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SCHWENCER,A. Licensing Branch 2

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SUBJECT: Forwards Amend 27 to FSAR.

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	NRR/DSI/RSB 23	1	1	REG FILE 04	1	1
	RGN5	3	3	RM/DDAMI/MIB	1	0
EXTERNAL:	ACRS 41	6	6	BNL(AMDTS ONLY)	1	1
	DMB/DSS (AMDTS)	1	1	FEMA-REP DIV 39	1	1
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INTERNAL:	ELD/HDS2	1	0	IE FILE	1	1
	IE/DEP EPDS 35	1	1	IE/DEP/EPLB 36	3	3
	NRR/DE/AEAB	1	0	NRR/DE/CEB 11	1	1
	NRR/DE/EQB 13	2	2	NRR/DE/GB 28	2	2
	NRR/DE/HGEB 30	1	1	NRR/DE/MEB 18	1	1
	NRR/DE/MTEB 17	1	1	NRR/DE/SAB 21	1	1
	NRR/DE/SAB 24	1	1	NRR/DE/SEB 25	1	1
	NRR/DHFS/HFEB40	1	1	NRR/DHFS/LQB 32	1	1
	NRR/DHFS/OLB 34	1	1	NRR/DL/SSPB	1	0
	NRR/DSI/AEB 26	1	1	NRR/DSI/ASB	1	1
	NRR/DSI/CPB 10	1	1	NRR/DSI/CSB 09	1	1
	NRR/DSI/ICSB 16	1	1	NRR/DSI/METB 12	1	1
	NRR/DSI/PSB 19	1	1	NRR/DSI/RAB 22	1	1
	NRR/DSI/RSB 23	1	1	REG FILE 04	1	1
	RGN5	3	3	RM/DDAMI/MIB	1	0
EXTERNAL:	ACRS 41	6	6	BNL(AMDTS ONLY)	1	1
	DMB/DSS (AMDTS)	1	1	FEMA-REP DIV 39	1	1
	LPDR 03	1	1	NRC PDR 02	1	1
	NSIC 05	1	1	NTIS	1	1

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Washington Public Power Supply System
P.O. Box 968 3000 George Washington Way Richland, Washington 99352 (509) 372-5000

January 7, 1983
G02-83-014
NS-L-02-CDT-83-003

Docket No. 50-397

Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Schwencer:

Subject: NUCLEAR PROJECT NO. 2
FSAR AMENDMENT NO. 27

The Washington Public Power Supply System herewith submits sixty (60) copies of Amendment 27 to its Final Safety Analysis Report.

Pursuant to 10CFR2.101, we will, within ten (10) days of filing, furnish to you an affidavit reflecting our distribution of this amendment to your designated distribution list.

Very truly yours,

G D Bouchey

G. D. Bouchey
Manager, Nuclear Safety and Regulatory Programs

CDT/jca
Attachment

cc: R Auluck - NRC
WS Chin - BPA
R Feil - NRC Site

B001
3/60

[illegible]

STATE OF WASHINGTON)
) ss
COUNTY OF BENTON)

Subject: FSAR Amend. 27

I, G. D. BOUCHEY, being duly sworn, subscribe to and say that I am the Manager, Nuclear Safety and Regulatory Programs, for the WASHINGTON PUBLIC POWER SUPPLY SYSTEM, the applicant herein; that I have full authority to execute this oath; that I have reviewed the foregoing; and that to the best of my knowledge, information and belief the statements made in it are true.

DATE Jan 6, 1983

G D Bouchey
G. D. BOUCHEY

On this day personally appeared before me G. D. BOUCHEY to me known to be the individual who executed the foregoing instrument and acknowledged that he signed the same as his free act and deed for the uses and purposes therein mentioned.

GIVEN under my hand and seal this 6th day of January, 1982.

LS

Rebecca C Hobson
Notary Public in and for the
State of Washington

Residing at Kennewick

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Move all 271 series questions to beginning of Volume 24.

VOLUME 24

Move all 361, 362, 371, 372, 421, 422, 423, 432, 441, and 600 series questions to Volume 25.

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50-397
Control #8301280233
Date 1/7/83

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2.3-7	0
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2.3-112	36
2.3-113	42
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2.3-124	42
2.3-125	42
2.3-126	42
2.3-127	42
2.3-128	42
2.3-129	42
2.4-1	48
2.4-2	48
2.4-3	0
2.4-4	13
2.4-5	13
2.4-6	13
2.4-7	48
2.4-8	37
2.4-8a	49
2.4-9	13
2.4-10	31
2.4-11	13
2.4-12	5
2.4-13	13
2.4-14	13
2.4-15	13
2.4-16	13
2.4-17	13
2.4-18	13
2.4-19	48
2.4-20	13
2.4-21	0
2.4-22	0
2.4-23	0
2.4-24	13
2.4-25	49

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2.4-29	13
2.4-30	23
2.4-30a	23
2.4-31	23
2.4-32	23
2.4-33	13
2.4-34	13
2.4-35	36
2.4-36	36
2.4-37	0
2.4-38	23
2.4-38a	23
2.4-38b	23
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2.4-42	26
2.4-43	26
2.4-44	13
2.4-45	13
2.4-46	13
2.4-47	23
2.4-48	23
2.4-48a	23
2.4-49	13
2.4-50	13
2.4-51	13
2.4-52	13
2.4-53	13
2.4-54	0
2.4-55	0
2.4-56	0
2.4-57	0
2.5-1	18
2.5-2	18
2.5-3	18
2.5-4	18
2.5-5	18
2.5-6	18
2.5-7	18
2.5-8	18
2.5-9	18
2.5-10	18

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2.5-109	18
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2.5-113	18
2.5-114	36
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2.5-116	36
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2.5-118	18
2.5-119	18
2.5-120	18
2.5-121	18
2.5-122	18
2.5-123	18
2.5-124	18
2.5-125	18
2.5-126	18
2.5-127	18
2.5-128	36
2.5-128a	36
2.5-129	18
2.5-130	36
2.5-131	36
2.5-132	36
2.5-133	36
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2.5-134	36
2.5-135	36
2.5-136	36
2.5-137	36
2.5-137a	36
2.5-138	36
2.5-139	36
2.5-140	36
2.5-140a	36
2.5-141	36
2.5-142	36
2.5-143	36
2.5-144	18
2.5-145	18
2.5-146	18
2.5-147	18
2.5-148	18
2.5-149	18
2.5-150	18

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2.5-152	18
2.5-153	23
2.5-154	36
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2.5-156	36
2.5-157	36
2.5-158	36
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2.5-168	18
2.5-169	18
2.5-170	18
2.5-171	18
2.5-172	18
2.5-173	18
2.5-174	18
2.5-175	18
2.5-176	18
2.5-177	18
2.5-178	18
2.5-179	18
2.5-180	18
2.5-181	18
2.5-182	18
2.5-183	18
2.5-184	18
2.5-185	18
2.5-186	18
2.5-187	18
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2.5-190	18
2.5-191	18
2.5-192	18
2.5-193	18
2.5-194	18
2.5-195	18
2.5-196	18
2.5-197	18
2.5-198	18

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2.5-199	18
2.5-200	18
2.5-201	18
2.5-202	18
2.5-203	18
2.5-204	18
2.5-205	18
2.5-206	18
2.5-207	18
2.5-208	18
2.5-209	18
2.5-210	18
2.5-211	0
2.5-212	0
2.5-213	0
2.5-214	0
2.5-215	0
2.5-216	0
2.5-217	0
2.5-218	0
2.5-219	0
2.5-220	18
2.5-221	18
2.5-222	18
2.5-223	18
2.5-224	18
2.5-225	18
2.5-226	18
2.5-227	18
2.5-228	18
2.5-229	18
2.5-230	18
2.5-231	18
2.5-232	18
2.5-233	18
2.5-234	18
2.5-235	18
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2.5-239	18
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2.5-243	18
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2.5-297	18
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2.5-299	18
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2.5-302	18
2.5-303	18
2.5-304	18
2.5-305	18
2.5-306	18
2.5-307	18
2.5-308	18
2.5-309	18
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2.5-312	18
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2.5-314	18
2.5-315	18
2.5-316	18
2.5-317	18
2.5-318	18
2.5-319	18
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2.5-321	18
2.5-322	18
2.5-323	18
2.5-324	18
2.5-325	18
2.5-326	18
2.5-327	18
2.5-328	18
2.5-329	18
2.5-330	18
2.5-331	18
2.5-332	18
2.5-333	18
2.5-334	18
2.5-335	18
2.5-336	18
2.5-337	18
2.5-338	18
2.5-339	18
2.5-340	18
2.5-341	18
2.5-342	18

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TEXT PAGES	AMENDMENT
2.5-343	18
2.5-344	18
2.5-345	18
2.5-346	18
2.5-347	18
2.5-348	18
2.5-349	18
2.5-350	18
2.5-351	18
2.5-352	18
2.5-353	18
2.5-354	18
2.5-355	18
2.5-356	18
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2.5-358	18
2.5-359	18
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2.5-361	18
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2.5-364	18
2.5-365	18
2.5-366	18
2.5-367	18
2.5-368	18
2.5-369	18
2.5-370	18
2.5-371	18
2.5-372	18
2.5-373	18
2.5-374	18
2.5-375	18
2.5-376	18
2.5-377	18
2.5-378	18
2.5-379	18
2.5-380	18
2.5-381	18
2.5-382	18
2.5-383	18
2.5-384	18
2.5-385	18
2.5-386	18
2.5-387	18
2.5-388	18
2.5-389	18
2.5-390	18

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TEXT PAGES	AMENDMENT
2.5-391	18
2.5-392	18
2.5-393	18
2.5-394	18
2.5-395	18
2.5-396	0
2.5-397	0
2.5-398	0
2.5-399	0
2.5-400	27
2.5-401	27
2.5-402	27

Appendix 2.5A Deep Geologic Drill Hole Data

TEXT PAGES	AMENDMENT
2.5A-i	0
2.5A-ii	0
2.5A-iii	0
2.5A-iv	0
2.5A-v	0
2.5A-1	0
2.5A-2	0

Appendix 2.5B Additional Borehole Data

TEXT PAGES	AMENDMENT
2.5B-i	0
2.5B-ii	0
2.5B-iii	0
2.5B-iv	0
2.5B-1	0
2.5B-2	0
2.5B-3	0
2.5B-4	0
2.5B-5	0
2.5B-6	0
2.5B-7	0
2.5B-8	0
2.5B-9	0
2.5B-10	0
2.5B-11	0
2.5B-12	0
2.5B-13	0

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TEXT PAGES AMENDMENT

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TEXT PAGES		AMENDMENT
(2.5E)3		0
(2.5E)4		0
(2.5E)5	Figure 1	0
(2.5E)6	Figure 2	0
(2.5E)7		0
(2.5E)8		0
(2.5E)9		0
(2.5E)10		0
(2.5E)11		0
(2.5E)12	Figure 3	0
(2.5E)13		0
(2.5E)14		0
(2.5E)15		0
(2.5E)16		0
(2.5E)17	Figure 4	0
(2.5E)18		0
(2.5E)19		0
(2.5E)20	Figure 5	0
(2.5E)21	Figure 6	0
(2.5E)22		0
(2.5E)23		0
(2.5E)24		0
(2.5E)25	Figure 7	0
(2.5E)26		0
(2.5E)27	Figure 8	0
(2.5E)28	Figure 9	0
(2.5E)29		0
(2.5E)30	Figure 10	0
(2.5E)31		0
(2.5E)32		0
(2.5E)33		0
(2.5E)34		0
(2.5E)35		0
(2.5E)36		0
(2.5E)37		0
(2.5E)38		0
(2.5E)39		0
(2.5E)40		0
(2.5E)41		0
(2.5E)42		0
(2.5E)43		0
(2.5E)44	Figure 11	0
(2.5E)45		0

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Appendix A Drilling Procedures and Subsurface Installations

TEXT PAGES	AMENDMENT
A-1	0
A-2	0
A-3	0
A-4	0
A-5	0

FIGURES	AMENDMENT
A-1	0
A-2	0
A-3	0
A-4	0
A-5	0
A-6	0
A-7	0
A-8	0

Appendix B Evaluation of Various Penetration Test Procedures for Determining Relative Density

TEXT PAGES	AMENDMENT
B-1	0
B-2	0
B-3	0

FIGURES	AMENDMENT
B-1	0

Appendix C Laboratory Test Procedures and Results

TEXT PAGES	AMENDMENT
C-1	0
C-2	0
C-3	0
C-4	0
C-5	0
C-6	0
C-7	0
C-8	0
C-9	0
C-10	0
C-11	0
C-12	0

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TEXT PAGES	AMENDMENT
Figure 21	0
Figure 22	0

Appendix A Field Investigation and Results

TEXT PAGES	AMENDMENT
A-1	0
A-2	0
A-3	0
A-4	0
A-5	0
A-6	0
A-7	0
A-8	0

FIGURES	AMENDMENT
A-1	0
A-2a	0
A-2b	0
A-2c	0
A-2d	0
A-2e	0
A-2f	0
A-3	0
A-4	0
A-5	0
A-6	0
A-7	0
A-8	0
A-9	0
A-10	0
A-11	0
A-12	0
A-13a	0
A-13b	0
A-13c	0
A-14	0
A-15	0
A-16	0
A-17	0
A-18a	0
A-18b	0
A-19	0
A-20	0
A-21	0
A-22	0

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FIGURES	AMENDMENT
B-14	0
B-15	0
B-16	0
B-17	0
B-18	0
B-19	0
B-20	0

Appendix C References

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Appendix D Evaluation of the Core From the WPPSS B-12 Boring

TEXT PAGES	AMENDMENT
Introduction	0
2	0
3	0
4	0
5	0
6	0
7	0
8	0
9	0
10	0
11	0

Appendix 2.5G Surface Investigation and Foundation Engineering Evaluation

TEXT PAGES	AMENDMENT
2.5G-i	0
2P-i	9
2P-ii	9
2P-iii	15
2P-iv	10
2P-v	10
2P-vi	21
2P-vii	21
2P-1	9
2P-2	9
2P-3	10
2P-4	10
2P-5	9
2P-6	9
2P-7	10

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2P-10	10
2P-11	13
2P-12	13
2P-13	11
2P-14	11
2P-15	15
2P-16	13
2P-17	13
2P-18	21
2P-19	21
2P-20	21
2P-20A	21
2P-21	21
2P-22	21
2P-23	21
2P-23A	21
2P-24	9
2P-25	13
2P-25A	21
2P-26	9
2P-27	9
2P-28	9

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TEXT PAGES	AMENDMENT
2PA-i	10
2PA-ii	10
2PA-1	10
2PA-2	10
2PA-3	10
2PA-4	10
2PA-5	10
2PA-6	10
2PA-7	10
2PA-8	10
2PA-9	9
2PA-10	9
2PA-11	9
2PA-12	9
2PA-13	10
2PA-14	10
2PA-15	10

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2PA-1	9
2PA-2 1 of 2	9
2PA-2 2 of 2	9
2PA-3	9
2PA-4	9
2PA-5	9
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2PA-7 1 of 2	9
2PA-7 2 of 2	11
2PA-8	9
2PA-9 1 of 3	9
2PA-9 2 of 3	9
2PA-9 3 of 3	9
2PA-10 1 of 2	9
2PA-10 2 of 2	9
2PA-11 1 of 3	9
2PA-11 2 of 3	9
2PA-11 3 of 3	9
2PA-12	9
2PA-13	9
2PA-14	9
2PA-15	9
2PA-16	9
2PA-17	9
2PA-18	9
2PA-19 1 of 2	9
2PA-19 2 of 2	9
2PA-20	9
2PA-21 1 of 3	9
2PA-21 2 of 3	9
2PA-21 3 of 3	9
2PA-22 1 of 3	9
2PA-22 2 of 3	11
2PA-22 3 of 3	9
2PA-23 1 of 2	9
2PA-23 2 of 2	9
2PA-24	9
2PA-25	9
2PA-26 1 of 3	9
2PA-26 2 of 3	11
2PA-26 3 of 3	9
2PA-27	9
2PA-28	9
2PA-29	9
2PA-30	9
2PA-31	9
2PA-32	9
2PA-33	9

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2PA-35	11
2PA-36 1 of 2	9
2PA-36 2 of 2	9
2PA-37 1 of 2	9
2PA-37 2 of 2	9
2PA-38 1 of 2	9
2PA-38 2 of 2	9
2PA-39	11
2PA-40	9

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TEXT PAGES	AMENDMENT
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2PB-ii	9
2PB-iii	9
2PB-iv	13
2PB-v	9
2PB-1	9
2PB-2	9
2PB-3	10
2PB-4	10
2PB-5	9
2PB-6	9
2PB-7	9
2PB-8	9
2PB-9	9
2PB-10	9
2PB-11	9
2PB-12	9
2PB-13	13
2PB-13a	13
2PB-13b	13
2PB-14	10
2PB-15	10
2PB-16	10
2PB-17 (Tables 166 pages)	9,10

FIGURES	AMENDMENT
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2PB-2	9
2PB-3	9
2PB-4	9

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Appendix 2PD Correlations for Control of Completed Sand Fill and Backfill 9

TEXT PAGES	AMENDMENT
2PD-i	9
2PD-ii	9
2PD-iii	9
2PD-1	9
2PD-2	9
2PD-3	10
2PD-4	10
2PD-5	21
2PD-6	21
2PD-7	21
2PD-7a	21
2PD-8	10
2PD-9	10
2PD-10	10
2PD-11	9
2PD-12	9
2PD-13	21
2PD-14	10
2PD-14a	10
2PD-15	10
2PD-16	10
2PD-17	10
2PD-18	10
2PD-19	21
2PD-19a	21
2PD-20	21
2PD-21	21
2PD-21a	21
2PD-21b	21
2PD-21c	21
2PD-22	10

FIGURES	AMENDMENT
2PD-1	9
2PD-2	9
2PD-3	9
2PD-4	9
2PD-5	9
2PD-6	9
2PD-7	9

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FIGURES	AMENDMENT
2PD-8	9
2PD-9	9
2PD-10	9
2PD-11	9
2PD-12	9
2PD-13	9
2PD-14	9
2PD-14a	9
2PD-15	9
2PD-15a	9
2PD-16	9

Appendix 2.5H Construction and Settlement Monitoring Data

TEXT PAGES	AMENDMENT
2.5H-i	36
2.5H-ii	48
2.5H-iii	21
2.5H-1	0
2.5H-2	36
2.5H-2a	36
2.5H-2b	36
2.5H-3	36
2.5H-4	48
2.5H-5	48
2.5H-6	0
2.5H-7	0
2.5H-8	48
2.5H-9	48

Appendix 2.5I Evaluation of Microearthquake Activity in Eastern Washington

TEXT PAGES	AMENDMENT
2.5I-i	0
2.5I-ii	0
2.5I-iii	0
2.5I-1	0
2.5I-2	0
2.5I-3	0
2.5I-4	0
2.5I-5	0
2.5I-6	0
2.5I-7	0

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TEXT PAGES	AMENDMENT
2.5I-56	0
2.5I-57	0
2.5I-58	0
2.5I-59	0
2.5I-60	0
2.5I-61	0
2.5I-62	0
2.5I-63	0
2.5I-64	0
2.5I-65	0
2.5I-66	0
2.5I-67	0
2.5I-68	0
2.5I-69	0
2.5I-70	0
2.5I-71	0
2.5I-72	0
2.5I-73	0
2.5I-74	0
2.5I-75	0
2.5I-76	0
2.5I-77	0
2.5I-78	0
2.5I-79	0
2.5I-80	0
2.5I-81	0
2.5I-82	0
2.5I-83	0
2.5I-84	0
2.5I-85	0
2.5I-86	0
2.5I-87	0
2.5I-88	0
2.5I-89	0
2.5I-90	0
2.5I-91	0
2.5I-92	0
2.5I-93	0
2.5I-94	0
2.5I-95	0
2.5I-96	0
2.5I-97	0
2.5I-98	0
2.5I-99	0
2.5I-100	0
2.5I-101	0
2.5I-102	0
2.5I-103	0

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TEXT PAGES	AMENDMENT
2.5I-104	0

Appendix 2.5J Analysis of the Instrumental Seismicity of the Columbia Plateau

TEXT PAGES	AMENDMENT
2.5J-i	18
2.5J-ii	18
2.5J-iii	18
2.5J-iv	18
2.5J-v	18
2.5J-vi	18
2.5J-1	18
2.5J-2	18
2.5J-3	18
2.5J-4	18
2.5J-5	18
2.5J-6	18
2.5J-7	18
2.5J-8	18
2.5J-9	18
2.5J-10	18
2.5J-11	18
2.5J-12	18
2.5J-13	18
2.5J-14	18
2.5J-15	18
2.5J-16	18
2.5J-17	18
2.5J-18	18
2.5J-19	18
2.5J-20	18
2.5J-21	18
2.5J-22	18
2.5J-23	18
2.5J-24	18
2.5J-25	18
2.5J-26	18
2.5J-27	18
2.5J-28	18
2.5J-29	18
2.5J-30	18
2.5J-31	18
2.5J-32	18
2.5J-33	18
2.5J-34	18

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

TEXT PAGES	AMENDMENT
2.5J-35	18
2.5J-36	18
2.5J-37	18
2.5J-38	18
2.5J-39	18
2.5J-40	18
2.5J-41	18
2.5J-42	18
2.5J-43	18
2.5J-44	18
2.5J-45	18
2.5J-46	18
2.5J-47	18
2.5J-48	18
2.5J-49	18
2.5J-50	18
2.5J-51	18
2.5J-52	18
2.5J-53	18
2.5J-54	18
2.5J-55	18
2.5J-56	18
2.5J-57	18
2.5J-58	18
2.5J-59	18
2.5J-60	18
2.5J-61	18
2.5J-62	18
2.5J-63	18
2.5J-64	18
2.5J-65	18
2.5J-66	18
2.5J-67	18
2.5J-68	18
2.5J-69	18
2.5J-70	18
2.5J-71	18

Appendix 2.5K Seismic Exposure Analysis for the WNP-2 and WNP-1/4 Sites

TEXT PAGES	AMENDMENT
2.5K-i	18
2.5K-ii	18
2.5K-iii	18
2.5K-iv	18

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

TEXT PAGES	AMENDMENT
2.5K-v	18
2.5K-vi	18
2.5K-vii	18
2.5K-viii	18
2.5K-ix	18
2.5K-x	18
2.5K-xi	18
2.5K-1	18
2.5K-2	18
2.5K-3	18
2.5K-4	18
2.5K-5	18
2.5K-6	18
2.5K-7	18
2.5K-8	18
2.5K-9	18
2.5K-10	18
2.5K-11	18
2.5K-12	18
2.5K-13	18
2.5K-14	18
2.5K-15	18
2.5K-16	18
2.5K-17	18
2.5K-18	18
2.5K-19	18
2.5K-20	18
2.5K-21	18
2.5K-22	18
2.5K-23	18
2.5K-24	18
2.5K-25	18
2.5K-26	18
2.5K-27	18
2.5K-28	18
2.5K-29	18
2.5K-30	18
2.5K-31	18
2.5K-32	18
2.5K-33	18
2.5K-34	18
2.5K-35	18
2.5K-36	18
2.5K-37	18
2.5K-38	18
2.5K-39	18
2.5K-40	18

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

TEXT PAGES	AMENDMENT
2.5K-41	18
2.5K-42	18
2.5K-43	18
2.5K-44	18
2.5K-45	18
2.5K-46	18
2.5K-47	18
2.5K-48	18
2.5K-49	18
2.5K-50	18
2.5K-51	18
2.5K-52	18
2.5K-53	18
2.5K-54	18
2.5K-55	18
2.5K-56	18
2.5K-57	18
2.5K-58	18
2.5K-59	18
2.5K-60	18
2.5K-61	18
2.5K-62	18
2.5K-63	18
2.5K-64	18
2.5K-65	18
2.5K-66	18
2.5K-67	18
2.5K-68	18
2.5K-69	18
2.5K-70	18
2.5K-71	18
2.5K-72	18
2.5K-73	18
2.5K-74	18
2.5K-75	18
2.5K-76	18
2.5K-77	18
2.5K-78	18
2.5K-79 Attachment A	18
2.5K-80	18
2.5K-81	18
2.5K-82	18
2.5K-83	18
2.5K-84	18
2.5K-85	18
2.5K-86	18
2.5K-87	18
2.5K-88	18

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

TEXT PAGES		AMENDMENT
2.5L-30		18
2.5L-31		18
2.5L-32		18
2.5L-33		18
2.5L-34	Attachment 1 Geologic Modelir the Columbia Plateau Constrained by Gravity Data	18
2.5L-35		18
2.5L-36		18
2.5L-37		18
2.5L-38		18
2.5L-39		18
2.5L-40		18
2.5L-41		18
2.5L-42		18
2.5L-43		18
2.5L-44		18
2.5L-45		18

Appendix 2.5M Not Used

Appendix 2.5N Late Cenogic Tectonics of the Pacific Northwest With Special Reference to the Columbia Plateau

TEXT PAGES	AMENDMENT
2.5N-i	18
2.5N-ii	18
2.5N-iii	18
2.5N-1	18
2.5N-2	18
2.5N-3	18
2.5N-4	18
2.5N-5	18
2.5N-6	18
2.5N-7	18
2.5N-8	18
2.5N-9	18
2.5N-10	18
2.5N-11	18
2.5N-12	18
2.5N-13	18
2.5N-14	18
2.5N-15	18
2.5N-16	18
2.5N-17	18

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

Appendix 2.5-O Models of the Development of Yakima Deformation

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

TEXT PAGES	AMENDMENT
2.5-O-55	18
2.5-O-56	18
2.5-O-57	18
2.5-O-58	18
2.5-O-59	18
2.5-O-60	18
2.5-O-61	18
2.5-O-62	18
2.5-O-63	18
2.5-O-64	18
2.5-O-65	18
2.5-O-66	18
2.5-O-67	18
2.5-O-68	18
2.5-O-69	18

Appendix 2.5P Length, Character, and Capability of Crew (Response to NRC Question 360.014)

TEXT PAGES	AMENDMENT
2.5P-1	36
2.5P-2	36
2.5P-3	36
2.5P-4	36
2.5P-5	36
2.5P-6	36
2.5P-7	36
2.5P-8	36
2.5P-9	36
2.5P-10	36
2.5P-11	36
2.5P-12	36
2.5P-13	36
2.5P-14	36
2.5P-15	36

FIGURES	AMENDMENT
2.5P-1	37
2.5P-2	37

Appendix 2.5Q Site-Specific Response Spectra (Response to NRC Question 361.017)

TEXT PAGES	AMENDMENT
2.5Q-1	36
2.5Q-2	36

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

TEXT PAGES	AMENDMENT
2.5Q-3	36
2.5Q-4	36
2.5Q-5	36
2.5Q-6	36
2.5Q-7	36
2.5Q-8	36
2.5Q-9	36
2.5Q-10	36
2.5Q-11	36
2.5Q-12	36
2.5Q-13	36
2.5Q-14	36
2.5Q-15	36
2.5Q-16	36
2.5Q-17	36
2.5Q-18	36
2.5Q-19	36
2.5Q-20	36
2.5Q-21	36
2.5Q-22	36
2.5Q-23	36
2.5Q-24	36
2.5Q-25	36
2.5Q-26	36
2.5Q-27	36
2.5Q-28	36
2.5Q-29	49
2.5Q-30	36
2.5Q-31	36
2.5Q-32	36
2.5Q-33	36
2.5Q-34	36
2.5Q-35	36
2.5Q-36	36
2.5Q-37	36
2.5Q-38	49
2.5Q-39	49

FIGURES	AMENDMENT
2.5Q-1	37
2.5Q-2	37
2.5Q-3	37
2.5Q-4	37
2.5Q-5	37
2.5Q-6	37
2.5Q-7	37
2.5Q-8	37

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

TEXT PAGES	AMENDMENT
2.5Q-9	37
2.5Q-10	37
2.5Q-11	37
2.5Q-12	37
2.5Q-13	37
2.5Q-14	37
2.5Q-15	37
2.5Q-16	37
2.5Q-17	37
2.5Q-18	37
2.5Q-19	37
2.5Q-20	37
2.5Q-21	37
2.5Q-22	37
2.5Q-23	37
2.5Q-24	37
2.5Q-25	37
2.5Q-26	37
2.5Q-27	37
2.5Q-28	37
2.5Q-29	37
2.5Q-A1	37
2.5Q-A2	37
2.5Q-A3	37
2.5Q-A4	37
2.5Q-A5	37
2.5Q-A6	37
2.5Q-A7	37
2.5Q-A8	37
2.5Q-A9	37
2.5Q-A10	37
2.5Q-A11	37
2.5Q-A12	37
2.5Q-A13	37
2.5Q-A14	37
2.5Q-A15	37
2.5Q-A16	37
2.5Q-A17	37
2.5Q-A18	37
2.5Q-A19	37
2.5Q-A20	37
2.5Q-A21	37
2.5Q-A22	37
2.5Q-A23	37

Appendix 2.5R Ground Motions from Small Magnitude Near-Field Earthquakes (Response to NRC Question 361.016)

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

FIGURES	AMENDMENT
2.1-7	47
2.1-8	37
2.1-9	20
2.1-10	20
2.1-11	20
2.1-12	20
2.1-13	20
2.1-14	20
2.1-15	20
2.1-16	20
2.1-17	20
2.1-18	20
2.1-19	37
2.2-1	48
2.2-2	38
2.2-3	48
2.2-4	38
2.2-5	38
2.2-6	38
2.3-1	10
2.3-2	0
2.3-3	47
2.3-4	0
2.3-5	0
2.3-6	0
2.3-7	0
2.3-8	0
2.3-9a	0
2.3-9b	0
2.3-10a	0
2.3-10b	0
2.3-11a	0
2.3-11b	0
2.3-12	0
2.3-13a	0
2.3-13b	0
2.3-13c	0
2.3-13d	0
2.3-14	0
2.4-1	0
2.4-2	0

