Response times of final control devices, as well as response to loss of power for these devices, will be measured and tested by generic procedures in conjunction with the associated mechanical/fluid system of which they are a part. 21

(2) Test Abstract 14A.1.43 addresses this testing. 19

(34)14A.1.53- Test Abstract 14A.1.53 has been modified to address this testing. 21

(35)14A.1.60- Test Abstract 14A.1.18 addresses Type B and C testing. FSAR Subsections 6.2.6.2 and 6.2.6.3 address Type B and C test commitments. Test Abstract 14A.1.18 has been expanded to reference the existing information. 20 23

Test Abstract 14A.1.60 has been expanded to include peak and reduced pressure sequence and to discuss outgassing as appropriate. Subsection 6.2.6.1 fully addressed ILRT test commitments. 27 20

(36)14A.1.68 - Test Abstract 14A.1.68 has been modified to respond to this position. 19

(37)14A.1.69 - The flow detectors in the ECCS dump to sump line will be tested for redundancy and separation by Test Abstract 14A.1.43. The abstract prerequisites have been expanded to include generic checkout of equipment, controls, and instruments in the dump to sump lines. 21

Question 423.3 (14.2)

Our review of your proposed startup testing phase provided in Table 14.2-2 disclosed that several tests described in Regulatory Guide 1.68 may not be scheduled to be performed. Describe your plans and provide test summaries (or justification for nonperformance) of tests identified in items C.1.a, C.1.h, C.1.j, D.1.h, and D.1.i of Regulatory Guide 1.68.

Our basis for including the generator trip test in Regulatory Guide 1.68 was to assure that the turbine generator would not exceed its design speed and to establish that the plant's electrical system would perform as designed for this transient test during which the system may be subjected to frequencies in excess of 60Hz. To accomplish the test objectives, the generator should be disconnected from the transmission system in a manner that will result in the calculated maximum overspeed condition. Normally, this is accomplished by opening of the generator output breaker in a manner that will require a turbine generator overspeed condition to initiate closure of the steam admission or stop valves.

It is our understanding that typical designs of the trip logic for the generator output breakers will, for certain sensed plant conditions, result in a direct and simultaneous trip of the turbine stop valves. There usually are additional trips that will also open the generator output breakers without directly tripping the turbine stop valves. Therefore, the latter type of trip should be simulated to initiate the transient. 19

Modify Section 14.2 and the test descriptions as necessary to clarify that the generator trip test will be performed as intended by Regulatory Guide 1.68 and to either state that the turbine test will be performed at 100% power or provide technical justification for conducting the test at a different power level.

Response

Test Abstract 14A.3.6 has been added to provide a summary of the proposed test covering the position of Regulatory Guide 1.68, Appendix A, item C.1.a.

Regulatory Guide 1.68, Appendix A, item C.1.h requires that flux distribution measurements be performed during low power test conditions. The sensitivity of the incore flux instrumentation is too low to allow performance of this test at this low power level. Flux distribution measurements will be performed at a higher power level as identified in Test Abstract 14A.4.3.

The pseudo rod ejection test identified in Regulatory Guide 1.68, Appendix A, item C.1.j is performed during the low power physics test procedure described in Test Abstract 14A.3.2.

criteria. Specific acceptance criteria will be provided in the test procedure. Within specified tolerances, the parameters measured should correspond with values predicted by the physics manuals of Midland Units 1 and 2, and when applicable, meet the requirements of the technical specifications in FSAR Subsection 14.2.7. Copies of startup test procedures will be made available for onsite review by the NRC 60 days prior to scheduled fuel loading dates. 19

(6) Further details, as requested, will be provided in the form of revised test abstracts after the basic process steam system startup program has been identified. The revised abstracts will be provided by amendment. 27

(7) This test will be performed at 40% and 75% power. Data are collected at approximately 6 different imbalance conditions ranging from a large positive imbalance to a large negative imbalance. The acceptance criteria specify that the indicated out-of-core imbalance shall represent the imbalance as detected by the incore system within allowable limits.

(8) The intent of the loss of offsite power test is to demonstrate the capability to shut down and maintain the reactor in a hot standby condition using only emergency sources of power. This can be demonstrated without having the turbine generator online by dumping steam to the condenser. Therefore, this test will be performed at an initial condition of reactor power $\geq$ 10% maintained by dumping steam to the condenser via the turbine bypass valves. 19
Additionally, temporary sources of backup power may be utilized to protect nonsafety-related equipment during the test, and the non-Class 1E distribution system will be reenergized prior to completion of the test to control and protect nonsafety-related equipment. Temporary backup power sources utilized and operations performed during the test which utilize the non-Class 1E distribution system will be documented to provide assurance that these actions do not invalidate test results. Test Abstract 14A.4.8 has been modified to incorporate the position described above.

(9) The test will be conducted from 40% power with the ICS in automatic. Xenon equilibrium will be established. The control rod configuration and other steady-state RCS conditions will be as specified in the test procedure.

It is anticipated that the test will be performed in approximately 12 hours following establishment of initial conditions. During the period of the test, increased surveillance of core parameters will be required according to the technical specification.

(10) The test will be performed at 40% full power with equilibrium xenon and stable temperature, pressure, and power. A boron

dilution will be initiated and reactivity will be balanced by withdrawal of the predicted maximum worth pseudoejected rod. Differential rod worth measurements using a fast insert and withdrawal technique will be performed at specified rod positions, then plotted and integrated to obtain the pseudoejected rod worth.

(11)FSAR Subsection 14 2.7, Regulatory Guide 1.68.2 was modified by Revision 18. Current revision of the abstract (Revision 17) and the modified position are consistent with the guide. 19

(12)The process steam system startup test program is presently being defined. This includes the startup sequence with respect to both units. Presently the process steam system startup program is scheduled to begin shortly after the start of the Unit 1 power ascension program.

Further detail, as requested, will be provided in the form of revised test abstracts after the basic startup program has been identified. These revised abstracts will be provided by amendment. 26

CHAPTER 15

CONTENTS

NRC Question No.	Revision No.	Q&R Page No.
312.40	8	15.6-5
211.75	16	15.6-6
211.76	12	15.6-7
222.9	15	15.6-8
312.43	18	15.6-9
312.28	3	15.7-1
312.41	18	15.7-2
312.44	16	15.7-3
312.45	18	15.7-5
211.153	17	15C-1
211.154	15	15D-1
211.157	16	15D-2
211.158	15	15D-3
211.159	15	15D-4
211.166	15	15D-6
211.167	17	15D-7
211.168	16	15D-8
211.169	16	15D-9
211.170	17	15D-10
211.171	27	15D-11
211.172	19	15D-12
211.173	17	15D-13
211.174	17	15D-14
211.185	19	15D-15
211.186	18	15D-18
211.163	18	15E-1
211.161	18	15E-3
211.162	18	15E-5

CHAPTER 15

FIGURES

Figure No.	Title	
15.2-1	MDNBR vs Time for MSIV Closure at Full Power	
15.2-2	Pressure vs Time for MSIV Closure and Loss of Feedwater Accidents	17
15.2-3	RCS Pressure vs Time for Design Turbine Trip	
15.2-4	Pressurizer Code Safety Valve Flowrate vs Time for the Design Turbine Trip	
15.2-5	RCS Pressure vs Time for Worst Case Loss of Feedwater Accident	
15.2-6	Pressurizer Code Safety Valve Flowrate for Worst Case Loss of Feedwater Accident	
15.2-7	RCS Pressure vs Time During Loss of Onsite AC Power Accident	19
15.2-8	Pressurizer Code Safety Valve Flowrate vs Time During Loss of Onsite AC Power Accident	
15.2-9	RCS Pressure vs Time During Worst Case Continuous Rod Withdrawal Accident	
15.2-10	Pressurizer Code Safety Valve Flowrate vs Time During Worst Case Rod Withdrawal Accident	
15.6-1	Thermal Hydraulic Transient Analysis Transient Conditions - 0.04 Ft^2 Break	
15.5-2	Thermal Hydraulic Transient Analysis Hot Unit Channel Resutls - 0.04 Ft^2 Break	10

Question 211.171 (15D)

Describe how the pressure drop and coolant flow rates through the hot channel were obtained and used in the RADAR code.

15

Response

The RADAR code will be used in evaluating the MDNBR following steam line break considering the transient power peaking that was requested in Question 211.166. Detailed responses to this question will be provided in conjunction with the response to Question 211.166, to be provided by amendment.

16
27

Question 211.172 (15D)

In addition to the total time dependent reactivity feedback, provide each component of reactivity feedback (Moderator, Doppler, rod worth, boron injection). 15

Response

The reactivity feedback breakdown as a function of time is provided for the 33.5 inch double ended rupture (DER), beginning of life (BOL), DNB case in Table 15D-14 where the breakdown of reactivity components is of interest. For the overcooling cases where minimum subcritical margin (shown in Figure 15D-3) is of interest, Tables 15D-6 and 15D-12A provide a breakdown of the reactivity components of moderator, Doppler, rod worth, and boron injection at the time of the occurrence of the minimum subcritical margin for break area and single failures, respectively. 17 19 17 19

SITE EMERGENCY PLAN

CONTENTS

NRC Question No.	Revision No.	Q&R Page No.
432.15	18	3.0-1
432.16	18	4.0-1
432.24	15	4.0-3
432.27	15	4.0-4
432.33	18	4.0-5
432.8	9	5.0-1
432.17	16	5.0-2
432.18	19	5.0-4
432.19	15	5.0-5
432.31	15	5.0-6
432.34	18	5.0-8
432.7	9	5.1-1
432.28	18	5.2-1
432.20	18	5.3-1
432.10	9	5.4-1
432.32	16	5.4-2
432.22	18	5.4-5
432.3	18	5.4-6
432.25	15	6.0-1
432.1	18	6.0-2
432.9	18	6.1-1
432.23	18	6.1-2
432.35	18	6.1-3
432.11	27	6.4-1
432.12	15	6.4-2
432.26	15	6.4-3
432.29	18	6.4-4
432.4	18	6.4-5
432.13	9	8.1-1
432.30	15	8.1-2
432.5	18	8.1-3
432.14	9	8.2-1
432.21	16	A-1
432.2	18	C-1
432.6	18	D-1

LIST OF EFFECTIVE PAGES

This list of Effective Pages identifies those text pages and figures that are currently effective in the Emergency Plan.

Page or Figure No.	Issue
i	Rev. 27
ii	Rev. 18
iii	Rev. 18
iv	Rev. 18
v	Rev. 18
LOEP-1	Rev. 27
LOEP-2	Rev. 25
LOEP-3	Rev. 26
LOEP-4	Rev. 27
Chapter 1 Tab	Rev. 5
1-1	Rev. 18
1-2	Rev. 18
Fig. 1-1	Rev. 5
Chapter 2 Tab	Rev. 5
2-1	Rev. 18
Chapter 3 Tab	Rev. 5
3-1	Rev. 18
3-2	Rev. 18
Chapter 4 Tab	Rev. 5
4-1	Rev. 18
4-2	Rev. 18
4-3	Rev. 18
4-4	Rev. 18
4-5	Rev. 18
4-6	Rev. 18
4-7	Rev. 18
4-8	Rev. 18
4-9	Rev. 18
4-10	Rev. 18
4-11	Rev. 18
Chapter 5 Tab	Rev. 15
5-1	Rev. 18
5-2	Rev. 18
5-3	Rev. 18
5-4	Rev. 18
5-5	Rev. 18
5-6	Rev. 18
5-7	Rev. 18
5-8	Rev. 18
5-9	Rev. 18
5-10	Rev. 18
5-11	Rev. 18
5-12	Rev. 18

5-13	Rev. 18
5-14	Rev. 18
5-15	Rev. 18
Fig. 5-1	Rev. 16
Fig. 5-2	Rev. 5
Fig. 5-3	Rev. 9
Fig. 5-4	Rev. 18
Chapter 6 Tab	Rev. 5
6-1	Rev. 18
6-2	Rev. 18
6-3	Rev. 18
6-4	Rev. 18
6-5	Rev. 18
6-6	Rev. 18
6-7	Rev. 18
6-8	Rev. 18
6-9	Rev. 18
6-10	Rev. 18
6-11	Rev. 18
6-12	Rev. 18
6-13	Rev. 18
6-14	Rev. 18
6-15	Rev. 18
6-16	Rev. 18
6-17	Rev. 18
6-18	Rev. 18
6-18a	Rev. 18
6-18b	Rev. 18
6-19	Rev. 18
6-20	Rev. 18
6-21	Rev. 18
TBL 6-1	
Sheet 1	Rev. 18
Sheet 2	Rev. 18
TBL 6-2	Rev. 18
Chapter 7 Tab	Rev. 5
7-1	Rev. 18
7-2	Rev. 18
7-3	Rev. 25
7-4	Rev. 25
7-5	Rev. 18
Chapter 8 Tab	Rev. 5
8-1	Rev. 18
8-2	Rev. 18
8-3	Rev. 18
8-4	Rev. 25
TBL 8-1	Rev. 18
Chapter 9 Tab	Rev. 5
9-1	Rev. 18
9-2	Rev. 18
Appendixes	