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

FIGURES	AMENDMENT
2.4-3	5
2.4-4	0
2.4-5	0
2.4-6	0
2.4-7	0
2.4-8	0
2.4-9	5
2.4-10	13
2.4-11	5
2.4-12	5
2.4-13	13
2.4-14	0
2.4-15	0
2.4-16	0
2.4-17	0
2.4-18	0
2.4-19	0
2.4-20	13
2.4-21	13
2.4-22	13
2.4-23	13
2.4-24	0
2.4-25	0
2.4-26	13
2.4-27	0
2.4-28	0
2.4-29	0
2.4-30	0
2.4-31	0
2.4-32	0
2.4-33	0
2.4-34	0
2.4-35	23
2.4-36	0
2.5-1	18
2.5-2	18
2.5-2a	18
2.5-3	18
2.5-4	18
2.5-5	18
2.5-6a	18
2.5-6b	18
2.5-6c	18
2.5-7	18
2.5-8	18
2.5-8a	18
2.5-8b	18

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

FIGURES	AMENDMENT
2.5A-4f	0
2.5A-4g	0
2.5A-4h	0
2.5A-4i	0
2.5A-4j	0
2.5A-4k	0
2.5A-5a	0
2.5A-5b	0
2.5A-5c	0
2.5A-5d	0
2.5A-5e	0
2.5A-5f	0
2.5A-5g	0
2.5A-5h	0
2.5A-5i	0
2.5A-6a	0
2.5A-6b	0
2.5A-6c	0
2.5A-6d	0
2.5A-6e	0
2.5A-6f	0
2.5A-6g	0
2.5A-6h	0
2.5A-7a	0
2.5A-7b	0
2.5A-7c	0
2.5A-7d	0
2.5A-7e	0
2.5A-7f	0
2.5A-7g	0
2.5A-8a	0
2.5A-8b	0
2.5A-8c	0
2.5A-8d	0
2.5A-8e	0
2.5A-8f	0
2.5A-8g	0
2.5A-9a	0
2.5A-9b	0
2.5A-9c	0
2.5A-9d	0
2.5A-9e	0
2.5A-9f	0
2.5A-9g	0
2.5A-10a	0
2.5A-10b	0

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

FIGURES	AMENDMENT
2.5A-10c	0
2.5A-10d	0
2.5A-10e	0
2.5A-10f	0
2.5A-11a	0
2.5A-11b	0
2.5A-11c	0
2.5A-12a	0
2.5A-12b	0
2.5A-12c	0
2.5A-12d	0
2.5A-13a	0
2.5A-13b	0
2.5A-13c	0
2.5A-13d	0
2.5A-14a	0
2.5A-14b	0
2.5A-14c	0
2.5A-14d	0
2.5A-15a	0
2.5A-15b	0
2.5A-15c	0
2.5A-16a	0
2.5A-16b	0
2.5A-16c	0
2.5A-17a	0
2.5A-17b	0
2.5A-18a	0
2.5A-18b	0
2.5A-19a	0
2.5A-19b	0
2.5A-20a	0
2.5A-20b	0

Appendix 2.5B	0

FIGURES	AMENDMENT
2.5B-1	0
2.5B-2	0
2.5B-3	0
2.5B-4	0
2.5B-5	0
2.5B-6	0
2.5B-7	0
2.5B-8	0

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

FIGURES	AMENDMENT
2.5B-9	0
2.5B-10	0
2.5B-11	0
2.5B-12	0
2.5B-13	0
2.5B-14	0
2.5B-15	0
2.5B-16	0
2.5B-17	0
2.5B-18	0
2.5B-19	0
2.5B-20	0
2.5B-21	0
2.5B-22	0
2.5B-23	0
2.5B-24	0
2.5B-25	0
2.5B-26	0

Appendix 2.5C

FIGURES	AMENDMENT
2.5C-1a	0
2.5C-1b	0
2.5C-2a	0
2.5C-2b	0
2.5C-3a	0
2.5C-3b	0
2.5C-4a	0
2.5C-4b	0
2.5C-5a	0
2.5C-5b	0
2.5C-5c	0
2.5C-6	0
2.5C-7	0

Appendix 2.5D

FIGURES	AMENDMENT
2.5D-1	0
2.5D-2	0
2.5D-3	0
2.5D-4	0
2.5D-5	0
2.5D-6	0
2.5D-7	0

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

FIGURES	AMENDMENT

Appendix 2.5I

FIGURES	AMENDMENT
2.5I-1a	0
2.5I-1b	0
2.5I-1c	0
2.5I-1d	0
2.5I-2	0
2.5I-3	0
2.5I-4	0
2.5I-5	0
2.5I-6	0
2.5I-7	0
2.5I-8	0
2.5I-9	0
2.5I-10	0
2.5I-11	0
2.5I-12	0

Appendix 2.5J

FIGURES	AMENDMENT
2.5J-0	18
2.5J-1	18
2.5J-2	18
2.5J-3	18
2.5J-4	18
2.5J-5	18
2.5J-6	18
2.5J-7	18
2.5J-8	18
2.5J-9	18
2.5J-10	18
2.5J-11	18
2.5J-12	18
2.5J-13	18
2.5J-14	18
2.5J-15	18
2.5J-16	18
2.5J-17	18
2.5J-18	18
2.5J-19	18
2.5J-20	18
2.5J-21	18
2.5J-22	18
2.5J-23	18

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

FIGURES	AMENDMENT
2.5K-14	18
2.5K-15	18
2.5K-16	18
2.5K-17	18
2.5K-18	18
2.5K-19	18
2.5K-20	18
2.5K-21	18
2.5K-22	18
2.5K-23	18
2.5K-24	18
2.5K-25	18
2.5K-26	18
2.5K-27	18
2.5K-28	18
2.5K-29	18
2.5K-30	18
2.5K-31	18
2.5K-32	18
2.5K-33	18
2.5K-34	18
2.5K-35	18
2.5K-36	18
2.5K-37	18
2.5K-38	18
2.5K-39	18
2.5K-40	18
2.5K-41	18
2.5K-42	18
2.5K-43	18
2.5K-44	18
2.5K-45	18
2.5K-46	18
2.5K-47	18
2.5K-48	18
2.5K-49	18
2.5K-50	18
2.5K-51	18
2.5K-52	18
2.5K-53	18
2.5K-54	18
2.5K-55	18
2.5K-56	18
2.5K-57	18
2.5K-58	18
2.5K-59	18
2.5K-60	18
2.5K-61	18

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

FIGURES	AMENDMENT
2.5K-62	18
2.5K-63	18
2.5K-64	18
2.5K-65	18
2.5K-66	18
2.5K-67	18
2.5K-68	18
2.5K-69	18

Appendix 2.5L

FIGURES	AMENDMENT
2.5L-1	18
2.5L-2	18
2.5L-3	18
2.5L-4	18
2.5L-5	18
2.5L-6	18
2.5L-7	18
2.5L-8	18
2.5L-9	18
2.5L-10	18
2.5L-11	18
2.5L-12	18
2.5L-13	18
2.5L-14	18
2.5L-15	18
2.5L-16	18
2.5L-17	18
2.5L-18	18
2.5L-19a	18
2.5L-19b	18
2.5L-19c	18
2.5L-19d	18
2.5L-19e	18
2.5L-19f	18
2.5L-19g	18
2.5L-20	18
2.5L-21	18
2.5L-22	18
2.5L-23	18
2.5L-24	18
2.5L-25	18
2.5L-26	18
2.5L-A1	18
2.5L-A2	18
2.5L-A3	18

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 2 (Continued)

FIGURES	AMENDMENT
2.50-15	18
2.50-15a	18
2.50-16	18
2.50-17	18
2.50-18	18
2.50-19	18
2.50-20	18
2.50-21	18
2.50-22	18
2.50-23	18
2.50-24	18

LIST OF EFFECTIVE PAGES

CHAPTER 3

TEXT PAGES	AMENDMENT
3-i	0
3-ii	50
3-iii	0
3-iv	0
3-v	36
3-vi	25
3-vii	0
3-viii	50
3-ix	36
3-ixa	27
3-x	50
3-xa	27
3-xi	36
3-xii	9
3-xiia	50
3-xiii	0
3-xiv	49
3-xv	9
3-xva	36
3-xvb	36
3-xvi	50
3-xvii	31
3-xviii	50
3-xix	50
3-xx	50
3-xxa	23
3-xxi	51
3-xxii	8
3-xxiia	1
3-xxiii	0
3-xxiv	50
3-xxv	0
3-xxvi	50
3-xxvia	8
3-xxvii	0
3-xxviii	0
3-xxix	8
3-xxx	43
3-xxxa	9
3-xxxi	0
3-xxxii	36
3-xxxiii	0
3-xxxiv	29
3-xxxv	32
3-xxxva	29
3-xxxvb	32
3-xxxvi	50
3-xxxvii	36
3-xxxviii	36

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.2-9	47
3.2-9a	33
3.2-10	33
3.2-11	39
3.2-12	52
3.2-13	49
3.2-14	38
3.2-15	36
3.2-16	36
3.2-17	51
3.2-18	52
3.2-19	52
3.2-20	40
3.2-21	36
3.2-22	49
3.2-23	50
3.2-24	39
3.2-25	36
3.2-25a	36
3.2-26	49
3.2-27	36
3.2-28	36
3.2-29	27
3.2-30	30
3.2-31	39
3.2-32	30
3.2-33	49
3.2-33a	52
3.2-34	36
3.2-35	36
3.2-36	36
3.2-37	36
3.2-38	36
3.2-39	36
3.2-40	36
3.2-41	36
3.2-42	36
3.2-43	36
3.2-44	36
3.2-45	36
3.2-46	36
3.2-47	36
3.2-48	36
3.2-49	36
3.2-50	36
3.2-51	36
3.2-52	36
3.2-53	36
3.2-54	36

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.2-55	36
3.2-56	36
3.2-57	36
3.2-58	36
3.2-59	36
3.2-60	36
3.2-61	36
3.2-62	36
3.2-63	50
3.2-64	36
3.2-65	36
3.2-66	36
3.3-1	27
3.3-2	0
3.3-3	40.
3.3-4	8
3.3-4a	40
3.3-4b	8
3.3-5	40
3.3-6	49
3.3-7	49
3.3-8	48
3.3-9	0
3.4-1	13
3.4-2	36
3.4-2a	5
3.4-2b	5
3.4-3	0
3.4-4	36
3.4-5	52
3.4-5a	5
3.4-6	0
3.4-7	5
3.5-1	36
3.5-1a	36
3.5-2	27
3.5-3	27
3.5-4	27
3.5-5	48
3.5-6	27
3.5-7	27
3.5-8	27
3.5-9	27
3.5-10	27
3.5-11	27
3.5-11a	27

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.6-3a	0
3.6-4	25
3.6-5	49
3.6-6	9
3.6-6a	9
3.6-6b	9
3.6-6c	9
3.6-6d	33
3.6-6e	9
3.6-6f	9
3.6-6g	9
3.6-6h	9
3.6-6i	9
3.6-6j	33
3.6-6k	9
3.6-6l	9
3.6-6m	25
3.6-7	33
3.6-7a	25
3.6-8	33
3.6-9	34
3.6-10	25
3.6-11	25
3.6-12	33
3.6-13	36
3.6-14	49
3.6-15	52
3.6-16	52
3.6-17	49
3.6-18	50
3.6-19	49
3.6-20	51
3.6-21	0
3.6-22	25
3.6-22a	9
3.6-22b	9
3.6-22c	9
3.6-22d	9
3.6-22e	9
3.6-22f	25
3.6-22g	36
2.6-22h	36
3.6-23	31
3.6-24	31
3.6-25	52
3.6-26	46
3.6-27	50
3.6-28	30
3.6-28a	25

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.6-29	36
3.6-30	9
3.6-30a	25
3.6-31	31
3.6-32	0
3.6-33	25
3.6-33a	25
3.6-34	31
3.6-35	25
3.6-36	0
3.6-37	31
3.6-38	31
3.6-39	0
3.6-40	0
3.6-41	0
3.6-42	31
3.6-42a	31
3.6-43	0
3.6-44	27
3.6-45	0
3.6-46	27
3.6-47	33
3.6-48	52
3.6-49	0
3.6-50	25
3.6-51	31
3.6-52	31
3.6-53	31
3.6-53a	51
3.6-54	0
3.6-55	0
3.6-56	49
3.6-57	46
3.6-57a	25
3.6-58	31
3.6-59	31
3.6-59a	14
3.6-60	9
3.6-61	9
3.6-62	9
3.6-63	50
3.6-64	50
3.6-64a	9
3.6-65	36
3.6-65a	36
3.6-66	25
3.6-67	43
3.6-68	43
3.6-69	9

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.6-70	25
3.6-71	25
3.6-72	9
3.6-72a	31
3.6-73	31
3.6-74	1
3.6-75	12
3.6-75a	25
3.6-76	33
3.6-77	43
3.6-78	0
3.6-79	0
3.6-80	0
3.6-81	51
3.6-82	51
3.6-83	51
3.6-84	51
3.6-85	51
3.6-86	51
3.6-87	51
3.6-88	9
3.6-89	9
3.6-90	9
3.6-91	9
3.6-92	9
3.6-93	36
3.6-94	51
3.6-95	51
3.6-96	9
3.6-97	9
3.6-98	9
3.6-99	9
3.6-100	9
3.6-101	25
3.7-1	0
3.7-2	0
3.7-3	0
3.7-4	12
3.7-5	30
3.7-6	0
3.7-7	0
3.7-8	30
3.7-9	30
3.7-10	23
3.7-11	30
3.7-11a	23
3.7-11b	23
3.7-12	30

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.7-13	8
3.7-13a	8
3.7-14	30
3.7-15	30
3.7-15a	25
3.7-16	30
3.7-17	52
3.7-18	30
3.7-19	0
3.7-20	36
3.7-21	36
3.7-22	30
3.7-23	1
3.7-24	0
3.7-25	36
3.7-26	36
3.7-27	42
3.7-28	36
3.7-29	36
3.7-30	36
3.7-31	8
3.7-31a	8
3.7-31b	8
3.7-32	8
3.7-33	42
3.7-34	25
3.7-35	25
3.7-36	30
3.7-36a	8
3.7-37	0
3.7-38	8
3.7-38a	8
3.7-38b	8
3.7-38c	8
3.7-38d	8
3.7-38e	8
3.7-38f	1
3.7-39	8
3.7-40	51
3.7-41	51
3.7-42	52
3.7-43	0
3.7-44	36
3.7-45	42
3.7-46	0
3.7-47	21
3.7-48	21
3.7-49	0
3.7-50	0

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.7-51	0
3.7-52	0
3.7-53	0
3.7-54	0
3.7-55	0
3.7-56	0
3.7-57	0
3.7-58	0
3.7-59	0
3.7-60	0
3.7-61	0
3.7-62	0
3.7-63	0
3.7-64	0
3.7-65	0
3.7-66	0
3.7-67	25
3.7-68	42
3.8-1	0
3.8-2	0
3.8-3	12
3.8-3a	1
3.8-3b	1
3.8-4	0
3.8-5	30
3.8-6	30
3.8-6a	8
3.8-6b	36
3.8-6c	30
3.8-7	36
3.8-8	0
3.8-9	8
3.8-10	30
3.8-11	40
3.8-12	0
3.8-13	46
3.8-13a	52
3.8-14	47
3.8-15	47
3.8-16	30
3.8-17	30
3.8-18	36
3.8-18a	40
3.8-19	51
3.8-20	51
3.8-21	36
3.8-22	51
3.8-23	0

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.8-24	0
3.8-25	0
3.8-26	14
3.8-27	14
3.8-28	0
3.8-29	0
3.8-30	0
3.8-31	0
3.8-32	0
3.8-33	0
3.8-34	0
3.8-35	0
3.8-36	0
3.8-37	30
3.8-38	30
3.8-39	50
3.8-40	30
3.8-41	30
3.8-42	8
3.8-42a	8
3.8-43	3
3.8-44	30
3.8-44a	3
3.8-44b	51
3.8-45	51
3.8-45a	51
3.8-46	49
3.8-46a	32
3.8-47	0
3.8-48	2
3.8-49	0
3.8-50	0
3.8-51	0
3.8-52	0
3.8-53	0
3.8-54	30
3.8-55	0
3.8-56	0
3.8-57	0
3.8-58	30
3.8-59	0
3.8-60	30
3.8-61	1
3.8-62	52
3.8-63	51
3.8-64	0
3.8-65	12
3.8-65a	1
3.8-65b	1

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.8-66	13
3.8-67	0
3.8-68	35
3.8-69	0
3.8-70	0
3.8-71	13
3.8-72	13
3.8-73	0
3.8-74	2
3.8-75	0
3.8-76	12
3.8-77	0
3.8-78	0
3.8-79	0
3.8-80	0
3.8-81	0
3.8-82	0
3.8-83	0
3.8-84	0
3.8-85	13
3.8-86	8
3.8-87	8
3.8-88	13
3.8-88a	8
3.8-89	8
3.8-89a	8
3.8-90	8
3.8-90a	8
3.8-91	8
3.8-91a	8
3.8-92	35
3.8-92a	0
3.8-93	2
3.8-94	49
3.8-95	5
3.8-96	21
3.8-97	0
3.8-98	36
3.8-99	12
3.8-100	1
3.8-101	36
3.8-102	52
3.8-102a	36
3.8-103	9
3.8-103a	9
3.8-104	9
3.8-105	0
3.8-106	0
3.8-107	0

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.8-108	0
3.8-109	0
3.8-110	0
3.8-111	5
3.8-112	4
3.8-113	37
3.8-114	4
3.8-115	4
3.8-116	0
3.8-117	0
3.8-118	0
3.8-119	0
3.8-119a	7
3.8-119b	5
3.8-120	0
3.8-121	0
3.8-122	0
3.8-123	0
3.8-124	0
3.8-125	0
3.8-126	9
3.8-127	9
3.8-128	49
3.8-129	9
3.8-129a	9
3.8-130	9
3.8-130a	9
3.8-131	0
3.8-132	0
3.8-133	0
3.8-134	0
3.8-135	9
3.8-136	0
3.8-137	12
3.8-137a	36
3.8-137b	1
3.8-138	0
3.8-139	0
3.8-140	0
3.8-141	10
3.8-142	0
3.8-143	0
3.8-144	8
3.8-144a	8
3.8-145	0
3.8-146	12
3.8-146a	12
3.8-147	9
3.8-148	0

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.8-149	40
3.8-149a	36
3.8-150	0
3.8-151	30
3.8-151a	30
3.8-152	51
3.8-153	51
3.8-154	0
3.8-155	51
3.8-156	51
3.8-157	37
3.8-158	51
3.8-159	51
3.8-160	51
3.8-161	51
3.8-162	0
3.8-163	0
3.8-164	0
3.8-165	51
3.8-166	51
3.8-167	0
3.8-168	0
3.8-169	0
3.8-170	51
3.8-171	0
3.8-172	0
3.8-173	0
3.8-174	0
3.8-175	14
3.8-176	34
3.8-177	51
3.8-178	0
3.8-179	0
3.8-180	51
3.8-181	0
3.8-182	51
3.8-183	51
3.8-184	51
3.8-184a	51
3.8-185	0
3.8-186	0
3.8-187	0
3.8-188	32
3.8-189	27
3.8-190	34
3.8-190a	32
3.8-191	27
3.8-192	27
3.8-193	30

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.8-194	27
3.8-195	0
3.8-196	0
3.8-197	0
3.8-198	0
3.8-199	8
3.8-200	0
3.8-201	9
3.8-202	9
3.8-203	9
3.8-204	9
3.8-205	8
3.8-206	0
3.9-1	29
3.9-2	29
3.9-3	29
3.9-4	32
3.9-5	32
3.9-6	29
3.9-7	32
3.9-8	29
3.9-9	29
3.9-10	29
3.9-11	29
3.9-12	52
3.9-13	29
3.9-14	29
3.9-15	29
3.9-16	29
3.9-17	29
3.9-18	29
3.9-19	29
3.9-20	29
3.9-21	29
3.9-22	36
3.9-23	29
3.9-24	29
3.9-25	29
3.9-26	32
3.9-27	36
3.9-28	29
3.9-29	36
3.9-30	36
3.9-31	36
3.9-32	36
3.9-33	36
3.9-34	29
3.9-35	36

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.9-36	36
3.9-37	52
3.9-37a	48
3.9-38	36
3.9-39	52
3.9-40	52
3.9-41	36
3.9-42	36
3.9-43	36
3.9-44	36
3.9-45	36
3.9-46	36
3.9-47	29
3.9-48	29
3.9-49	34
3.9-49a	34
3.9-49b	34
3.9-49c	48
3.9-50	32
3.9-51	52
3.9-52	36
3.9-53	36
3.9-54	52
3.9-55	29
3.9-56	36
3.9-57	37
3.9-58	35
3.9-59	50
3.9-60	52
3.9-61	32
3.9-62	32
3.9-63	29
3.9-64	29
3.9-65	29
3.9-66	47
3.9-67	50
3.9-68	35
3.9-69	38
3.9-70	38
3.9-71	38
3.9-71a	38
3.9-72	38
3.9-73	38
3.9-74	38
3.9-74a	38
3.9-75	36
3.9-76	30
3.9-77	30
3.9-78	36

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.9-79	29
3.9-80	49
3.9-81	36
3.9-82	29
3.9-83	29
3.9-84	49
3.9-85	49
3.9-86	49
3.9-87	36
3.9-87a	36
3.9-88	29
3.9-89	29
3.9-90	36
3.9-91	33
3.9-92	50
3.9-93	50
3.9-94	52
3.9-95	51
3.9-96	52
3.9-97	52
3.9-98	52
3.9-99	36
3.9-100	36
3.9-101	36
3.9-101a	36
3.9-101b	36
3.9-101c	36
3.9-101d	36
3.9-102	32
3.9-103	29
3.9-104	29
3.9-105	32
3.9-106	36
3.9-107	36
3.9-108	36
3.9-109	34
3.9-109a	36
3.9-110	29
3.9-111	52
3.9-112	52
3.9-113	52
3.9-114	52
3.9-115	50
3.9-116	50
3.9-117	52
3.9-118	50
3.9-119	52
3.9-120	29
3.9-121	29

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.9-122	29
3.9-123	29
3.9-124	32
3.9-125	29
3.9-126	29
3.9-127	31
3.9-128	29
3.9-129	29
3.9-130	29
3.9-131	29
3.9-132	29
3.9-133	29
3.9-134	29
3.9-135	32
3.9-136	29
3.9-137	29
3.9-138	29
3.9-139	29
3.9-140	29
3.9-141	29
3.9-142	29
3.9-143	29
3.9-144	32
3.9-145	31
3.9-146	31
3.9-147	31
3.9-148	31
3.9-149	31
3.9-150	29
3.9-151	29
3.9-152	29
3.9-153	29
3.9-154	29
3.9-155	29
3.9-156	36
3.9-157	36
3.9-158	36
3.9-159	29
3.9-160	29
3.9-161	29
3.9-162	36
3.9-163	29
3.9-164	52
3.9-165	52
3.9-166	52
3.9-167	29
3.9-168	29
3.9-169	29
3.9-170	29

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CHAPTER 3 (Continued)

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CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.9-219	35
3.9-220	52
3.9-221	35
3.9-222	35
3.10-1	49
3.10-1a	49
3.10-2	47
3.10-2a	52
3.10-2b	47
3.10-2c	47
3.10-3	52
3.10-4	52
3.10-5	36
3.10-5a	36
3.10-5b	52
3.10-5c	36
3.10-5d	36
3.10-6	47
3.10-7	36
3.10-8	36
3.10-9	52
3.10-10	47
3.10-11	47
3.10-12	47
3.10-13	47
3.10-14	47
3.10-15	47
3.10-16	52
3.10-17	47
3.10-18	36
3.10-19	36
3.10-20	36
3.10-21	52
3.10A-1	0
3.10A-2	0
3.10A-3	0
3.10A-4	0
3.10A-5	0
3.10A-6	0
3.10A-7	0
3.10B-1	0
3.10B-2	0
3.10B-3	0
3.10B-4	0
3.10B-5	0
3.10B-6	0
3.10B-7	0
3.10B-8	0

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.10B-9	0
3.10B-10	0
3.10B-11	0
3.10B-12	0
3.10B-13	0
3.10B-14	0
3.10B-15	0
3.10B-16	0
3.10C-1	0
3.10C-2	36
3.10C-3	0
3.10C-4	0
3.10C-5	36
3.10C-5a	36
3.10D-1	26
3.11-1	52
3.11-2	52
3.11-2a	52
3.11-3	49
3.11-4	52
3.11-5	52
3.11-5a	49
3.11-6	52
3.11-7	52
3.11-8	49
3.11-8a	52
3.11-8b	49
3.11-8c	49
3.11-9	48
3.11-10	49
3.11-11	49
3.11-12	52
3.11-12a	52
3.11-13	49
3.11-14	40
3.11-15	32
3.11-16	40
3.11-17	32
3.11-18	32
3.11-19	32
3.11-20	49
3.11-21	49
3.11A-1	33
3.11A-2	33
3.11A-3	33
3.11A-4	33
3.11A-5	33

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

TEXT PAGES	AMENDMENT
3.11A-6	33
3.12-1	0
3.12-2	0
3.12-3	0
3.12-4	0
3.12-5	0
3.12-6	0
3.12-7	0
3.12-8	0
3.12-9	0
3.12-10	0
3.12-11	0
3.12-12	0
3.12-13	0
3.12-14	0
3.12-15	25
3.12-16	29
3.12-17	29
3.12-18	34
3.12-18a	36
3.12-18b	36
3.12-18c	36
3.12-19	36
3.12-20	29
3.12-21	29
3.12-22	29
3.12-23	29
3.12-24	29
3.12-25	29
3.12-26	29
3.12-27	29
3.12-28	29
3.12-29	29
3.12-30	29
3.12-31	29

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

FIGURES	AMENDMENT
3.2-1	37
3.2-2	52
3.2-3 1 of 2	52
3.2-3 2 of 2	52
3.2-4 1 of 2	52
3.2-4 2 of 2	52
3.2-5	52
3.2-6a	52
3.2-6b	52
3.2-7	51
3.2-8	52
3.2-9	51
3.2-10	52
3.2-11 1 of 2	52
3.2-11 2 of 2	50
3.2-12	51
3.2-13a	52
3.2-13b	52
3.2-13c	52
3.2-14	50
3.2-15a	52
3.2-15b	48
3.2-15c	52
3.2-16	52
3.2-17	52
3.2-18 1 of 3	52
3.2-18 2 of 3	52
3.2-18 3 of 3	52
3.2-19	52
3.2-20	52
3.2-21a	51
3.2-21b	51
3.2-22a	51
3.2-22b	51
3.2-22c	51
3.2-22d	51
3.2-23a	51
3.2-23b	51
3.2-23c	50
3.2-24	51
3.2-25	48
3.2-26	52
3.2-27	52
3.5-1	50
3.5-2	48
3.5-3	50
3.5-4	50
3.5-5	52

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

FIGURES	AMENDMENT
3.5-6	50
3.5-7	48
3.5-8	50
3.5-9	40
3.5-10	48
3.5-11	52
3.5-12	48
3.5-13	50
3.5-14	51
3.5-15	52
3.5-16	37
3.5-17	48
3.5-18	48
3.5-19	37
3.5-20	37
3.5-21	42
3.5-22	37
3.5-23	42
3.5-24	37
3.5-25	37
3.5-26	37
3.5-27	37
3.5-28	37
3.5-29	38
3.5-30	50
3.5-31	50
3.5-32	50
3.5-33	23
3.5-34	23
3.5-35	23
3.5-36	0
3.5-37	0
3.5-38	48
3.5-39	37
3.5-40	50
3.5-41	50
3.5-42	40
3.5-43	48
3.5-44	43
3.5-45	37
3.5-46	37
3.5-47	51
3.5-48	50
3.5-49	42
3.5-50	50
3.5-51	50
3.5-52	37
3.5-53	48

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

FIGURES	AMENDMENT
3.6-1	0
3.6-2	0
3.6-3	27
3.6-4	31
3.6-5	0
3.6-5a	0
3.6-5b	0
3.6-5c	0
3.6-5d	0
3.6-5e	0
3.6-6a	0
3.6-6b	0
3.6-6c	2
3.6-6d	0
3.6-6e	0
3.6-6f	0
3.6-6g	0
3.6-6h	2
3.6-6j	0
3.6-6k	0
3.6-7a	0
3.6-7b	0
3.6-7c	0
3.6-8	0
3.6-9a	2
3.6-9b	0
3.6-10	0
3.6-11	9
3.6-12a	46
3.6-12b	46
3.6-12c	9
3.6-13a	48
3.6-13b	48
3.6-13c	9
3.6-14a	52
3.6-14b	52
3.6-14c	9
3.6-15a	46
3.6-15b	46
3.6-15c	9
3.6-16a	49
3.6-16b	43
3.6-16c	43
3.6-16d	9
3.6-16e	9
3.6-17a	43
3.6-17b	43
3.6-18a	34
3.6-18b	50

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

FIGURES	AMENDMENT
3.6-18c	48
3.6-19a	50
3.6-19b	50
3.6-20a	46
3.6-20b	46
3.6-21a	46
3.6-21b	46
3.6-22a	46
3.6-22b	46
3.6-23a	50
3.6-23b	50
3.6-24a	50
3.6-24b	50
3.6-25a	50
3.6-25b	50
3.6-26a	46
3.6-26b	46
3.6-27a	46
3.6-27b	46
3.6-28a	34
3.6-28b	48
3.6-29a	48
3.6-29b	48
3.6-30a	34
3.6-30b	34
3.6-30c	34
3.6-31a	52
3.6-31b	52
3.6-31c	48
3.6-32a	48
3.6-32b	48
3.6-33a	9
3.6-33b	34
3.6-34a	34
3.6-34b	34
3.6-35a 1 of 2	52
3.6-35a 2 of 2	52
3.6-35b 1 of 2	50
3.6-35b 2 of 2	50
3.6-36a	49
3.6-36b	49
3.6-36c	49
3.6-37	25
3.6-38	2
3.6-39	2
3.6-40a	2
3.6-40b	2
3.6-41a	33
3.6-41b	33