App A Tab	Rev. 5
A-i	Rev. 5
A-1	Rev. 5
A-2	Rev. 5
A-3	Rev. 5
A-4	Rev. 5
A-5	Rev. 5
A-6	Rev. 5
A-7	Rev. 5
A-8	Rev. 5
A-9	Rev. 9
A-10	Rev. 9
A-11	Rev. 17
A-12	Rev. 17
A-13	Rev. 5
A-14	Rev. 16
A-15	Rev. 16
A-16	Rev. 16
A-17	Rev. 16
A-18	Rev. 16
A-19	Rev. 16
App B Tab	Rev. 5
B-i	Rev. 5
B-1	Rev. 5
B-2	Rev. 5
B-3	Rev. 5
B-4	Rev. 5
B-5	Rev. 5
App C Tab	Rev. 5
C-i	Rev. 5
C-1	Rev. 18
C-2	Rev. 5
C-3	Rev. 16
C-4	Rev. 16
C-5	Rev. 5
TBL C-1	
Sheet 1	Rev. 18
Sheet 2	Rev. 18
Sheet 3	Rev. 18
Fig. C-1	Rev. 26
Fig. C-2	Rev. 26
Fig. C-3	Rev. 26
App D Tab	Rev. 5
D-i	Rev. 5
D-1	Rev. 5
Fig. D-1	Rev. 5
Fig. D-2	Rev. 5
App E Tab	Rev. 5
E-i	Rev. 25
E-1	Rev. 18
E-2	Rev. 18

F-1	Rev. 18
F-2	Rev. 18
SEP Q&R Tab	Rev. 9
i	Rev. 27
3.0-1	Rev. 18
4.0-1	Rev. 18
4.0-2	Rev. 18
4.0-3	Rev. 15
4.0-4	Rev. 15
4.0-5	Rev. 18
4.0-6	Rev. 18
5.0-1	Rev. 9
5.0-2	Rev. 15
5.0-3	Rev. 16
5.0-4	Rev. 19
5.0-5	Rev. 15
5.0-6	Rev. 15
5.0-7	Rev. 15
5.0-8	Rev. 18
5.1-1	Rev. 9
5.1-2	Rev. 15
5.2-1	Rev. 18
5.3-1	Rev. 18
5.4-1	Rev. 9
5.4-2	Rev. 16
5.4-3	Rev. 16
5.4-4	Rev. 16
5.4-5	Rev. 18
5.4-6	Rev. 18
5.4-7	Rev. 18
6.0-1	Rev. 15
6.0-2	Rev. 18
6.1-1	Rev. 26
6.1-2	Rev. 18
6.1-3	Rev. 18
6.4-1	Rev. 27
6.4-2	Rev. 15
6.4-3	Rev. 15
6.4-4	Rev. 18
6.4-5	Rev. 18
8.1-1	Rev. 9
8.1-2	Rev. 15
8.1-3	Rev. 18
8.2-1	Rev. 9
A-1	Rev. 16
C-1	Rev. 18
D-1	Rev. 18

Question 432.11 (SEP 6.4.1)

Amend Subsection 6.4.1 of the SEP in response to the following items:

a. State whether or not the Midland City Police has jurisdiction over the offsite areas included in the evacuation and take cover plans. If more than one agency has jurisdiction, indicate how they will coordinate their efforts.

b. State whether those agencies involved in Item (a) have been given authority to begin protective measures, e.g., evacuation, without the need for obtaining approval from any other agency. 9

c. Your plan states that the emergency response and evacuation plans of offsite State and local agencies will be added to the appendix of the site emergency plan. Provide these plans or indicate their status and provide a schedule for when they will be made a part of the docket record.

d. Discuss the offsite agencies' plans involving areas beyond the LPZ.

Response

Subsection 6.4.1b has been revised in response to parts a, b, and d. Response to part c is as follows:

Emergency plans of offsite local agencies are still not complete as of this date. Midland City and County authorities are meeting as a task force to establish lines of authority and responsibility and agency assignment. After this first stage is accomplished, plan writing will begin. The state has prepared its response to Fixed Nuclear Facilities Emergency Planning. The response was submitted to the NRC in late 1979. 27 14 26

Additional information regarding this question was previously submitted in response to Question 432.3(13.3.4) in Revision 3 of the FSAR. 9

Question 432.12 (SEP 6.4.2, 3A)

With respect to respiratory protection, Section C.4.c of Regulatory Guide 1.95 discusses provisions for an offsite supply of bottled air. Amend Section 6.4.2 of the SEP to address this offsite supply. 9

Response

Subsection 6.4.2 of the SEP has been revised in response to this question. 15

Instructions

For Inserting and Removing Revision 27 of the P&IDs

REMOVE	INSERT
M-400 sh 1, 2, 3	M-400 sh 1, 2, 3
M-403 sh 1B, 2B	M-403 sh 1B, 2B
M-404 sh 1B	M-404 sh 1B
M-406 sh 1,2,3,4	M-406 sh 1,2,3,4
M-407 sh 2A, 2B, 4	M-407 sh 2A, 2B, 4
M-408 sh 1,3B,4A,4B,5,6	M-408 sh 1,3B,4A,4B,5,6
M-409A, B	M-409A, B
M-412 sh A, B	M-412 sh A, B
M-413 sh A, B	M-413 sh A, B
M-414 sh A	M-414 sh A
M-420 sh 1B	M-420 sh 1B
M-428 sh A,B,C	M-428 sh A,B,C
M-430 sh 1A, 1B	M-430 sh 1A, 1B
M-431 sh 2	M-431 sh 2A, 2B
M-432 sh 2	M-432 sh 2A, 2B
M-438 sh 3A, 3B	M-438 sh 3A, 3B
M-439 sh 2A,2B,3A,3B	M-439 sh 2A,2B,3A,3B
M-448 sh 1	M-448 sh 1
M-449 sh 1A,1B	M-449 sh 1A,1B
M-452A, B	M-452A, B
M-453	M-453
M-456 sh 2A,2B,3A	M-456 sh 2A,2B,3A
M-457 sh 2A,2B,4,5B,6	M-457 sh 2A,2B,4A,4B,5B,6
------	M-458 sh 1C, 2

REMOVE	INSERT
M-460 sh 4	M-460 sh 4
M-461 sh 1, 2, 6	M-461 sh 1A,1B,2A,2B,6
M-462	M-462
M-464	M-464
M-466	M-466
M-468 sh 1, 3	M-468 sh 1, 3A, 3B

SUPPLEMENTAL REFERENCE DRAWINGS

Piping and Instrumentation Diagrams

These drawings are in accordance with Midland's FSAR Revision 25.

Bechtel Dwg No.	FSAR Fig No.	FSAR Figure Title	Rev
M-400 Sh 1	1.1-1	Piping and Instrumentation Diagram Legend	3
M-400 Sh 2	1.1-2	Piping and Instrumentation Diagram Legend	3
M-400 Sh 3	1.1-3	Piping and Instrumentation Diagram Legend	4
M-401	5.1-1	Reactor Coolant and Pressure Control - Unit 1	4
M-401A	5.1-1 Sh 1	Reactor Coolant and Pressure Control - Unit 1	0
M-401B	5.1-1 Sh 2	Reactor Coolant and Pressure Control - Unit 1	0
M-402	5.1-2	Reactor Coolant and Pressure Control - Unit 2	4
M-402A	5.1-2 Sh 1	Reactor Coolant and Pressure Control - Unit 2	0
M-402B	5.1-2 Sh 2	Reactor Coolant and Pressure Control - Unit 2	0
M-403 Sh 1A	9.3-31 Sh 1	Makeup and Purification - Unit 1	1
M-403 Sh 1B	9.3-31 Sh 2	Makeup and Purification - Unit 2	1
M-403 Sh 2A	9.3-32 Sh 1	Makeup and Purification - Unit 1	0
M-403 Sh 2B	9.3-32 Sh 2	Makeup and Purification - Unit 1	1
M-404 Sh 1A	9.3-33 Sh 1	Makeup and Purification - Unit 2	1
M-404 Sh 1B	9.3-33 Sh 2	Makeup and Purification - Unit 2	1

Piping and Instrumentation Diagrams (continued)

Bechtel Dwg No.	FSAR Fig No.	FSAR Figure Title	Rev
M-404 Sh 2A	9.3-34 Sh 1	Makeup and Purification - Unit 2	0
M-404 Sh 2B	9.3-34 Sh 2	Makeup and Purification - Unit 2	0
M-405 Sh A	9.3-40 Sh 1	Reactor Coolant Addition - Units 1 & 2	0
M-405 Sh B	9.3-40 Sh 2	Reactor Coolant Addition - Units 1 & 2	0
M-406 Sh 1	9.3-3	Reactor Plant Sample System	4
M-406 Sh 2	9.3-4	Reactor Plant Sample System	4
M-406 Sh 3	9.3-5	Reactor Plant Sample System	4
M-406 Sh 4	9.3-6	Reactor Plant Sample System	4
M-407 Sh 1A	11.2-1 Sh 1	Liquid Waste - Units 1 & 2	0
M-407 Sh 1B	11.2-1 Sh 2	Liquid Waste - Units 1 & 2	0
M-407 Sh 2A	11.2-2 Sh 1	Liquid Waste - Units 1 & 2	1
M-407 Sh 2B	11.2-2 Sh 2	Liquid Waste - Units 1 & 2	1
M-407 Sh 3A	11.2-3 Sh 1	Liquid Waste - Units 1 & 2	0
M-407 Sh 3B	11.2-3 Sh 2	Liquid Waste - Units 1 & 2	0
M-407 Sh 4	11.2-3A	Radwaste Pump Seal Water System - Units 1 & 2	1
M-408 Sh 1	9.3-35	Boron Recovery - Units 1 & 2	7
M-408 Sh 2A	9.3-36 Sh 1	Boron Recovery - Units 1 & 2	0

Piping and Instrumentation Diagrams (continued)

Bechtel Dwg No.	FSAR Fig No.	FSAR Figure Title	Rev
M-408 Sh 2B	9.3-36 Sh 2	Boron Recovery - Units 1 & 2	0
M-408 Sh 3A	9.3-37 Sh 1	Boron Recovery - Units 1 & 2	0
M-408 Sh 3B	9.3-37 Sh 2	Boron Recovery - Units 1 & 2	1
M-408 Sh 4A	9.3-38	Boron Recovery - Units 1 & 2 Sh 1	1
M-408 Sh 4B	9.3-38 Sh 2	Boron Recovery - Units 1 & 2	1
M-408 Sh 5	9.3-18	Boron Recovery - Units 1 & 2 Riser Diagram	7
M-408 Sh 6	9.3-19	Boron Recovery - Units 1 & 2 Riser Diagram	7
M-409A	11.3-2 Sh 1	Radwaste Gas - Units 1 & 2	1
M-409B	11.3-2 Sh 2	Radwaste Gas - Units 1 & 2	1
M-410	5.4-10	Decay Heat Removal and Core Flooding - Unit 1	9
M-411	5.4-11	Decay Heat Removal and Core Flooding - Unit 2	9
M-412 Sh A	6.2-51 Sh 1	Reactor Building Spray - Unit 1	1
M-412 Sh B	6.2-51 Sh 2	Reactor Building Spray - Unit 1	1
M-413 Sh A	6.2-52 Sh 1	Reactor Building Spray - Unit 2	1
M-413 Sh B	6.2-52 Sh 2	Reactor Building Spray - Unit 2	1

Piping and Instrumentation Diagrams (continued)

Bechtel Dwg No.	FSAR Fig No.	FSAR Figure Title	Rev
M-414 Sh A	9.1-1 Sh 1	Fuel Pool Cooling and Purification	1
M-414 Sh B	9.1-1 Sh 2	Fuel Pool Cooling and Purification	0
M-416 Sh 1A	9.2-7 Sh 1	Component Cooling Water - Unit 1	0
M-416 Sh 1B	9.2-7 Sh 2	Component Cooling Water - Unit 1	0
M-416 Sh 2A	9.2-8 Sh 1	Component Cooling Water - Unit 1	0
M-416 Sh 2B	9.2-8 Sh 2	Component Cooling Water - Unit 1	0
M-417 Sh 1A	9.2-9 Sh 1	Component Cooling Water - Unit 2	0
M-417 Sh 1B	9.2-9 Sh 2	Component Cooling Water - Unit 2	0
M-417 Sh 2A	9.2-10 Sh 1	Component Cooling Water - Unit 2	0
M-417 Sh 2B	9.2-10 Sh 2	Component Cooling Water - Unit 2	0
M-418 Sh A	9.2-2 Sh 1	Service Water Cooling Tower and Pump Structures - Units 1 & 2	0
M-418 Sh B	9.2-2 Sh 2	Service Water Cooling Tower and Pump Structures - Units 1 & 2	0
M-419 Sh A	9.2-3 Sh 1	Service Water Reactor and Auxiliary Building - Units 1 & 2	0
M-419 Sh B	9.2-3 Sh 2	Service Water Reactor and Auxiliary Building - Units 1 & 2	0
M-420 Sh 1A	9.2-4 Sh 1	Service Water Turbine Building - Units 1 & 2	7
M-420 Sh 1B	9.2-4 Sh 2	Service Water Turbine Building - Units 1 & 2	1

Piping and Instrumentation Diagrams (continued)

Bechtel Dwg No.	FSAR Fig No.	FSAR Figure Title	Rev
M-420 Sh 2	9.2-5	Service Water Turbine Building - Units 1 & 2	7
M-421 Sh 1	6.8-3	Reactor Building Penetration Pressurization - Unit 1	1
M-421 Sh 2	6.8-4	Reactor Building Penetration Pressurization - Unit 1	1
M-421 Sh 3	6.8-5	Reactor Building Penetration Pressurization - Unit 1	1
M-422 Sh 1	6.8-6	Reactor Building Penetration Pressurization - Unit 2	1
M-422 Sh 2	6.8-7	Reactor Building Penetration Pressurization - Unit 2	1
M-422 Sh 3	6.8-8	Reactor Building Penetration Pressurization - Unit 2	1
M-423	3.9-4	CCW and CRDM Interface - Unit 1	6
M-425 Sh 1	11.4-1	Solid Waste System	2
M-425 Sh 2	11.4-2 Sh 1	Solid Waste System	2
M-425 Sh 3	11.4-2 Sh 2	Solid Waste System	1
M-425 Sh 4	11.4-2 Sh 3	Solid Waste System	1
M-425 Sh 5	11.4-2 Sh 4	Solid Waste System	1
M-426	9.3-39	Boric Acid Evaporator	5
M-427	11.2-4	Liquid Waste Evaporator	5
M-428 Sh A	9.2-11 Sh 1	Makeup Demineralizer	1
M-428 Sh B	9.2-11 Sh 2	Makeup Demineralizer	1

Piping and Instrumentation Diagrams (continued)

Bechtel Dwg No.	FSAR Fig No.	FSAR Figure Title	Rev
M-428 Sh C	9.2-11 Sh 3	Makeup Demineralizer	1
M-429 Sh 1	9.3-15	Evaporator Plant Sample System	2
M-429 Sh 2	9.3-16	Evaporator Plant Sample System	2
M-429 Sh 3	9.3-17	Evaporator Plant Sample System	2
M-429 Sh 4	9.3-17A	Evaporator Plant Sample System	1
M-430 Sh 1A	10.4-26 Sh 1	Auxiliary Steam Boiler System	1
M-430 Sh 1B	10.4-26 Sh 2	Auxiliary Steam Boiler System	1
M-430 Sh 2	10.4-27	Auxiliary Steam Boiler System	2
M-430 Sh 3A	10.4-28 Sh 1	Auxiliary Steam Boiler System	0
M-430 Sh 3B	10-4-28 Sh 2	Auxiliary Steam Boiler System	0
M-431 Sh 1A	10.3-1 Sh 1	Main Steam Supply System - Unit 1	0
M-431 Sh 1B	10.3-1 Sh 2	Main Steam Supply System - Unit 1	0
M-431 Sh 2A	10.3-2 Sh 1	Main Steam Supply System - Unit 1	0
M-431 Sh 2B	10.3-2 Sh 2	Main Steam Supply System - Unit 1	0
M-432 Sh 1A	10.3-3 Sh 1	Main Steam Supply System - Unit 2	0
M-432 Sh 1B	10.3-3 Sh 2	Main Steam Supply System - Unit 2	0
M-432 Sh 2A	10.3-4 Sh 1	Main Steam Supply System - Unit 2	0

Piping and Instrumentation Diagrams (continued)

Bechtel Dwg No.	FSAR Fig No.	FSAR Figure Title	Rev
M-432 Sh 2B	10.3-4 Sh 2	Main Steam Supply System - Unit 2	0
M-433A	10.4-1 Sh 1	Auxiliary Steam System - Unit 1	0
M-433B	10.4-1 Sh 2	Auxiliary Steam System - Unit 1	0
M-434A	10.4-2 Sh 1	Auxiliary Steam System - Unit 2	0
M-434B	10.4-2 Sh 2	Auxiliary Steam System - Unit 2	0
M-436 Sh 1A	10.2-1 Sh 1	Turbine Extraction, Heater Vents and Drains - Unit 1	0
M-436 Sh 1B	10.2-1 Sh 2	Turbine Extraction, Heater Vents and Drains - Unit 1	0
M-436 Sh 2A	10.2-2 Sh 1	Turbine Extraction, Heater Vents and Drains - Unit 1	0
M-436 Sh 2B	10.2-2 Sh 2	Turbine Extraction, Heater Vents and Drains - Unit 1	0
M-437 Sh 1A	10.2-3 Sh 1	Turbine Extraction, Heater Vents and Drains - Unit 2	0
M-437 Sh 1B	10.2-3 Sh 2	Turbine Extraction, Heater Vents and Drains - Unit 2	0
M-437 Sh 2A	10.2-4 Sh 1	Turbine Extraction, Heater Vents and Drains - Unit 2	0
M-437 Sh 2B	10.2-4 Sh 2	Turbine Extraction, Heater Vents and Drains - Unit 2	0
M-438 Sh 1A	10.4-8 Sh 1	Condensate and Feedwater System - Unit 1	0
438 Sh 1B	10.4-8 Sh 2	Condensate and Feedwater System - Unit 1	0
M-438 Sh 2A	10.4-9 Sh 1	Condensate and Feedwater System - Unit 1	0

Piping and Instrumentation Diagrams (continued)

Bechtel Dwg No.	FSAR Fig No.	FSAR Figure Title	Rev
M-438 Sh 2B	10.4-9 Sh 2	Condensate and Feedwater System - Unit 1	0
M-438 Sh 3A	10.4-10 Sh 1	Condensate and Feedwater System - Unit 1	1
M-438 Sh 3B	10.4-10 Sh 2	Condensate and Feedwater System - Unit 1	1
M-438 Sh 4	10.4-10 Sh 3	Condensate and Feedwater System - Unit 1	0
M-439 Sh 1A	10.4-11 Sh 1	Condensate and Feedwater System - Unit 2	0
M-439 Sh 1B	10.4-11 Sh 2	Condensate and Feedwater System - Unit 2	0
M-439 Sh 2A	10.4-12 Sh 1	Condensate and Feedwater System - Unit 2	1
M-439 Sh 2B	10.4-12 Sh 2	Condensate and Feedwater System - Unit 2	1
M-439 Sh 3A	10.4-13 Sh 1	Condensate and Feedwater System - Unit 2	1
M-439 Sh 3B	10.4-13 Sh 2	Condensate and Feedwater System - Unit 2	1
M-439 Sh 4	10.4-13 Sh 3	Condensate and Feedwater System - Unit 2	0
M-440A	10.4-4 Sh 1	Condensate Demineralizer System - Unit 1	0
M-440B	10.4-4 Sh 2	Condensate Demineralizer System - Unit 1	0
M-441A	10.4-5 Sh 1	Condensate Demineralizer System - Unit 1	0
M-411B	10.4-5 Sh 2	Condensate Demineralizer System - Unit 1	0
M-442	10.4-6 Sh 1	Condensate Demineralizer System - Unit 2	0

Piping and Instrumentation Diagrams (continued)

Bechtel Dwg No.	FSAR Fig No.	FSAR Figure Title	Rev
M-442B	10.4-6 Sh 2	Condensate Demineralizer System - Unit 2	0
M-443A	10.4-7 Sh 1	Condensate Demineralizer System - Unit 2	0
M-443B	10.4-7 Sh 2	Condensate Demineralizer System - Unit 2	0
M-444 Sh A	10.4-25 Sh 1	Feedwater Chemical Addition System	0
M-444 Sh B	10.4-25 Sh 2	Feedwater Chemical Addition System	0
M-445 Sh 1	9.3-7	Steam Plant Sample System	2
M-445 Sh 2	9.3-8	Steam Plant Sample System	2
M-445 Sh 3	9.3-9	Steam Plant Sample System	2
M-445 Sh 4	9.3-10	Steam Plant Sample System	2
M-445 Sh 5	9.3-11	Steam Plant Sample System	2
M-445 Sh 6	9.3-12	Steam Plant Sample System	2
M-445 Sh 7	9.3-13	Steam Plant Sample System	2
M-445 Sh 8	9.3-14	Steam Plant Sample System	2
M-446A	10.4-3 Sh 1	Circulating Demineralizer - Units 1 & 2	0
M-446B	10.4-3 Sh 2	Circulating Demineralizer - Units 1 & 2	0
M-448 Sh 1	9.3-1	Instrument and Service Air	6
M-448 Sh 2	9.3-2	Instrument and Service Air	8
M-449 Sh 1A	9.2-18 Sh 1	Plant Water Storage and Transfer	1
M-449 Sh 1B	9.2-18 Sh 2	Plant Water Storage and Transfer	1

Piping and Instrumentation Diagrams (continued)

Bechtel Dwg No.	FSAR Fig No.	FSAR Figure Title	Rev
M-449 Sh 2	9.2-19	Plant Water Storage and Transfer	4
M-452A	9.2-25 Sh 1	Emergency Diesel Engine Oil Storage and Transfer System	1
M-452B	9.2-25 Sh 2	Emergency Diesel Engine Oil Storage and Transfer System	1
M-453	9.4-10	HVAC Auxiliary Building Units 1 & 2	6
M-454 Sh 1	9.4-3	HVAC Auxiliary Building Units 1 & 2	5
M-454 Sh 2	9.4-4	HVAC Auxiliary Building Units 1 & 2	2
M-454 Sh 3	9.4-5	HVAC Auxiliary Building Units 1 & 2	3
M-454 Sh 4	9.4-6	HVAC Auxiliary Building Units 1 & 2	1
M-454 Sh 5	9.4-7	HVAC Auxiliary Building Units 1 & 2	5
M-455 Sh 1	9.4-8	HVAC Turbine Building Unit 1	2
M-455 Sh 2	9.4-9	HVAC Turbine Building Unit 2	2
M-456 Sh 1A	9.4-13 Sh 1	Plant Heating Turbine Building	0
M-456 Sh 1B	9.4-13 Sh 2	Plant Heating Turbine Building	0
M-456 Sh 1C	9.4-13 Sh 3	Plant Heating Turbine Building	0
M-456 Sh 2A	9.4-14 Sh 1	Plant Heating Turbine Building	1
M-456 Sh 2B	9.4-14 Sh 2	Plant Heating Turbine Building	1
M-456 Sh 3A	9.4-15A	Plant Heating Office and Service Buildings	1
M-456 Sh 3B	9.4-15B	Plant Heating Office and Service Buildings	0
M-456 Sh 4	9.4-16	Plant Heating Miscellaneous Structures	3

Piping and Instrumentation Diagrams (continued)

Bechtel Dwg No.	FSAR Fig No.	FSAR Figure Title	Rev
M-457 Sh 1A	9.2-20 Sh 1	Chilled Water Auxiliary Building	0
M-457 Sh 1B	9.2-20 Sh 2	Chilled Water Auxiliary Building	0
M-457 Sh 2A	9.2-2 Sh 1	Chilled Water Safeguard Equipment Unit 2	2
M-457 Sh 2B	9.2-2 Sh 2	Chilled Water Safeguard Equipment Unit 2	2
M-457 Sh 3A	9.2-25 Sh 1	Chilled Water Safeguard Equipment Unit 2	1
M-457 Sh 3B	9.2-25 Sh 2	Chilled Water Safeguard Equipment Unit 2	1
M-457 Sh 4A	9.2-21 Sh 1	Chilled Water Turbine Building Unit 1	0
M-457 Sh 4B	9.2-21 Sh 2	Chilled Water Turbine Building Unit 1	0
M-457 Sh 5A	9.2-22 Sh 1	Chilled Water Turbine Building Unit 2	1
M-457 Sh 5B	9.2-22B	Chilled Water Turbine Building Unit 2	0
M-457 Sh 6	9.2-23	Chilled Water Office and Service Buildings	5
M-458 Sh 1A	9A-30 Sh 1	Fir Protection	0
M-458 Sh 1B	9A-30 Sh 2	Fire Protection	0
M-458 Sh 1C	9A-30 Sh 3	Fire Protection	0
M-458 Sh 2	9A-30 Sh 4	Fire Protection	3
M-459 Sh 1A	9.2-12 Sh 1	Domestic Water	0

Piping and Instrumentation Diagrams (continued)

Bechtel Dwg No.	FSAR Fig No.	FSAR Figure Title	Rev
M-459 Sh 1B	9.2-12 Sh 2	Domestic Water	0
M-459 Sh 2	9.2-12 Sh 3	Domestic Water	2
M-459 Sh 3	9.2-12 Sh 4	Domestic Water	2
M-460 Sh 1	10.4-20	Process Steam, Supply and Return System	4
M-460 Sh 2A	10.4-21 Sh 1	Process Steam, Supply and Return System	0
M-460 Sh 2B	10.4-21 Sh 2	Process Steam, Supply and Return System	0
M-460 Sh 3A	10.4-22 Sh 1	Process Steam, Supply and Return System	0
M-460 Sh 3B	10.4-22 Sh 2	Process Steam, Supply and Return System	0
M-460 Sh 4	10.4-22A	Process Steam, Supply and Return System	3
M-461 Sh 1A	10.4-14 Sh 1	Process Steam Evaporator System	0
M-461 Sh 1B	10.4-14 Sh 2	Process Steam Evaporator System	0
M-461 Sh 2A	10.4-15 Sh 1	Process Steam Evaporator System	0
M-461 Sh 2B	10.4-15 Sh 2	Process Steam Evaporator System	0
M-461 Sh 3	10.4-16	Process Steam Evaporator System	3
M-461 Sh 4	10.4-17	Process Steam Evaporator System	3
M-461 Sh 5	10.4-18	Process Steam Evaporator System	3
M-461 Sh 6	10.4-19	Process Steam Evaporator System	4
M-461 Sh 7	10.4-19 Sh 1	Process Steam Evaporator System	1

Piping and Instrumentation Diagrams (continued)

Bechtel Dwg No.	FSAR Fig No.	FSAR Figure Title	Rev
M-461 Sh 8	10.4-19 Sh 2	Process Steam Evaporator System	0
M-462	9.4-10A	HVAC - Reactor Building	6
M-463 Sh 1A	9.3-41 Sh 1	Miscellaneous Gas System Hydrogen Supply	0
M-463 Sh 1B	9.3-41 Sh 2	Miscellaneous Gas System Hydrogen Supply	0
M-463 Sh 2A	9.3-43 Sh 1	Miscellaneous Gas System Carbon Dioxide Supply	0
M-463 Sh 2B	9.3-43 Sh 2	Miscellaneous Gas System Carbon Dioxide Supply	0
M-463 Sh 3	9.3-42	Miscellaneous Gas System Nitrogen Supply	2
M-464	10.4-24	Cooling Pond Blowdown and Makeup System	5
M-465 Sh 1	9.4-1	HVAC-Control Room-Battery Room-Switchgear and Cable Spreading Room	4
M-465 Sh 2	9.4-2	HVAC-Control Room-Battery Room-Switchgear and Cable Spreading Room	4
M-466	9.4-12	HVAC Access Control and Computer Area	4
M-467 Sh 1	9.4-17	HVAC Office and Service Buildings	1
M-467 Sh 2	9.4-18	HVAC Office and Service Buildings	1
M-467 Sh 3	9.4-18A	HVAC Office and Service Buildings	1
M-468 Sh 1	9.4-11	HVAC Diesel Generator Building and Service Water Pump Structure	3
M-468 Sh 2	9.4-20	Miscellaneous Structures HVAC	2
M-468 Sh 3A	9.4-19 Sh 1	Miscellaneous Building HVAC System Evapoarator and Auxiliary Boiler Building	0