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

FIGURES	AMENDMENT
3.6-78	25
3.6-79	25
3.6-80	25
3.6-81	25
3.6-82	25
3.6-83	25
3.6-84	25
3.6-85	25
3.6-86	25
3.6-87	25
3.6-88	25
3.6-89	25
3.6-90	25
3.6-91	25
3.6-92	25
3.6-93	25
3.6-94	25
3.6-95	25
3.6-96	25
3.6-97	25
3.6-98	25
3.6-99	25
3.6-100	25
3.6-101	25
3.6-102	25
3.6-103	25
3.6-104	25
3.6-105	25
3.6-106	25
3.6-107	25
3.6-108	25
3.6-109	22
3.6-110	25
3.6-111	25
3.6-112	25
3.6-113	25
3.6-114	25
3.6-115	25
3.6-116	9
3.6-117	9
3.6-118	25
3.6-119	9
3.6-120	9
3.6-121	9
3.6-122	9
3.6-123	9
3.6-124	9
3.6-125	9
3.6-126	9

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

FIGURES	AMENDMENT
3.6-127	9
3.6-128	9
3.6-129	9
3.6-130	9
3.6-131	9
3.6-132	9
3.6-133	9
3.6-134	9
3.6-135	9
3.6-136	9
3.6-137	9
3.6-138	9
3.6-139	9
3.6-140	9
3.6-141	9
3.6-142	9
3.6-143	9
3.6-144	9
3.6-145	9
3.6-146	9
3.6-147a	25
3.6-147b	25
3.6-147c	25
3.6-147d	25
3.6-148	33
3.7-1	0
3.7-2	0
3.7-3	0
3.7-4	0
3.7-5	0
3.7-6	0
3.7-7	0
3.7-8	0
3.7-9	0
3.7-10	0
3.7-11a	0
3.7-11b	0
3.7-12a	0
3.7-12b	0
3.7-13	0
3.7-14a	0
3.7-14b	0
3.7-15	0
3.7-16	0
3.7-17	0
3.7-18	0
3.7-19	0
3.7-20	0

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

FIGURES	AMENDMENT
3.8-41	40
3.8-42	37
3.8-43	42
3.8-44	42
3.8-45	37
3.8-46	0
3.8-47	0
3.8-48	8
3.8-49	0
3.8-50	1
3.8-51	1
3.8-52	1
3.8-53	1
3.8-54	37
3.8-55	50
3.8-56	42
3.8-57	3
3.8-58	3
3.8-59	5
3.8-60	37
3.8-61	37
3.8-62a	13
3.8-62b	13
3.8-63	13
3.9-1	52
3.9-2	52
3.9-3	0
3.9-4	0
3.9-5	0
3.9-6	0
3.9-7	0
3.9-8a	29
3.9-8b	29
3.10-1	0
3.10-2	0
3.10-3	0
3.10-4	0
3.10-5a	52
3.10-5b	52
3.10-5c	52
3.10-5d	52
3.10-5e	52
3.10-6a	52
3.10-6b	52
3.10-7a	52
3.10-7b	52
3.10-8a	52

LIST OF EFFECTIVE PAGES

CHAPTER 3 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 4

TEXT PAGES	AMENDMENT
4-i	49
4-ii	0
4-iii	0
4-iv	50
4-v	50
4-vi	50
4-vii	48
4-viii	48
4-ix	52
4-x	52
4-xi	50
4-xii	48
4-xiii	48
4-xiv	50
4-xv	50
4-xvi	50
4-xvii	51
4-xviii	52
4-xix	50
4.1-1	52
4.1-2	52
4.1-3	52
4.1-4	52
4.1-4a	52
4.1-5	52
4.1-6	52
4.1-7	0
4.1-8	30
4.1-9	52
4.1-9a	52
4.1-10	0
4.1-11	36
4.1-12	36
4.1-13	36
4.1-14	0
4.1-15	36
4.1-16	0
4.1-17	38
4.1-18	52
4.1-19	52
4.1-20	36
4.1-21	46
4.1-22	52
4.1-22a	52

LIST OF EFFECTIVE PAGES

CHAPTER 4 (Continued)

TEXT PAGES	AMENDMENT
4.2-1	52
4.2-2	52
4.2-3	52
4.2-4	49
4.2-4a	49
4.2-4b	49
4.2-5	52
4.2-6	52
4.2-7	52
4.2-8	52
4.2-9	51
4.2-10	50
4.2-11	52
4.2-11a	52
4.2-12	52
4.2-13	52
4.2-13a	52
4.3-1	52
4.3-2	52
4.3-3	51
4.3-4	52
4.3-4a	52
4.3-5	39
4.3-6	51
4.3-7	52
4.3-8	30
4.4-1	52
4.4-1a	38
4.4-2	52
4.4-2a	52
4.4-2b	52
4.4-3	52
4.4-4	52
4.4-5	52
4.4-6	52
4.4-7	52
4.4-8	52
4.4-8a	36
4.4-9	52
4.4-9a	52
4.4-10	52
4.4-11	52
4.4-12	52
4.4-13	38

LIST OF EFFECTIVE PAGES

CHAPTER 4 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 4 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 4 (Continued)

FIGURES	AMENDMENT
4.6-6b	37
4.6-6c	37
4.6-6d	16
4.6-6e	16
4.6-7	0
4.6-8	0

LIST OF EFFECTIVE PAGES

CHAPTER 5

TEXT PAGES	AMENDMENT
5-i	50
5-ii	50
5-iii	36
5-iv	0
5-v	51
5-vi	50
5-vii	50
5-viii	52
5-ix	50
5-x	36
5-x(a)	49
5-xi	51
5-xii	44
5-xiii	36
5-xiv	36
5-xv	50
5-xv(a)	49
5-xvi	50
5-xvii	51
5-xviii	52
5-xix	50
5.1-1	0
5.1-2	0
5.1-3	0
5.1-4	36
5.2-1	0
5.2-2	0
5.2-3	51
5.2-4	51
5.2-5	51
5.2-5a	23
5.2-6	36
5.2-6a	51
5.2-7	48
5.2-7a	30
5.2-8	51
5.2-8a	51
5.2-8b	51
5.2-9	32
5.2-10	32
5.2-10a	51

LIST OF EFFECTIVE PAGES

CHAPTER 5 (Continued)

TEXT PAGES	AMENDMENT
5.2-11	50
5.2-12	30
5.2-13	32
5.2-14	30
5.2-15	32
5.2-15a	32
5.2-15b	32
5.2-15c	32
5.2-15d	36
5.2-15e	47
5.2-15f	36
5.2-16	36
5.2-17	52
5.2-18	0
5.2-19	52
5.2-20	0
5.2-21	0
5.2-22	0
5.2-23	33
5.2-24	50
5.2-24a	36
5.2-25	46
5.2-26	32
5.2-27	0
5.2-28	27
5.2-29	52
5.2-29a	36
5.2-30	36
5.2-31	36
5.2-32	49
5.2-33	30
5.2-34	36
5.2-34a	7
5.2-35	36
5.2-35a	36
5.2-35b	36
5.2-35c	36
5.2-35d	36
5.2-35e	38
5.2-35f	36
5.2-35g	36
5.2-35h	36
5.2-35i	50
5.2-36	36
5.2-37	36
5.2-38	36
5.2-39	36

LIST OF EFFECTIVE PAGES

CHAPTER 5 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 5 (Continued)

TEXT PAGES	AMENDMENT
5.3-9	36
5.3-10	30
5.3-11	51
5.3-12	5
5.3-13	51
5.3-14	36
5.3-15	0
5.3-16	0
5.3-17	36
5.3-18	39
5.3-18a	36
5.3-18b	36
5.3-19	30
5.3-20	0
5.3-21	51
5.3-22	0
5.3-23	30
5.3-24	30
5.3-25	44
5.3-26	36
5.3-27	36
5.3-28	36
5.3-29	49
5.3-30	36
5.3-31	36
5.3-32	36
5.3-33	36
5.3-34	36
5.4-1	52
5.4-2	52
5.4-3	52
5.4-4	52
5.4-5	52
5.4-6	52
5.4-7	36
5.4-8	51
5.4-9	52
5.4-10	51
5.4-11	51
5.4-12	43
5.4-13	0
5.4-14	13
5.4-15	35
5.4-16	35
5.4-17	43
5.4-18	49

LIST OF EFFECTIVE PAGES

CHAPTER 5 (Continued)

TEXT PAGES	AMENDMENT
5.4-19	44
5.4-20	36
5.4-20a	36
5.4-21	36
5.4-22	36
5.4-22a	36
5.4-22b	36
5.4-23	52
5.4-23a	49
5.4-24	44
5.4-25	51
5.4-26	49
5.4-27	49
5.4-28	49
5.4-29	36
5.4-29a	36
5.4-29b	36
5.4-30	36
5.4-30a	36
5.4-31	36
5.4-32	49
5.4-33	49
5.4-34	49
5.4-35	49
5.4-35a	51
5.4-36	36
5.4-37	52
5.4-37a	51
5.4-38	51
5.4-38a	49
5.4-38b	43
5.4-39	49
5.4-39a	51
5.4-40	51
5.4-40a	44
5.4-41	51
5.4-41a	52
5.4-42	44
5.4-42a	51
5.4-42b	49
5.4-43	49
5.4-44	52
5.4-45	40
5.4-46	51
5.4-47	40
5.4-48	51
5.4-48a	40

LIST OF EFFECTIVE PAGES

CHAPTER 5 (Continued)

TEXT PAGES	AMENDMENT
5.4-48b	36
5.4-49	13
5.4-49a	13
5.4-50	12
5.4-50a	12
5.4-51	0
5.4-52	36
5.4-53	36
5.4-53a	36
5.4-54	51
5.4-55	52
5.4-56	40
5.4-57	30
5.4-58	30
5.4-59	14
5.4-60	50

FIGURES	AMENDMENT
5.1-1	52
5.1-2	52
5.1-3a	50
5.1-3b1	50
5.1-3b2	51
5.1-3c	37
5.2-1a	23
5.2-1b	23
5.2-2	0
5.2-3	23
5.2-4	23
5.2-5	23
5.2-6	51
5.2-7	0
5.2-8	0
5.2-9	0
5.2-10	31
5.2-11	0
5.2-12	0
5.2-13	0
5.2-14	0
5.2-15	37
5.3-1	37
5.3-2	37
5.3-3	0

LIST OF EFFECTIVE PAGES

CHAPTER 5 (Continued)

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LIST OF EFFECTIVE PAGES

CHAPTER 6

LIST OF EFFECTIVE PAGES

CHAPTER 6 (Continued)

TEXT PAGES	AMENDMENT
6.2-12	51
6.2-13	51
6.2-14	51
6.2-15	51
6.2-16	51
6.2-17	51
6.2-18	52
6.2-19	52
6.2-20	51
6.2-21	51
6.2-22	51
6.2-23	51
6.2-24	51
6.2-25	51
6.2-26	51
6.2-27	51
6.2-28	51
6.2-29	51
6.2-30	51
6.2-31	51
6.2-32	51
6.2-33	51
6.2-34	51
6.2-35	51
6.2-36	51
6.2-37	51
6.2-38	51
6.2-39	51
6.2-40	51
6.2-41	51
6.2-42	51
6.2-43	51
6.2-44	51
6.2-45	51
6.2-46	51
6.2-47	51
6.2-48	51
6.2-49	51
6.2-50	51
6.2-51	51
6.2-52	51
6.2-53	51
6.2-54	51
6.2-55	51
6.2-56	52
6.2-57	52
6.2-58	51

LIST OF EFFECTIVE PAGES

CHAPTER 6 (Continued)

TEXT PAGES	AMENDMENT
6.2-59	52
6.2-60	51
6.2-61	52
6.2-62	51
6.2-63	51
6.2-64	51
6.2-65	51
6.2-66	51
6.2-67	51
6.2-68	51
6.2-69	51
6.2-70	52
6.2-71	51
6.2-72	51
6.2-73	51
6.2-74	51
6.2-75	52
6.2-76	51
6.2-77	51
6.2-78	51
6.2-79	51
6.2-80	51
6.2-81	51
6.2-82	51
6.2-83	51
6.2-84	51
6.2-85	51
6.2-86	51
6.2-87	51
6.2-88	51
6.2-89	51
6.2-90	51
6.2-91	52
6.2-92	51
6.2-93	51
6.2-94	52
6.2-95	52
6.2-96	52
6.2-97	52
6.2-98	51
6.2-99	51
6.2-100	51
6.2-101	51
6.2-102	52
6.2-103	52
6.2-104	51
6.2-105	51

LIST OF EFFECTIVE PAGES

CHAPTER 6 (Continued)

TEXT PAGES	AMENDMENT
6.2-106	51
6.2-107	51
6.2-108	51
6.2-109	51
6.2-110	52
6.2-111	51
6.2-112	52
6.2-113	51
6.2-114	51
6.2-115	52
6.2-116	52
6.2-117	52
6.2-118	52
6.2-119	51
6.2-120	52
6.2-121	52
6.2-122	51
6.2-123	51
6.2-124	51
6.2-125	51
6.2-126	51
6.2-127	51
6.2-128	51
6.2-129	51
6.2-130	51
6.2-131	51
6.2-132	51
6.3-1	51
6.3-2	51
6.3-3	51
6.3-4	52
6.3-5	51
6.3-6	51
6.3-7	51
6.3-8	51
6.3-9	51
6.3-10	51
6.3-11	51
6.3-12	51
6.3-13	51
6.3-14	51
6.3-15	51
6.3-16	51
6.3-17	51
6.3-18	51
6.3-19	51

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7-ix	50
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7.1-5	12
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7.1-8	10
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7.1-10	36
7.1-11	36
7.1-12	35
7.1-13	46
7.1-14	43
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7.1-15	10
7.1-16	40
7.1-17	32
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7.3-22	42
7.3-23	52
7.3-23a	52
7.3-24	52
7.3-25	36
7.3-25a	12
7.3-26	48
7.3-27	51
7.3-28	51
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7.3-30	13
7.3-31	10
7.3-32	10
7.3-33	49
7.3-34	10
7.3-35	36
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7.3-39	35
7.3-40	36
7.3-41	35
7.3-42	35
7.3-43	35
7.3-44	35
7.3-45	35
7.3-46	51
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7.3-48	35
7.3-49	43
7.3-50	35
7.3-51	35
7.3-52	35
7.3-53	35
7.3-54	35
7.3-55	35
7.3-56	35
7.3-57	35
7.3-58	35
7.3-59	35
7.3-60	35
7.3-61	35
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7.3-67	35
7.3-68	35
7.3-69	35
7.3-70	35
7.3-71	47
7.3-72	35
7.3-73	35
7.3-74	35
7.3-75	35
7.3-76	35
7.3-77	39
7.3-78	35
7.3-79	21
7.4-1	40
7.4-1a	40
7.4-2	42
7.4-3	49
7.4-3a	33
7.4-4	52
7.4-5	49
7.4-6	43
7.4-6a	13
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7.4-7a	40
7.4-8	52
7.4-8a	34
7.4-9	40
7.4-9a	51
7.4-10	50
7.4-10a	52
7.4-10b	52
7.4-10c	40
7.4-11	40
7.4-11a	47
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7.4-13	47
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7.4-15	49
7.4-15a	49
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7.4-21	35
7.4-22	35
7.4-23	35
7.4-24	40
7.4-25	40
7.5-1	35
7.5-1a	52
7.5-2	51
7.5-2a	23
7.5-3	48
7.5-4	47
7.5-4a	37
7.5-5	50
7.5-6	52
7.5-6a	51
7.5-7	35
7.5-8	51
7.5-8a	37
7.5-9	23
7.5-10	49
7.5-11	39
7.5-12	39
7.5-13	23
7.5-14	23
7.5-15	23
7.5-16	23
7.5-17	23
7.5-18	51
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7.5-20	40
7.5-20a	40
7.5-21	39
7.5-22	39
7.5-22a	37
7.5-23	52
7.5-24	39
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7.5-25a	51
7.5-26	39
7.5-27	39
7.5-28	39
7.5-29	50
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7.5-34	51
7.5-35	50
7.5-35a	49
7.6-1	36
7.6-1a	42
7.6-2	21
7.6-3	42
7.6-4	52
7.6-4a	37
7.6-5	27
7.6-6	36
7.6-7	51
7.6-8	51
7.6-8a	29
7.6-9	37
7.6-9a	37
7.6-10	35
7.6-11	50
7.6-12	50
7.6-13	52
7.6-14	42
7.6-14a	47
7.6-15	49
7.6-15a	21
7.6-16	21
7.6-17	47
7.6-18	47
7.6-19	42
7.6-20	10
7.6-21	12
7.6-22	10
7.6-23	10
7.6-24	12
7.6-25	13
7.6-26	27
7.6-27	27
7.6-28	10
7.6-29	10
7.6-30	35
7.6-31	10
7.6-32	35
7.6-33	10
7.6-34	35
7.6-35	35
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7.6-42	35
7.6-43	35
7.6-44	35
7.6-45	35
7.6-46	37
7.6-47	37
7.6-48	37
7.6-49	47
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7.7-2	52
7.7-3	10
7.7-4	49
7.7-5	10
7.7-6	10
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7.7-7	10
7.7-8	10
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7.7-10	10
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7.7-17	12
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7.7-18a	36
7.7-19	10
7.7-20	52
7.7-21	52
7.7-21a	52
7.7-22	36
7.7-23	36
7.7-24	10
7.7-25	36
7.7-26	36
7.7-27	36
7.7-28	10
7.7-29	52
7.7-30	35
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7.7-35	39
7.7-36	39
7.7-37	39
7.7-38	10
7.7-39	39
7.7-40	52
7.7-41	52
7.7-42	52
7.7-43	52
7.7-44	34
7.7-44a	52
7.7-44b	21
7.7-45	21
7.7-45a	21
7.7-46	21
7.7-46a	50
7.7-46b	50
7.7-46c	50
7.7-46d	50
7.7-46e	50
7.7-47	10
7.7-48	23
7.7-49	52
7.7-50	35
7.7-51	35
7.7-52	35

FIGURES	AMENDMENT
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7.2-1b	51
7.2-1c	37
7.2-1d	51
7.2-2	51
7.2-3	0
7.2-4	0
7.2-5	51
7.2-6	0
7.2-7	0
7.2-8a	51
7.2-8b	37
7.2-8c	48
7.2-9	0
7.2-10a	10
7.2-10b	10
7.2-11	23

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7.3-4a	50
7.3-4b	50
7.3-4c	37
7.3-5	37
7.3-6	0
7.3-7	16
7.3-8a	50
7.3-8b	37
7.3-8c	37
7.3-9a	50
7.3-9b1	50
7.3-9b2	50
7.3-9c	37
7.3-10a	42
7.3-10b	51
7.3-10c	51
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7.3-14b	50
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7.3-17a-2	50
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7.3-17k	52
7.3-17l	52
7.3-17m	52
7.3-17n	52
7.3-17o	52
7.3-17p	52
7.3-17q(1)	50
7.3-17q(2)	50
7.3-17q(3)	50
7.3-17q(4)	50
7.3-17r	37
7.3-17s	50
7.3-18a	52
7.3-18b	50
7.3-18c	50
7.3-18d	37
7.3-18e	50
7.3-18f	50
7.3-18g	52
7.3-18h	50
7.3-18i	50
7.3-18j	52
7.3-18k	37
7.3-19a	50
7.3-19b	50
7.3-19c	50
7.3-19d	50
7.3-19e	50
7.3-19f	50
7.3-19g	50
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7.3-20g(1)	39
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7.3-21c	50
7.3-21d	50
7.3-21e	37
7.3-21f	37
7.4-1	43
7.4-1a	52
7.4-1b	52
7.4-2a	47
7.4-2b	47
7.4-2c	47
7.4-2d	42
7.4-2e	37
7.4-3	32
7.4-4	38
7.4-5a	50
7.4-5b	51
7.6-1a	51
7.6-1b	51
7.6-2	10
7.6-3	21
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7.6-5	10
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7.6-6b	37
7.6-6c	37
7.6-6d	37
7.6-6e	37
7.6-6f	37
7.6-6g	37
7.6-7	10
7.6-8	10
7.6-9	37
7.6-10	10
7.6-11a	38
7.6-11b	50
7.6-11c	50
7.6-11d	38
7.6-11e	50
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7.6-11g	39
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7.7-2b	16
7.7-3a	37
7.7-3b	37
7.7-3c	37
7.7-3d	37
7.7-3e	37
7.7-3f	37
7.7-3g	43
7.7-4a	37
7.7-4b	37
7.7-5a	10
7.7-5b	10
7.7-6	10
7.7-7	52
7.7-8	10
7.7-9	34
7.7-10	10
7.7-11	10
7.7-12	10
7.7-13	10
7.7-14	10
7.7-15	34
7.7-16	50

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8-iii	50
8-iv	51
8-v	50
8-va	31
8-vb	31
8-vc	36
8-vd	43
8-vi	23
8-vii	50
8-viii	50
8-ix	31
8-ixa	31
8-x	50
8-xi	0
8-xii	12
8-xiii	31
8-xiv	51
8-xv	31
8-xvi	23
8.1-1	52
8.1-2	52
8.1-3	36
8.1-4	36
8.1-5	36
8.1-6	49
8.1-7	47
8.1-7a	36
8.1-8	0
8.1-9	36
8.1-10	36
8.1-10a	36
8.1-11	0
8.1-12	0
8.1-13	0
8.1-14	36
8.1-15	35
8.1-16	23
8.1-17	0
8.2-1	31
8.2-2	31
8.2-2a	31
8.2-3	0
8.2-4	31

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8.2-6	50
8.2-7	35
8.2-8	0
8.2-9	0
8.2-10	47
8.2-11	31
8.2-12	0
8.2-13	0
8.2-14	0
8.2-15	52
8.3-1	27
8.3-2	52
8.3-3	42
8.3-4	50
8.3-4a	51
8.3-4b	52
8.3-4c	42
8.3-5	50
8.3-6	34
8.3-6a	23
8.3-7	46
8.3-8	23
8.3-8a	51
8.3-9	50
8.3-10	47
8.3-11	52
8.3-12	32
8.3-13	46
8.3-13a	51
8.3-14	23
8.3-14a	23
8.3-15	27
8.3-15a	23
8.3-16	52
8.3-17	51
8.3-18	51
8.3-19	52
8.3-20	51
8.3-21	36
8.3-22	51
8.3-23	47
8.3-24	31
8.3-24a	31
8.3-25	51
8.3-26	51

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8.3-28	52
8.3-29	47
8.3-29a	47
8.3-30	47
8.3-31	52
8.3-32	0
8.3-33	34
8.3-34	50
8.3-34a	52
8.3-34b	51
8.3-35	36
8.3-35a	36
8.3-36	23
8.3-37	27
8.3-38	23
8.3-38a	23
8.3-39	47
8.3-40	27
8.3-41	23
8.3-42	51
8.3-43	30
8.3-44	30
8.3-45	47
8.3-46	23
8.3-47	23
8.3-48	27
8.3-48a	36
8.3-49	52
8.3-49a	47
8.3-50	23
8.3-51	47
8.3-52	23
8.3-52a	51
8.3-52b	51
8.3-53	31
8.3-54	31
8.3-55	31
8.3-56	31
8.3-56a	31
8.3-57	31
8.3-57a	36
8.3-57b	40
8.3-57c	36
8.3-57d	43
8.3-57e	31
8.3-57f	31

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TEXT PAGES	AMENDMENT
8.3-57g	31
8.3-58	31
8.3-58a	31
8.3-58b	47
8.3-58c	43
8.3-58d	52
8.3-58e	38
8.3-59	36
8.3-59a	31
8.3-59b	43
8.3-60	36
8.3-60a	36
8.3-60b	44
8.3-60c	49
8.3-60d	31
8.3-60e	31
8.3-60f	31
8.3-61	43
8.3-62	36
8.3-62a	48
8.3-62b	52
8.3-63	50
8.3-64	47
8.3-65	52
8.3-66	47
8.3-67	43
8.3-67a	43
8.3-67b	47
8.3-68	47
8.3-68a	47
8.3-68b	36
8.3-69	36
8.3-69a	50
8.3-70	47
8.3-70a	23
8.3-71	36
8.3-72	43
8.3-73	43
8.3-74	43
8.3-75	52
8.3-76	52
8.3-77	52
8.3-78	52
8.3-79	52
8.3-80	52
8.3-81	52
8.3-82	52

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8.3-84	31
8.3-85	36
8.3-86	36
8.3-87	36
8.3-88	2
8.3-89	36
8.3-90	47
8.3-91	47
8.3-92	14
8.3-93	52
8.3-94	36
8.3-95	1
8.3-96	52
8.3-97	52
8.3-98	23
8.3-99	31
8.3-100	31
8.3-101	31
8.3-102	40
8.3-103	31
8.3-104	31
8.3-105	31
8.3-106	31
8.3-107	23

FIGURES	AMENDMENT
8.1-1	not used
8.1-1a	not used
8.1-2	not used
8.1-3	38
8.1-4	38
8.1-5	38
8.1-6	38
8.1-7	52
8.1-8	52
8.1-9a	52
8.1-9b	51
8.1-9c	52
8.1-9d	52
8.1-10a	50
8.1-10b	50
8.2-1	0
8.2-2a	0
8.2-2b	0

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TEXT PAGES	AMENDMENT
8.2-2c	0
8.2-3a	0
8.2-3b	0
8.2-3c	0
8.2-4a	0
8.2-4b	0
8.2-4c	0
8.2-4d	0
8.2-4e	0
8.2-5a	0
8.2-5b	0
8.2-5c	0
8.2-6	0
8.2-7a	0
8.2-7b	0
8.2-7c	0
8.3-1a	52
8.3-1b	52
8.3-1c	52
8.3-1d	52
8.3-1e	51
8.3-1f	51
8.3-2	52
8.3-3	50
8.3-4	50
8.3-5	50
8.3-6	50
8.3-7	50
8.3-8	50
8.3-9	50
8.3-10	51
8.3-11	50
8.3-12	50
8.3-13	50
8.3-14	50
8.3-15	51
8.3-16a	48
8.3-16b	50
8.3-16c	50
8.3-17a	48
8.3-17b	50
8.3-17c	50
8.3-18a	50
8.3-18b	50
8.3-18c	50
8.3-19	50

LIST OF EFFECTIVE PAGES

CHAPTER 8 (Continued)

FIGURES	AMENDMENT
8.3-20	31
8.3-21	31
8.3-22	31
8.3-23	50
8.3-24a	16
8.3-24b	16
8.3-24c	16
8.3-25a	51
8.3-25b	51
8.3-25c	51
8.3-25d	51
8.3-26a	51
8.3-26b	51
8.3-27	51
8.3-28	0
8.3-29a	31
8.3-29b	31
8.3-29c	31
8.3-29d	31
8.3-30	27
8.3-31	23
8.3-32	27
8.3-33	23
8.3-34	23
8.3-35	23
8.3-36	23
8.3-37	31
8.3-38	23
8.3-39	23
8.3-40	27
8.3-41	31
8.3-41a	34
8.3-42	31
8.3-43a	27
8.3-43b	23
8.3-43c	27
8.3-43d	27
8.3-43e	23

LIST OF EFFECTIVE PAGES

CHAPTER 9

TEXT PAGES	AMENDMENT
9-i	27
9-ii	52
9-iii	0
9-iv	52
9-v	12
9-vi	50
9-vii	40
9-viia	40
9-viii	39
9-viiia	8
9-ix	0
9-x	32
9-xi	52
9-xii	0
9-xiii	50
9-xiv	50
9-xv	45
9-xvi	50
9-xvii	45
9-xviii	52
9-xviiia	12
9-xix	51
9-xixa	50
9-xx	51
9-xxi	51
9-xxia	50
9-xxii	52
9-xxiii	51
9.1-1	51
9.1-2	51
9.1-2a	23
9.1-3	51
9.1-4	51
9.1-4a	29
9.1-5	51
9.1-6	0
9.1-7	27
9.1-8	5
9.1-9	36
9.1-9a	36
9.1-10	50
9.1-11	35
9.1-12	12
9.1-13	52
9.1-13a	52
9.1-13b	50

LIST OF EFFECTIVE PAGES

CHAPTER 9 (Continued)

TEXT PAGES	AMENDMENT
9.1-14	1
9.1-15	50
9.1-15a	52
9.1-16	50
9.1-17	0
9.1-18	0
9.1-19	32
9.1-20	49
9.1-21	0
9.1-22	13
9.1-23	51
9.1-23a	52
9.1-24	52
9.1-24a	44
9.1-25	37
9.1-26	50
9.1-26a	52
9.1-26b	44
9.1-26c	52
9.1-27	37
9.1-28	44
9.1-29	52
9.1-30	0
9.1-31	0
9.1-32	0
9.1-33	0
9.1-34	0
9.1-35	0
9.1-36	0
9.1-37	51
9.1-38	0
9.1-39	1
9.1-40	35
9.1-41	0
9.1-42	51
9.1-43	51
9.1-44	51
9.1-45	51
9.1-46	52
9.1-47	51
9.1-48	52
9.1-49	51
9.1-50	52
9.1-51	52
9.1-52	52
9.1-53	52
9.1-54	52

LIST OF EFFECTIVE PAGES

CHAPTER 9 (Continued)

TEXT PAGES	AMENDMENT
9.1-55	1
9.1-56	43
9.1-57	52
9.1-57a	43
9.1-58	51
9.1-59	51
9.1-60	52
9.1-61	0
9.1-62	13
9.1-63	52
9.1-63a	51
9.1-64	51
9.1-64a	52
9.1-65	37
9.1-65a	52
9.1-66	52
9.1-66a	51
9.1-67	51
9.1-68	0
9.1-69	51
9.1-70	0
9.1-71	0
9.2-1	52
9.2-2	48
9.2-2a	52
9.2-3	52
9.2-3a	37
9.2-4	36
9.2-5	52
9.2-6	36
9.2-7	51
9.2-8	51
9.2-8a	51
9.2-9	51
9.2-10	51
9.2-11	51
9.2-12	40
9.2-13	51
9.2-13a	13
9.2-14	48
9.2-15	52
9.2-16	32
9.2-17	49
9.2-18	52
9.2-18a	46
9.2-19	35