Piping and Instrumentation Diagrams (continued)

Bechtel Dwg No.	FSAR Fig No.	FSAR Figure Title	Rev
M-468 Sh 3B	9.4-19 Sh 2	Miscellaneous Building HVAC System Evaporator and Auxiliary Boiler Building	0
M-468 Sh 4	9.4-21	Miscellaneous Structure HVAC (Guard House)	1
M-468 Sh 5	9.4-22	Miscellaneous Structures HVAC	1
M-469A	9.3-39 Sh 1	Boron Recovery Degasifier	0
M-469B	9.3-39 Sh 2	Boron Recovery Degasifier	0
M-470 Sh 1A	9.5-30 Sh 1	Chemical and Oily Waste System	0
M-470 Sh 1B	9.5-30 Sh 2	Chemical and Oily Waste System	0
M-470 Sh 2A	9.5-29 Sh 1	Chemical Waste System	0
M-470 Sh 2B	9.5-29 Sh 2	Chemical Waste System	0
M-472 Sh 1	6.2-119	Miscellaneous Instrumentation Reactor Building - Unit 1	0
M-472 Sh 2	6.2-120	Miscellaneous Instrumentation Reactor Building - Unit 2	0

TABLE 1.7-2

BOP LOGIC DIAGRAMS, ELECTRICAL AUXILIARY DISTRIBUTION SYSTEM

Drawing No.	Rev.	Date	Title	Remarks	
J-870	1	10-04-78	480V MCC Feeder Breaker to Battery Chargers	Ref FSAR 8.3.1.1.9	18
J-873-1	2	08-29-78	Class 1E 4.16kV Bus Incoming Breakers	Ref FSAR 8.3.1.1.9	14
J-873-2	2	08-29-78	Class 1E 4.16kV Bus Incoming Breakers	Ref FSAR 8.3.1.1.9	14
J-874	1	09-22-78	Class 1E 480V Bus Incoming Breakers	Ref FSAR 8.3.1.1.9	18
J-877-1	1	02-09-79	Diesel Generator Breakers	Ref FSAR 8.3.1.1.9 and Figure 8.3-43	19
J-877-2	0	02-09-79	Diesel Generator Breakers	Ref FSAR 8.3.1.1.9 and Figure 8.3-44	
J-878-1	2	11-19-79	6.9 and 4.16kV Bus Undervoltage Relays	Ref FSAR 8.3.1.1.9	27
J-878-2	2	11-19-79	6.9 and 4.16kV Bus Undervoltage Relays	Ref FSAR 8.3.1.1.9	27
J-879-1	0	02-09-79	Diesel Generator	Ref FSAR 8.3 and Figure 8.3-45	
J-879-2	0	02-09-79	Diesel Generator	Ref FSAR 8.3 and Figure 8.3-46	
J-879-3	0	02-09-79	Diesel Generator	Ref FSAR 8.3 and Figure 8.3-47	19
J-879-4	0	02-09-79	Diesel Generator	Ref FSAR 8.3 and Figure 8.3-48	
J-879-5	0	02-09-79	Diesel Generator	Ref FSAR 8.3.1.1.9 and Figure 8.3-45	

TABLE 1.7-2 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-879-6	0	02-09-79	Diesel Generator	Ref FSAR 8.3.1.1.9 and Figure 8.3-46	19
J-879-7	1	11-19-79	Diesel Generator	Ref FSAR 8.3.1.1.9 and Figure 8.3-47	27 19
J-879-8	1	11-19-79	Diesel Generator	Ref FSAR 8.3.1.1.9 and Figure 8.3-48	27 19
J-880	1	02-09-79	Diesel Generator Protection	Ref FSAR 8.3.1.1.9	
J-885-1	A	08-10-78	Safety-Related MCC and LC Relays	Ref FSAR 8.3.1.1.9	
J-885-2	A	08-10-78	Safety-Related MCC and LC Relays	Ref FSAR 8.3.1.1.9	
J-888-1	3	09-27-78	Class 1E 480V Load Center Feeder to 480V MCCs	Ref FSAR 8.3.1.1.9	
J-888-2	3	09-27-78	Class 1E 480V Load Center Feeder to 480V MCCs	Ref FSAR 8.3.1.1.9	18
J-890-1	4	09-20-78	Class 1E 4,160-480V Station Power Transformer Feeder Breaker	Ref FSAR 8.3.1.1.9	
J-890-2	4	09-20-78	Class 1E 4,160-480V Station Power Transformer Feeder Breaker	Ref FSAR 8.3.1.1.9	
J-891-1	1	09-27-78	Diesel Generator 480V MCC Incoming Breaker	Ref FSAR 8.3.1.1.9	
J-891-2	1	09-27-78	Diesel Generator 480V MCC Incoming Breaker	Ref FSAR 8.3.1.1.9	
J-891-3	1	09-27-78	Diesel Generator 480V MCC Incoming Breaker	Ref FSAR 8.3.1.1.9	

TABLE 1.7-3

BOP SINGLE LINE DIAGRAMS

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-001	5	08-14-79	Plant Single Line Diagram	Ref FSAR 8.3.1	
E-005	8	09-04-79	6,900 and 4,160V Systems, Unit 1	Ref FSAR 8.3.1	25
E-006	8	09-04-79	6,900 and 4,160V Systems, Unit 2	Ref FSAR 8.3.1	18
E-011	5	09-27-79	Class 1E 480V Load Centers, Unit 1	Ref FSAR 8.3.1	27 18
E-015	5	09-27-79	Class 1E 480V Load Centers, Unit 2	Ref FSAR 8.3.1	27 18
E-017	10	12-03-79	Class 1E 460V MCC Schedule, Unit 1	Ref FSAR 8.3.1	
1	7				
2	6				27
3	7				
4	6				
5	2				18
6	6				
7	5				21
8	7				
9	7				
9A	3				
10	6				
11	7				27
11A	3				
12	5				
13	4				
14	4				
15	4				
					21
E-018	10	12-03-79	Class 1E 460V MCC Schedule, Unit 2	Ref FSAR 8.3.1	
1	7				
2	6				27
3	7				
4	7				
5	2				18

TABLE 1.7-3 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
6	5				21
7	6				
8	6				
9	7				
10	7				
11	7				
11A	3				
12	4				
13	4				
14	5				
15	4				27
16	6				
17	4				
18	4				
19	4				
20	4				
21	4				
22	4				
23	4				
E-021	5	02-06-79	250 and 125Vdc Systems, Unit 1	Ref FSAR 8.3.2	19
E-022	5	02-06-79	250 and 125Vdc Systems, Unit 2	Ref FSAR 8.3.2	
E-023-1	4	09-26-79	120Vac Instrument and Preferred Systems, Unit 1	Ref FSAR 8.3.1	27 18
E-023-2	0	~~09~~-26-79	120Vac Instrument and Preferred Systems, Unit 1	Ref FSAR 8.3.1	27
E-024	4	09-26-79	120Vac Instrument and Preferred Systems, Unit 2	Ref FSAR 8.3.1	
E-025-1	3	06-11-79	Synchronizing Diagram	Ref FSAR 8.3.1.2	25
E-025-2	3	06-11-79	Synchronizing Diagram	Ref FSAR 8.3.1.2	

TABLE 1.7-3 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-031	8	02-07-80	120Vac Distribution Panels, Unit 1	Ref FSAR 8.3.1	
3	7				27
4	7				
5	7				
6	6				
7	7				25
8	7				
E-032	10	01-15-80	120Vac Distribution Panels, Unit 2 and Common	Ref FSAR 8.3.1	24
3	7				
4	6				
5	6				
6	7				
7	7				
8	7				
13	7				
14	7				
36	3				
37	2				
38	2				27
E-033	7	01-18-80	DC Distribution Panel Schedule	Ref FSAR 8.3.2	
6	5				
7	5				
12	5				
13	5				
17	2				
18	2				
19	2				
20	2				
E-034	2	02-02-79	Electrical Penetration Schedule	Ref FSAR 8.3.1	19

TABLE 1.7-3 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-035	9	02-21-80	480V Distribution Panel Schedule	Ref FSAR 8.3.1	
5	5				
6	5				
28	5				
29	5				
56	7				
57	7				
58	6				27
61	5				
62	5				
63	4				
69	1				
70	1				

TABLE 1.7-6

BOP SCHEMATIC DIAGRAMS, ELECTRICAL AUXILIARY DISTRIBUTION SYSTEM

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-071	2	08-03-79	Typical 6.9 and 4.16kV Circuit Breaker Internal Schematic	Ref FSAR 8.3.1.1.9	25
E-072	2	07-05-77	Typical 480V Circuit Breaker Internal Schematic	Ref FSAR 8.3.1.1.9	
1	2				18
2	2				
E-073	3	08-03-79	6.9 and 4.16kV Bus Incoming Breaker From Station Power Transformer	Ref FSAR 8.3.1.1.9	25
1	1				18
2	2				
3	3				25
4	2				
5	1				18
6	2				
7	3				25
8	1				18
9	2				
E-074	3	08-13-79	6.9 and 4.16kV Bus Incoming Breaker From Startup Transformer	Ref FSAR 8.3.1.1.9	25
1	2				18
2	2				
3	3				25
4	3				
5	1				18
6	2				
7	3				25
8	0				
8A	1				
9	0				18
10	1				

TABLE 1.7-6 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-075	4	05-16-79	6.9 and 4.16kV Bus Under-Voltage Relays	Ref FSAR 8.3.1.1.9, 8.3.1.2.4	25 18 19
4	3				
5	4				25
5A	0				
6	3				
7	2				
E-076	4	06-19-79	4,160-480V Station Power and CRD Transformer Feeder Breakers	Ref FSAR 8.3.1.1.9, 8.3.1.2.4	25 18
1	4				
4	3				
5	3				
6	3				25
7	3				
8	3				
9	3				
10	0				18
E-077	3	05-11-79	4.16kV Bus Incoming Breakers	Ref FSAR 8.3.1.1.9, 8.3.1.2.4	27 18
1	3				
2	2				25
2A	1				
3	1				
E-078	5	05-11-79	Diesel Generator Breakers	Ref FSAR 8.3.1.1.9, 8.3.1.2.4	25 18
1	3				
2	4				25
3	4				
4	4				

TABLE 1.7-6 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-080	6	08-03-79	460V MCC Feeder Breakers	Ref FSAR 8.3.1.1.9	
1	4				
2	3				
3	5				25
3A	3				
4	1				
5	2				
7	5				
E-081	3	12-21-78	Diesel Generator Protection	Ref FSAR 8.3.1.1.9, 8.3.1.2.4	
1	2				18
2	1				
3	3				
4	2				
E-082	4	05-22-79	480V Load Center Incoming Breakers	Ref FSAR 8.3.1.1.9	25
4	2				
5	3				21
6	4				
E-083	5	05-16-79	480V Load Center Feeder Breakers to 460V MCCs	Ref FSAR 8.3.1.1.9	25
4	5				
5	4				
6	4				21
7	3				
8	2				
E-091	2	08-13-79	6.9 and 4.16kV Bus Auto Transfer	Ref FSAR 8.3.1.1.9	25
E-097	4	07-13-79	Low Voltage AC Distribution Panels	Ref FSAR 8.3.1.1.9	25
1	2				21
2	3				25
3	2				21

TABLE 1.7-6 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-098	3	12-18-78	480V Feeder Breakers to Battery Chargers	Ref FSAR 8.3.1.1.9	18
1	2				
3	2				
4	3				

TABLE 1.7-9

BOP CONTROL BOARD AND PANEL ARRANGEMENT DRAWINGS

Drawing No.	Rev.	Date	Title	Remarks	
J-721	2	05-17-79	Control Board 0C10 ESFAS Status Display Arrangement	Ref FSAR 7.3.3.2, 7.5, Table 7.5-1, 9.4.1.2, 9.4.2.2, 9.4.8.2	27 2
J-722-1 & J-722-2	2	02-23-79	Control Board 1C14 ESFAS Status Display Arrangement	Ref FSAR 5.4.7.2, 6.2.2.1, 6.2.2.2, 6.2.4.2, 6.8.2.3, 7.3.3.2, 7.5, Table 7.5-1, 9.1.3.2, 9.2.1.2, 9.2.2.2, 9.2.6.2, 9.2.10.2, 9.3.4.2, 10.3.2.3, 10.4.7.2, 10.4.9.2	19 2
J-723-1 & J-723-2	3	02-08-79	Control Board 2C14 ESFAS Status Display Arrangement	Ref FSAR 5.4.7.2, 6.2.2.1, 6.2.2.2, 6.2.4.2, 6.8.2.3, 7.3.3.2, 7.5, Table 7.5-1, 9.1.3.2, 9.2.1.2, 9.2.2.2, 9.2.6.2, 9.2.10.2, 9.3.4.2, 10.3.2.3, 10.4.7.2, 10.4.9.2	19 2
J-725	6	04-09-79	Main Control Room Arrangement	Ref FSAR 7.5. While this drawing is not specifically referenced in the FSAR, it is submitted as an aid in understanding the arrangement of control panels in the control room area (FSAR Figure 6.4-3).	21 12 14
J-726	4	05-17-79	Control Board 0C10 Arrangement	Ref FSAR 7.3.3.2, Table 7.5-1, 9.1.3.2, 9.2.1.2, 9.4.1.2, 9.4.2.2, 10.4.9.2	22 2
J-727	6	02-27-79	Control Board 1C11 Arrangement	Ref FSAR 6.2.4.2, 7.4.1.1, 7.5, Table 7.5-1 & 7.5-2, 9.2.6.2, 10.4.4.2, 10.4.7.2, 10.4.9.2	21 2
J-729	5	10-23-78	Control Board 1C12 Arrangement	Ref FSAR 5.2.5.4, 6.2.4.2, 7.5, Tables 7.5-1 and 7.5-2, 7.6.1.4, 9.2.2.2 9.3.4.2	19
J-730	7	02-07-79	Control Board 1C14 Arrangement	Ref FSAR 5.2.5.4, 5.4.7.2, 6.2.2.1, 6.2.4.2, 6.8.2.3, 7.3.2.2, 7.3.3.2, 7.5, Table 7.5-1 & 7.5-2, 7.6.1.2, 7.6.1.3, 9.2.1.2, 9.2.2.2, 9.2.6.2, 9.2.10.2, 9.3.4.2, 10.3.2.3, 10.4.7.2, 10.4.9.2	18 2
J-731	6	02-27-79	Control Board 2C11 Arrangement	Ref FSAR 6.2.4.2, 7.4.1.1, Table 7.5-1 & 7.5-2, 9.2.6.2, 10.4.4.2, 10.4.7.2, 10.4.9.2	21 2
J-732	5	10-04-78	Control Board 2C13/2C23 Arrangement	Ref FSAR 7.2.1.2, Table 7.5-2	
J-733	5	10-02-78	Control Board 2C12 Arrangement	Ref FSAR 5.2.5.4, 6.2.4.2, Tables 7.5-1 and 7.5-2, 7.6.1.4, 9.2.2.2 9.3.4.2	19