LIST OF EFFECTIVE PAGES

CHAPTER 9 (Continued)

TEXT PAGES	AMENDMENT
9.2-19a	36
9.2-20	49
9.2-21	51
9.2-21a	51
9.2-21b	49
9.2-22	52
9.2-23	30
9.2-24	47
9.2-25	0
9.2-26	49
9.2-27	52
9.2-28	52
9.2-29	52
9.2-30	35
9.2-31	52
9.2-31a	39
9.2-32	49
9.2-33	48
9.2-33a	48
9.2-33b	48
9.2-34	43
9.2-35	35
9.2-36	51
9.2-37	47
9.2-38	47
9.2-39	47
9.2-40	52
9.2-41	52
9.2-42	52
9.2-43	43
9.2-44	3
9.2-45	0
9.2-46	47
9.2-47	51
9.2-48	51
9.2-49	51
9.2-50	47
9.3-1	48
9.3-2	52
9.3-3	48
9.3-3a	48
9.3-4	48
9.3-5	52
9.3-5a	52
9.3-6	46
9.3-6a	48

LIST OF EFFECTIVE PAGES

CHAPTER 9 (Continued)

TEXT PAGES	AMENDMENT
9.3-6b	48
9.3-6c	39
9.3-7	36
9.3-8	36
9.3-9	50
9.3-10	39
9.3-10a	36
9.3-11	36
9.3-12	36
9.3-13	0
9.3-14	48
9.3-15	30
9.3-16	49
9.3-17	48
9.3-18	48
9.3-19	36
9.3-19a	49
9.3-19b	36
9.3-20	48
9.3-21	48
9.3-22	48
9.3-23	48
9.3-24	36
9.3-25	49
9.3-26	52
9.3-27	49
9.3-28	49
9.3-29	52
9.3-30	49
9.3-31	49
9.3-32	52
9.3-33	36
9.3-34	48
9.3-35	48
9.3-36	36
9.3-37	37
9.3-38	36
9.3-39	50
9.3-40	36
9.3-40a	50
9.3-40b	50
9.3-41	49
9.3-42	49
9.4-1	47
9.4-2	40
9.4-3	48

LIST OF EFFECTIVE PAGES

CHAPTER 9 (Continued)

TEXT PAGES	AMENDMENT
9.4-3a	40
9.4-4	48
9.4-5	49
9.4-6	52
9.4-7	51
9.4-7a	9
9.4-8	52
9.4-8a	48
9.4-9	48
9.4-10	49
9.4-11	52
9.4-12	49
9.4-12a	42
9.4-13	48
9.4-14	52
9.4-15	0
9.4-16	40
9.4-17	2
9.4-18	36
9.4-19	52
9.4-20	52
9.4-21	34
9.4-22	49
9.4-23	34
9.4-24	35
9.4-25	0
9.4-26	0
9.4-27	43
9.4-28	0
9.4-29	48
9.4-30	48
9.4-31	43
9.4-32	52
9.4-33	52
9.4-34	52
9.4-35	52
9.4-36	52
9.4-37	52
9.4-37a	52
9.4-38	52
9.4-39	27
9.4-40	50
9.4-41	50
9.4-42	0
9.4-43	50
9.4-44	36
9.4-45	49

LIST OF EFFECTIVE PAGES

CHAPTER 9 (Continued)

TEXT PAGES	AMENDMENT
9.4-46	52
9.4-47	48
9.4-48	48
9.4-49	52
9.4-49a	30
9.4-50	49
9.4-50a	46
9.4-51	48
9.4-51a	32
9.4-52	48
9.4-53	48
9.4-53a	21
9.4-54	37
9.4-55	47
9.4-56	52
9.4-56a	48
9.4-57	52
9.4-58	48
9.4-58a	32
9.4-59	47
9.4-60	51
9.4-61	51
9.4-62	49
9.4-63	25
9.4-63a	25
9.4-64	0
9.4-65	32
9.4-66	48
9.4-67	0
9.4-68	32
9.4-68a	32
9.4-69	0
9.4-70	48
9.4-71	36
9.4-72	36
9.4-73	37
9.4-74	37
9.4-75	43
9.4-75a	2
9.4-75b	49
9.4-75c	2
9.4-75d	30
9.4-76	34
9.4-77	49
9.4-78	34
9.4-78a	35
9.4-79	40

LIST OF EFFECTIVE PAGES

CHAPTER 9 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 9 (Continued)

TEXT PAGES	AMENDMENT
9.5-22	36
9.5-23	48
9.5-24	52
9.5-25	52
9.5-26	52
9.5-27	51
9.5-28	52
9.5-29	52
9.5-29a	51
9.5-30	52
9.5-31	48
9.5-32	43
9.5-33	42
9.5-34	36
9.5-35	48
9.5-36	36
9.5-37	52
9.5-38	52
9.5-39	7
9.5-40	31
9.5-41	52
9.5-42	52
9.5-43	37
9.5-44	36
9.5-45	36
9.5-46	49
9.5-47	36
9.5-48	36

FIGURES	AMENDMENT
9.1-1	0
9.1-1a	51
9.1-2	0
9.1-3	0
9.1-3a	46
9.1-4	51
9.1-5	0
9.1-6	0
9.1-7	0
9.1-8	0
9.1-9	0
9.1-10	0
9.1-11	0
9.1-12	0
9.1-13	0
9.1-14	35

LIST OF EFFECTIVE PAGES

CHAPTER 9 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 9 (Continued)

FIGURES	AMENDMENT
9.4-2 2 of 3	52
9.4-2 3 of 3	52
9.4-3	52
9.4-4	43
9.4-5	52
9.4-6	52
9.4-7	52
9.4-8a	52
9.4-8b	50
9.4-8c	52
9.4-9	50
9.4-10	50
9.4-11	50
9.4-12	43
9.4-13	30
9.5-1	48
9.5-2	48
9.5-3	Deleted
9.5-4a	51
9.5-4b	51
9.5-4c	51
9.5-4d	51
9.5-5	51
9.5-6	43
9.5-7	43
9.5-8	43
9.5-9	48

LIST OF EFFECTIVE PAGES

CHAPTER 10

TEXT PAGES	AMENDMENT
10-i	50
10-ii	0
10-iii	36
10-iv	36
10-v	0
10-vi	50
10-vii	50
10.1-1	48
10.1-2	36
10.1-3	0
10.1-4	52
10.2-1	48
10.2-2	36
10.2-3	48
10.2-4	43
10.2-4a	48
10.2-5	36
10.2-6	36
10.2-6a	36
10.2-7	38
10.2-7a	7
10.2-8	36
10.2-9	36
10.2-10	36
10.2-11	9
10.3-1	36
10.3-2	36
10.3-3	36
10.3-4	36
10.3-5	36
10.3-6	36
10.4-1	36
10.4-2	51
10.4-2a	36
10.4-3	51
10.4-3a	7
10.4-4	36
10.4-4a	51
10.4-5	2
10.4-6	49
10.4-7	51
10.4-8	0
10.4-9	0

LIST OF EFFECTIVE PAGES

CHAPTER 10 (Continued)

TEXT PAGES	AMENDMENT
10.4-10	49
10.4-11	46
10.4-12	7
10.4-13	36
10.4-13a	51
10.4-14	36
10.4-15	36
10.4-16	37
10.4-17	36
10.4-17a	51
10.4-17b	51
10.4-17c	51
10.4-17d	52
10.4-18	50
10.4-18a	36
10.4-19	36
10.4-20	36
10.4-21	36
10.4-22	36
10.4-22a	36
10.4-23	48
10.4-24	52
10.4-25	8
10.4-26	33
10.4-27	36
10.4-28	4
10.4-29	0

FIGURES	AMENDMENT
10.1-1	51
10.1-2	51
10.2-1	0
10.2-2	0
10.2-3	0
10.2-4	52
10.2-5	42
10.2-6	46
10.2-7	50
10.2-8	50
10.2-9	52
10.2-10(1)	51
10.2-10(2)	51
10.3-1a	51
10.3-1b	51

LIST OF EFFECTIVE PAGES

CHAPTER 10 (Continued)

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LIST OF EFFECTIVE PAGES

CHAPTER 11

TEXT PAGES	AMENDMENT
11-i	0
11-ii	50
11-iii	50
11-iv	31
11-v	51
11-vi	51
11-via	52
11-vii	39
11-viia	50
11-viii	48
11-ix	36
11-x	0
11-xi	49
11-xii	51
11-xiia	51
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	48
11.1-13a	48
11.1-14	0
11.1-15	0
11.1-16	0
11.1-17	0
11.1-18	0
11.1-19	0
11.2-1	49
11.2-1a	49
11.2-1b	48
11.2-2	0
11.2-3	48
11.2-3a	36
11.2-4	49
11.2-5	0
11.2-6	49
11.2-7	42

LIST OF EFFECTIVE PAGES

CHAPTER 11 (Continued)

TEXT PAGES	AMENDMENT
11.2-7a	36
11.2-8	33
11.2-8a	33
11.2-9	35
11.2-10	49
11.2-10a	48
11.2-11	0
11.2-12	0
11.2-13	0
11.2-14	0
11.2-15	49
11.2-16	0
11.2-17	0
11.2-18	0
11.2-19	51
11.2-20	51
11.2-21	51
11.2-22	51
11.2-23	51
11.2-24	51
11.2-25	51
11.2-26	51
11.2-27	51
11.2-28	51
11.2-29	49
11.2-30	51
11.2-31	51
11.2-32	0
11.2-33	0
11.2-34	0
11.2-35	0
11.2-36	0
11.2-37	0
11.2-38	0
11.2-39	0
11.2-40	0
11.2-41	0
11.2-42	0
11.2-43	0
11.2-44	0
11.2-45	0
11.2-46	49
11.2-47	51
11.3-1	0
11.3-2	49
11.3-3	52

LIST OF EFFECTIVE PAGES

CHAPTER 11 (Continued)

TEXT PAGES	AMENDMENT
11.3-3a	52
11.3-4	52
11.3-5	52
11.3-6	52
11.3-7	37
11.3-8	30
11.3-9	30
11.3-10	30
11.3-11	30
11.3-12	30
11.3-13	0
11.3-14	52
11.3-15	51
11.3-16	30
11.3-17	30
11.3-18	0
11.3-19	44
11.3-20	30
11.3-21	0
11.3-22	0
11.3-23	52
11.3-24	0
11.3-25	52
11.3-26	0
11.3-27	0
11.3-28	0
11.3-29	52
11.3-30	0
11.3-31	51
11.3-32	0
11.3-33	51
11.3-34	36
11.4-1	52
11.4-2	52
11.4-3	52
11.4-4	52
11.4-5	52
11.4-6	52
11.4-7	52
11.4-8	52
11.4-9	52
11.4-10	52
11.4-10a	52
11.4-11	52
11.4-12	52
11.4-13	52

LIST OF EFFECTIVE PAGES

CHAPTER 11 (Continued)

TEXT PAGES	AMENDMENT
11.4-14	52
11.4-15	52
11.4-16	52
11.4-17	49
11.4-18	49
11.4-19	49
11.4-20	49
11.4-21	51
11.4-22	51
11.4-23	51
11.5-1	39
11.5-2	39
11.5-3	0
11.5-4	35
11.5-5	51
11.5-6	48
11.5-7	49
11.5-7a	49
11.5-8	48
11.5-9	48
11.5-10	52
11.5-11	52
11.5-12	52
11.5-12a	50
11.5-13	48
11.5-14	49
11.5-14a	48
11.5-15	49
11.5-16	47
11.5-17	48
11.5-18	36
11.5-18a	52
11.5-18b	36
11.5-19	29
11.5-20	35
11.5-21	42
11.5-22	36
11.5-23	49
11.5-24	52
11.5-25	50
11.5-26	39
11.5-27	50
11.5-28	50
11.5-29	50
11.5-30	50
11.5-31	0

LIST OF EFFECTIVE PAGES

CHAPTER 11

FIGURES	AMENDMENT
11.1-1	0
11.1-2	0
11.1-3	0
11.2-1	50
11.2-2	52
11.2-3	52
11.2-4a	48
11.2-4b	48
11.2-4c	50
11.3-1	37
11.3-2	0
11.4-1	52
11.4-2	49
11.5-1	51
11.5-2	48
11.5-3	49
11.5-4	29
11.5-5	52
11.5-6	52
11.5-7	49
11.5-8	37
11.5-9	0
11.5-10	50
11.5-11	52

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LIST OF EFFECTIVE PAGES

CHAPTER 12

TEXT PAGES	AMENDMENT
12-i	50
12-ii	5
12-iii	36
12-iv	50
12-v	50
12-vi	50
12-vii	51
12-viii	50
12-ix	50
12-x	31
12.1-1	52
12.1-2	51
12.1-3	52
12.1-4	51
12.1-4a	34
12.1-5	27
12.1-6	27
12.1-7	0
12.1-8	34
12.1-9	52
12.1-10	52
12.1-11	49
12.1-12	49
12.1-13	51
12.2-1	0
12.2-2	16
12.2-3	16
12.2-4	16
12.2-5	12
12.2-6	16
12.2-7	16
12.2-8	49
12.2-9	0
12.2-10	43
12.2-11	49
12.2-12	0
12.2-13	43
12.2-14	16
12.2-15	49
12.2-16	34
12.2-16a	49
12.2-17	0

LIST OF EFFECTIVE PAGES

CHAPTER 12 (Continued)

TEXT PAGES	AMENDMENT
12.2-18	51
12.2-19	51
12.2-20	51
12.2-21	51
12.2-22	0
12.2-23	0
12.2-24	0
12.2-25	0
12.2-26	0
12.2-27	0
12.2-28	30
12.2-29	49
12.2-30	0
12.2-31	0
12.2-32	49
12.2-33	49
12.2-34	49
12.2-35	51
12.3-1	50
12.3-2	52
12.3-3	34
12.3-4	43
12.3-5	43
12.3-6	43
12.3-7	49
12.3-8	35
12.3-9	0
12.3-10	49
12.3-11	52
12.3-12	27
12.3-13	27
12.3-13a	20
12.3-14	43
12.3-15	27
12.3-16	35
12.3-17	4
12.3-18	0
12.3-19	27
12.3-20	49
12.3-20a	40
12.3-21	49
12.3-21a	29
12.3-22	14
12.3-22a	14
12.3-22b	29

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CHAPTER 12 (Continued)

TEXT PAGES	AMENDMENT
12.3-23	50
12.3-24	34
12.3-25	34
12.3-26	49
12.3-27	0
12.3-28	49
12.3-29	49
12.3-30	49
12.3-31	14
12.3-32	50
12.3-33	49
12.4-1	43
12.4-2	5
12.4-3	36
12.4-3a	35
12.4-4	36
12.4-5	49
12.4-5a	49
12.4-6	49
12.4-7	51
12.4-8	36
12.4-9	36
12.4-10	5
12.4-11	5
12.4-12	49
12.4-13	49
12.4-14	49
12.4-15	5
12.4-16	49
12.4-17	49
12.4-18	49
12.4-19	49
12.4-20	49
12.4-21	49
12.4-22	49
12.5-1	52
12.5-1a	52
12.5-2	52
12.5-3	51
12.5-3a	49
12.5-3b	49
12.5-4	49
12.5-5	51
12.5-6	49
12.5-7	51

LIST OF EFFECTIVE PAGES

CHAPTER 12 (Continued)

TEXT PAGES	AMENDMENT
12.5-7a	52
12.5-7b	52
12.5-7c	52
12.5-8	51
12.5-9	50
12.5-10	52
12.5-11	49
12.5-12	50
12.5-12a	50
12.5-13	52
12.5-14	52
12.5-15	52
12.5-16	49
12.5-17	52
12.5-17a	49
12.5-18	52
12.5-19	52
12.5-20	51
12.5-21	49

FIGURES	AMENDMENT
12.3-1	20
12.3-2	20
12.3-3	20
12.3-4	20
12.3-5	20
12.3-6	20
12.3-7	51
12.3-8a	52
12.3-8b	43
12.3-9	51
12.3-10	51
12.3-11	27
12.3-12	50
12.3-13	39
12.3-14	51
12.3-15	50
12.3-16	12
12.3-17	12

LIST OF EFFECTIVE PAGES

CHAPTER 12 (Continued)

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CHAPTER 13

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13-i	51
13-ii	52
13-iii	52
13-iv	52
13-v	51
13.1-1	51
13.1-2	51
13.1-3	51
13.1-4	51
13.1-5	51
13.1-6	51
13.1-7	50
13.1-8	52
13.1-9	52
13.1-10	51
13.1-11	51
13.1-12	52
13.1-13	51
13.1-14	52
13.1-15	52
13.1-16	50
13.1-17	51
13.1-18	51
13.1-19	51
13.1-20	52
13.1-21	52
13.2-1	52
13.2-2	52
13.2-3	51
13.2-4	52
13.2-5	51
13.2-6	51
13.2-7	52
13.2-7a	52
13.2-8	51
13.2-8a	52
13.3-1	31
13.4-1	52
13.4-2	52
13.4-3	52
13.5-1	51

LIST OF EFFECTIVE PAGES

CHAPTER 13 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 14

TEXT PAGES	AMENDMENT
14-i	50
14-ii	50
14-iii	50
14-iv	50
14-iva	50
14-v	50
14-vi	50
14-vii	34
14-viii	34
14-ix	34
14-x	34
14-xi	50
14-xii	50
14-xiii	50
14-xiv	50
14-xiv(a)	50
14-xv	34
14-xva	50
14-xvi	34
14-xvi(a)	36
14-xvi(b)	34
14-xvii	50
14-xviii	34
14-xix	50
14-xx	50
14.1-1	0
14.2-1	34
14.2-2	34
14.2-3	34
14.2-4	34
14.2-5	34
14.2-6	34
14.2-7	34
14.2-8	34
14.2-9	34
14.2-10	34
14.2-11	34
14.2-12	34
14.2-13	34
14.2-14	34
14.2-15	34
14.2-16	34
14.2-17	34
14.2-18	34
14.2-19	34

LIST OF EFFECTIVE PAGES

CHAPTER 14 (Continued)

TEXT PAGES	AMENDMENT
14.2-20	36
14.2-21	50
14.2-22	34
14.2-23	34
14.2-24	34
14.2-25	34
14.2-26	34
14.2-27	34
14.2-28	34
14.2-29	34
14.2-30	34
14.2-31	34
14.2-32	34
14.2-33	34
14.2-34	34
14.2-35	34
14.2-36	34
14.2-37	34
14.2-38	34
14.2-39	34
14.2-40	34
14.2-41	34
14.2-42	34
14.2-43	34
14.2-44	34
14.2-45	34
14.2-46	34
14.2-47	34
14.2-48	34
14.2-49	34
14.2-50	34
14.2-51	34
14.2-52	34
14.2-53	34
14.2-54	35
14.2-54a	34
14.2-55	34
14.2-56	49
14.2-57	34
14.2-58	34
14.2-59	34
14.2-60	34
14.2-61	34
14.2-62	52
14.2-63	34
14.2-64	34
14.2-65	34

LIST OF EFFECTIVE PAGES

CHAPTER 14 (Continued)

TEXT PAGES	AMENDMENT
14.2-66	34
14.2-67	34
14.2-68	34
14.2-69	34
14.2-70	34
14.2-71	35
14.2-72	34
14.2-73	34
14.2-74	34
14.2-75	34
14.2-76	34
14.2-77	34
14.2-78	36
14.2-79	34
14.2-80	34
14.2-81	34
14.2-82	34
14.2-83	34
14.2-84	34
14.2-85	34
14.2-86	34
14.2-87	34
14.2-88	34
14.2-89	34
14.2-90	34
14.2-91	34
14.2-92	34
14.2-93	34
14.2-94	34
14.2-95	34
14.2-96	34
14.2-97	34
14.2-98	34
14.2-99	49
14.2-100	34
14.2-101	34
14.2-102	34
14.2-103	34
14.2-104	34
14.2-105	34
14.2-106	34
14.2-107	34
14.2-108	34
14.2-109	34
14.2-110	34
14.2-111	34
14.2-112	34

LIST OF EFFECTIVE PAGES

CHAPTER 14 (Continued)

TEXT PAGES	AMENDMENT
14.2-113	34
14.2-114	34
14.2-115	34
14.2-116	34
14.2-117	38
14.2-118	34
14.2-119	34
14.2-120	34
14.2-121	34
14.2-122	34
14.2-123	34
14.2-124	34
14.2-125	34
14.2-126	34
14.2-127	34
14.2-128	34
14.2-129	34
14.2-130	49
14.2-131	35
14.2-132	34
14.2-133	34
14.2-134	34
14.2-135	34
14.2-136	34
14.2-137	36
14.2-138	36
14.2-139	36
14.2-140	36
14.2-141	36
14.2-142	34
14.2-143	37
14.2-144	34
14.2-145	34
14.2-146	34
14.2-147	34
14.2-148	34
14.2-149	34
14.2-150	34
14.2-151	52
14.2-152	34
14.2-153	34
14.2-154	34
14.2-155	34
14.2-156	34
14.2-157	34
14.2-158	34
14.2-159	36

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CHAPTER 14 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 15

LIST OF EFFECTIVE PAGES

CHAPTER 15 (Continued)

TEXT PAGES	AMENDMENT
15.0-1	52
15.0-2	51
15.0-3	51
15.0-4	51
15.0-5	51
15.0-6	51
15.0-7	51
15.0-8	51
15.0-9	52
15.0-10	52
15.0-11	52
15.0-12	52
15.0-13	52
15.0-14	52
15.0-15	52
15.1-1	51
15.1-2	51
15.1-3	51
15.1-4	51
15.1-5	51
15.1-6	51
15.1-7	51
15.1-8	51
15.1-9	51
15.1-10	51
15.1-11	51
15.1-12	51
15.1-13	51
15.1-14	51
15.1-15	51
15.1-16	51
15.1-17	51
15.1-18	51
15.1-19	51
15.1-20	52
15.1-21	51
15.1-22	51
15.2-1	51
15.2-2	51
15.2-3	51
15.2-4	51
15.2-5	51
15.2-6	51
15.2-7	51
15.2-8	51

LIST OF EFFECTIVE PAGES

CHAPTER 15 (Continued)

TEXT PAGES	AMENDMENT
15.2-9	51
15.2-10	51
15.2-11	51
15.2-12	51
15.2-13	51
15.2-14	51
15.2-15	51
15.2-16	51
15.2-17	51
15.2-18	51
15.2-19	51
15.2-20	51
15.2-21	51
15.2-22	51
15.2-23	51
15.2-24	51
15.2-25	51
15.2-26	51
15.2-27	51
15.2-28	51
15.2-29	51
15.2-30	51
15.2-31	51
15.2-32	51
15.2-33	51
15.2-34	52
15.2-35	51
15.2-36	51
15.2-37	51
15.2-38	51
15.2-39	51
15.2-40	51
15.2-41	51
15.2-42	51
15.2-43	51
15.2-44	51
15.2-45	51
15.3-1	51
15.3-2	51
15.3-3	52
15.3-4	52
15.3-5	52
15.3-6	52
15.3-7	52
15.3-8	52
15.3-9	52

LIST OF EFFECTIVE PAGES

CHAPTER 15 (Continued)

TEXT PAGES	AMENDMENT
15.3-10	52
15.3-11	51
15.3-12	52
15.3-13	52
15.3-14	52
15.3-15	52
15.3-16	52
15.3-17	52
15.3-18	52
15.4-1	51
15.4-2	52
15.4-3	52
15.4-4	51
15.4-5	51
15.4-6	51
15.4-7	51
15.4-8	52
15.4-9	52
15.4-10	52
15.4-11	52
15.4-12	52
15.4-13	51
15.4-14	51
15.4-15	52
15.4-16	52
15.4-17	51
15.4-18	51
15.4-19	51
15.4-20	52
15.4-21	52
15.4-22	52
15.4-23	51
15.4-24	52
15.4-25	51
15.4-26	51
15.4-27	51
15.4-28	51
15.4-29	51
15.5-1	51
15.5-2	51
15.5-3	51
15.5-4	51

LIST OF EFFECTIVE PAGES

CHAPTER 15 (Continued)

TEXT PAGES	AMENDMENT
15.6-1	51
15.6-2	51
15.6-3	51
15.6-4	51
15.6-5	51
15.6-6	51
15.6-7	51
15.6-8	51
15.6-9	51
15.6-10	51
15.6-11	51
15.6-12	51
15.6-13	51
15.6-14	51
15.6-15	51
15.6-16	51
15.6-17	51
15.6-18	51
15.6-19	51
15.6-20	51
15.6-21	51
15.6-22	51
15.6-23	51
15.6-24	51
15.6-25	51
15.6-26	51
15.6-27	51
15.6-28	51
15.6-29	51
15.6-30	51
15.6-31	51
15.6-32	51
15.6-33	51
15.6-34	51
15.6-35	51
15.6-36	51
15.7-1	51
15.7-2	51
15.7-3	51
15.7-4	51
15.7-5	51
15.7-6	51
15.7-7	51
15.7-8	51
15.7-9	52
15.7-10	51

LIST OF EFFECTIVE PAGES

CHAPTER 15 (Continued)

LIST OF EFFECTIVE PAGES

CHAPTER 15

FIGURES	AMENDMENT
15.0-1	52
15.0-1a	52
15.0-2	23
15.0-3	23
15.1-1	0
15.1-2	0
15.1-3	51
15.1-4	43
15.2-1	51
15.2-2	51
15.2-3	0
15.2-4	51
15.2-5	51
15.2-6	51
15.2-7	51
15.2-8	51
15.2-9	51
15.2-10	8
15.2-11	8
15.2-12	0
15.2-13	0
15.2-14	48
15.2-15	0
15.2-16	8
15.2-17	8
15.2-18	8
15.2-19	8
15.3-1	52
15.3-2	52
15.3-3	52
15.3-4	52
15.3-5	52
15.4-1	51
15.4-2	51
15.4-3	51
15.4-4	51
15.4-5	51
15.4-6	52
15.4-7	52
15.4-8	52
15.4-9	51
15.4-10	51

LIST OF EFFECTIVE PAGES

CHAPTER 15 (Continued)

FIGURES	AMENDMENT
15.5-1	51
15.6-1	0
15.6-2	0
15.6-3	9
15.6-4	0
15.7-1	0
15.8-1	51
15.8-2	51
15.8-3	51
15.8-4	51
15.8-5	51

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CHAPTER 15 APPENDIX F

TEXT PAGES	AMENDMENT
15.F-i	48
15.F-ii	52
15.F-iii	48
15.F-iv	48
15.F-v	51
15.F-vi	49
15.F-vii	52
15.F-1	52
15.F-2	51
15.F-2a	51
15.F-3	52
15.F-4	46
15.F-5	52
15.F-6	52
15.F-7	48
15.F-8	52
15.F-9	52
15.F-10	52
15.F-11	52
15.F-12	52
15.F-12a	52
15.F-13	52
15.F-14	52
15.F-15	49
15.F-16	51
15.F-17	52
15.F-18	38
15.F-19	52
15.F-20	52
15.F-21	52
15.F-22	52
15.F-23	52
15.F-24	52
15.F-25	48
15.F-26	52
15.F-27	52
15.F-28	46
15.F-29	52
15.F-31	52
15.F-32	52
15.F-33	52
15.F-34	52
15.F-35	52
15.F-36	52
15.F-37	52
15.F-38	46
15.F-39	52

LIST OF EFFECTIVE PAGES

CHAPTER 15 APPENDIX F (Continued)

FIGURES	AMENDMENT
15.F.1-1	49
15.F.1-2	49
15.F.1-3	49
15.F.1-4	49
15.F.1-5	49
15.F.1-6	49
15.F.2-1	49
15.F.2-2	49
15.F.2-3	49
15.F.2-4	49
15.F.2-5	49
15.F.2-6	49
15.F.2-7	48
15.F.2-8	48
15.F.4-1	48
15.F.4-2	52
15.F.4-3	46

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CHAPTER 16

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LIST OF EFFECTIVE PAGES

CHAPTER 17

TEXT PAGES	AMENDMENT
17-i	30
17-ii	17
17-iii	17
17-iv	17
17-v	17
17.1-1	17
17.1-2	27
17.1-2a	27
17.1-2b	27
17.1-3	27
17.1-3a	27
17.1-3b	27
17.1-3c	27
17.1-4	29
17.1-4a	29
17.1-4b	29
17.1-5	27
17.1-6	27
17.1-7	20
17.1-7a	20
17.1-7b	20
17.1-7c	27
17.1-7d	20
17.1-7e	20
17.1-8	30
17.1-8a	20
17.1-9	27
17.1-9a	27
17.1-10	17
17.1-11	17
17.1-12	30
17.1-13	17
17.1-14	17
17.1-15	30
17.1-16	17
17.1-17	27
17.1-17a	30
17.1-18	17
17.1-19	20
17.1-19a	20
17.1-20	30
17.1-21	17
17.1-22	26
17.1-23	20
17.1-24	17
17.1-25	30

LIST OF EFFECTIVE PAGES

CHAPTER 17 (Continued)

TEXT PAGES	AMENDMENT
17.1-26	30
17.1-27	30
17.1-27a	30
17.1-28	20
17.1-29	27
17.1-30	27
17.1-31	27
17.1-32	27
17.1-33	27
17.1-34	17
17.1-35	17
17.1-36	17
17.1-37	27
17.1-38	27
17.1-38a	27
17.1-39	30
17.1-40	17
17.1-41	27
17.1-42	20
17.2-1	52

FIGURES	AMENDMENT
17.1-1	27
17.1-2	27
17.1-3	27
17.1-4	20
17.1-5	17

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APPENDIX A

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APPENDIX B

TEXT PAGES	AMENDMENT
Title Page	17
B-i	50
B-ii	50
B-iii	17
B-iv	51
1	46
2	37
3	46
4	37
B.1-1	17
B.1-2	17
B.1-3	36
B.1-3a	49
B.1-3b	36
B.1-4	17
B.1-5	36
B.1-5a	36
B.1-6	36
B.1-7	36
B.1-8	17
B.1-9	17
B.1-10	32
B.1-11	36
B.1-12	51
B.1-13	17
B.1-14	36
B.1-14a	36
B.1-15	36
B.1-15a	36
B.1-16	Deleted
B.1-17	36
B.1-18	Deleted
B.1-19	17
B.1-20	51
B.1-21	51
B.1-22	Deleted
B.1-23	17
B.1-24	30
B.1-25	17
B.1-26	36
B.1-27	36
B.1-28	17
B.1-29	36
B.1-30	17
B.1-31	33
B.1-32	36
B.1-32a	36

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APPENDIX B

TEXT PAGES	AMENDMENT
B.1-33	36
B.1-33a	30
B.1-34	17
B.1-35	36
B.1-35a	51
B.1-35b	51
B.1-36	17
B.1-37	23
B.1-37a	43
B.1-37b	36
B.1-38	36
B.1-39	36
B.1-40	17
B.1-41	23
B.1-42	46
B.1-43	46
B.1-44	48
B.1-44a	48
B.1-44b	48
B.1-45	36
B.1-46	36
B.1-47	17
B.1-48	36
B.2-1	17
B.2-2	17
B.2-3	17
B.2-4	17
B.2-5	21
B.2-5a	21
B.2-5b	21
B.2-5c	43
B.2-5d	43
B.2-5e	36
B.2-6	17
B.2-7	17
B.2-8	17
B.2-9	17
B.2-10	17
B.2-11	36
B.2-12	23
B.2-13	17
B.2-14	17
B.2-15	17
B.2-16	39
B.2-16a	39
B.2-16b	39
B.2-16c	52

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APPENDIX B

LIST OF EFFECTIVE PAGES

APPENDIX B

LIST OF EFFECTIVE PAGES

APPENDIX B

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B.2-97	17
B.2-98	17
B.2-99	17
B.2-100	17
B.2-101	17
B.2-102	17
B.2-103	36
B.3-1	50
B.3-2	51
B.3-3	51
B.3-4	51
B.3-4a	Deleted
B.3-4b	Deleted
B.3-4c	Deleted
B.3-4d	Deleted
B.3-4e	Deleted
B.3-4f	Deleted
B.3-4g	Deleted
B.3-4h	Deleted
B.3-4i	Deleted
B.3-4j	Deleted
B.3-4k	Deleted
B.3-4l	Deleted
B.3-4m	Deleted
B.3-4n	Deleted
B.3-4o	Deleted
B.3-4p	Deleted
B.3-5	23
B.3-5a	23
B.3-6	23
B.3-6a	36
B.3-7	23
B.3-8	23
B.3-9	52
B.3-9a	36
B.3-10	17
B.3-11	17
B.3-12	36

LIST OF EFFECTIVE PAGES

APPENDIX C

TEXT PAGES	AMENDMENT
C-i	48
C-ii	48
C-iii	48
C-iv	48
C-v	48
C-vi	48
C-vii	51
C.1-1	0
C.2-1	0
C.2-2	0
C.2-3	36
C.2-4	0
C.2-5	0
C.2-6	0
C.2-7	36
C.2-8	0
C.2-9	36
C.2-10	0
C.2-11	0
C.2-12	47
C.2-13	47
C.2-14	30
C.2-15	36
C.2-16	4
C.2-17	0
C.2-18	36
C.2-19	13
C.2-20	36
C.2-21	0
C.2-22	36
C.2-23	36
C.2-24	0
C.2-25	0
C.2-26	0
C.2-27	0
C.2-28	0
C.2-29	36
C.2-30	0
C.2-31	0
C.2-32	36
C.2-33	0
C.2-34	0
C.2-35	0
C.2-36	0
C.2-37	0
C.2-38	36

LIST OF EFFECTIVE PAGES

APPENDIX C

TEXT PAGES	AMENDMENT
C.2-39	0
C.2-40	27
C.2-41	36
C.2-42	0
C.2-43	36
C.2-44	21
C.2-45	36
C.2-46	13
C.2-47	36
C.2-48	30
C.2-49	0
C.2-50	0
C.2-51	51
C.2-52	30
C.2-53	36
C.2-54	0
C.2-55	36
C.2-56	0
C.2-57	0
C.2-58	36
C.2-59	0
C.2-60	36
C.2-61	0
C.2-62	0
C.2-63	50
C.2-64	0
C.2-65	30
C.2-66	36
C.2-67	36
C.2-67a	36
C.2-68	9
C.2-69	0
C.2-70	7
C.2-71	0
C.2-72	7
C.2-73	0
C.2-74	0
C.2-75	0
C.2-76	47
C.2-77	0
C.2-78	0
C.2-79	0
C.2-80	0
C.2-81	0
C.2-82	23
C.2-83	30
C.2-83a	30
C.2-84	50

LIST OF EFFECTIVE PAGES

APPENDIX C

TEXT PAGES	AMENDMENT
C.2-85	0
C.2-86	14
C.2-87	0
C.2-88	0
C.2-89	36
C.2-90	32
C.3-1	0
C.3-2	40
C.3-3	48
C.3-4	0
C.3-5	48
C.3-6	0
C.3-7	0
C.3-8	0
C.3-9	13
C.3-10	0
C.3-11	48
C.3-12	0
C.3-13	30
C.3-14	12
C.3-15	0
C.3-16	0
C.3-17	2
C.3-17a	2
C.3-18	13
C.3-19	47
C.3-20	0
C.3-21	31
C.3-22	5
C.3-23	29
C.3-24	30
C.3-25	8
C.3-26	27
C.3-27	0
C.3-28	23
C.3-29	0
C.3-30	0
C.3-31	31
C.3-32	8
C.3-33	8
C.3-34	8
C.3-35	11
C.3-36	0
C.3-37	0
C.3-38	0
C.3-39	27
C.3-40	0

LIST OF EFFECTIVE PAGES

APPENDIX C

TEXT PAGES	AMENDMENT
C.3-41	21
C.3-41a	21
C.3-42	0
C.3-43	0
C.3-44	0
C.3-45	51
C.3-45a	51
C.3-45b	51
C.3-45c	51
C.3-45d	51
C.3-46	0
C.3-47	8
C.3-48	0
C.3-49	13
C.3-49a	9
C.3-50	0
C.3-51	13
C.3-52	0
C.3-53	0
C.3-54	8
C.3-55	13
C.3-56	51
C.3-57	26
C.3-58	0
C.3-59	7
C.3-60	14
C.3-61	14
C.3-62	0
C.3-63	0
C.3-64	27
C.3-65	0
C.3-66	47
C.3-67	8
C.3-68	23
C.3-69	0
C.3-70	9
C.3-71	0
C.3-72	0
C.3-73	27
C.3-74	27
C.3-75	20
C.3-76	11
C.3-77	47
C.3-78	0
C.3-79	0
C.3-80	48
C.3-81	4
C.3-82	23

LIST OF EFFECTIVE PAGES

APPENDIX C

TEXT PAGES	AMENDMENT
C.3-83	48
C.3-84	13
C.3-85	27
C.3-86	14
C.3-87	33
C.3-88	0
C.3-89	0
C.3-90	0
C.3-91	13
C.3-92	9
C.3-93	0
C.3-94	0
C.3-95	0
C.3-96	0
C.3-97	43
C.3-98	44
C.3-99	0
C.3-100	0
C.3-101	0
C.3-102	8
C.3-103	0
C.3-104	0
C.3-105	43
C.3-106	0
C.3-107	8
C.3-108	30
C.3-109	0
C.3-110	0
C.3-111	27
C.3-112	14
C.3-112a	50
C.3-112b	48
C.3-113	27
C.3-114	27
C.3-115	23
C.3-116	42
C.3-117	47

LIST OF EFFECTIVE PAGES

APPENDIX D

TEXT PAGES	AMENDMENT
Title Page	27

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
005.001	2	27
010.001	1	1
010.002	1	34
010.003	1	50
010.004	1	1
010.005	1	1
010.006	1	13
010.007	1	43
010.008	1	1
010.009	1	1
010.010	1	51
010.011	9	9,44,34
010.012	2	33
010.013	2	5,25
010.014	3	5
010.015	1	13
010.016	3	5,13
010.017	1	13
010.018	1	13
010.019	1	5
010.020	1	5
010.021	1	21
010.022	1	5
010.023	2	5
010.024	1	5
010.025	1	5
010.026	1	5
010.027	1	5
010.028	2	5,21
010.029	2	5
010.030	1	5
010.031	1	5
010.032	1	5
010.033	1	5
010.034	1	21
010.035	1	51
010.036	5	30,26
010.037	3	27
010.038	1	27
010.039	1	26
010.040	2	21,33
010.041	8	21,42

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
010.042	2	21,42
010.043	2	23
010.044	1	21
010.045	1	21
010.046	1	21
010.047	1	21
010.048	1	21
010.049	7	21,30
010.050	1	21
010.051	1	35
010.052	1	21
010.053	1	35
010.054	1	51
010.055	5	26
010.056	2	48
010.057	1	21
010.058	1	21
010.059	1	21
010.060	1	48
010.061	1	21
010.062	1	21
010.063	1	29
010.064	1	21
010.065	1	21
010.066	11	27,29
010.067	1	31
010.068	1	29
010.069	1	29
010.070	1	29
010.071	1	29
010.072	1	29
010.073	1	29
010.074	1	29
022.001	1	1
022.002	1	34
022.003	1	52
022.004	1	1
022.005	3	8
022.006	1	13
022.007	1	11
022.008	1	34
022.009	1	1
022.010	1	52
022.011	1	1
022.012	1	52
022.013	1	35

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
022.014	1	13
022.015	1	3
022.016	1	3
022.017	1	52
022.018	1	3
022.019	1	3
022.020	1	3
022.021	1	47
022.022	1	30
022.023	1	3
022.024	1	51
022.025	1	14
022.026	1	52
022.027	1	14
022.028	1	3
022.029	1	31
022.030	1	3
022.031	5	16,31
022.032	4	5
022.033	1	5
022.034	1	5
022.035	3	33
022.036	1	5
022.037	2	5
022.038	1	5
022.039	3	30
022.040	1	5
022.041	1	52
022.042	1	52
022.043	2	52
022.044	1	52
022.045	1	52
022.046	1	52
022.047	1	5
022.048	4	49
022.049	4	52
022.050	2	5
022.051	1	52
022.052	1	52
022.053	3	20
022.054	2	20
022.055	2	20
022.056	4	20
022.057	1	20
022.058	3	20
022.059	6	20

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
022.060	1	20
022.061	8	20
022.062	2	20
022.063	3	20
022.064	1	21
022.065	1	21
022.066	1	21
022.067	1	21
022.068	1	21
022.069	1	21
022.070	1	21
022.071	1	21
022.072	1	52
022.073	1	52
022.074	1	52
022.075	1	52
022.076	1	52
022.077	1	21
022.078	1	26
022.079	1	21
022.080	1	52
022.081	1	52
022.082	1	52
022.083	1	21
022.084	1	21
022.085	1	21
022.086	1	21
022.087	1	21
022.088	1	49
022.089	1	21
022.090	1	21
022.091	1	30
022.092	1	21
022.093	3	21
022.094	2	21,49
022.095	1	49
022.096	1	21
022.097	1	21
022.098	1	49
022.099	2	34,49
022.100	2	21
022.101	2	21
022.102	1	21
022.103	1	21
022.104	1	21
022.105	1	21

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
022.106	1	21
022.107	8	20
022.109	2	20
022.110	1	20
022.111	1	20
022.112	2	20
022.113	1	20
022.114	1	20
031.001(a)	1	0
031.001(b)	1	14
031.001(c)	1	14
031.001(d)	1	14
031.001(e)	1	52
031.001(f)	1	0
031.001(g)	1	14
031.001(h)	1	14
031.001(i)	2	0,46
031.001(j)	1	33
031.001(k)	1	33
031.001(l)	1	0
031.001(m)	1	34
031.001(n)	1	0
031.001(o)	1	0
031.001(p)	1	0
031.001(q)	1	0
031.001(r)	2	0,14
031.001(s)	1	0
031.001(t)	1	0
031.001(u)	1	47
031.001(v)	1	42
031.001(w)	1	14
031.001(x)	1	0
031.001(y)	1	14
031.001(z)	1	14
031.001(aa)	1	47
031.001(bb,cc)	1	47
031.001(dd)	1	14
031.001(ee)	1	14
031.001(ff)	1	14
031.001(gg)	1	0
031.001(hh)	1	52
031.001(ii)	1	14
031.002	1	42
031.003	1	0
031.004	1	47
031.005	1	47

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
031.006	2	32,47
031.007	1	0
031.008	1	0
031.009	4	0,50
031.010	4	0,14
031.011	1	14
031.012	1	0
031.013	1	14
031.014	1	30
031.015	3	0,14
031.016	2	0,34
031.017	2	0
031.018	2	0
031.019	1	14
031.020	1	0
031.021	2	14
031.022	1	14
031.023	1	25
031.024	1	0
031.025	2	0
031.026	2	29
031.027	1	14
031.028	1	14
031.029	1	0
031.030	2	0,47
031.031	1	14
031.032	1	0
031.033	1	0
031.034	2	0
031.035	1	14
031.036	1	14
031.037	1	14
031.038	2	14
031.039	2	0,14
031.040	1	14
031.041	1	14
031.042	1	0
031.043	1	0
031.044	2	0,14
031.045	1	14
031.046	1	14
031.047	1	14
031.048	3	0,14,51
031.049	1	49
031.050	3	0
031.051	1	0

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
031.052	1	14
031.053	2	0
031.054	2	14
031.055	1	32
031.056	1	10
031.057	1	10
031.058	3	52
031.059	5	52
031.060	1	3
031.061	1	3
031.062	1	3
031.063	1	3
031.064	1	3
031.065	2	3
031.066	2	3
031.067	1	3
031.068	1	3
031.069	1	14
031.070	5	3,21,35
031.071	1	29
031.072	1	34
031.073	1	3
031.074	1	42
031.075	1	14
031.076	3	5,25,42
031.077	1	3
031.078	2	3,14
031.079	2	3
031.080	7	10,33,34,42
031.081	2	17,31
031.082	1	10
031.083	1	33
031.084	1	10
031.085	1	10
031.086	1	10
031.087	6	10
031.088	1	10
031.089	1	10
031.090	1	10
031.091	1	10
031.092	2	10,35
031.093	1	31
031.094	1	10
031.095	1	10
031.096	1	10
031.097	1	10

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
031.098	1	10
031.099	1	34
031.100	1	23
031.101	1	10
031.102	1	49
031.103	5	10,42
031.104	2	10
031.105	2	10
031.106	1	32
031.107	1	10
031.108	2	10,52
031.109	1	10
031.110	1	10
031.111	1	10
031.112	1	10
031.113	1	10
031.114	2	21
031.115	1	46
031.116	1	21
031.117	3	23,52
031.118	1	29
031.119	1	21
031.120	1	21
031.121	1	32
031.122	1	21
031.123	1	21
031.124	2	31
031.125	1	21
031.126	2	21
031.127	1	21
031.128	1	23
031.129	1	21
031.130	1	21
031.131	2	21
031.132	1	21
031.133	1	21
031.134	1	21
031.135	97	31,48,49,52
031.136	6	29
031.137	33	31,51,52
031.138	48	31
031.138A	27	31,47
031.139	17	27,30,43,49
031.140	1	30
031.141	1	30
031.142	2	35

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
031.143	1	35
031.144	1	35
031.145	2	35
031.146	1	35
031.147	2	35
031.148	2	35
031.149	1	35
031.150	2	35
031.151	1	35
031.152	1	35
031.153	1	35
031.154	1	35
031.155	1	35
031.156	1	35
031.157	1	35
031.158	1	35
031.159	1	35
040.001	2	0
040.002	1	0
040.003	1	0
040.004	1	1
040.005	1	0
040.006	1	0
040.007	1	0
040.008	1	0
040.009	1	32
040.010	2	0,31
040.011	1	0
040.012	1	0
040.013	1	0
040.014	1	43
040.015	1	26
040.016	1	0
040.017	1	26
040.018	1	26
040.019	1	26
040.020	7	0
040.021	1	0
040.022	1	0
040.023	2	26
040.024	2	0
040.025	1	0
040.026	2	43,50
040.027	1	0
040.028	1	0
040.029	1	46

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
040.030	1	0
040.031	1	0
040.032	1	26
040.033	1	0
040.034	11	49,51
040.035	1	26
040.036	2	7,25
040.037	1	29
040.038	1	7
040.039	4	11,50
040.040	1	7
040.041	1	7
040.042	1	47
040.043	1	14
040.044	2	7,32
040.045	6	26,50
040.046	1	26
040.047	3	26,27
040.048	1	7
040.049	1	7
040.050	1	26
040.051	1	34
040.052	1	26
040.053	2	7
040.054	1	26
040.055	1	7
040.056	1	26
040.057	1	7
040.058	1	7
040.059	1	26
040.060	2	7,14
040.061	1	26
040.062	1	7
040.063	1	7
040.064	1	7
040.065	1	7
040.066	1	7
040.067	1	7
040.068	1	7
040.069	1	7
040.070	1	14
040.071	1	7
040.072	1	7
040.073	1	7
040.074	1	7
040.075	2	43

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
040.076	4	43,45
040.077	3	43,45
040.078	3	31,43
040.079	2	43
040.080	2	25
040.081	2	31,34
040.082	3	21,26
040.083	1	35
040.084	4	26,27,35
040.085	1	52
040.086	1	32
040.087	1	21
040.088	3	26,31,48
040.089	1	21
110.001	1	9
110.002	1	25
110.003	1	27
110.004	1	25
110.005	1	9
110.006	1	9
110.007	1	9
110.008	1	9
110.009	1	9
110.010	1	9
110.011	1	9
110.012	1	9
110.013	1	9
110.014	1	9
110.015	1	9
110.016	1	9
110.017	1	25
110.018	1	9
110.019	5	9,32
110.020	1	9
110.021	1	9
110.022	1	25
110.023	1	9
110.024	1	9
110.025	1	9
110.026	1	31
110.027	1	30
110.028	2	9
110.029	1	9
110.030	2	35
110.031	1	9
110.032	1	34

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
110.033	1	33
110.034	1	21
110.035	1	9
110.036	2	9,30
110.037	2	9,31
110.038	2	30
110.039	3	30
110.040	12	33
121.001	4	5
121.002	8	5,31
121.003	1	5
121.004	1	29
121.005	1	5
121.006	1	5
121.007	1	48
121.008	12	5,10,27,35
121.009	1	5
121.010	3	7,31
121.011	2	23
121.012	1	23
121.013	1	23
121.014	1	23
121.015	2	46
121.016	1	23
121.017	1	23
121.018	1	23
121.019	1	30
130.001	1	1
130.002	1	1
130.003	1	1
130.004	1	1
130.005	1	1
130.006	1	1
130.007	1	1
130.008	1	1
130.009	1	13
130.010	1	8
130.011	1	8
130.012	1	8
130.013	1	23
130.014	1	8
130.015	1	8
130.016	1	8
130.017	1	8
130.018	1	8
130.019	1	8

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
130.020	1	23
130.021	1	8
130.022	1	8
130.023	1	8
130.024	5	23
130.025	1	8
130.026	1	8
130.027	1	8
130.028	1	8
130.029	1	8
130.030	1	8
130.031	1	8
130.032	1	8
130.033	1	8
130.034	1	8
130.035	4	8,25
130.036	1	8
130.037	1	8
130.038	2	8
130.039	7	8
130.040	1	8
130.041	1	8
130.042	8	8
130.043	1	8
130.044	1	8
130.045	7	0,12
130.046	6	12
130.047	1	12
130.048	2	12,23
130.049	3	12
130.050	1	23
130.051	2	23
130.052	1	23
130.053	4	23
130.054	1	23
130.055	9	23
130.056	9	23
130.057	1	23
130.058	1	23
130.059	1	23
130.060	11	23,30
130.061	2	23,30
130.062	3	23,30
130.063	1	30
130.064	2	23
130.065	1	23

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
130.066	2	23
130.067	4	23,30
130.068	3	23
130.069	2	23
130.070	2	23
130.071	3	23
130.072	6	23
130.073	13	23
130.074	1	23
130.075	1	23
130.076	1	23
130.077	1	23
130.078	1	23
210.001	1	0
211.002	1	8
211.003	1	8
211.004	1	34
211.005	1	8
211.006	1	21
211.007	1	14
211.008	2	8,14
211.009	1	52
211.010	2	21,23
211.011	1	8
211.012	2	8,23
211.013	1	8
211.014	2	8
211.015	1	8
211.016	2	29
211.017	2	8
211.018	1	21
211.019	4	23
211.020	1	8
211.021	2	8
211.022	1	8
211.023	2	27
211.024	1	33
211.025	2	23,33
211.026	1	35
211.027	4	33,49
211.028	2	8
211.029	1	34
211.030	1	8
211.031	10	23,33,49
211.032	1	21
211.033	4	8,30,31

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
211.034	1	8
211.035	1	8
211.036	1	8
211.037	1	17
211.038	3	8,27
211.039	1	33
211.040	1	49
211.041	1	8
211.042	1	8
211.043	1	8
211.044	1	8
211.045	1	8
211.046	1	8
211.047	1	8
211.048	2	8
211.049	1	46
211.050	2	11
211.051	19	11,23
211.052	1	43
211.053	1	11
211.054	1	23
211.055	1	11
211.056	2	11
211.057	1	32
211.058	3	11
211.059	1	11
211.060	1	11
211.061	2	11,31
211.062	1	11
211.063	1	32
211.064	1	11
211.065	2	11
211.066	2	11,27
211.067	1	11
211.068	1	31
211.069	1	11
211.070	1	31
211.071	1	11
211.072	3	23
211.073	1	11
211.074	1	52
211.075	1	11
211.076	2	33,48
211.077	4	49
211.078	1	11
211.079	4	11,52

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
211.080	2	11
211.081	2	11
211.082	3	11
211.083	1	11
211.084	1	49
211.085	4	11
211.086	1	11
211.087	6	0,21
211.088	2	11
211.089	5	11
211.090	1	11
211.091	2	11
211.092	3	23
211.093	1	27
211.094	1	11
211.095	1	11
211.096	1	49
211.097	1	49
211.098	1	43
211.099	1	23
211.100	1	31
211.101	2	11,46
211.102	1	11
211.103	1	11
211.104	1	11
211.105	3	11,46
211.106	1	11
211.107	1	21
211.108	1	21
211.109	1	21
211.110	1	21
211.111	1	21
211.112	1	21
211.113	2	21
211.114	1	21
211.115	1	20
211.116	3	21
211.117	1	21
211.118	1	21
211.119	1	21
211.120	2	21
211.121	1	21
211.122	1	21
211.123	1	21
211.124	1	34
211.125	1	21

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
211.126	1	21
211.127	2	20,30
211.128	2	44
211.129	1	23
211.130	1	21
211.131	1	21
211.132	2	21
211.133	1	21
211.134	1	21
211.135	1	21
211.136	1	23
211.137	1	20
211.138	1	21
211.139	2	20,30
211.140	1	20
211.141	1	20
211.142	1	20
211.143	1	33
211.144	2	33
211.145	1	20
211.146	1	23
211.147	1	20
211.148	3	23
211.149	1	20
211.150	1	21
211.151	1	20
211.152	1	21
211.153	2	20
211.154	1	20
211.155	2	20
211.156	2	20
211.157	2	20
211.158	1	20
211.159	1	23
211.160	1	20
211.161	1	20
211.162	1	20
211.163	1	20
211.164	2	21
211.165	2	20
211.166	2	20
211.167	1	20
211.168	1	27
211.169	2	20
211.170	1	20
211.171	4	21,52

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
211.172	1	20
211.173	1	21
211.174	1	32
211.175	1	31
211.176	1	20
211.177	1	20
211.178	1	20
211.179	1	20
211.180	1	21
211.181	1	20
211.182	1	21
211.183	1	20
211.184	1	20
211.185	1	21
211.186	1	20
211.187	1	20
211.188	1	20
211.189	2	21
211.190	1	20
211.191	1	20
211.192	1	20
211.193	1	20
211.194	1	20
211.195	2	20
211.196	1	21
211.197	1	23
211.198	2	30
211.199	2	33
211.200	1	20
211.201	1	21
211.202	2	21
211.203	1	21
211.204	1	21
211.205	2	20
211.206	11	21,52
211.207	2	20,21
211.208	1	21
211.209	1	30
211.210	1	20
211.211	1	21
211.212	1	49
211.213	2	21
212.001	1	3
212.002	1	3
212.003	4	27
212.004	1	3

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
221.001	2	7,32
221.002	1	7
221.003	1	7
221.004	2	32
221.005	1	32
221.006	1	7
221.007	1	32
221.008	1	32
221.009	3	7,32
221.010	3	7,32
221.011	1	7
221.012	3	7
221.013	1	32
222.001	1	8
222.002	2	8,25
222.003	1	8
222.004	1	8
231.001	1	32
231.002	3	3
231.003	1	32
231.004	2	20,32
231.005	7	20,32
231.006	1	29
232.001	1	3
232.002	1	32
232.003	1	29
232.004	1	29
232.005	2	30
271.001	3	35
271.002	1	35
271.003	3	21
271.004	1	33
271.005	1	33
271.006	1	21
271.007	1	29
271.008	1	29
271.009	1	29
271.010	1	32
271.011	1	29
271.012	1	33
271.013	1	29
271.014	1	29
271.015	1	52
271.016	1	52
272.001	7	30
272.002	2	30

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
281.001	2	21,50
281.002	1	21
281.003	1	30
281.004	1	21
281.005	1	21
281.006	1	50
281.007	1	21
281.008	1	21
281.009	2	21,34
281.010	1	50
281.011	1	35
281.012	1	21
281.013	1	21
281.014	1	21
311.001	1	23
312.001	1	1
312.002	1	1
312.003	1	1
312.004	1	1
312.005	1	1
312.006	1	1
312.007	1	1
312.009	1	8
312.010	1	1
312.011	1	1
312.012	2	1
312.013	1	49
312.014	1	1
312.015	1	8
312.016	1	5
312.017	1	51
312.018	1	11
312.019	1	5
321.001	1	14
321.002	1	1
321.003	1	13
321.004	1	21
321.005	4	5,20,49
331.001	1	13
331.002	2	13
331.003	2	1
331.004	1	1
331.005	1	1
331.006	1	1
331.007	1	1
331.008	1	1

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
331.009	1	1
331.010	1	1
331.011	1	1
331.012	1	1
331.013	1	1
331.014	1	1
331.015	2	5,47
331.016	1	5
331.017	1	5
331.018	1	5
331.019	1	32
331.020	1	5
331.021	1	13
331.022	1	5
331.023	1	5
331.024	1	48
331.025	2	20
331.026	2	20
331.027	1	20
331.028	2	49
331.029	1	20
360.001	1	0
360.002	1	0
360.003	1	0
360.004	3	10,29
360.005	6	10,29
360.006	2	21
360.007	3	21
360.008	4	21
360.009	7	21
360.010	3	21
360.011	2	21
360.012	2	21
360.013	3	21
360.014	15	23
360.015	7	23
360.016	6	23
360.017	21	23
360.018	5	23
360.019	6	23
360.020	13	23
360.021	1	23
360.022	4	23
361.001	1	21
361.002	2	21
361.003	1	21

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
361.004	28	21
361.005	6	21
361.006	2	21,29
361.007	2	21
361.008	2	21
361.009	3	21
361.010	4	21
361.011	2	21
361.012	1	21
361.013	2	21
361.014	1	21
361.015	8	0,23
361.016	33	27
361.017	88	23,27
361.018	8	23
361.019	44	23
361.020	5	27
361.021	24	27
361.022	1	27
361.023	12	27
361.024	5	27
361.025	3	27
362.001	1	3
362.002	2	3
362.003	1	3
362.004	2	3
362.005	1	5
362.006	1	5
362.007	1	5
362.008	1	5
362.009	2	5
362.010	5	48
362.011	6	48
362.012	2	21
362.013	1	21
362.014	4	21
371.001	1	23
371.002	1	1
371.003	1	1
371.004	1	1
371.005	1	1
371.006	1	5
371.008	1	23
371.009	1	5
371.010	1	5
371.011	1	5

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
371.012	1	5
371.013	1	5
371.014	1	5
371.015	5	23
371.016	5	23,27
371.017	2	23
371.018	4	23,34
371.019	2	23
371.020	1	23
371.03E	2	20
371.04E	1	20
371.05E	1	20
371.06E	1	20
371.07E	1	20
372.001	1	1
372.002	1	1
372.003	1	1
372.004	1	1
372.005	1	1
372.006	1	1
372.007	1	3
372.008	14	5,29
372.009	1	5
372.010	1	5
372.011	1	5
372.012	1	5
372.013	1	5
372.014	4	5,43
372.015	5	46
372.016	3	43
372.017	1	5
421.001	1	20
421.002	1	20
421.003	1	20
421.004	2	20
421.005	1	20
421.006	1	20
421.007	1	20
421.008	1	21
421.009	1	20
421.010	1	20
421.011	1	20
421.012	1	20
421.013	1	20
421.014	1	27
421.015	1	20

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
421.016	1	30
421.017	1	20
421.018	1	20
421.019	1	20
421.020	2	20
421.021	1	20
421.022	1	20
421.023	1	20
421.024	1	20
421.025	1	20
421.026	1	20
421.027	1	20
421.028	1	20
421.029	1	20
421.030	1	20
421.031	1	20
421.032	1	20
421.033	1	20
421.034	1	20
421.035	1	20
421.036	1	20
421.037	1	20
421.038	1	20
421.039	1	20
421.040	1	20
421.041	2	21
421.042	1	29
421.043	17	20,25,30,31
422.001	2	43
422.002	1	26
422.003	1	26
422.004	3	51
422.005	1	7
422.006	3	51
422.007	2	52
422.008	2	7
422.009	1	7
423.001	1	1
423.002	1	1
423.003	1	1
423.004	1	0
423.005	1	1
423.006	2	1
423.007	1	1
423.008	1	1
423.009	1	1