TABLE 1.7-9 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-734	7	02-07-79	Control Board 2C14 Arrangement	Ref FSAR 5.2.5.4, 5.4.7.2, 6.2.2.1, 6.2.4.2, 6.8.2.3, 7.3.2.2, 7.3.3.2, Table 7.5-1 & 7.5-2, 7.6.1.2, 7.6.1.3, 9.2.1.2, 9.2.2.2, 9.2.6.2, 9.2.10.2, 9.3.4.2, 10.3.2.3, 10.4.7.2, 10.4.9.2	18 2
J-735	4	05-17-79	Control Board 0C20 Arrangement	Ref FSAR 6.2.4.2, Table 7.5-1 & 7.5-2, 9.1.2.2, 9.1.3.2, 9.2.6.2, 9.4.1.2, 9.4.2.2	25 2
J-736	5	02-27-79	Control Board 1C21 Arrangement	Ref FSAR 7.5, Table 7.5-2	21
J-737	1	04-05-76	Control Board 1C23 Arrangement	Ref FSAR 7.5	2
J-738	5	10-02-78	Control Board 1C22 Arrangement	Ref FSAR 5.2.5.4, 5.4.7.2, 6.2.4.2, 7.5, Table 7.5-1, 9.2.2.2, 9.2.6.2, 9.3.4.2	25 2
J-739	5	02-23-79	Control Board 1C24 Arrangement	Ref FSAR 6.2.2.2, 6.8.2.3, 7.5, Table 7.5-1, 9.2.1.2, 9.2.2.2, 9.2.10.2, 9.3.4.2, 9.4.5.2, 9.5.4.2	21
J-740	5	02-27-79	Control Board 2C21 Arrangement	Ref Table 7.5-2	
J-741	1	04-05-76	Control Board 2C23 Arrangement	Ref FSAR 7.5	2
J-742	5	10-02-78	Control Board 2C22 Arrangement	Ref FSAR 5.2.5.4, 5.4.7.2, 6.2.4.2, Table 7.5-1, 9.2.2.2, 9.2.6.2 9.3.4.2	19
J-743	5	02-08-79	Control Board 2C24 Arrangement	Ref FSAR 6.2.2.2, 6.8.2.3, Table 7.5-1 & 7.5-2, 9.2.1.2, 9.2.2.2, 9.2.10.2, 9.3.4.2, 9.4.5.2, 9.5.4.2	21 2
J-744	4	09-15-78	Control Board 1C15 Arrangement	Ref FSAR 7.5	18 11
J-746	4	08-17-78	Control Board 2C15 Arrangement	Ref Table 7.5-2	18 2
J-749	4	04-09-79	Main Control Room Floor Penetration at Elevation 659'-0" and Control Panel Layout		21 2

TABLE 1.7-9 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-750	4	04-09-79	Main Control Room Floor Penetration - Elevation 674'-6" and Control Panel Layout		21 2
J-908	6	03-22-79	Local Control Panel 1C114 Auxiliary Shutdown Panel Arrangement (Unit 1)	Ref FSAR 6.2.4.2, 7.3.3.2, 7.4.1.1, 7.4.3, 7.4.3.1, Table 7.5-1 & 7.5-2, 9.2.1.2, 9.2.2.2, 9.2.6.2, 9.3.4.2, 10.4.9.2	21 2
J-909	6	03-22-79	Local Control Panel 2C114 Auxiliary Shutdown Panel Arrangement (Unit 2)	Ref FSAR 6.2.4.2, 7.3.3.2, 7.4.1.1, 7.4.3, 7.4.3.1, Table 7.5-1 & 7.5-2, 9.2.1.2, 9.2.2.2, 9.2.6.2, 9.3.4.2, 10.4.9.2	21 2
J-922	3	04-25-79	Local Control Panel 1C150 Reactor Building Heating and Ventilation Panel Arrangement	Ref FSAR 6.2.2.2, 6.2.4.2, 6.2.5.2, 9.4.6.2	27 2
J-923	3	04-25-79	Local Control Panel 2C150 Reactor Building Heating and Ventilation Panel Arrangement	Ref FSAR 6.2.2.2, 6.2.4.2, 6.2.5.2, 9.4.6.2	27 2
J-924	5	09-28-79	Local Control Panel 0C151 Auxiliary Building Heating and Ventilation Panel Arrangement	Ref FSAR 9.4.1.2, 9.4.2.2	21 27 2
J-933	4	08-14-79	Local Control Panel 0C180	Ref FSAR 9.4.8.2	27
J-939	2	01-30-79	Local Control Panel 1C175A	Ref FSAR 9.4.7.2	21
J-940	2	01-30-79	Local Control Panel 1C175B	Ref FSAR 9.4.7.2	
J-941	2	01-30-79	Local Control Panel 2C175A	Ref FSAR 9.4.7.2	
J-942	2	01-30-79	Local Control Panel 2C175B	Ref FSAR 9.4.7.2	
J-946	2	01-15-80	Vertical Control Panel 0C29		27
2717-1002 Sh 1	4	09-08-78	ESFAS General Arrangement (1C43, 2C43)	Ref FSAR Tables 7.5-1 and 7.5-2	19 18

TABLE 1.7-9 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
2717-1002 Sh 2	4	09-08-78	ESFAS General Arrangement (1C44, 2C44)	REF FSAR Tables 7.5-1 and 7.5-2	
2717-1002 Sh 3	4	09-08-78	ESFAS General Arrangement (1C35, 2C35)	Ref FSAR Tables 7.5-1 and 7.5-2	19
2717-1002 Sh 4	4	09-08-78	ESFAS General Arrangement (Alarm Panels)	Ref FSAR Tables 7.5-1 and 7.5-2	
2717-1002 Sh 5	4	09-08-78	ESFAS General Arrangement (Test Panel, Auto/Manual Switch Panel)	Ref FSAR Tables 7.5-1 and 7.5-2	18
2717-1002 Sh 6	4	09-08-78	ESFAS General Arrangement (nameplate Arrangement)	Ref FSAR Tables 7.5-1 and 7.5-2	19 18

TABLE 1.7-4

BOP SCHEMATIC THREE LINE METER AND RELAY DIAGRAMS

Drawing No.	Rev	Date	Title	Remarks	
E-053	6	09-10-79	4,160V Class 1E System	Ref FSAR 8.3.1.1.9	25

TABLE 1.7-5

SCHEMATIC TWO LINE METER AND RELAY DIAGRAMS

Drawing No.	Rev	Date	Title	Remarks	
E-058	5	02-06-80	Class 1E 125Vdc System	Ref FSAR 8.3.1.2 and 8.3.2	27

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TABLE 1.7-11

BOP EQUIPMENT LOGIC DIAGRAMS

Drawing No.	Rev.	Date	Title	Remarks	
J-001-1	2	05-21-76	Logic Diagram Legend and Notes	While this drawing is not specifically referenced in the FSAR, it is submitted as an aid in understanding the logic diagrams.	2
J-001-2, J-001-3, & J-001-4	1	01-26-76	Logic Diagram Legend and Notes	While this drawing is not specifically referenced in the FSAR, it is submitted as an aid in understanding the logic diagrams.	
J-007-1,	5	06-11-79	Makeup Pump	Ref FSAR 9.3.4.2	25
J-007-2, &	5	06-11-79			
J-007-3	3	01-08-79			18
J-008	2	12-27-77	Reactor Coolant Letdown Cooler Inlet Valve	Ref FSAR 7.6.1, 7.6.1.4, 9.2.2.2, 9.3.4.2	
J-009	1	12-12-77	Reactor Coolant Letdown Shutoff Valve	Ref FSAR 6.2.4.2, 9.3.4.2	5
J-011	2	12-12-77	Reactor Coolant Pump Seal Injection Valve	Ref FSAR 6.2.4.2, 9.3.4.2	
J-012	2	08-29-78	Reactor Coolant Pump Seal Return Valve	Ref FSAR 6.2.4.2, 9.2.2.2, 9.3.4.2	14
J-014	3	11-23-78	High-Pressure Injection Valve	Ref FSAR 6.2.4.2, 9.3.4.2	
J-015-1	3	01-08-79	Makeup and Purification System Isolation Valve	Ref FSAR 6.2.4.2, 9.3.4.2	18
J-016	3	12-05-78	Makeup Tank Isolation Valve	Ref FSAR 9.3.4.2	
J-017-1 &	5	03-26-79	Decay Heat Removal Pump	Ref FSAR 5.4.7.2	
J-017-2	4	11-07-77			21
J-018-1 &	3	11-27-78	Decay Heat Removal Heat	Ref FSAR 5.4.7.2	
J-018-2	2	11-28-78	Exchanger Discharge Valve		18
J-019-1	4	05-16-78	Decay Heat Removal Heat Exchanger Bypass Valve	Ref FSAR 5.4.7.2, 7.1.2.5	11

TABLE 1.7-11 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-019-2	4	05-16-78	Decay Heat Removal Heat Exchanger Bypass Valve	Ref FSAR 5.4.7.2, 7.1.2.5	2 11
J-020-1 & J-020-2	5	11-27-78	Low-Pressure Injection Valve	Ref FSAR 5.4.7.2, 6.2.4.2, 7.1.2.5	
J-021-1 & J-021-2	3 2	11-27-78 09-14-76	Decay Heat Cooldown Isolation Valve	Ref FSAR 5.4.7.2, 6.2.4.2	
J-022-1 & J-022-2	4	11-27-78	Core Flood Tank Outlet Block Valve	Ref FSAR 5.4.7.2, 7.1.2.5, 7.6.1, 7.6.1.3	
J-026-1 & J-026-2	3	11-27-78	Reactor Building Spray Pump	Ref FSAR 6.2.2.1	18
J-027	3	11-27-78	Reactor Building Spray Valve	Ref FSAR 6.2.2.1, 6.2.4.2	
J-028-1 & J-028-2	2	11-27-78	Borated Water Storage Tank Outlet Valve	Ref FSAR 5.4.7.2, 6.2.2.1	
J-029-1 & J-029-2	3	11-27-78	Reactor Building Emergency Sump Outlet Valve	Ref FSAR 5.4.7.2, 6.2.2.1, 6.2.4.2	
J-031	2	08-16-77	Fuel Pool Cooling Pump	Ref FSAR 9.1.3.2	
J-035-1 & J-035-2	2	07-05-77	Component Cooling Water Pump	Ref FSAR 9.2.2.2	
J-036-1 & J-036-2	2	07-05-77	Component Cooling Water Spare Pump	Ref FSAR 9.2.2.2	
J-040	1	07-05-77	Component Cooling Water Decay Heat Cooler Block Valve	Ref FSAR 9.2.2.2	2
J-041	1	07-05-77	Component Cooling Water Heat Exchanger Bypass Isolation Valve	Ref FSAR 9.2.2.2	

TABLE 1.7-11 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-043-1 & J-043-2	1	07-05-77	Component Cooling Water Loop Isolation Valve	Ref FSAR 9.2.2.2	2
J-044	1	07-05-77	Component Cooling Water System Reactor Building Isolation Valve	Ref FSAR 6.2.4.2, 9.2.2.2	
J-045-1, J-045-2, & J-045-3	2	12-01-78	Service Water Pump	Ref FSAR 9.2.1.2	18 2
J-046-1, J-046-2, & J-046-3	2 2 1	03-29-79 03-29-79 01-18-77	Spare Service Water Pump	Ref FSAR 9.2.1.2	21 25
J-050-1& J-050-2	2	08-21-78	Service Water Pump Pit Sluice Gate Motor	Ref FSAR 9.2.1.2	
J-051-1& J-051-2	3	08-10-78	Service Water System Loop Isolation Valve	Ref FSAR 9.2.1.2	14
J-052	2	12-17-79	Service Water System Turbine Plant and Cooling Tower Isolation Valve	Ref FSAR 9.2.1.2	27 2
J-053	2	08-21-78	Diesel Generator Cooler Isolation Valve	Ref FSAR 9.2.1.2	14 18
J-054	2	04-17-79	Service Water System Emergency Cooling Pond Return Valve	Ref FSAR 9.2.1.2	21 2
J-055	2	11-16-78	Service Water System CCW Heat Exchanger Block Valve	Ref FSAR 9.2.1.2	18
J-056	1	01-18-77	Service Water to Circulating Water Pumps and Chemical Injection System Isolation Valve	Ref FSAR 9.2.1.2	2
J-058	2	11-16-78	Reactor Building Air Cooler Isolation Valve	Ref FSAR 6.2.2.2, 6.2.4.2, 9.2.1.2	18

TABLE 1.7-11 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-085	0	12-21-78	Service Water System Strainers	Ref FSAR 9.2.1.2	2 18
J-102	1	12-27-77	Reactor Coolant Letdown Block Valve	Ref FSAR 7.6.1, 7.6.1.4, 9.2.2.2, 9.3.4.2	5
J-132-1, J-132-2, J-132-3, & J-132-4	5	01-08-79	Auxiliary Feedwater Pump-Turbine	Ref FSAR 7.4.1, 7.4.1.1, 9.2.1.2, 10.4.9.2	1 2
J-133-1 & J-133-2	5 4	01-08-79 01-08-79	Auxiliary Feedwater Pump-Electric	Ref FSAR 7.4.1, 7.4.1.1, 9.2.1.2, 10.4.9.2	16
J-136	2	04-03-78	Auxiliary Feedwater Pump Recirculating Valve	Ref FSAR 10.4.9.2	2
J-138-1 J-138-2 J-138-3 J-138-4	3	09-29-78	Steam Generator Main Feedwater Isolation Valve	Ref FSAR 6.2.4.2, 10.4.7.2	18 14
J-139	2	01-08-78	Main-Auxiliary Feedwater Crosstie Isolation Valve	Ref FSAR 10.4.9.2	18 2
J-141-1, & J-141-2	4	01-10-79	Auxiliary Feedwater System Valves	Ref FSAR 7.4.1.1, 10.4.9.2	
J-167	2	08-16-78	Reactor Building Collection Header Isolation Valve	Ref FSAR 6.2.4.2	14 2
J-173-1 & J-173-2	3	11-27-78	Reactor Building Isolation Valve - Motor Operated	Ref FSAR 6.2.2.1, 6.2.4.2, 9.1.3.2	18 2
J-174	1	08-10-78	Reactor Building Isolation Valve - Air Operated	Ref FSAR 6.2.2.1, 6.2.4.2	14 2
J-175	1	08-29-78	Reactor Coolant Letdown Cooler Isolation Valve	Ref FSAR 6.2.4.2, 9.3.4.2	14 2

TABLE 1.7-11 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-176	1	12-12-77	Reactor Coolant Pump Seal Return Shutoff Valve	Ref FSAR 6.2.4.2, 9.3.4.2	2 5 2
J-177-1 & J-177-2	3	03-06-79	Reactor Building Isolation Valve Solenoid Valve	Ref FSAR 5.4.7.2, 6.2.4.2, 6.8.2.3, 9.2.6.2	21 2
J-178	4	05-30-79	Typical Safety-Related Motor Operated Valve	Ref FSAR 5.4.7.2	27 18
J-179	1	11-27-78	BWST Recirculation and Purification Outlet and Return Valves	Ref FSAR 6.2.2.1	2
J-184	5	01-12-79	Typical Solenoid Valve, Energize to Open	Ref FSAR 5.4.7.2, 6.8.2.3	18 2
J-185	1	07-05-77	Typical Solenoid Valve, Energize to Close	Ref FSAR 9.2.2.2	
J-188	1	11-16-78	Emergency Diesel Oil Transfer Pump	Ref FSAR 9.5.4.2	18
J-189	0	02-07-79	Reactor Building Spray System Hydrazine Pumps	Ref FSAR 6.2.2.1	14
J-198	1	05-05-76	Penetration Pressurization System Valve	Ref FSAR 6.2.4.2, 6.8.2.3	2
J-203	3	12-12-78	Auxiliary Feedwater Pump Turbine Main Steam Supply Block Valve	Ref FSAR 6.2.4.2, 10.4.9.2	18 2
J-215	1	09-12-78	Reactor Building Vent Header Isolation Valve	Ref FSAR 6.2.4.2	14 2
J-221	4	01-12-79	High-Pressure Penetration Pressurization Valve	Ref FSAR 6.2.4.2, 6.8.2.3	18
J-226-1 & J-226-2	2	01-18-79	Condensate Storage Tank Auxiliary Feedwater Supply Valve	Ref FSAR 10.4.9.2	19 2

TABLE 1.7-11 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-227-1,	3	01-18-79	Service Water System	Ref FSAR 10.4.9.2	2
J-227-2, &	3	01-18-79	Auxiliary Feedwater Supply		19
J-227-3	0	01-12-79	Valve		
J-230	1	11-29-78	Feedwater Startup Drain Valve	Ref FSAR 6.2.4.2, 10.4.7.2	18
J-231	2	01-16-79	Motor Driven Auxiliary Feedwater Pump Condensate Storage Tank Block Valve	Ref FSAR 10.4.9.2	2
J-232-1 & J-232-2	4	06-11-79	Standby Makeup Pump	Ref FSAR 9.3.4.2	25 18
J-234-1,	3	02-21-79	Steam Generator Auxiliary	Ref FSAR 6.2.4.2, 10.4.9.2	
J-234-2, &	3	02-20-79	Feedwater Isolation Valve		19
J-234-3	4	02-20-79	Motor Operated		
J-235	2	11-27-78	High-Pressure Injection Supply Valve	Ref FSAR 9.3.4.2	2
J-237-1 & J-237-2	3	06-11-79	Makeup Pump Auxiliary Lube Oil Pump	Ref FSAR 9.3.4.2	25 2
J-238-1 & J-238-2	3	06-11-79	Standby Makeup Pump Auxiliary Lube Oil Pump	Ref FSAR 9.3.4.2	25 2
J-251	2	11-16-78	Reactor Building Air Cooler Throttling Valve	Ref FSAR 6.2.2.2, 6.2.4.2, 9.2.1.2	18 2
J-252	2	02-01-79	Auxiliary Feedwater Isolation Valve	Ref FSAR 10.4.9.2	21 2
J-253-1 & J-253-2	2	11-27-78	Decay Heat Return Isolation Valve	Ref FSAR 5.4.7.2, 6.2.4.2, 7.6.1, 7.6.1.2	18 2
J-258	2	02-21-79	Main Steam Line Isolation Valve Alarms and Status Light	Ref FSAR 6.2.4.2, 10.3.2.3	21 2
J-261-1 & J-261-2	2	12-12-78	Auxiliary Feedwater Flow Control Valve Indication	Ref FSAR 7.4.1.1, 10.4.9.2	18 2

TABLE 1.7-11 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-262	1	07-18-77	ESFAS Subsystem Manual Bypass Status Lamp		2
J-263	0	02-24-78	Decay Heat Removal System Dump to Sump Valves	Ref FSAR 5.4.7.2	13 2
J-264	2	05-30-79	Low Pressure Injection Crosstie Valves	Ref FSAR 5.4.7.2	27 2
J-298	1	05-16-78	Core Flood Tank Vent Valve	Ref FSAR 5.4.7.2, 7.1.2.5	5
J-420-1 & J-420-2	1 2	08-03-78 12-12-78	Service Water Pump Cooling Fans	Ref FSAR 9.4.8.2	14 18
J-421-1 & J-421-2	1	08-03-78	Service Water Standby Pump Cooling Fan	Ref FSAR 9.4.8.2	14 2
J-423-1 & J-423-2	1	01-05-78	Diesel Generator Supply	Ref FSAR 9.4.7.2	27
J-806-1 & J-806-2	1	04-28-77	Component Cooling Water Pump Room Unit Cooler	Ref FSAR 9.4.5.2	
J-807	1	03-24-78	Spare CCW Pump Room Unit Cooler	Ref FSAR 9.4.5.2	2
J-808-1 & J-808-2	1	04-28-77	Makeup Pump Room Unit Cooler	Ref FSAR 9.4.5.2	
J-809	0	01-13-76	Spare Makeup Pump Unit Cooler	Ref FSAR 9.4.5.2	
J-810	1	04-28-77	Auxiliary Feedwater Electric Pump Room Unit Cooler	Ref FSAR 9.4.5.2	
J-811	2	01-08-79	Auxiliary Feedwater Steam Driven Pump Room Unit Cooler	Ref FSAR 9.4.5.2	18 2
J-812	1	04-28-77	Decay Heat Removal Heat Exchanger Room Unit Cooler	Ref FSAR 9.4.5.2	

TABLE 1.7-11 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-813	1	04-28-77	Engineered Safeguards Pump Room Unit Cooler	Ref FSAR 9.4.5.2	2
J-824	1	01-08-79	Safeguards Chilled Water Pump	Ref FSAR 9.2.10.2	18 2
J-825	1	03-27-79	Switchgear and Battery Room Unit Coolers	Ref FSAR 9.4.1.2	21 5
J-829-1, J-829-2, J-829-3, J-829-4, & J-829-5	3	10-13-78	Auxiliary Building Safety-Related Chiller Indication and Alarms	Ref FSAR 9.2.10.2	18 5
J-831	1	08-08-77	Fuel Area Safety Isolation Dampers	Ref FSAR 9.4.2.2	2
J-832-1 & J-832-2	2	12-28-78	Fuel Area Emergency Exhaust Fan	Ref FSAR 9.4.2.2	18 2
J-834-1 & J-834-2	2 2	03-02-79 01-10-79	Reactor Building Recirculating Air Cooling Unit Fan	Ref FSAR 6.2.2.2	21 18 2
J-841-1 & J-841-2	2 1	09-12-78 02-09-77	Reactor Building Isolation Dampers Motor Operated	Ref FSAR 6.2.4.2	14 18
J-854	2	07-18-77	Control Room A/H Unit	Ref FSAR 9.4.1.2	
J-855	2	07-18-77	Control Room A/H Unit Discharge and Return Dampers	Ref FSAR 9.4.1.2	2
J-856	3	02-01-79	Control Room Recirculating Air Fan	Ref FSAR 9.4.1.2	21
J-857	4	04-02-79	Control Room Recirculating Air Filter Fan Discharge and Suction Dampers	Ref FSAR 9.4.1.2	2

TABLE 1.7-11 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-858	2	07-18-77	Control Room Recirculating Air Filter Fan Bypass Damper	Ref FSAR 9.4.1.2	2
J-859	3	02-01-79	Control Room Makeup Air Supply Fan	Ref FSAR 9.4.1.2	21
J-860	2	07-18-77	Control Room Makeup Air Supply Fan Discharge and Suction Dampers	Ref FSAR 9.4.1.2	
J-861	2	07-28-77	Control Room Makeup Air Supply Fan Bypass Damper	Ref FSAR 9.4.1.2	2
J-862	2	07-18-77	Control Room Outside Air Intake and Switchgear Room Air Supply Isolation Dampers	Ref FSAR 9.4.1.2	
J-863-1 & J-863-2	3	02-01-79	Cable Spreading Room Supply and Control Room Exhaust Dampers	Ref FSAR 9.4.1.2	21 2
J-864	4	02-01-79	Control Room Emergency Makeup Air Supply Valve	Ref FSAR 9.4.1.2	21
J-865	2	07-18-77	Control Room A/H Humidifier Steam Supply Isolation valve	Ref FSAR 9.4.1.2	2
J-867	2	02-01-79	Battery Room Exhaust Fan and Discharge Damper	Ref FSAR 9.4.1.2	21 2
J-869	B	06-20-79	Control Room Pressurizing System Flow Control Valve	Ref FSAR 9.4.1.2	27 2

TABLE 1.7-12

BOP SYSTEM AND EQUIPMENT LOOP DIAGRAMS

Drawing No.	Rev.	Date	Title	Remarks	
J-300-1	3	05-22-79	Loop Diagram Legend and Notes	While loop diagrams are not specifically referenced in the FSAR test, they are supplied to provide representative loop details to clarify instrument installation	27
					5
J-300-2	0	05-22-79	Loop Diagram Legend and Notes		25
J-300-3	0	06-06-79	Loop Diagram Legend and Notes		
J-303-06	1	01-19-79	Makeup and Purification, Units 1 & 2		5
J-303-07	1	01-19-79	Makeup and Purification, Units 1 & 2		14
					5
J-303-08	1	07-13-79	Makeup and Purification, Units 1 & 2		25
J-303-09	2	07-13-79	Makeup and Purification, Units 1 & 2		
J-316-02	3	06-11-79	Component Cooling Water, Units 1 & 2		27
					5
J-316-04	2	06-11-79	Component Cooling Water, Units 1 & 2		27
					5
J-316-05	1	06-11-79	Component Cooling Water, Units 1 & 2		27
J-316-06	0	10-06-77	Component Cooling Water, Units 1 & 2		5
J-316-08	1	10-06-77	Component Cooling Water, Units 1 & 2		
J-316-09	1	10-05-77	Component Cooling Water, Units 1 & 2		18
					5
J-316-11	1	08-10-78	Component Cooling Water, Units 1 & 2		14

TABLE 1.7-12 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-318-07	2	12-03-79	Service Water Cooling Tower and Pump Service Structure		27 5
J-319-05	3	09-10-79	Service Water, Reactor, and Auxiliary Building		27 5
J-321-07	1	07-18-79	Reactor Building Penetration Pressurization, Units 1 & 2		25 5
J-337-07	2	06-05-79	Feedwater and Condensate, Unit 2		
J-337-17	2	07-23-79	Feedwater and Condensate, Unit 2		25
J-337-25	1	06-05-79	Feedwater and Condensate, Unit 2		
J-337-26	1	06-05-79	Feedwater and Condensate, Unit 2		5
J-337-29	1	01-30-79	Feedwater and Condensate, Unit 2		21 5
J-337-30	1	10-02-79	Feedwater and Condensate, Unit 2		27 19
J-337-31	1	10-02-79	Feedwater and Condensate, Unit 2		27
J-337-32	0	02-02-79	Feedwater and Condensate, Unit 2		19
J-338-19	2	06-05-79	Feedwater and Condensate, Unit 1		
J-338-20	2	06-05-79	Feedwater and Condensate, Unit 1		25
J-338-22	2	07-23-79	Feedwater and Condensate, Unit 1		