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
423.010	1	1
423.011	4	7
423.012	1	7
423.013	1	7
423.014	1	7
423.015	1	29
423.016	2	7
423.017	1	29
423.018	1	7
423.019	7	7,46,52
423.020	4	7,34,52
423.021	3	34
423.022	1	7
423.023	12	7,12,26
423.024	1	7
423.025	1	7
423.026	1	7
423.027	1	7
423.028	1	7
423.029	1	7
423.030	22	20,26,27,52
423.031	1	20
423.032	1	20
423.033	1	26
423.034	1	20
423.035	1	20
423.036	1	20
423.037	1	20
423.038	1	20
423.039	1	26
423.040	1	20
423.041	9	26,31
423.042	4	26
432.001	7	5,49
432.002	2	5
432.003	2	5
432.004	3	5
432.005	1	5
432.006	1	5
432.007	1	5
432.008	1	5
432.009	1	5
432.010	1	5
432.011	2	5
432.012	1	5
432.013	2	5,43

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
432.014	1	5
432.015	2	5
432.016	1	5
432.017	2	21
432.018	1	21
432.019	1	21
432.020	1	21
432.021	1	21
432.022	1	21
432.023	1	21
432.024	1	21
432.025	1	21
441.001	3	43
441.002	1	7
441.003	1	29
441.004	1	7
441.005	1	7
600.001	4	23
600.002	3	23
600.003	2	23
600.004	2	23
600.005	1	23
600.006	1	23
600.007	1	23
600.008	1	23
600.009	1	23

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APPENDIX E

TEXT PAGES	AMENDMENT
Title Page	42
E.1.1	7
E.2-1	48
E.3-1	8
E.3-2	0
E.3-3	12
E.3-4	12
E.3-5	12
E.3-5a	3
E.3-6	0
E.3-7	0
E.3-8	0
E.3-9	3
E.3-10	5
E.7-1	13
E.7-2	13
E.7-3	13
E.7-4	13
E.7-5	13
E.8-1	0
E.8-2	0
E.9-1	8
E.9-2	5
E.9-3	45
E.9-3a	8
E.10-1	5
E.11-1	20
E.12-1	12
E.12-2	16
E.12-3	45

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APPENDIX F

LIST OF EFFECTIVE PAGES

APPENDIX F

TEXT PAGES	AMENDMENT
F.2-30	51
F.2-31	45
F.2-32	45
F.2-33	45
F.2-34	45
F.2-35	45
F.2-36	45
F.2-37	45
F.2-38	45
F.2-39	45
F.2-40	45
F.2-41	45
F.2-42	45
F.2-43	51
F.2-44	51
F.3-1	45
F.3-2	52
F.3-3	45
F.3-4	45
F.3-5	45
F.3-6	45
F.3-7	45
F.3-8	45
F.3-9	45
F.3-10	52
F.3-11	45
F.3-12	45
F.3-13	45
F.3-14	45
F.3-15	45
F.3-16	45
F.3-17	45
F.3-18	52
F.3-19	45
F.3-20	51
F.3-21	45
F.3-22	51
F.3-23	45
F.3-24	51
F.3-25	52
F.3-26	45
F.3-27	45
F.3-28	45
F.3-29	45
F.3-30	51
F.3-31	45
F.3-32	45

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APPENDIX F

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APPENDIX F

TEXT PAGES	AMENDMENT
F.3-81	45
F.3-82	45
F.4-1	50
F.4-2	51
F.4-3	45
F.4-4	45
F.4-5	45
F.4-6	45
F.4-7	51
F.4-7a	51
F.4-8	51
F.4-8a	51
F.4-9	51
F.4-10	50
F.4-11	50
F.4-11a	50
F.4-11b	50
F.4-12	45
F.4-13	45
F.4-14	51
F.4-15	51
F.4-16	51
F.4-17	51
F.4-18	51
F.4-19	51
F.4-20	51
F.4-21	50
F.4-22	50
F.4-23	51
F.4-24	51
F.4-25	45
F.4-26	51
F.4-27	51
F.4-28	51
F.4-29	51
F.4-30	51
F.4-31	45
F.4-32	45
F.4-33	51
F.4-34	51
F.4-35	52
F.4-36	45
F.4-37	51
F.4-38	50
F.4-39	50
F.4-40	50
F.4-41	51

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APPENDIX F

TEXT PAGES	AMENDMENT
F.4-42	52
F.4-43	51
F.4-44	50
F.4-45	51
F.4-46	52
F.4-47	52
F.4-48	45
F.4-49	49
F.4-50	45
F.4-51	49
F.4-52	49
F.4-53	49
F.4-54	49
F.4-55	49
F.4-56	45
F.4-57	49
F.4-58	45
F.4-59	49
F.4-60	45
F.4-61	49
F.4-62	45
F.4-63	49
F.4-64	45
F.4-65	49
F.4-66	45
F.4-67	49
F.4-68	45
F.4-69	52
F.4-70	51
F.4-71	49
F.4-72	49
F.4-73	49
F.4-74	49
F.4-75	50
F.4-76	50
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F.4-78	50
F.4-79	49
F.4-80	50
F.4-81	51
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F.4-85	50
F.4-86	49
F.4-87	50
F.4-88	49

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APPENDIX F

TEXT PAGES	AMENDMENT
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F.4-90	49
F.4-91	50
F.4-92	49
F.4-93	50
F.4-94	49
F.4-95	50
F.4-96	49
F.4-97	50
F.4-98	49
F.4-99	50
F.4-100	49
F.4-101	50
F.4-102	51
F.4-103	51
F.4-104	49
F.4-105	50
F.4-106	51
F.4-107	51
F.4-108	49
F.4-109	50
F.4-110	50
F.4-111	50
F.4-112	50
F.4-113	50
F.4-114	49
F.4-115	50
F.4-116	50
F.4-117	50
F.4-118	45
F.4-119	49
F.4-120	49
F.4-121	49
F.4-122	45
F.4-123	50
F.4-124	49
F.4-125	45
F.4-126	50
F.4-127	49
F.4-128	50
F.4-129	49
F.4-130	50
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F.4-132	50
F.4-133	49
F.4-134	50
F.4-135	49
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APPENDIX F

TEXT PAGES	AMENDMENT
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F.4-139	49
F.4-140	50
F.4-141	49
F.4-142	51
F.4-143	51
F.4-144	50
F.4-145	49
F.4-146	50
F.4-147	49
F.4-148	50
F.4-149	49
F.4-150	45
F.4-151	50
F.4-152	49
F.4-153	50
F.4-154	49
F.4-155	50
F.4-156	49
F.4-157	50
F.4-158	49
F.4-159	50
F.4-160	49
F.4-161	50
F.4-162	49
F.4-163	50
F.4-164	49
F.4-165	50
F.4-166	49
F.4-167	50
F.4-168	49
F.4-169	50
F.4-170	45
F.4-171	45
F.4-172	45
F.4-173	49
F.4-174	49
F.4-175	45
F.4-176	50
F.4-177	49
F.4-178	50
F.4-179	49
F.4-180	50
F.4-181	49
F.4-182	50
F.4-183	49
F.4-184	50

LIST OF EFFECTIVE PAGES

APPENDIX F

TEXT PAGES	AMENDMENT
F.4-185	52
F.4-186	52
F.5-1	45
F.5-2	52
F.5-3	52
F.5-4	51
F.5-5	51
F.5-6	51
F.5-7	45
F.5-8	52
F.5-9	52
F.5-10	51
F.5-11	51
F.5-12	51
F.5-13	45
F.5-14	52
F.5-14a	52
F.5-15	51
F.5-16	52
F.5-17	51
F.5-18	45
F.5-19	45
F.5-20	45
F.5-21	51
F.6-1	51
F.7-1	45
F.7-2	51
F.7-3	50
F.7-4	50
F.7-5	52
F.7-6	51

FIGURES	AMENDMENT
F.6-1	51
F.6-2	51
F.6-3	51
F.6-4	51
F.6-5	51
F.6-6	51
F.6-7	51
F.6-8	51
F.6-9	51
F.6-10	51
F.6-11	51

LIST OF EFFECTIVE PAGES

APPENDIX G
(DAR)

TEXT PAGES	AMENDMENT
Title Page	7
i	28
ii	28
iii	28
iv	28
v	28
vi	28
vii	28
viii	28
ix	28
x	28
xi	28
xii	28
xiii	28
xiv	28
xv	28
xvi	28
xvii	28
xviii	28
xix	28
xx	28
xxi	28
xxii	28
1.1-1	28
1.1-2	28
1.1-3	28
2.1-1	33
2.1-1a	33
2.1-2	28
2.1-3	28
2.2-1	28
2.2-2	48
2.2-3	28
3.1-1	28
3.1-2	28
3.1-3	28
3.1-4	28
3.1-5	48
3.1-6	48
3.1-7	48
3.1-8	51
3.1-9	48

LIST OF EFFECTIVE PAGES

APPENDIX G
(DAR)

TEXT PAGES	AMENDMENT
3.2-1	33
3.2-1a	33
3.2-2	33
3.2-3	33
3.2-3a	33
3.2-4	28
3.2-5	28
3.2-6	28
3.2-7	28
3.2-8	28
3.2-9	28
3.2-10	28
3.2-11	28
3.2-12	28
3.2-13	28
3.2-14	28
3.2-15	28
3.2-16	28
3.2-17	28
3.2-18	28
3.2-19	28
3.2-20	28
3.2-21	28
3.2-22	28
3.2-23	28
3.2-24	28
3.2-25	28
3.2-26	28
3.2-27	28
3.2-28	28
3.2-29	28
3.2-30	28
3.2-31	33
3.2-32	28
3.2-33	28
3.2-34	28
3.3-1	28
3.3-2	36
3.4-1	28
3.4-2	28
3.5-1	28
3.5-2	28
3.5-3	28

LIST OF EFFECTIVE PAGES

APPENDIX G
(DAR)

TEXT PAGES	AMENDMENT
3.5-4	28
3.5-5	28
3.5-6	28
3.5-7	28
3.5-8	28
3.5-9	28
3.5-10	28
3.5-11	28
3.5-12	28
3.5-13	28
3.5-14	36
3.5-15	28
4.1-1	28
4.1-2	28
4.1-3	28
4.1-4	36
4.1-5	36
4.1-6	28
4.1-7	28
4.1-8	28
4.1-9	28
4.1-10	28
4.1-11	28
4.1-12	28
4.1-13	36
4.1-14	28
4.1-15	28
4.1-16	28
4.1-17	28
4.1-18	28
4.1-19	28
4.1-20	28
4.1-21	28
4.1-22	28
4.1-23	28
4.1-24	28
4.1-25	28
4.1-26	28
4.1-27	28
4.1-28	28
4.2-1	33
4.2-1a	33
4.2-2	28
4.2-3	28
4.2-4	28

LIST OF EFFECTIVE PAGES

APPENDIX G
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APPENDIX G
(DAR)

LIST OF EFFECTIVE PAGES

APPENDIX G
(DAR)

TEXT PAGES	AMENDMENT
Appendix A	28
Appendix B	28
B-1	28
B-2	28
B-3	28
B-4	28
B-5	28
B-6	28
B-7	28
B-8	28
B-9	28
B-10	28
B-11	28
B-12	28
B-13	28
B-14	28
B-15	28
B-16	28
B-17	28

FIGURES	AMENDMENT
B-1	28
B-2	28
B-3	28
B-4	28
B-5	28
B-6	28
B-7	28
B-8	28
B-9	28

TEXT PAGES	AMENDMENT
Appendix C	28
C-0	28
C-1	28
C-2	28
C-3	28
Appendix D	28
D-1	28
D-2	28
D-3	28
D-4	28
D-5	28

LIST OF EFFECTIVE PAGES

APPENDIX G
(DAR)

LIST OF EFFECTIVE PAGES

APPENDIX G
(DAR)

LIST OF EFFECTIVE PAGES

APPENDIX H

TEXT PAGES	AMENDMENT
H.0-i	52
H.0-ii	52
H.0-iii	52
H.0-iii(a)	52
H.0-iv	52
H.0-v	52
H.0-vi	52
H.0-vii	52
H.0-viia	52
H.0-viii	52
H.0-ix	52
H.0-x	4
H.0-xi	52
H.0-xii	52
H.0-xiii	52
H.1.1-1	52
H.1.2-1	52
H.1.2-2	52
H.1.2-3	52
H.1.2-4	52
H.1.2-4a	52
H.2.1-1	4
H.2.1-2	52
H.2.1-3	52
H.2.1-4	52
H.2.1-5	52
H.2.1-5a	52
H.2.1-6	52
H.2.1-7	52
H.2.1-8	52
H.2.1-9	52
H.2.1-10	52
H.2.2-1	36
H.2.2-2	52
H.2.2-3	52
H.2.2-4	52
H.2.3-1	52
H.2.3-2	52
H.2.3-3	52
H.2.3-3a	52
H.2.3-4	52
H.2.3-5	52
H.2.3-5a	52
H.2.3-6	52
H.2.3-6a	52

LIST OF EFFECTIVE PAGES

APPENDIX H

TEXT PAGES	AMENDMENT
H.2.3-7	4
H.2.3-8	52
H.2.4-1	52
H.2.4-2	52
H.2.4-3	52
H.2.5-1	52
H.2.5-2	52
H.2.5-3	52
H.2.5-4	52
H.2.5-5	52
H.2.5-6	52
H.2.5-7	52
H.2.5-8	52
H.2.5-9	4
H.3.0-1	4
H.3.1-1	52
H.3.1-2	4
H.3.1-3	52
H.3.2-1	52
H.3.2-2	52
H.3.2-3	52
H.3.2-4	52
H.3.3-1	36
H.3.3-2	36
H.3.3-2a	52
H.3.3-3	52
H.3.3-4	52
H.3.3-5	52
H.3.3-6	52
H.3.3-7	52
H.3.3-8	52
H.3.3-9	52
H.3.3-10	52
H.3.3-11	52
H.3.3-12	52
H.3.3-12a	52
H.3.3-13	52
H.3.3-14	52
H.3.3-15	52
H.4.0-1	4
H.4.1-1	4
H.4.1-2	4
H.4.1-3	4
H.4.1-4	4
H.4.1-5	4
H.4.1-6	52

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APPENDIX H

TEXT PAGES	AMENDMENT
H.4.1-7	52
H.4.1-8	52
H.4.2-1	36
H.4.3-1	36
H.4.3-1a	12
H.4.3-2	4
H.4.3-3	52
H.5.1-1	4
H.5.1-2	52
H.5.1-3	4
H.5.1-4	44
H.5.1-5	4
H.5.1-6	4
H.5.1-7	4
H.5.1-8	4
H.5.1-9	4
H.5.2-1	52
H.5.2-2	52
H.5.2-3	52
H.5.2-4	52
H.5.2-4a	52
H.5.2-5	52
H.5.2-6	52
H.5.2-6a	52
H.5.2-7	52
H.5.2-8	52
H.5.2-9	52
H.5.2-10	52
H.5.2-11	4
H.5.2-12	52
H.6.1-1	52
H.6.1-2	52
H.6.1-3	52
H.6.1-4	52
H.6.2-1	52
H.6.2-2	52
H.6.2-3	52
H.6.2-4	52
H.6.3-1	52
H.6.3-2	52
H.6.3-3	52
H.6.3-4	52
H.6.4-1	52
H.6.4-2	52
H.6.4-3	52
H.6.4-4	52

LIST OF EFFECTIVE PAGES

APPENDIX H

TEXT PAGES	AMENDMENT
H.6.5-1	52
H.6.5-2	52
H.6.5-3	52
H.6.5-4	52
H.6.6-1	52
H.6.6-2	52
H.6.6-3	52
H.6.6-4	52
H.6.6-5	52
H.7.0-1	52
H.A.0-i	52
Title Page	4
H.B.0-i	52
H.B.0-ii	52
H.B.1-1	4
H.B.1-2	4
H.B.1-3	4
H.B.2-1	52
H.B.2-2	52
H.B.2-3	52
H.B.2-4	52
H.B.2-5	52
H.B.2-6	52
H.B.2-7	4
H.B.2-8	4
H.B.2-9	4
H.B.2-10	4
H.B.2-11	4
H.B.2-12	4
H.B.2-13	4
H.B.2-14	4
H.B.2-15	4
H.B.2-16	4
H.B.2-17	36
H.B.2-18	4
H.B.2-19	4
H.B.2-20	4
H.B.2-21	4
H.B.2-22	4
H.B.2-23	4
H.B.2-24	4
H.B.2-25	4
H.B.3-1	4
H.B.3-2	4
H.B.3-3	4
H.B.4-1	4

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APPENDIX H

LIST OF EFFECTIVE PAGES

APPENDIX H

FIGURES	AMENDMENT
H.2.5-3	52
H.3.1-1	52
H.3.3-1	52
H.3.3-2	52
H.3.3-3	52
H.3.3-4	52
H.3.3-5	52
H.4.1-1	4
H.4.1-2	4
H.5.1-1	52
H.5.1-2	4
H.5.1-3	44
H.5.2-1	52
H.5.2-2	52
H.5.2-3	52
H.5.2-4	52
H.6.1-1	52
H.6.2-1	52
H.6.3-1	52
H.6.4-1	52
H.6.4-2	52
H.6.5-1	52
H.6.5-2	52
H.6.6-1	52
H.A-1a	52
H.A-1b	52
H.A-1c	52
H.A-1d	52
H.A-1e	52
H.A-1f	52
H.A-1g	52
H.A-1h	52
H.B.2-1	52

LIST OF EFFECTIVE PAGES

APPENDIX I

TEXT PAGES	AMENDMENT
I-i	52
I-ii	23
I-iii	23
I-iv	52
I-v	23
I.1-1	23
I.1-2	23
I.1-3	23
I.2-1	23
I.2-2	23
I.2-3	23
I.2-4	23
I.2-5	52
I.2-6	52
I.2-7	52
I.3-1	23
I.3-2	23
I.3-3	23
I.3-4	23
I.3-5	23
I.3-6	23
I.3-7	23
I.3-8	32
I.3-9	23
I.3-10	29
I.3-11	29
I.4-1	32
I.4-2	23
I.4-3	23
I.4-4	23
I.4-5	23
I.4-6	23
I.4-7	23
I.4-8	23
I.4-9	23
I.5-1	23
I.5-2	23
I.5-3	23
I.5-4	23
I.5-5	23
I.5-6	32
I.5-7	32

LIST OF EFFECTIVE PAGES

APPENDIX I

TEXT PAGES	AMENDMENT
I.6-1	23
I.6-2	23
I.6-3	23
I.6-4	23
I.6-5	23
I.6-6	23
I.6-7	23
I.6-8	33
I.6-9	23
I.6-10	23
I.6-11	30
I.6-12	30
I.6-13	23
I.6-14	23
I.6-15	23
I.6-16	23
I.6-17	23
I.6-18	23
I.6-19	23
I.6-20	23
I.6-21	23
I.6-22	23
I.6-23	23
I.6-24	23
I.6-25	23
I.6-26	30
I.6-27	23
I.7-1	23
I.7-2	23
I.7-3	31
I.7-4	31
I.7-5	23
I.7-6	23
I.7-7	31
I.7-8	31
I.7-9	29
I.8-1	30
I.8-2	23
I.8-3	23
I.8-4	23
I.8-5	46
I.8-6	23
I.8-7	29
I.8-8	23
I.8-9	23

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APPENDIX I

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LIST OF EFFECTIVE PAGES

APPENDIX J

TEXT PAGES	AMENDMENT
Title Page	27

Shielding Evaluation Report

TEXT PAGES	AMENDMENT
J.i	0
J.ii	0
J.iii	51
J.iv	35
J.v	35
vi	0
J.vii	51
J.viii	35
J.ix	35
J.x	51
J.xi	51
J.xi(a)	48
J.xii	38
xiii	0
xiv	0
J.xv	51
xvi	0
J.xvii	48
xviii	0
1-1	0
1-2	0
2-1	0
2-2	0
2-3	0
2-4	0
2-5	0
J.2-6	35
J.2-7	35
2-8	0
3-1	0
J.3-2	35
J.3-3	35
J.3-4	35
3-5	0
J.3-6	51
J.3-7	51
J.3-8	51
3-9	35

LIST OF EFFECTIVE PAGES

APPENDIX J

LIST OF EFFECTIVE PAGES

APPENDIX J

LIST OF EFFECTIVE PAGES

APPENDIX J

TEXT PAGES	AMENDMENT
Appendix B	
J.B-1	51
J.B-2	51
J.B-3	35
B-4	0
B-5	0
B-6	0
J.B-7	35
B-8	0
B-9	0
B-10	0
B-11	0
B-12	0
B-13	0
J.B-14	35
B-15	0
B-16	0
B-17	0
B-18	0
B-19	0
B-20	0
B-21	0
B-22	0
J.B-23	35
J.B-24	51
B-25	0

FIGURES	AMENDMENT
B-1	0
B-2	0
B-3	0
B-4	0
B-5	0
B-6	0
B-7	0
B-8	0
B-9	0
B-10	0
B-11	0
B-12	0
B-13	0
B-14	0
B-15	0
B-16	0
B-17	0
B-18	0

LIST OF EFFECTIVE PAGES

APPENDIX J

LIST OF EFFECTIVE PAGES

APPENDIX J

TEXT PAGES	AMENDMENT
D-7	0
D-8	0
J.D-9	35
J.D-10	35
J.D-11	35
J.D-12	51

FIGURES	AMENDMENT
D-1	0
D-2	0
D-3	0

TEXT PAGES	AMENDMENT
J.E-1	35
J.E-2	52
J.E-3	35
E-4	0
J.E-5	35
J.E-6	35
J.E-7	35
J.E-8	35
J.E-9	35
J.E-10	35

FIGURES	AMENDMENT
J.E-1	51
J.E-2	51
J.E-3	35
J.E-4	35
J.E-5	35
J.E-6	35
J.E-7	35
J.E-8	35
J.E-9	35

TEXT PAGES	AMENDMENT
J.F-1	51
J.F-2	51
J.F-3	51
J.F-4	0
J.F-5	51
J.F-6	35
J.F-7	51

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APPENDIX J

TEXT PAGES	AMENDMENT
J.F-8	51
J.F-9	51
J.F-10	51
F-11	0
F-12	0
J.F-13	49
F-14	0
F-15	0
J.F-16	35
J.F-17	35
F-18	0
J.F-19	35
J.F-20 (Table J.F-1)	51
J.F-21 (Table J.F-2)	51
F-22 (Table J.F-3)	0
J.F-23 (Table J.F-4)	51
J.F-24 (Table J.F-5)	51
J.F-25 (Table J.F-6)	51
F-26 (Table J.F-7)	0
F-27 (Table J.F-8)	0

FIGURES	AMENDMENT
F-1	0
F-2	0
F-3	0
F-4	0
F-5	0
F-6	0
F-7	0
F-8	0
F-9	0
J.F-10	51

TEXT PAGES	AMENDMENT
J.G-1	51
J.G-2	35
J.G-3	35
J.G-4	35
J.G-5	35

FIGURES	AMENDMENT
J.G-1	51
J.G-2	51

LIST OF EFFECTIVE PAGES

APPENDIX J

TEXT PAGES	AMENDMENT
H-1	0
H-2	0
H-3	0
H-4	0
H-5	0
H-6	0
H-7	0
H-8	0
H-9	0
H-10	0
H-11	0

LIST OF EFFECTIVE PAGES

APPENDIX A

TEXT PAGES	AMENDMENT
A-1	0
A-2	0
A-3	0
A-4	0
A-5	0
A-6	0
A-7	0
A-8	0
A-9	0
A-10	43
A-11	0
A-12	0
A-13	0
A-14	0
A-15	0
A-16	0
A-17	0
A-18	0
A-19	0
A-20	20
A-21	0
A-22	0

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LIST OF EFFECTIVE PAGES

APPENDIX B

TEXT PAGES	AMENDMENT
Title Page	17
B-i	50
B-ii	50
B-iii	17
B-iv	29
1	46
2	37
3	46
4	37
B.1-1	17
B.1-2	17
B.1-3	36
B.1-3a	49
B.1-3b	36
B.1-4	17
B.1-5	36
B.1-5a	36
B.1-6	36
B.1-7	36
B.1-8	17
B.1-9	17
B.1-10	32
B.1-11	36
B.1-12	36
B.1-13	17
B.1-14	36
B.1-14a	36
B.1-15	36
B.1-15a	36
B.1-16	Deleted
B.1-17	36
B.1-18	Deleted
B.1-19	17
B.1-20	47
B.1-21	36
B.1-22	Deleted
B.1-23	17
B.1-24	30
B.1-25	17
B.1-26	36
B.1-27	36
B.1-28	17
B.1-29	36
B.1-30	17
B.1-31	33
B.1-32	36
B.1-32a	36

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APPENDIX B

LIST OF EFFECTIVE PAGES

APPENDIX B

TEXT PAGES	AMENDMENT
B.2-16d	39
B.2-17	36
B.2-17a	48
B.2-18	36
B.2-18a	23
B.2-19	48
B.2-20	48
B.2-21	17
B.2-22	36
B.2-23	17
B.2-24	17
B.2-25	49
B.2-26	17
B.2-27	36
B.2-28	25
B.2-29	17
B.2-30	17
B.2-31	17
B.2-32	17
B.2-33	17
B.2-34	17
B.2-35	17
B.2-36	17
B.2-37	50
B.2-37a	50
B.2-37b	50
B.2-38	17
B.2-39	17
B.2-40	17
B.2-41	50
B.2-42	17
B.2-43	36
B.2-44	23
B.2-45	36
B.2-46	17
B.2-47	36
B.2-48	23
B.2-49	36
B.2-50	37
B.2-51	36
B.2-51a	36
B.2-52	36
B.2-53	36
B.2-54	17
B.2-55	21
B.2-56	21
B.2-57	21
B.2-57a	33

LIST OF EFFECTIVE PAGES

APPENDIX B

TEXT PAGES	AMENDMENT
B.2-57b	33
B.2-57c	21
B.2-58	23
B.2-59	36
B.2-60	36
B.2-61	33
B.2-62	36
B.2-62a	Deleted
B.2-62b	Deleted
B.2-62c	33
B.2-63	36
B.2-63a	32
B.2-63b	32
B.2-64	17
B.2-65	23
B.2-66	23
B.2-67	21
B.2-68	40
B.2-69	36
B.2-70	36
B.2-71	36
B.2-72	17
B.2-73	36
B.2-74	23
B.2-75	36
B.2-75a	36
B.2-76	30
B.2-77	36
B.2-78	30
B.2-79	17
B.2-80	17
B.2-81	17
B.2-82	17
B.2-83	36
B.2-84	17
B.2-85	17
B.2-86	17
B.2-87	17
B.2-88	17
B.2-89	17
B.2-90	17
B.2-91	17
B.2-91a	17
B.2-92	17
B.2-93	17
B.2-94	17
B.2-95	17
B.2-96	17

LIST OF EFFECTIVE PAGES

APPENDIX B

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LIST OF EFFECTIVE PAGES

APPENDIX C

LIST OF EFFECTIVE PAGES

APPENDIX C

LIST OF EFFECTIVE PAGES

APPENDIX C

TEXT PAGES	AMENDMENT
C.2-85	0
C.2-86	14
C.2-87	0
C.2-88	0
C.2-89	36
C.2-90	32
C.3-1	0
C.3-2	40
C.3-3	48
C.3-4	0
C.3-5	48
C.3-6	0
C.3-7	0
C.3-8	0
C.3-9	13
C.3-10	0
C.3-11	48
C.3-12	0
C.3-13	30
C.3-14	12
C.3-15	0
C.3-16	0
C.3-17	2
C.3-17a	2
C.3-18	13
C.3-19	47
C.3-20	0
C.3-21	31
C.3-22	5
C.3-23	29
C.3-24	30
C.3-25	8
C.3-26	27
C.3-27	0
C.3-28	23
C.3-29	0
C.3-30	0
C.3-31	31
C.3-32	8
C.3-33	8
C.3-34	8
C.3-35	11
C.3-36	0
C.3-37	0
C.3-38	0
C.3-39	27
C.3-40	0

LIST OF EFFECTIVE PAGES

APPENDIX C

TEXT PAGES	AMENDMENT
C.3-41	21
C.3-41a	21
C.3-42	0
C.3-43	0
C.3-44	0
C.3-45	5
C.3-46	0
C.3-47	8
C.3-48	0
C.3-49	13
C.3-49a	9
C.3-50	0
C.3-51	13
C.3-52	0
C.3-53	0
C.3-54	8
C.3-55	13
C.3-56	50
C.3-57	26
C.3-58	0
C.3-59	7
C.3-60	14
C.3-61	14
C.3-62	0
C.3-63	0
C.3-64	27
C.3-65	0
C.3-66	47
C.3-67	8
C.3-68	23
C.3-69	0
C.3-70	9
C.3-71	0
C.3-72	0
C.3-73	27
C.3-74	27
C.3-75	20
C.3-76	11
C.3-77	47
C.3-78	0
C.3-79	0
C.3-80	48
C.3-81	4
C.3-82	23
C.3-83	48
C.3-84	13
C.3-85	27
C.3-86	14

LIST OF EFFECTIVE PAGES

APPENDIX C

TEXT PAGES	AMENDMENT
C.3-87	33
C.3-88	0
C.3-89	0
C.3-90	0
C.3-91	13
C.3-92	9
C.3-93	0
C.3-94	0
C.3-95	0
C.3-96	0
C.3-97	43
C.3-98	44
C.3-99	0
C.3-100	0
C.3-101	0
C.3-102	8
C.3-103	0
C.3-104	0
C.3-105	43
C.3-106	0
C.3-107	8
C.3-108	30
C.3-109	0
C.3-110	0
C.3-111	27
C.3-112	14
C.3-112a	50
C.3-112b	48
C.3-113	27
C.3-114	27
C.3-115	23
C.3-116	42
C.3-117	47

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LIST OF EFFECTIVE PAGES

APPENDIX D

TEXT PAGES	AMENDMENT
Title Page	27

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
005.001	2	27
010.001	1	1
010.002	1	34
010.003	1	50
010.004	1	1
010.005	1	1
010.006	1	13
010.007	1	43
010.008	1	1
010.009	1	1
010.010	1	49
010.011	9	9,44,34
010.012	2	33
010.013	2	5,25
010.014	3	5
010.015	1	13
010.016	3	5,13
010.017	1	13
010.018	1	13
010.019	1	5
010.020	1	5
010.021	1	21
010.022	1	5
010.023	2	5
010.024	1	5
010.025	1	5
010.026	1	5
010.027	1	5
010.028	2	5,21
010.029	2	5
010.030	1	5
010.031	1	5
010.032	1	5
010.033	1	5
010.034	1	21
010.035	1	49
010.036	5	30,26
010.037	3	27
010.038	1	27
010.039	1	26
010.040	2	21,33
010.041	8	21,42

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
010.042	2	21,42
010.043	2	23
010.044	1	21
010.045	1	21
010.046	1	21
010.047	1	21
010.048	1	21
010.049	7	21,30
010.050	1	21
010.051	1	35
010.052	1	21
010.053	1	35
010.054	1	23
010.055	5	26
010.056	2	48
010.057	1	21
010.058	1	21
010.059	1	21
010.060	1	48
010.061	1	21
010.062	1	21
010.063	1	29
010.064	1	21
010.065	1	21
010.066	11	27,29
010.067	1	31
010.068	1	29
010.069	1	29
010.070	1	29
010.071	1	29
010.072	1	29
010.073	1	29
010.074	1	29
022.001	1	1
022.002	1	34
022.003	1	1
022.004	1	1
022.005	3	8
022.006	1	13
022.007	1	11
022.008	1	34
022.009	1	1
022.010	1	13
022.011	1	1
022.012	1	3
022.013	1	35

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
022.014	1	13
022.015	1	3
022.016	1	3
022.017	1	3
022.018	1	3
022.019	1	3
022.020	1	3
022.021	1	47
022.022	1	30
022.023	1	3
022.024	1	11
022.025	1	14
022.026	1	3
022.027	1	14
022.028	1	3
022.029	1	31
022.030	1	3
022.031	5	16,31
022.032	4	5
022.033	1	5
022.034	1	5
022.035	3	33
022.036	1	5
022.037	2	5
022.038	1	5
022.039	3	30
022.040	1	5
022.041	1	5
022.042	1	5
022.043	2	5,14
022.044	1	5
022.045	1	30
022.046	1	5
022.047	1	5
022.048	4	49
022.049	4	5
022.050	2	5
022.051	1	32
022.052	1	5
022.053	3	20
022.054	2	20
022.055	2	20
022.056	4	20
022.057	1	20
022.058	3	20
022.059	6	20

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
022.060	1	20
022.061	8	20
022.062	2	20
022.063	3	20
022.064	1	21
022.065	1	21
022.066	1	21
022.067	1	21
022.068	1	21
022.069	1	21
022.070	1	21
022.071	1	21
022.072	1	21
022.073	1	29
022.074	1	21
022.075	1	21
022.076	1	21
022.077	1	21
022.078	1	26
022.079	1	21
022.080	1	21
022.081	1	21
022.082	1	31
022.083	1	21
022.084	1	21
022.085	1	21
022.086	1	21
022.087	1	21
022.088	1	49
022.089	1	21
022.090	1	21
022.091	1	30
022.092	1	21
022.093	3	21
022.094	2	21,49
022.095	1	49
022.096	1	21
022.097	1	21
022.098	1	49
022.099	2	24,49
022.100	2	21
022.101	2	21
022.102	1	21
022.103	1	21
022.104	1	21
022.105	1	21

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
022.106	1	21
022.107	8	20
022.109	2	20
022.110	1	20
022.111	1	20
022.112	2	20
022.113	1	20
022.114	1	20
031.001(a)	1	0
031.001(b)	1	14
031.001(c)	1	14
031.001(d)	1	14
031.001(e)	1	0
031.001(f)	1	0
031.001(g)	1	14
031.001(h)	1	14
031.001(i)	2	0,46
031.001(j)	1	33
031.001(k)	1	33
031.001(l)	1	0
031.001(m)	1	34
031.001(n)	1	0
031.001(o)	1	0
031.001(p)	1	0
031.001(q)	1	0
031.001(r)	2	0,14
031.001(s)	1	0
031.001(t)	1	0
031.001(u)	1	47
031.001(v)	1	42
031.001(w)	1	14
031.001(x)	1	0
031.001(y)	1	14
031.001(z)	1	14
031.001(aa)	1	47
031.001(bb,cc)	1	47
031.001(dd)	1	14
031.001(ee)	1	14
031.001(ff)	1	14
031.001(gg)	1	0
031.001(hh)	1	14
031.001(ii)	1	14
031.002	1	42
031.003	1	0
031.004	1	47
031.005	1	47

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
031.006	2	32,47
031.007	1	0
031.008	1	0
031.009	4	0
031.010	4	0,14
031.011	1	14
031.012	1	0
031.013	1	14
031.014	1	30
031.015	3	0,14
031.016	2	0,34
031.017	2	0
031.018	2	0
031.019	1	14
031.020	1	0
031.021	2	14
031.022	1	14
031.023	1	25
031.024	1	0
031.025	2	0
031.026	2	29
031.027	1	14
031.028	1	14
031.029	1	0
031.030	2	0,47
031.031	1	14
031.032	1	0
031.033	1	0
031.034	2	0
031.035	1	14
031.036	1	14
031.037	1	14
031.038	2	14
031.039	2	0,14
031.040	1	14
031.041	1	14
031.042	1	0
031.043	1	0
031.044	2	0,14
031.045	1	14
031.046	1	14
031.047	1	14
031.048	3	0,14
031.049	1	49
031.050	3	0
031.051	1	0

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
031.052	1	14
031.053	2	0
031.054	2	14
031.055	1	32
031.056	1	10
031.057	1	10
031.058	3	3,11
031.059	5	34
031.060	1	3
031.061	1	3
031.062	1	3
031.063	1	3
031.064	1	3
031.065	2	3
031.066	2	3
031.067	1	3
031.068	1	3
031.069	1	14
031.070	5	3,21,35
031.071	1	29
031.072	1	34
031.073	1	3
031.074	1	42
031.075	1	14
031.076	3	5,25,42
031.077	1	3
031.078	2	3,14
031.079	2	3
031.080	7	10,33,34,42
031.081	2	17,31
031.082	1	10
031.083	1	33
031.084	1	10
031.085	1	10
031.086	1	10
031.087	6	10
031.088	1	10
031.089	1	10
031.090	1	10
031.091	1	10
031.092	2	10,35
031.093	1	31
031.094	1	10
031.095	1	10
031.096	1	10
031.097	1	10

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
031.098	1	10
031.099	1	34
031.100	1	23
031.101	1	10
031.102	1	49
031.103	5	10,42
031.104	2	10
031.105	2	10
031.106	1	32
031.107	1	10
031.108	2	10
031.109	1	10
031.110	1	10
031.111	1	10
031.112	1	10
031.113	1	10
031.114	2	21
031.115	1	46
031.116	1	21
031.117	3	23
031.118	1	29
031.119	1	21
031.120	1	21
031.121	1	32
031.122	1	21
031.123	1	21
031.124	2	31
031.125	1	21
031.126	2	21
031.127	1	21
031.128	1	23
031.129	1	21
031.130	1	21
031.131	2	21
031.132	1	21
031.133	1	21
031.134	1	21
031.135	97	31,48,49
031.136	6	29
031.137	33	31
031.138	48	31
031.138A	27	31,47
031.139	17	27,49
031.140	1	30
031.141	1	30
031.142	2	35

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
031.143	1	35
031.144	1	35
031.145	2	35
031.146	1	35
031.147	2	35
031.148	2	35
031.149	1	35
031.150	2	35
031.151	1	35
031.152	1	35
031.153	1	35
031.154	1	35
031.155	1	35
031.156	1	35
031.157	1	35
031.158	1	35
031.159	1	35
040.001	2	0
040.002	1	0
040.003	1	0
040.004	1	1
040.005	1	0
040.006	1	0
040.007	1	0
040.008	1	0
040.009	1	32
040.010	2	0,31
040.011	1	0
040.012	1	0
040.013	1	0
040.014	1	43
040.015	1	26
040.016	1	0
040.017	1	26
040.018	1	26
040.019	1	26
040.020	7	0
040.021	1	0
040.022	1	0
040.023	2	26
040.024	2	0
040.025	1	0
040.026	2	43,50
040.027	1	0
040.028	1	0
040.029	1	46

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
040.030	1	0
040.031	1	0
040.032	1	26
040.033	1	0
040.034	11	49
040.035	1	26
040.036	2	7,25
040.037	1	29
040.038	1	7
040.039	4	11,50
040.040	1	7
040.041	1	7
040.042	1	47
040.043	1	14
040.044	2	7,32
040.045	6	26,50
040.046	1	26
040.047	3	26,27
040.048	1	7
040.049	1	7
040.050	1	26
040.051	1	34
040.052	1	26
040.053	2	7
040.054	1	26
040.055	1	7
040.056	1	26
040.057	1	7
040.058	1	7
040.059	1	26
040.060	2	7,14
040.061	1	26
040.062	1	7
040.063	1	7
040.064	1	7
040.065	1	7
040.066	1	7
040.067	1	7
040.068	1	7
040.069	1	7
040.070	1	14
040.071	1	7
040.072	1	7
040.073	1	7
040.074	1	7
040.075	2	43

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QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
040.076	4	43,45
040.077	3	43,45
040.078	3	31,43
040.079	2	43
040.080	2	25
040.081	2	31,34
040.082	3	21,26
040.083	1	35
040.084	4	26,27,35
040.085	1	26
040.086	1	32
040.087	1	21
040.088	3	26,31,48
040.089	1	21
110.001	1	9
110.002	1	25
110.003	1	27
110.004	1	25
110.005	1	9
110.006	1	9
110.007	1	9
110.008	1	9
110.009	1	9
110.010	1	9
110.011	1	9
110.012	1	9
110.013	1	9
110.014	1	9
110.015	1	9
110.016	1	9
110.017	1	25
110.018	1	9
110.019	5	9,32
110.020	1	9
110.021	1	9
110.022	1	25
110.023	1	9
110.024	1	9
110.025	1	9
110.026	1	31
110.027	1	30
110.028	2	9
110.029	1	9
110.030	2	35
110.031	1	9
110.032	1	34

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QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
110.033	1	33
110.034	1	21
110.035	1	9
110.036	2	9,30
110.037	2	9,31
110.038	2	30
110.039	3	30
110.040	12	33
121.001	4	5
121.002	8	5,31
121.003	1	5
121.004	1	29
121.005	1	5
121.006	1	5
121.007	1	48
121.008	12	5,10,27,35
121.009	1	5
121.010	3	7,31
121.011	2	23
121.012	1	23
121.013	1	23
121.014	1	23
121.015	2	46
121.016	1	23
121.017	1	23
121.018	1	23
121.019	1	30
130.001	1	1
130.002	1	1
130.003	1	1
130.004	1	1
130.005	1	1
130.006	1	1
130.007	1	1
130.008	1	1
130.009	1	13
130.010	1	8
130.011	1	8
130.012	1	8
130.013	1	23
130.014	1	8
130.015	1	8
130.016	1	8
130.017	1	8
130.018	1	8
130.019	1	8

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
130.020	1	23
130.021	1	8
130.022	1	8
130.023	1	8
130.024	5	23
130.025	1	8
130.026	1	8
130.027	1	8
130.028	1	8
130.029	1	8
130.030	1	8
130.031	1	8
130.032	1	8
130.033	1	8
130.034	1	8
130.035	4	8,25
130.036	1	8
130.037	1	8
130.038	2	8
130.039	7	8
130.040	1	8
130.041	1	8
130.042	8	8
130.043	1	8
130.044	1	8
130.045	7	0,12
130.046	6	12
130.047	1	12
130.048	2	12,23
130.049	3	12
130.050	1	23
130.051	2	23
130.052	1	23
130.053	4	23
130.054	1	23
130.055	9	23
130.056	9	23
130.057	1	23
130.058	1	23
130.059	1	23
130.060	11	23,30
130.061	2	23,30
130.062	3	23,30
130.063	1	30
130.064	2	23
130.065	1	23

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QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
130.066	2	23
130.067	4	23,30
130.068	3	23
130.069	2	23
130.070	2	23
130.071	3	23
130.072	6	23
130.073	13	23
130.074	1	23
130.075	1	23
130.076	1	23
130.077	1	23
130.078	1	23
210.001	1	0
211.002	1	8
211.003	1	8
211.004	1	34
211.005	1	8
211.006	1	21
211.007	1	14
211.008	2	8,14
211.009	1	30
211.010	2	21,23
211.011	1	8
211.012	2	8,23
211.013	1	8
211.014	2	8
211.015	1	8
211.016	2	29
211.017	2	8
211.018	1	21
211.019	4	23
211.020	1	8
211.021	2	8
211.022	1	8
211.023	2	27
211.024	1	33
211.025	2	23,33
211.026	1	35
211.027	4	33,49
211.028	2	8
211.029	1	34
211.030	1	8
211.031	10	23,33,49
211.032	1	21
211.033	4	8,30,31

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
211.034	1	8
211.035	1	8
211.036	1	8
211.037	1	17
211.038	3	8,27
211.039	1	33
211.040	1	49
211.041	1	8
211.042	1	8
211.043	1	8
211.044	1	8
211.045	1	8
211.046	1	8
211.047	1	8
211.048	2	8
211.049	1	46
211.050	2	11
211.051	19	11,23
211.052	1	43
211.053	1	11
211.054	1	23
211.055	1	11
211.056	2	11
211.057	1	32
211.058	3	11
211.059	1	11
211.060	1	11
211.061	2	11,31
211.062	1	11
211.063	1	32
211.064	1	11
211.065	2	11
211.066	2	11,27
211.067	1	11
211.068	1	31
211.069	1	11
211.070	1	31
211.071	1	11
211.072	3	23
211.073	1	11
211.074	1	30
211.075	1	11
211.076	2	33,48
211.077	4	49
211.078	1	11
211.079	4	11

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
211.080	2	11
211.081	2	11
211.082	3	11
211.083	1	11
211.084	1	49
211.085	4	11
211.086	1	11
211.087	6	0,21
211.088	2	11
211.089	5	11
211.090	1	11
211.091	2	11
211.092	3	23
211.093	1	27
211.094	1	11
211.095	1	11
211.096	1	49
211.097	1	49
211.098	1	43
211.099	1	23
211.100	1	31
211.101	2	11,46
211.102	1	11
211.103	1	11
211.104	1	11
211.105	3	11,46
211.106	1	11
211.107	1	21
211.108	1	21
211.109	1	21
211.110	1	21
211.111	1	21
211.112	1	21
211.113	2	21
211.114	1	21
211.115	1	20
211.116	3	21
211.117	1	21
211.118	1	21
211.119	1	21
211.120	2	21
211.121	1	21
211.122	1	21
211.123	1	21
211.124	1	34
211.125	1	21

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
211.126	1	21
211.127	2	20,30
211.128	2	44
211.129	1	23
211.130	1	21
211.131	1	21
211.132	2	21
211.133	1	21
211.134	1	21
211.135	1	21
211.136	1	23
211.137	1	20
211.138	1	21
211.139	2	20,30
211.140	1	20
211.141	1	20
211.142	1	20
211.143	1	33
211.144	2	33
211.145	1	20
211.146	1	23
211.147	1	20
211.148	3	23
211.149	1	20
211.150	1	21
211.151	1	20
211.152	1	21
211.153	2	20
211.154	1	20
211.155	2	20
211.156	2	20
211.157	2	20
211.158	1	20
211.159	1	23
211.160	1	20
211.161	1	20
211.162	1	20
211.163	1	20
211.164	2	21
211.165	2	20
211.166	2	20
211.167	1	20
211.168	1	27
211.169	2	20
211.170	1	20
211.171	4	21

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
211.172	1	20
211.173	1	21
211.174	1	32
211.175	1	31
211.176	1	20
211.177	1	20
211.178	1	20
211.179	1	20
211.180	1	21
211.181	1	20
211.182	1	21
211.183	1	20
211.184	1	20
211.185	1	21
211.186	1	20
211.187	1	20
211.188	1	20
211.189	2	21
211.190	1	20
211.191	1	20
211.192	1	20
211.193	1	20
211.194	1	20
211.195	2	20
211.196	1	21
211.197	1	23
211.198	2	30
211.199	2	33
211.200	1	20
211.201	1	21
211.202	2	21
211.203	1	21
211.204	1	21
211.205	2	20
211.206	11	21
211.207	2	20,21
211.208	1	21
211.209	1	30
211.210	1	20
211.211	1	21
211.212	1	49
211.213	2	49
212.001	1	3
212.002	1	3
212.003	4	27
212.004	1	3

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
221.001	2	7,32
221.002	1	7
221.003	1	7
221.004	2	32
221.005	1	32
221.006	1	7
221.007	1	32
221.008	1	32
221.009	3	7,32
221.010	3	7,32
221.011	1	7
221.012	3	7
221.013	1	32
222.001	1	8
222.002	2	8,25
222.003	1	8
222.004	1	8
231.001	1	32
231.002	3	3
231.003	1	32
231.004	2	20,32
231.005	7	20,32
231.006	1	29
232.001	1	3
232.002	1	32
232.003	1	29
232.004	1	29
232.005	2	30
271.001	3	35
271.002	1	35
271.003	3	21
271.004	1	33
271.005	1	33
271.006	1	21
271.007	1	29
271.008	1	29
271.009	1	29
271.010	1	32
271.011	1	29
271.012	1	33
271.013	1	29
271.014	1	29
271.015	1	33
271.016	1	29
272.001	7	30
272.002	2	30

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
281.001	2	21,50
281.002	1	21
281.003	1	30
281.004	1	21
281.005	1	21
281.006	1	50
281.007	1	21
281.008	1	21
281.009	2	21,34
281.010	1	50
281.011	1	35
281.012	1	21
281.013	1	21
281.014	1	21
311.001	1	23
312.001	1	1
312.002	1	1
312.003	1	1
312.004	1	1
312.005	1	1
312.006	1	1
312.007	1	1
312.009	1	8
312.010	1	1
312.011	1	1
312.012	2	1
312.013	1	49
312.014	1	1
312.015	1	8
312.016	1	5
312.017	1	14
312.018	1	11
312.019	1	5
321.001	1	14
321.002	1	1
321.003	1	13
321.004	1	21
321.005	4	5,20,49
331.001	1	13
331.002	2	13
331.003	2	1
331.004	1	1
331.005	1	1
331.006	1	1
331.007	1	1
331.008	1	1

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
331.009	1	1
331.010	1	1
331.011	1	1
331.012	1	1
331.013	1	1
331.014	1	1
331.015	2	5,47
331.016	1	5
331.017	1	5
331.018	1	5
331.019	1	32
331.020	1	5
331.021	1	13
331.022	1	5
331.023	1	5
331.024	1	48
331.025	2	20
331.026	2	20
331.027	1	20
331.028	2	49
331.029	1	20
360.001	1	0
360.002	1	0
360.003	1	0
360.004	3	10,29
360.005	6	10,29
360.006	2	21
360.007	3	21
360.008	4	21
360.009	7	21
360.010	3	21
360.011	2	21
360.012	2	21
360.013	3	21
360.014	15	23
360.015	7	23
360.016	6	23
360.017	21	23
360.018	5	23
360.019	6	23
360.020	13	23
360.021	1	23
360.022	4	23
361.001	1	21
361.002	2	21
361.003	1	21

LIST OF EFFECTIVE PAGES

APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
361.004	28	21
361.005	6	21
361.006	2	21,29
361.007	2	21
361.008	2	21
361.009	3	21
361.010	4	21
361.011	2	21
361.012	1	21
361.013	2	21
361.014	1	21
361.015	8	0,23
361.016	33	27
361.017	88	23,27
361.018	8	23
361.019	44	23
361.020	5	27
361.021	24	27
361.022	1	27
361.023	12	27
361.024	5	27
361.025	3	27
362.001	1	3
362.002	2	3
362.003	1	3
362.004	2	3
362.005	1	5
362.006	1	5
362.007	1	5
362.008	1	5
362.009	2	5
362.010	5	48
362.011	6	48
362.012	2	21
362.013	1	21
362.014	4	21
371.001	1	23
371.002	1	1
371.003	1	1
371.004	1	1
371.005	1	1
371.006	1	5
371.008	1	23
371.009	1	5
371.010	1	5
371.011	1	5

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
371.012	1	5
371.013	1	5
371.014	1	5
371.015	5	23
371.016	5	23,27
371.017	2	23
371.018	4	23,34
371.019	2	23
371.020	1	23
371.03E	2	20
371.04E	1	20
371.05E	1	20
371.06E	1	20
371.07E	1	20
372.001	1	1
372.002	1	1
372.003	1	1
372.004	1	1
372.005	1	1
372.006	1	1
372.007	1	3
372.008	14	5,29
372.009	1	5
372.010	1	5
372.011	1	5
372.012	1	5
372.013	1	5
372.014	4	5,43
372.015	5	46
372.016	3	43
372.017	1	5
421.001	1	20
421.002	1	20
421.003	1	20
421.004	2	20
421.005	1	20
421.006	1	20
421.007	1	20
421.008	1	21
421.009	1	20
421.010	1	20
421.011	1	20
421.012	1	20
421.013	1	20
421.014	1	27
421.015	1	20

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
421.016	1	30
421.017	1	20
421.018	1	20
421.019	1	20
421.020	2	20
421.021	1	20
421.022	1	20
421.023	1	20
421.024	1	20
421.025	1	20
421.026	1	20
421.027	1	20
421.028	1	20
421.029	1	20
421.030	1	20
421.031	1	20
421.032	1	20
421.033	1	20
421.034	1	20
421.035	1	20
421.036	1	20
421.037	1	20
421.038	1	20
421.039	1	20
421.040	1	20
421.041	2	21
421.042	1	29
421.043	17	20,25,30,31
422.001	2	43
422.002	1	26
422.003	1	26
422.004	3	26
422.005	1	7
422.006	3	7
422.007	2	43
422.008	2	7
422.009	1	7
423.001	1	1
423.002	1	1
423.003	1	1
423.004	1	0
423.005	1	1
423.006	2	1
423.007	1	1
423.008	1	1
423.009	1	1

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
423.010	1	1
423.011	4	7
423.012	1	7
423.013	1	7
423.014	1	7
423.015	1	29
423.016	2	7
423.017	1	29
423.018	1	7
423.019	7	7,46
423.020	4	7,34
423.021	3	34
423.022	1	7
423.023	12	7,12,26
423.024	1	7
423.025	1	7
423.026	1	7
423.027	1	7
423.028	1	7
423.029	1	7
423.030	22	20,26,27
423.031	1	20
423.032	1	20
423.033	1	26
423.034	1	20
423.035	1	20
423.036	1	20
423.037	1	20
423.038	1	20
423.039	1	26
423.040	1	20
423.041	9	26,31
423.042	4	26
432.001	7	5,49
432.002	2	5
432.003	2	5
432.004	3	5
432.005	1	5
432.006	1	5
432.007	1	5
432.008	1	5
432.009	1	5
432.010	1	5
432.011	2	5
432.012	1	5
432.013	2	5,43

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APPENDIX D

QUESTIONS	NRC QUESTIONS NO. OF PAGES	AMENDMENT
432.014	1	5
432.015	2	5
432.016	1	5
432.017	2	21
432.018	1	21
432.019	1	21
432.020	1	21
432.021	1	21
432.022	1	21
432.023	1	21
432.024	1	21
432.025	1	21
441.001	3	43
441.002	1	7
441.003	1	29
441.004	1	7
441.005	1	7
600.001	4	23
600.002	3	23
600.003	2	23
600.004	2	23
600.005	1	23
600.006	1	23
600.007	1	23
600.008	1	23
600.009	1	23

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APPENDIX E

TEXT PAGES	AMENDMENT
Title Page	42
E.1.1	7
E.2-1	48
E.3-1	8
E.3-2	0
E.3-3	12
E.3-4	12
E.3-5	12
E.3-5a	3
E.3-6	0
E.3-7	0
E.3-8	0
E.3-9	3
E.3-10	5
E.7-1	13
E.7-2	13
E.7-3	13
E.7-4	13
E.7-5	13
E.8-1	0
E.8-2	0
E.9-1	8
E.9-2	5
E.9-3	45
E.9-3a	8
E.10-1	5
E.11-1	20
E.12-1	12
E.12-2	16
E.12-3	45

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APPENDIX F

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APPENDIX F

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APPENDIX F

TEXT PAGES	AMENDMENT
F.4-48	45
F.4-49	49
F.4-50	45
F.4-51	49
F.4-52	49
F.4-53	49
F.4-54	49
F.4-55	49
F.4-56	45
F.4-57	49
F.4-58	45
F.4-59	49
F.4-60	45
F.4-61	49
F.4-62	45
F.4-63	49
F.4-64	45
F.4-65	49
F.4-66	45
F.4-67	49
F.4-68	45
F.4-69	45
F.4-70	50
F.4-71	49
F.4-72	49
F.4-73	49
F.4-74	49
F.4-75	50
F.4-76	50
F.4-77	49
F.4-78	50
F.4-79	49
F.4-80	50
F.4-81	45
F.4-82	49
F.4-83	50
F.4-84	45
F.4-85	50
F.4-86	49
F.4-87	50
F.4-88	49
F.4-89	50
F.4-90	49
F.4-91	50
F.4-92	49
F.4-93	50
F.4-94	49
F.4-95	50

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APPENDIX F

TEXT PAGES	AMENDMENT
F.4-96	49
F.4-97	50
F.4-98	49
F.4-99	50
F.4-100	49
F.4-101	50
F.4-102	49
F.4-103	50
F.4-104	49
F.4-105	50
F.4-106	49
F.4-107	50
F.4-108	49
F.4-109	50
F.4-110	50
F.4-111	50
F.4-112	50
F.4-113	50
F.4-114	50
F.4-115	50
F.4-116	50
F.4-117	50
F.4-118	45
F.4-119	49
F.4-120	49
F.4-121	49
F.4-122	45
F.4-123	50
F.4-124	49
F.4-125	45
F.4-126	50
F.4-127	49
F.4-128	50
F.4-129	49
F.4-130	50
F.4-131	49
F.4-132	50
F.4-133	49
F.4-134	50
F.4-135	49
F.4-136	50
F.4-137	49
F.4-138	50
F.4-139	49
F.4-140	50
F.4-141	49
F.4-142	45
F.4-143	45

LIST OF EFFECTIVE PAGES

APPENDIX F

TEXT PAGES	AMENDMENT
F.4-144	50
F.4-145	49
F.4-146	50
F.4-147	49
F.4-148	50
F.4-149	49
F.4-150	45
F.4-151	50
F.4-152	49
F.4-153	50
F.4-154	49
F.4-155	50
F.4-156	49
F.4-157	50
F.4-158	49
F.4-159	50
F.4-160	49
F.4-161	50
F.4-162	49
F.4-163	50
F.4-164	49
F.4-165	50
F.4-166	49
F.4-167	50
F.4-168	49
F.4-169	50
F.4-170	45
F.4-171	45
F.4-172	45
F.4-173	49
F.4-174	49
F.4-175	45
F.4-176	50
F.4-177	49
F.4-178	50
F.4-179	49
F.4-180	50
F.4-181	49
F.4-182	50
F.4-183	49
F.4-184	50
F.5-1	45
F.5-2	45
F.5-3	45
F.5-4	45
F.5-5	45
F.5-6	45

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APPENDIX F

TEXT PAGES	AMENDMENT
F.5-7	50
F.5-8	45
F.5-9	45
F.5-10	45
F.5-11	45
F.5-12	45
F.5-13	45
F.5-14	45
F.5-15	45
F.5-16	45
F.5-17	45
F.5-18	45
F.5-19	45
F.5-20	45
F.5-21	45
F.6-1	45
F.7-1	45
F.7-2	45
F.7-3	50
F.7-4	45
F.7-5	50

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APPENDIX G
(DAR)

TEXT PAGES	AMENDMENT
Title Page	7
i	28
ii	28
iii	28
iv	28
v	28
vi	28
vii	28
viii	28
ix	28
x	28
xi	28
xii	28
xiii	28
xiv	28
xv	28
xvi	28
xvii	28
xviii	28
xix	28
xx	28
xxi	28
xxii	28
1.1-1	28
1.1-2	28
1.1-3	28
2.1-1	33
2.1-1a	33
2.1-2	28
2.1-3	28
2.2-1	28
2.2-2	48
2.2-3	28
3.1-1	28
3.1-2	28
3.1-3	28
3.1-4	28
3.1-5	48
3.1-6	48
3.1-7	48
3.1-8	37
3.1-9	48

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APPENDIX G
(DAR)

TEXT PAGES	AMENDMENT
3.2-1	33
3.2-1a	33
3.2-2	33
3.2-3	33
3.2-3a	33
3.2-4	28
3.2-5	28
3.2-6	28
3.2-7	28
3.2-8	28
3.2-9	28
3.2-10	28
3.2-11	48
3.2-12	28
3.2-13	48
3.2-14	48
3.2-15	48
3.2-16	48
3.2-17	48
3.2-18	28
3.2-19	28
3.2-20	28
3.2-21	28
3.2-22	28
3.2-23	28
3.2-24	28
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1.2.1.3 Plant Design Criteria

The plant design criteria are based on general design criteria given in Appendix A of 10 CFR Part 50. Conformance to these criteria is discussed in 3.1. The classification of structures, components, and systems is discussed in 3.2.