TABLE 1.7-12 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-338-27	1	01-30-79	Feedwater and Condensate, Unit 1		21 5
J-338-28	2	06-05-79	Feedwater and Condensate, Unit 1		25 5
J-338-29	1	02-06-79	Feedwater and Condensate, Unit 1		21 19
J-338-30	1	10-02-79	Feedwater and Condensate, Unit 1		27 19
J-338-31	1	10-02-79	Feedwater and Condensate, Unit 1		27
J-338-32	0	02-02-79	Feedwater and Condensate, Unit 1		19
J-352-05	3	07-31-79	Emergency Diesel Fuel Oil Storage and Transfer		27
J-357-05	0	12-16-77	Chilled Water System		5
J-357-06	0	09-27-77	Chilled Water System		
J-365-01	2	09-13-79	Control Room HVAC		
J-365-06	2	08-24-79	Control Room HVAC		27
J-365-07	2	09-13-79	Control Room HVAC		
J-368-01	2	12-21-78	Miscellaneous Structure HVAC		
J-368-02	1	02-13-79	Miscellaneous Structure HVAC		18
J-368-03	1	11-21-78	Miscellaneous Structure HVAC		
J-368-04	1	11-21-78	Miscellaneous Structure HVAC		14
J-392-1	2	10-30-79	Instrument Rack UN 1C166		

TABLE 1.7-12 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-392-2	2	10-30-79	Instrument Rack UN 1C166		5
J-392-3	1	10-30-79	Instrument Rack UN 1C166		
J-392-4	1	10-30-79	Instrument Rack UN 1C166		
J-393-1	2	10-30-79	Instrument Rack UN 2C166		27
J-393-2	2	10-30-79	Instrument Rack UN 2C166		
J-393-3	1	10-30-79	Instrument Rack UN 2C166		
J-393-4	1	10-30-79	Instrument Rack UN 2C166		
J-397	0	09-23-77	Instrument Rack Power Diagram		5

TABLE 1.7-13

BOP INSTRUMENT LOCATION DRAWINGS

Drawing No.	Rev.	Date	Title	Remarks	
J-31 1	6	05-29-79	Area 1, Elevation 568'-0"	While instrument location drawings are not specifically referenced in the FSAR text, they are supplied to aid in determining seismic and environmental criteria and to illustrate instrument location and separation where applicable	27
J-3102	5	06-08-79	Area 1, Elevation 584'-0"		
J-3103	6	09-11-79	Area 1, Elevation 584'-0"		
J-3104	4	06-20-79	Area 1, Elevation 599'-0"		
J-3105	4	06-26-79	Area 1, Elevation 599'-0"		
J-3106	4	06-12-79	Area 1, Elevation 614'-0"		
J-3107	3	06-12-79	Area 1, Elevation 614'-0"		
J-3108	1	06-20-79	Area 1, Elevation 624'-0"		
J-3109	5	09-11-79	Area 1, Elevation 634'-6"		
J-3110	4	09-11-79	Area 1, Elevation 634'-6"		
J-3111	3	03-08-79	Area 1, Elevation 634'-6"		21
J-3112	3	05-29-79	Area 1, Elevation 645'-0"		27
J-3113	2	10-10-78	Area 1, Elevation 645'-0"		18
J-3115	2	05-23-79	Area 1, Elevation 659'-0"		
J-3116	2	05-29-79	Area 1, Elevation 659'-0"		27
J-3124	2	07-23-79	Area 2, Elevation 593'-6"		
J-3125	0	09-07-78	Area 2, Elevation 626'-0"		18
J-3126	1	01-10-79	Area 2, Elevation 640'-0"	Ref Fig. 7.2-5	19
J-3127	0	09-07-78	Area 2, Elevation 659'-0"		
J-3128	0	09-07-78	Area 2, Elevation 685'-0"		18
J-3130	0	01-10-79	Solid Radwaste Building		
J-3132	1	11-08-79	Safety-Related Yard Piping		27

TABLE 1.7-13 (continued)

Drawing No.	Rev.	Date	Title	Remarks	
J-3133	1	11-08-79	Safety-Related Yard Piping		
J-3134	5	06-08-79	Area 3, Elevation 568'-0"		27
J-3135	4	05-29-79	Area 3, Elevation 584'-0"		
J-3136	4	03-09-79	Area 3, Elevation 599'-0"		21
J-3137	1	06-08-79	Area 3, Elevation 614'-0"		
J-3138	1	06-14-79	Area 3, Elevation 614'-0"		27
J-3139	1	06-20-79	Area 3, Elevation 634'-6"		
J-3140	1	06-20-79	Area 3, Elevation 634'-6"		
J-3141	0	09-23-77	Area 3, Elevation 634'		18
J-3143	0	09-15-76	Area 3, Elevation 659'-0"		
J-3147	1	07-17-79	Area 3, Elevation 685'-0"		27
J-3148	0	12-16-77	Area 3, Elevation 704'-0"		18
J-3150	2	06-14-79	Area 4, Elevation 593'-6"		27
J-3151	0	09-07-78	Area 4, Elevation 626'-0"		
J-3152	1	12-01-78	Area 4, Elevation 640'-0"	Ref Fig. 7.2-5	
J-3153	0	09-07-78	Area 4, Elevation 659'-0"		18
J-3154	0	09-07-78	Area 4, Elevation 685'-0"		
J-3198	0	09-15-78	Diesel Generator Building Section		
J-3199	1	01-11-80	Diesel Generator Building Section		27
J-3204	5	11-08-79	Service Water Pump Structure, Elevation 634'-6"		21
J-3205	3	04-06-78	Service Water Pump Structure Below Elevation 634'-6"		18

TABLE 1.7-15

BOP EQUIPMENT SCHEMATIC DIAGRAMS

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-139	2	04-05-79	Steam Generator Recirculation Pumps	Ref FSAR 8.3.1.2	18 21 19
E-153	3	12-18-79	Auxiliary Feedwater Turbines	Ref FSAR 7.4.1.1, 8.3.1.2, 9.2.1.2, 10.4.9.2	27 19
1	3				27
2	3				19
3	1				
4	3				
5	3				27
6	3				
7	3				
8	3				
9	2				21
10	3				
11	3				
12	3				
13	2				27
E-154	2	12-28-79	Motor Driven Auxiliary Feedwater Pump	Ref FSAR 7.4.1.1, 8.3.1.2, 9.2.1.2, 10.4.9.2	
1	2				
2	1				
3	1				21
4	1				
5	2				27
6	1				
7	1				21
8	1				
9	1				27
10	0				
11	0				
12	0				
E-155	2	03-09-79	Main Feedwater Isolation and Startup Drain Valves	Ref FSAR 6.2.4.2, 10.4.7.2	21
1	1				
1A	1				
2	2				
3	2				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-158	3	08-03-79	Auxiliary Feedwater System Valves	Ref FSAR 6.2.4.2, 7.4.1.1, 10.4.9.2	27 18
1	1				
2	1				
3	1				
4	1				
5	1				
6	1				
7	1				
8	1				
9	1				
10	1				
11	1				
12	1				
13	1				
14	1				
15	1				
16	1				
17	1				
18	1				22
19	1				
20	1				
21	2				
22	2				
23	2				
24	1				
25	1				
26	1				
27	1				
28	1				
29	1				
30	1				
30A	1				
31	1				
32	1				
33	1				
34	1				
35	1				
36	0				
37	0				
38	A				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-185	2	05-16-79	Service Water Pumps Vent Valves	Ref FSAR 9.2.1.2	18
1	2				27
2	1				
3	1				
4	1				18
5	1				
6	1				
E-186	4	06-11-79	Service Water Pumps	Ref FSAR 8.3.1.2, 9.2.1.2	
1	2				
2	2				
3	2				27
4	3				
5	2				
E-187	4	06-11-79	Spare Service Water Pump	Ref FSAR 8.3.1.2, 9.2.1.2	
1	3				
2	2				
3	2				
4	3				21
5	3				
6	2				
E-191	3	04-16-79	Service Water Pump Pit Sluice Gates	Ref FSAR 9.2.1.2	
1	3				
2	3				
E-192	2	06-11-79	Service Water System Loop Isolation Valves	Ref FSAR 9.2.1.2	
1	1				27
2	1				
3	1				
E-193	2	08-03-79	Service Water System Plant Isolation Valves	Ref FSAR 9.2.1.2	
1	2				
2	2				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-194	3	04-16-79	Diesel Generator Cooler Isolation Valves	Ref FSAR 9.2.1.2	18
1	3				27
2	2				
E-195	2	04-16-79	Service Water System Emergency Cooling Pond Return Valves	Ref FSAR 9.2.1.2	
1	2				18
2	1				27
					18
E-196	2	04-05-79	Service Water System Component Cooling Water Heat Exchanger Block Valve	Ref FSAR 9.2.1.2	21
1	2				18
2	1				21
					18
E-198	2	04-16-79	Reactor Building Air Cooler Throttling Valves	Ref FSAR 6.2.2.2, 6.2.4.2, 8.3.1.2, 9.2.1.2	
1	2				
2	2				
E-199	2	04-16-79	Reactor Building Air Cooler Isolation Valves	Ref FSAR 6.2.2.2, 6.2.4.2, 8.3.1.2, 9.2.1.2	
1	2				
2	2				
3	2				
4	2				27
E-200	2	04-16-79	Service Water to Circulating Water Pumps and Chemical Injection System Isolation Valves	Ref FSAR 9.2.1.2	
1	2				
2	2				
E-203	4	10-29-79	Component Cooling Water to RCP Solenoid Valve	Ref FSAR 8.3.1.2, 9.2.2.2	

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-205	4	05-16-79	Component Cooling Water Pumps	Ref FSAR 8.3.1.2, 9.2.2.2	18
1	3				
2	3				27
3	4				
4	4				
5	4				
6	4				
7	3				18
E-206	2	05-16-79	Spare Component Cooling Water Pump	Ref FSAR 8.3.1.2, 9.2.2.2	
1	2				
2	2				27
3	2				
4	2				
5	2				
6	1				
E-209	2	04-05-79	Component Cooling Water Decay Heat Cooler Block Valve	Ref FSAR 9.2.2.2	21
1	1				
2	1				18
E-210	2	04-05-79	Component Cooling Water Heat Exchanger Bypass Isolation Valve	Ref FSAR 9.2.2.2	27
					18
1	2				
2	1				21
E-211	1	03-21-79	Component Cooling Water Letdown Cooler Block Valves	Ref FSAR 8.3.1.2	18
1	1				
2	1				21
E-212	2	04-05-79	Component Cooling Water Loop Isolation Valves	Ref FSAR 9.2.2.2	27
1	2				21
2	1				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-213	2	03-29-79	Component Cooling Water Reactor Building Isolation Valves	Ref FSAR 6.2.4.2, 8.3.1.2, 9.2.2.2	18
2	2				
2	2				
3	2				21
4	2				
5	2				
6	2				
E-214	3	03-23-79	Reactor Coolant Pumps	Ref FSAR 8.3.1.2	
1	1				
2	1				18
3	2				
4	1				
5	2				
6	3				
7	0				
E-215	3	03-29-79	Reactor Coolant Pump Auxiliary Control	Ref FSAR 8.3.1.2	
1	3				21
3	3				
3	3				
4	3				
5	3				
E-216	3	03-21-79	Reactor Coolant Pumps ac Lube Oil Pumps	Ref FSAR 8.3.1.2	
1	3				
2	2				18
E-217	3	04-16-79	Reactor Coolant Pumps dc Lube Oil Pumps	Ref FSAR 8.3.1.2	27
1	3				
2	2				18
E-218	4	12-27-79	Reactor Coolant Pressurizer Heaters	Ref FSAR 8.3.1.2	
1	2				21
2	2				
3	2				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
4	1				18
5	1				
6	2				21
7	1				
8	2				
9	1				18
10	0				
E-220	3	03-21-79	Reactor Coolant Pump Power Monitoring System	Ref FSAR 7.2.1.2	21
1	0				18
2	2				
3	2				
4	1				
5	1				21
E-222	2	03-21-79	Reactor Coolant Pressurizer Spray Valve	Ref FSAR 8.3.1.2	
1	1				18
2	2				
3	0				21
E-223	2	03-21-79	Reactor Coolant Pressurizer Electrically Operated Relief Valve	Ref FSAR 8.3.1.2	18
E-224	3	12-28-79	Reactor Coolant Pump Space Heaters	Ref FSAR 8.3.1.2	27 18
E-225	2	03-21-79	Air Operated Valves	Ref FSAR 6.2.2.1, 6.2.4.2	
2	2				21
2	2				
3	1				
4	1				18
5	0				
E-226	2	10-02-79	Reactor Coolant System Motor Operated Valves	Ref FSAR 8.3.1.2	
1	1				27
2	2				
3	2				
4	1				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-227	2	04-16-79	Reactor Coolant and Pressurizer System Solenoid Valves	Ref FSAR 6.2.4.2, 8.3.1.2	18
1	1				27
2	0				18
3	2				
E-231	3	08-13-79	Makeup Pumps	Ref FSAR 8.3.1.2, 9.3.4.2	27
1	3				
2	2				
3	1				20
4	3				
5	3				
6	3				
7	2				27
8	2				
9	2				
10	0				
11	0				
12	0				20
E-232	5	08-13-79	Spare Makeup Pump	Ref FSAR 8.3.1.2	
1	4				27
2	3				
3	1				20
4	4				
5	4				27
6	3				
7	2				20
8	0				
9	2				27
10	0				
11	0				20
12	0				
E-233	3	07-03-79	Makeup Pump Auxiliary Lube Oil Pump	Ref FSAR 8.3.1.2, 9.3.4.2	27
1	3				
2	3				
3	2				
4	1				20
5	0				27

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-234	3	07-03-79	Spare Makeup Pump Auxiliary Lube Oil Pump	Ref FSAR 8.3.1.2, 9.3.4.2	18
1	3				27
2	3				
3	3				
4	1				
5	0				
E-235	2	03-23-79	Reactor Coolant Letdown Cooler Isolation Valves	Ref FSAR 6.2.4.2, 8.3.1.2, 9.3.4.2	21
1	2				
2	1				
E-236	1	11-09-78	Reactor Coolant Pump Seal Return Shutoff Valve	Ref FSAR 6.2.4.2, 9.3.4.2	18
E-237	2	03-23-79	Reactor Coolant Letdown Cooler Inlet Valves	Ref FSAR 7.6.1.4, 8.3.1.2, 9.2.2.2, 9.3.4.3	
1	2				
2	2				21
E-238	2	03-21-79	Reactor Coolant Letdown Shutoff Valves	Ref FSAR 6.2.4.2, 9.3.4.2	
1	2				
2	1				
E-240	0	08-03-78	Reactor Coolant Pump Seal Injection Valves	Ref FSAR 6.2.4.2, 9.3.4.2	18
E-241	2	04-05-79	Reactor Coolant Pump Seal Return Valves	Ref FSAR 6.2.4.2, 8.3.1.2, 9.2.2.2, 9.3.4.2	
1	1				21
2	2				
E-242	2	01-21-80	High-Pressure Injection Valves	Ref FSAR 6.2.4.2, 9.3.4.2	
1	2				27
2	2				
3	2				
4	2				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-243	5	01-21-80	Makeup Pump Recirculation Isolation Valves	Ref FSAR 6.2.4.2, 9.3.4.2	18 27
1	4				21
2	5				27
E-244	3	07-03-79	Makeup and Purification System Isolation Valve	Ref FSAR 9.3.4.2	
1	2				21
2	2				
3	0				27
E-246	2	03-21-79	Reactor Coolant Letdown Block Valve	Ref FSAR 7.6.1.4, 8.3.1.2, 9.2.2.2, 9.3.4.2	21
E-248	1	11-14-78	High-Pressure Injection Supply Valve	Ref FSAR 9.3.4.2	18
1	1				
2	1				
E-249	2	02-27-79	Decay Heat Removal Pumps	Ref FSAR 5.4.7.2, 8.3.1.2	
1	2				
2	2				
3	2				21
4	2				
5	2				
6	2				
7	0				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-250	3	12-28-79	Decay Heat Removal System Motor Operated Valves	Ref FSAR 5.4.7.2, 7.1.2.5	18
1	3				
2	1				
3	1				27
4	0				
5	2				
6	2				
7	1				18
E-251	2	03-09-79	Core Flooding Tank Sample Line Isolation Valves	Ref FSAR 5.4.7.2, 6.2.4.2, 8.3.1.2	21
E-252	3	12-28-79	Decay Heat Removal Low-Pressure Injection Valves	Ref FSAR 5.4.7.2, 6.2.4.2, 7.1.2.5	27 21
1	2				18
2	1				
3	2				
4	2				
5	1				
6	2				
7	2				
E-253	3	12-28-79	Decay Heat Cooldown and Return Isolation Valves	Ref FSAR 5.4.7.2, 6.2.4.2, 7.6.1.2, 8.3.1.2	
1	3				
2	1				
3	3				
4	1				27
5	2				
6	3				
7	3				
8	3				
9	3				
10	2				
11	3				
E-254	3	12-28-79	Core Flooding Tank Outlet and Gas Sample Valves	Ref FSAR 5.4.7.2, 7.6.1.3, 8.3.1.2, 7.1.2.5	
1	3				
2	3				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-255	3	12-28-79	Reactor Building Spray Pump	Ref FSAR 6.2.2.1, 8.3.1.2	18
1	2				
2	2				
3	2				
3A	1				
4	2				27
5	2				
E-256	2	12-28-79	Reactor Building Spray Valves	Ref FSAR 6.2.2.1, 6.2.4.2	
1	2				
2	2				
E-257	3	12-28-79	Borated Water Storage Tank Recirculation and Outlet Valves	Ref FSAR 5.4.7.2, 6.2.2.1, 6 1.2	21
1	3				27
2	1				21
3	1				27
4	3				18
5	1				
6	1				
E-258	3	12-28-79	Reactor Building Emergency Sump Outlet Valves	Ref FSAR 5.4.7.2, 6.2.2.1, 6.2.4.2	27
1	3				
2	1				
E-260	1	11-14-78	Reactor Building Motor Operated Isolation Valve	Ref FSAR 6.2.2.1, 6.2.4.2, 8.3.1.2	18
1	1				
2	1				
E-313	1	02-04-80	Radwaste Gas Vent Header Isolation Valves	Ref FSAR 6.2.4.2, 8.3.1.2	27
1	1				
2	1				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-318	1	03-21-79	Spent Fuel Pool Cooling Pump	Ref FSAR 9.1.3.2	18
1	1				
2	1				21
E-322	3	02-05-80	Fuel Pool Cooling Purification System Valves	Ref FSAR 6.2.4.2, 9.1.3.2	
1	1				
2	2				
3	2				
E-325	1	05-16-79	Penetration Pressurization System	Ref FSAR 6.2.4.2, 6.8.2.3, 8.3.1.2	27
1	1				
2	0				
3	1				
4	1				
5	1				
E-347	4	02-12-80	Boron Recovery System Reactor Building Collection Header Isolation Valve	Ref FSAR 6.2.4.2, 8.3.1.2	
					18
1	0				
2	1				27
3	0				
4	0				
E-352	0	07-31-78	Main Steam Line Valves	Ref FSAR 6.2.4.2, 10.3.2.3	
1	0				
2	0				
3	0				
4	0				18
5	0				
6	0				
7	0				
8	0				
9	0				
10	0				
11	0				
12	0				21
13	0				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
14	0				27
E-370	3	02-06-80	Reactor Nuclear Instrumentation Protection		18
1	0				18
2	2				
3	2				27
4	3				
5	2				
6	0				18
7	0				
8	1				
9	1				
10	1				
11	3				
12	1				27
13	1				
14	3				
15	1				
16	2				
17	1				
18	3				
19	1				
20	0				
21	0				21
22	1				
23	0				27
24	0				
25	0				21
26	1				
27	0				27
28	0				
29	0				
30	0				21
31	0				
32	1				27
33	0				
34	0				
35	0				21
36	0				
37	0				
38	0				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
39	0				18
40	0				
41	0				
42	0				
43	0				
44	0				
45	0				
46	0				21
47	0				
48	0				
49	0				
50	0				
51	0				
52	0				
53	0				
54	0				
55	3				
56	3				
57	3				
58	3				
59	3				
60	3				
61	3				
62	3				
63	3				
64	3				
E-374	3	06-19-79	Emergency Core Cooling Actuation System (Bailey 881)	Ref FSAR 7.5.1.2	27
1	2				
2	1				
3	2				
4	1				
5	2				
6	1				
7	2				
8	1				
9	1				
10	0				
11	0				21
12	0				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
13	0				18
14	0				
15	0				
16	1				
17	1				
18	1				
19	1				21
20	1				
21	1				
22	0				
23	0				
24	0				
25	0				
26	0				
27	1				
28	1				
29	3				27
30	2				
31	1				
32	1				21
33	1				
E-37	2	01-23-80	BOP - Engineered Safety Features Actuation System	Ref FSAR 5.4.7.2, 6.2.2.1, 6.2.4.2, 6.8.2.3, 7.3.3.2, 7.5.1.2.1, 9.2.1.2, 9.2.2.2, 9.2.10.2, 9.3.4.2, 9.4.1.2, 9.4.2.2, 9.4.5.2, 10.3.2.3, 10.4.7.2, 10.4.9.2	27 18
1	0				
2	1				
8	1				
9	0				
10	1				
20	1				
21	1				
22	1				21
27	0				
28	0				
29	0				
30	0				
31	0				
32	1				
33	0				
34	0				
35	0				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
36	0				18
37	0				
59	1				21
60	1				
61	1				
62	1				
63	1				
64	1				
65	1				
66	1				
67	1				
68	1				
69	1				27
70	1				
71	1				
72	0				
73	1				
74	1				
75	1				
76	1				
77	1				
78	1				
79	1				
E-376	F	08-14-78	Control Rod Power Supply Control	Ref FSAR 7.2.1.2	
8	D				18
9	D				
E-395	1	02-29-79	Diesel Fuel Oil Transfer Pumps	Ref FSAR 9.5.4.2	
1	1				21
2	1				
E-402	1	01-23-80	Diesel Generator Controls	Ref FSAR 8.3.1.2, 8.3.1.2, 9.5.5.2, 9.5.6.2, 9.5.7.2	
1	1				
2	1				
3	1				27
4	1				
5	1				
6	1				
7	1				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
36	0				18
37	0				
59	1				21
60	1				
61	1				
62	1				
63	1				
64	1				
65	1				
66	1				
67	1				
68	1				
69	1				27
70	1				
71	1				
72	0				
73	1				
74	1				
75	1				
76	1				
77	1				
78	1				
79	1				
E-376	F	08-14-78	Control Rod Power Supply Control	Ref FSAR 7.2.1.2	
8	D				18
9	D				
E-395	1	02-29-79	Diesel Fuel Oil Transfer Pumps	Ref FSAR 9.5.4.2	
1	1				21
2	1				
E-402	1	01-23-80	Diesel Generator Controls	Ref FSAR 8.3.1.2, 8.3.1.2, 9.5.5.2, 9.5.6.2, 9.5.7.2	
1	1				
2	1				
3	1				27
4	1				
5	1				
6	1				
7	1				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
8	1				18
9	1				
10	1				
11	1				
12	1				
13	1				
14	1				
15	1				
16	1				
17	1				
18	1				27
19	1				
20	1				
21	1				
22	1				
23	1				
24	1				
25	1				
26	1				
27	1				
28	1				
29	1				
E-438	2	09-17-79	Reactor Building Recirculating Air Cooling Unit Fans	Ref FSAR 6.2.2.2, 8.3.1.2	
					21
1	1				
2	2				
3	2				27
E-439	0	07-12-78	Reactor Building Isolation Dampers	Ref FSAR 6.2.4.2, 8.3.1.2	
1	0				
2	0				
3	0				
4	0				18
5	0				
6	0				
7	0				
8	0				
9	0				
10	0				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
11	0				21
12	0				
E-440	2	09-21-79	Reactor Building H&V	Ref FSAR 6.2.5.2, 8.3.1.2	
1	2				
2	2				
3	2				
4	2				
5	2				
6	1				
7	2				
8	2				
9	2				
10	2				
11	2				
12	2				
13	2				
14	2				
15	2				
16	2				
17	2				
18	2				27
19	2				
20	2				
21	2				
22	2				
23	2				
24	2				
25	2				
26	2				
27	2				
28	2				
28A	1				
29	2				
30	2				
31	2				
32	2				
33	2				
33A	1				
34	2				
35	1				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-452	3	02-06-80	Auxiliary Building H&V	Ref FSAR 8.3.1.2, 9.4.2.2	18
1	1				
2	3				
3	3				
4	2				
5	2				
6	1				
7	2				
8	1				
9	2				
10	2				
11	2				
12	2				
13	2				
14	2				
15	1				
15A	1				27
16	2				
17	2				
18	2				
19	1				
21	1				
22	1				
23	2				
24	2				
25	2				
26	1				
27	2				
28	0				
29	2				
30	2				
31	3				
32	2				
33	0				
34	0				
E-456	1	07-03-79	Control Room Outside Makeup and Emergency Make-up Air	Ref FSAR 9.4.1.2	
1	1				18
2	1				
3	1				27

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
4	1				18
6	1				
7	1				27
8	1				
9	1				
10	1				
E-457	0	11-13-78	Control Room Air Handling	Ref FSAR 8.3.1.2, 9.4.1.2	
1	0				
2	0				
4	0				
5	0				
6	0				
7	0				
E-458	0	11-10-78	Control Room Area Recirculation and Exhaust Air	Ref FSAR 9.4.1.2	18
1	0				
2	0				
4	0				
5	0				
6	0				
7	0				
9	0				
10	0				
11	0				
12	0				
14	0				
15	0				21
17	0				
18	0				
24	0				
E-468	5	02-19-80	Office Service and Miscellaneous Building H&V	Ref FSAR 8.3.1.2, 9.4.7.2, 9.4.8.2	27
					18
42	0				
43	1				21
47	0				
48	1				
49	1				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
51	0				18
52	0				21
53	1				
54	2				
55	2				
56	2				
57	2				
58	0				
E-478	2	05-22-79	Auxiliary Building Safeguard Chillers	Ref FSAR 8.3.1.2, 9.2.10.2	
1	1				27
2	2				
3	2				
3A	1				
4	2				
5	2				
6	1				
7	1				
E-480	1	02-27-79	Auxiliary Building Safeguards Chilled Water Pumps	Ref FSAR 9.2.10.2	
1	1				21
2	1				
3	1				
E-485	2	07-27-79	Engineered Safeguards Unit Coolers	Ref FSAR 9.4.1.2, 9.4.5	
1	2				
2	2				
3	2				
4	2				
5	2				27
6	2				
7	1				
8	2				
9	2				
10	2				
11	1				
12	2				

TABLE 1.7-15 (continued)

Drawing and Sheet	Rev.	Date	Title	Remarks	
E-487	2	01-21-80	Plant Water Storage and Transfer System	Ref FSAR 6.2.4.2, 9.2.6.2	13
1	2				
2	2				
3	2				
4	1				
5	2				
6	2				
7	2				
8	1				27
8A	1				
9	2				
10	1				
11	2				
12	2				
13	2				
14	2				
15	2				
15A	0				
16	2				
17	0				