The principal regulations and codes that are used extensively in plant design are highlighted in Table 1.2-1. Note that the codes listed may not be applicable in their entirety. The many codes and regulations used in relation to individual systems or structures are discussed throughout the FSAR, including applicable addendums and issue dates.

The plant shielding and radiation zone classification can be found in Table 1.2-2. Chapter 12, Radiation Protection, provides further details.

1.2.2 PLANT DESCRIPTION

1.2.2.1 Site Characteristics

1.2.2.1.1 Site Location and Size

WNP-2 is located in the southeast area of U.S. DOE's Hanford Reservation in Benton County, Washington. The site is approximately three miles west of the Columbia River at River Mile 352, approximately eight miles north of North Richland, 12 miles north of the City of Richland, 18 miles northwest of Pasco, and 21 miles northwest of Kennewick. The site is approximately square shaped with a corridor extending to the makeup water pumphouse located on the Columbia River as shown in Figure 1.2-1a. The WNP-2 site encompasses an area of approximately 1089 acres.

1.2.2.1.2 Description of Site Environs

1.2.2.1.2.1 Site Land

The plant site grade level is 441 feet above mean sea level (MSL). The site is situated near the middle of a relatively flat, essentially featureless plain which is best described as a shrub steppe with sagebrush interspersed with perennial native and introduced annual grasses extending in a northerly, westerly, and southerly direction for several miles. On the east, the site runs within three miles of the Columbia River. The plain is characterized by slight topographic relief with a maximum, across the plant site, of approximately ten feet.

1.2.2.1.2.2 Population

It is estimated that 251,700 people were living within a 50-mile radius of the project in 1980. Since the site is situated within the Hanford Reservation, there are no significant clusters of population within a 10-mile radius. The closest inhabitants occupy farms which are located east of the Columbia River and are thinly spread over five compass sectors. None are located within three miles of the site. Only 80 persons reside in the 3-5 mile area and all are east of the Columbia River. The nearest population center is the City of Richland, 12 miles to the south, with a 1980 population of 33,578.

By the year 2020, the 5-mile radius population is projected to be 255 and the 50-mile population is projected to be about 380,000.

1.2.2.1.2.3 Land Use

Natural physical characteristics of the plant site which indicate that the area is ideally situated for and suited for operation of the plant include: favorable geographical, geological, and seismological characteristics; adequate water supply; ideal climatological characteristics; and remoteness from population centers or areas of special ecological concern. The site area has served as a nuclear industrial center since 1943 when it was selected by the federal government as the location for construction of one of the world's first nuclear production reactors. Since 1943, nine plutonium production reactors and a number of test reactors have been constructed and operated at the Hanford Reservation.

1.2.2.1.2.4 Meteorology

The climate around WNP-2 is basically continental with a wide range of annual temperatures. Summers are warm and dry with infrequent thunderstorms. Summer temperatures reach 90°F or above about 56 days a year. The average summer temperature is 73.7°F, but temperatures greater than 100°F can be expected 13 days each year. During the winter months, the mean daily temperature is 32.4°F. Temperatures below 0°F are expected four days each year. The minimum and maximum temperatures were 27°F in December 1919 and 115°F in July 1939. Precipitation averages 6.25 inches per year. The heaviest rainfall of the record occurred in October 1957, with 1.68 inches in six hours. The greatest recently recorded snow depth of 12 inches was observed in December 1964. Winds at the site show a bi-modal direction distribution from approximately south and northwest. The Hanford region experiences high wind speeds due to squall lines, frontal passages, strong pressure gradients and thunderstorms. The site has experienced only one recorded tornado and has not been known to be affected by typhoons. The average wind speed is 7.6 mph. Peak wind gusts measured at towers in the area have never exceeded 80 mph.

1.2.2.1.2.5 Hydrology

The Columbia River is the controlling water body in the region as a surface water source. The river also forms a potential discharge boundary for the aquifer. The surface soils at Hanford are sufficiently permeable to take in water from precipitation and industrial discharges.

The surface water flow of the Columbia River in the Hanford reach is to a large extent controlled by regulation of upstream reservoir projects which have a total active storage capacity of more than 34 million acre-feet. Control of flow in the immediate vicinity of the site (River Mile 352) is experienced from operation of the nearest upstream hydroelectric projects. Minimal effect on the river flow at River Mile 352 is caused by back water from McNary Dam at River Mile 292, approximately 60 river miles downstream from the Site area.

Consumptive use of water upstream from the Hanford reach is primarily associated with irrigation. The effects of this consumptive use on streamflow has been taken into account in the modified mean monthly discharges for the Columbia River below Priest Rapids Dam.

In general, the groundwater table resulting from groundwater flowing under the Reservation is highest in the southwestern area near Rattlesnake Mountain and slopes toward the area near the center of the Reservation. From this central area the general slope is northeast and southeast.

Project administration programs will be managed so as to minimize all avoidable release of undesirable discharges of chemicals and other noxious wastes during operation of the project.

A considerable amount of research, predicting and recording has been made on the Columbia River temperatures in the Hanford reach. Statutory controls have included the Federal Water Quality Act, the State of Washington Water Quality Standards for Intrastate Waters by the Water Pollution Control Commission, Water and Environmental Quality Improvment Act and National Environmental Policy Act.

Washington State standards for the Columbia River from the Washington-Oregon border (River Mile 309) to Priest Rapids Dam (River Mile 397) categorize this reach as Class A and among other criteria stipulate temperature requirements. No measurable increases are permitted within the waters designated which result in water temperatures exceeding 68°F., nor shall the cumulative total of all such increases arising from non-natural causes be permitted in excess of $t=110/(T-15)$, with "t" the permissive increase and "T" the resultant water temperature.

The main stem of the Columbia River shows little change in mineralization from the International Boundary to the point of its confluence with the Snake River. The effect of incoming tributaries with higher mineralization is partly offset by the contribution of tributaries with lower mineralization. The major reason for the uniformity of mineralization in this stretch of the main stem is the relative discharge of the Columbia River compared to that of its tributaries. The average flow of the largest tributary above the plant, Spokane River, is less that 10 percent of the average flow of the Columbia River at Pasco.

The Columbia River as it enters the United States from Canada has a calcium bicarbonate type water which has an average dissolved-solids concentration of approximately 90 mg/l (milligrams per liter). Samples collected daily at the International Boundary (Northport, Washington) since 1952 have had a dissolved-solids range of 71-158 mg/l. The water is moderately hard, ranging from 62 to 128 mg/l hardness. At River Mile 385 the dissolved-solids range is 75-104 mg/l, and hardness range 62-81 mg/l.

Water temperatures range on the average at Priest Rapids from 36°F to 68°F, with a low in February-March and a high in August.

A phase shift caused by upstream reservoirs has in recent years caused a shift in peak temperatures toward the fall months. High temperatures of 70.7°F were observed during the high year of record, 1958.

Dissolved oxygen concentrations are normally near saturation. Occasional dips do occur seasonally, but do not constitute any significant impairment of water quality. Oxygen levels near the study area range from 9.5 to 14.0 mg/l, with a mean of 11.8 mg/l.

Coliform organisms average 131MF/100 ml in the reach below Priest Rapids Dam; the observed range is from 0 to 430MF/100 ml.

1.2.2.1.2.6 Geology

The Hanford Reservation lies in the east central part of the Pasco Basin, a structural and topographic depression in the Columbia Plateau. The region is underlain by three major geologic units: (1) Tertiary basaltic lavas and intercalated sediments of the Columbia River Group at the base, (2) Plio-Pleistocene sediments of the Ringold Formation, and (3) the Pasco (glaciofluvial) gravels and associated sediments of late Pleistocene age at the surface.

The Hanford Reservation lies near the center of a major structural basin traversed by largely east-trending anticlinal (upfolded) ridges. The ridges, as deduced by geological studies and the determined age of the Ringold Formation, began to rise towards the end of the Miocene period. Uplift has been slow and continuous, comparable to basining. The Ringold and younger sediments are essentially undeformed. There are no mapped faults or capable faults known in the immediate vicinity of the site. The closest mapped fault is about 12 miles northwest of the site.

The Columbia River Group basalts of Miocene Age are more than 5,000 feet thick. They extend to a considerable depth below sea level on the Reservation. Their present position resulted from long, slow basining, beginning about early Pliocene time. Beneath the Columbia River basalts are over 5,000 feet of older unidentified extrusive volcanics with an oceanic basement of probable Jurassic age.

The basalts and their associated sedimentary interbeds are unconformably overlain by the Ringold Formation sediments of late Pliocene and early Pleistocene age. The Formation has been divided into three members - a lower, so-called "blue clays", a middle conglomerate, and an upper fine sand and silt. The "blue clays" are largely compact and calcium carbonate-indurated silts.

The conglomerates generally blanket the silts, although they also interfinger with them in part. They are in turn overlain by the silts and sands of the uppermost part of the formation. These upper silts and sands are known only from White Bluffs. They, or their equivalents, were eroded from the other parts of the Hanford area.

Where exposed to weathering, as in the White Bluffs, the Ringold tends to soften and to be subject to sliding and sloughing. However, when subject to the surcharge of appreciable cover, and protected from weathering, the Ringold Formation takes on the aspect of bedrock with measured compressional wave velocities in the neighborhood of 10,000 fps.

The Pasco Gravels and their fine-grained variant, the Touchet Beds, are the compact though uncemented deposits of late Pleistocene age. They were laid down by glacial meltwater and glacial lake floodwaters.

The Pasco Gravels, because of their manner of deposition and depth of burial, have a suitability and load bearing capacity considerably in excess of that experienced with normal alluvium.

The glaciofluvial deposits occur at the surface, or under a thin cover of loessial materials. The unconfined ground water table in these deposits is controlled by the Columbia River elevation.

1.2.2.1.2.7 Seismology

The WNP-2 plant site is situated in an area characterized by low seismicity and widely scattered epicenters. Only one of the earthquakes that has occurred within a radius of approximately 20 miles of the site during the more than 140 years of historic record of seismic activity in the region was large enough to be felt at the site. Of the thirteen earthquakes that have been felt at, or possibly affected, the site, the highest intensity at the site was estimated to have been an intensity IV-V (MM) from the December 14, 1872 earthquake, and an intensity IV (MM) from the Milton-Freewater shock of July 15, 1936. It is estimated that the vibratory ground motion at the site from either of these earthquakes did not exceed an acceleration of 0.015g.

a. Main steam line radiation monitoring system,

b. Air ejector and off-gas radiation monitoring systems,

c. Liquid radwaste effluent radiation monitoring system,

d. Service water blowdown radiation monitoring system,

e. Standby service water radiation monitoring system,

f. Reactor building ventilation exhaust plenum radiation monitoring system,

g. Reactor building elevated release point radiation monitoring system,

h. Turbine building ventilation exhaust radiation monitoring system,

i. Radwaste building ventilation exhaust radiation monitoring system, and

j. Reactor building closed cooling water monitoring system.

1.2.2.9.2 Area Radiation Monitors

Radiation monitoring devices are provided in key areas throughout the plant buildings to ensure that plant personnel will not be inadvertently exposed to high radiation doses.

1.2.2.9.3 Site Environs Radiation Monitoring

A comprehensive radiation surveillance program was initiated in the spring of 1978 to measure radiation levels in the environs surrounding the plant. The program is designed to measure radiation dose or radioisotope levels in 8 different media. Ambient radiation dose will be monitored using thermoluminescent dosimeters (TLD). Airborne particulates are measured by filtering known quantities of air and analyzing the filtered material.

River water is samples, at the plant intake, at the plant discharge, in the river below the plant and at the nearest downstream municipal water supply. Groundwater will also be monitored.

The radiation monitoring program includes sampling of vegetation where available in the vicinity of the site, the collection of sediment samples from the river, and collection of milk samples at four locations around the site.

Sampling for the radiation monitoring program occurs at forty-three sampling stations within ten miles of the site, at one sampling station approximately 11 miles downstream on the Columbia River, one sampling station at Lower Granite Dam on the Snake River about 80 miles east of the project, and at one control station at Grandview approximately 33 miles west southwest of the plant. The details of this monitoring program are given in the Environmental Report.

1.2.2.9.4 Liquid Radwaste System Control

Liquid wastes to be discharged are handled on a batch basis with protection against accidental discharge provided by procedural controls. Instrumentation with alarms to detect abnormal concentration of the radwaste is provided, including automatic closure of discharge valves isolating the system from the environment.

1.2.2.9.5 Solid Radwaste System Control

The solid radwaste system collects, treats, and stores solid radioactive wastes for offsite shipment. Wastes are handled on a batch basis. Radiation levels of the various batches are monitored by the operator.

The sanitary drain system effluent is directed to a septic tank and distributed into a tile field located on the plant site.

1.2.2.12.6 Process Sampling Systems

The process sampling system provides process information that is required to monitor plant and equipment performance and changes to operating parameters. Representative liquid and gas samples are taken automatically and/or manually during normal plant operation for laboratory or on-line analyses.

1.2.2.12.7 Condensate Supply System

The condensate storage facility provides a source of water for testing and makeup during operation. Two 400,000 gallon condensate storage tanks are interconnected to simultaneously supply condensate to the main condenser via one header, to the CRD pumps via a second header, and to the RHR, RCIC, and HPCS systems and condensate supply and condensate filter/demineralizer backwash pumps via a third header. The condensate supply pumps deliver condensate to miscellaneous services in the reactor and radwaste buildings.

Condensate is returned to the condensate tanks from the HPCS, RCIC and radwaste systems, from CRD, condensate supply, and condensate filter/demineralizer backwash pump mini flows, and from the main condensate system (equivalent to excess CRD injection water). Initial fill and makeup is from the demineralized water system.

1.2.2.12.8 Equipment and Floor Drainage Systems

Plant equipment and floor drainage systems handle both radioactive and nonradioactive drains. Drainage systems which carry radioactive waste are isolated from drainage systems which do not carry radioactive waste.

All drains in the reactor building and radwaste building are considered radioactive. Turbine building drains are divided into radioactive and nonradioactive.

Floor and equipment drains in the diesel-generator building, service building, and storm water drainage are non-radioactive.

1.2.2.12.9 Compressed Air Systems

The compressed air system consists of the contol and service air system and the containment instrument air system.

The control air system is designed to supply clean, dry, oil free air to station instrumentation and controls and to the accumulators of the main steam isolation valves located outside the primary containment.

The service air system is designed to supply clean, oil free air for station services, such as backwashing demineralizers and filters, hose connections for maintenance throughout the station and breathing air at selected locations.

The containment instrument air system is designed to supply clean, dry, oil free air for main steam line isolation valves, safety/relief valve accumulators, and pneumatic operators located inside the primary containment.

1.2.2.12.10 Heating, Ventilating, and Air Conditioning Systems

The heating, ventilating, and air conditioning (HVAC) systems are designed to maintain proper air quality for personnel comfort and safety. In addition, the main control room, the critical switchgear area, the cable spreading room HVAC systems, the standby service water pump room heat removal systems, the reactor building emergency pump and critical electric equipment area cooling systems, and the ventilation system for the standby diesel generators are designed to operate under all station conditions. The primary containment drywell cooling and ventilation system is designed to operate during normal operation and under most upset conditions except a LOCA. All air distribution systems are designed so that airflow is directed from areas of lesser potential contamination to areas of progressively greater potential contamination.

Three separate and redundant HVAC systems service the main control room, cable spreading room, and critical switchgear areas. Standby service water is used as the cooling medium for each system when the normal cooling water supply is unavailable.

Heating and ventilation for the standby diesel generator rooms is provided continuously for each diesel generator unit. Water cooled air handling units provide additional cooling when the diesel generators operate.

The turbine building is provided with a once-through ventilation system based on the use of evaporative coolers.

Ventilation for the radwaste building is provided by means of a once-through ventilation system with particulates filtered before release to the atmosphere.

The standby service water pump room heat removal systems consist of two independent and separate fan coil units.

REACTOR BLDG.

1. REACTOR
2. REACTOR PRESSURE VESSEL PEDESTAL
3. VENT PIPE
4. LPCS PUMP LPCS-P-1
5. HPCS PUMP HPCS-P-1
6. LPCS WATER LEG PUMP LPCS-P-2
7. HPCS WATER LEG PUMP HPCS-P-3
8. RHR PUMP
9. RHR WATER LEG PUMP RHR-P-3
10. RCIC PUMP CRIC-P-1
11. RCIC WATER LEG PUMP RCIC-P-3
12. VACUUM TANK RCIC-TK-1
13. CONDENSER PUMP RCIC-P-4
14. VACUUM PUMP RCIC-P-2
15. RCIC BAROMETRIC CONDENSER RCIC-HX-1
16. REACTOR BLDG AUX COND SPLY PUMP COND-P-3
17. RADWASTE BLDG AUX COND SPLY PUMP COND-P-4
18. CONDENSATE F/D BACKWASH PUMP COND-P-5
19. REACTOR BLDG EQUIP DRAIN HEAT EXCH EDR-HX-2
20. PUMP SUCTION FILTER CRD-FU-10
21. CONTROL ROD DRIVE PUMP CRD-P-1A & 1B
22. AIR TIGHT/WATERTIGHT HATCH #1
23. SUPPRESSION POOL CLEAN UP PUMP FPC-P-3
24. VACUUM BREAKER VALVE
25. EQUIP DRAIN SUMP
26. FLOOR DRAIN SUMP
27. CONTROL INSTRUMENT AIR TANK CIA-TK-1
28. MOTOR CONTROL CENTER
29. INSTR. RACK & STANDBY LIQUID CONTROL PANEL
30. VAPORIZER CN-VZ-1
31. WALL HUNG TRAVELING JIB CRANE MT CRA 15
32. INDEX MECHANISM
33. RECIRCULATING PUMP P-1A & -B
34. PERSONNEL LOCK
35. CRD REMOVAL HATCH
36. CRD REPAIR ROOM
37. PORTABLE BENCH & STORAGE RACK
38. DECONTAMINATION AREA
39. AIR COMPRESSOR
40. MAIN STEAM TUNNEL
41. VALVE PURGE ASSEMBLY
42. DRIVE MECHANISM
43. PRE AMP CABINET
44. CRD TEMP RECORDER PANEL
45. MOTOR CONTROL CENTER ROOM DMC #2
46. CRD MODULE C12-D001
47. RWCU PUMP ROOM
48. MASTER CONTROL AREA - PIPING
49. SACRIFICIAL SHIELD WALL
50. RBCC WATER PUMP P-1A, -1B & -1C
51. RBCC WATER HEAT EXCHANGERS HX-1A, 1B & -1C
52. RBCC WATER CHEM METERING PUMP
53. RBCC WATER CHEM ADDITION TANK
54. RHR HEAT EXCHANGER HX-1A & -1B
55. FUEL POOL CIRC PUMP P-1A & -1B
56. FUEL POOL HEAT EXCHANGER HX-1A & -1B
57. RWCU SAMPLING & ANALYZER ROOM 1A & 1B
58. STAND-BY LIQUID CONTROL STORAGE TANK
59. STAND-BY LIQUID CONTROL TEST TANK
60. STAND-BY LIQUID CONTROL PUMPS
61. REGENERATIVE HEAT EXCHANGER
62. NON REGENERATIVE HEAT EXCHANGER
63. REACTOR WELL
64. SKIMMER SURGE TANK
65. AIR LOCK
66. STEAM DRYER
67. SHROUD HEAT & STM SEPARATOR
68. CASK
69. FUEL PREP MACHINE
70. FUEL POOL STORAGE VALVE BOX
71. NEW FUEL INSPECTION STAND BASEPLATE
72. CHANNEL HANDLING CRANE BOOM
73. JIB CRANE MOUNTING BASE
74. UPPER & LOWER SHIELD PLUG LAYDOWN
75. RPV HEAD INSULATION
76. FLUX MONITOR SHIPPING CRATE
77. NEW FUEL STORAGE VAULT
78. NEW FUEL INSPECTION STAND
79. DRYWELL HEAD LAYDOWN
80. HEAD STUD RACK
81. HEAD NUT WASHER RACK
82. UPPER POOL PLUG LAYDOWN
83. LOWER POOL PLUG LAYDOWN
84. RPV HEAD LAYDOWN
85. CASK WASHDOWN AREA
86. REFUELG. PLATF. ELECT BOX
87. SKIMMER SURGE TANK VALVE BOX
88. SLOT PLUGS
89. STUD TENSIONER SPREADER
90. FUEL STORAGE POOL
91. RBCC WATER SURGE TANK RBCC-TK-1
92. STANDBY GAS FILTER UNIT
93. DAMPER (AIR OPERATORS)
94. HYDROGEN RECOMBINER CAC-HR-1A & -1B
95. RETURN AIR PLENUM
96. FILTER UNIT FU-2A & B
97. FLOOR DRAIN RADIOACTIVE
98. EQUIP DRAIN RADIOACTIVE
99. RAILROAD LOCK FAN COIL RRA-AH-7
100. FAN COIL UNIT
101. SUPPRESSION POOL ACCESS
102. T.I.P. ROOM
103. CDR TRANSFER CART
104. LOWER LEVEL RECIRC FAN
105. UPPER LEVEL RECIRC FAN
106. RETURN AIR FAN
107. H&V UNIT
108. AC UNIT
109. RELEASE STACK OPENING
110. GAMMA SCAN COLLIMATOR PORT
111. BRIDGE CRANE
112. DRYER & SEPARATOR STORAGE POOL
113. POTABLE WATER COLD PUMPS PWC-P-4A & B
114. SAMPLE RACK SR-6
115. FUME HOOD SR-7
116. PARTICULATES, I2 NOBLE GAS ANALYZERS
117. H_2-O_2 ANALYZERS SR-14 & SR-15
118. ELECTRONICS ROOM
119. GAS MONITOR RACK
120. AIR WASH CIRC. PUMPS ROA-P-1A & -1B
121. FAN REA-FN-2B & REA-FN-15
122. EXHAUST AIR FAN REA-FN-1A & -1B
123. FAN MSLC-FN-1 & -2
124. AIR DRYER
125. EXHAUST AIR FILTERS HF-15 & FL-15
126. RETURN AIR FANS FN-15 & FN-17
127. RETURN AIR FAN COILS FC-15 & FC-17
128. RETURN AIR COOLING COILS CC-15 & CC-17

TURBINE GEN. BLDG.

200. MAIN CONDENSER
201. TURBINE GENERATOR UNIT
202. MAIN STEAM & FEEDWATER PIPE CHASE
203. OIL DRAIN SUMP
204. GAS DRYER
205. GENERATOR H_2 CONTROL STATION
206. H_2 CONTROL PANEL
207. H_2 SEAL OIL UNIT
208. CARDOX UNIT FP-TK-1
209. GENERATOR STATOR WATER COOLING UNIT
210. BUS DUCT
211. CHLORINE ANALYZER PANEL
212. CONDENSATE PUMP P-1A, -1B & -1C
213. CONDENSATE BOOSTER PUMP P-2A, -2B & -2C
214. REACTOR FEED PUMP P-1A & -1B
215. MECH VACUUM PUMP P-1A & -1B
216. STEAM JET AIR EJECTOR COND HX-6A & -6B
217. GLAND SEAL STEAM COND COND-HX-7
218. CATALYTIC RECOMBINER RC-5A & -5B
219. OFF GAS SAMPLE ROOM
220. OFF GAS LOCAL PANEL
221. MOTOR CONTROL CENTER
222. INSTRUMENT RACK
223. JUNCTION BOX
224. OFF GAS CONDENSER OG-HX-2
225. WATER SEPARATOR OG-MS-6
226. SEAL WATER LIQUID TANK TK-2
227. PUMPED DRAIN TANK TK-1
228. CONDENSATE STORAGE TANK TK-1A & -1B
229. REACTOR FEEDWATER TURBINE PANEL
230. EXHAUST FAN FN-5A & -5B
231. TRANSFORMER
232. SERVICE & INSTRUMENT AIR COMP. C-1A, B & C
233. SERVICE & INSTRUMENT AIR RECEIVER AR-1A, B & C
234. AIR DRYER DY-1A & B
235. BOILER ROOM
236. AUX BOILER AS-BLR-1
237. AUX BOILER CONTROL PANEL
238. AUX BOILER COND RETURN TANK CO-TK-1
239. DEAERATOR FEED PUMP P-1A & B
240. BOILER FEED PUMP P-2A & B
241. DEAERATOR CO-HX-1
242. FUEL OIL SERV PUMP & STRAINER UNIT
243. BOILER CHEM FEED TANK BFC-TK-1
244. BLOWDOWN TANK BD-TK-1
245. AIR HANDLING UNIT
246. TURBINE LUBE OIL STORAGE TANK TO-TK-1
247. MAIN LUBE OIL TRANSFER PUMP TO-P-1
248. TURBINE LUBE OIL CONDITIONER TO-LOC-1
249. TURBINE OIL PUMP TO-P-2
250. ELECTRICAL PULL BOX
251. STEAM UNIT HEATER TRA-SUH-1
252. H.P. FEEDWATER HEATER
253. L.P. FEEDWATER HEATER
254. STEAM EVAPORATOR
255. DRAIN TANK
256. RH DRAIN TANK
257. TURBINE BY-PASS VALVE ACCUMULATOR ASSY
258. TURBINE BY-PASS VALVE ASSEMBLY
259. TURBINE OIL COOLER TO-HX-1A & -1B
260. TURBINE OIL RESERVOIR TO-TK-2
261. ELECTRO-HYDRAULIC FLUID SUPPLY PUMPS
262. AUX BOILER STACK
263. MOISTURE SEPARATOR DRAIN TANK
264. GEN BUS DUCT HEAT COOLING UNIT & HEAT EXCH
265. GEN LOOP SEAL TANK TO-TK-4
266. GEN LOOP SEAL VAPOR EXTRACTOR TO-EX-4
267. NEUT GROUNDING XFMR & RESISTOR CUBICLE
268. EXCITATION CUBICLES
269. SWITCHGEAR
270. MOISTURE SEPARATOR REHEATER
271. EXHAUST PLENUM
272. LOUVER PENTHOUSE
273. EQUIPMENT DRAIN RADIOACTIVE T-6 & -7
274. FLOOR DRAIN RADIOACTIVE T-4 & -5
275. FLOOR DRAIN NON RADIOACTIVE T-1, -2 & 3
276. H&V UNIT
277. P/T CUBICLE
278. BRIDGE CRANE
279. CIRC WATER INTAKE TUNNEL
280. TURB. EXHAUST FANS TEA-FN-52 & -53
281. AIR CONDITIONING UNIT TRA-AC-52
282. CORROSION PRODUCTS MONITOR B22-N001
283. FILTER UNIT TEA-FU-52
284. SAMPLE RACKS SR-1 & D17-J003
285. VIAL SAMPLER D17-J004
286. SAMPLE CHAMBER D17-J002
287. CONSTANT TEMPERATURE BATH
288. HYDROGEN ANALYSER ROOM
289. HYDROGEN ANALYSERS H64-N012A & -12B
290. ELECTRICAL RACK SA-4
291. FUME HOOD SR-5

RADWASTE & CONTROL BLDG.

300. FLOOR DRAIN COLLECTOR TANK FDR-TK-6
301. WASTE COLLECTOR TANK EDR-TK-2
302. CONDENSATE SEPARATOR TANK CPR-TK-92A
303. PHASE TANK CPR-TK-92B
304. CONDENSATE BACKWASH RECEIVING TANK CPR-TK-14
305. SPENT RESIN TANK EDR-TK-1
306. WASTE SLUDGE PHASE SEP TANK FDR-TK-22
307. CLEAN-UP PHASE SEPARATOR TANK TK-104A & -104B
308. CHEMICAL WASTE TANK TK-23A & -23B
309. DISTILLATE TANK TK-29A & -29B
310. DETERGENT DRAIN TANK TK-8A & -8B
311. DECONTAMINATION SOL CONC WASTE TANK TK-31A & -31B
312. WASTE SURGE TANK EDR-TK-5
313. WASTE SAMPLE TANK TK-4A & -4B
314. FLOOR DRAIN SAMPLE TANK FDR-TK-9
315. POLYMER DAY TANK CF-TK-7A
316. CATALYST MIXING TANK TK-6A & B
317. POLYMER TANKS
318. FLOOR DRAIN COLLECTOR PUMP FDR-P-16
319. WASTE COLLECTOR PUMP EDR-P-11
320. COND SLUDGE DISCHARGE MIXING PUMP CPR-P-25
321. COND DECONT PUMP CPR-P-24
322. COND BACKWASH XFER PUMP CPR-P-22
323. WASTE SURGE PUMP EDR-P-15
324. WASTE SAMPLE PUMP
325. COND PUMP SET WMCO-CU-1
326. FLOOR DRAIN SAMPLE PUMP FDR-P-21
327. SPENT RESIN PUMP EDR-P-10
328. DECONT PUMP FDR-P-36
329. CLEAN-UP DECANT PUMP RWCU-P-27
330. WASTE SLUDGE DISCHARGE PUMP FDR-P-23
331. CONCENTRATOR FEED PUMP P-34A & B
332. CHEMICAL WASTE PUMP
333. DISTILLATE TANK PUMP P-37A & B
334. DETERGENT DRAIN PUMP P-20A & B
335. DECON WASTE PUMP MWR-P-39
336. POLYMER TRANSFER PUMP CF-P-6
337. CLEAN-UP SLUDGE DISCH MIXING PUMP RWCU-P-28
338. POLYMER DAY TANK PUMP CF-P-7
339. OFF GAS CHILLER PUMP P-7A & B
340. FLOOR DRAIN SUMP RADIOACTIVE W-1 & 2
341. EQUIPMENT DRAIN SUMP RADIOACTIVE W-3
342. CHEMICAL DRAIN SUMP RADIOACTIVE W-4
343. MOTOR CONTROL CENTER
344. INSTRUMENT RACK
345. LOCAL CONTROL PANEL
346. POLYMER TANK LEVEL INDICATION PANEL
347. AIR BLOWER BA-C-1
348. COOLER CONDENSER HX-10A & B
349. MOISTURE SEPARATOR MS-10A & B
350. GLYCOL DRUM DRAIN
351. DESICANT DRYER DY-30A THRU -30D
352. REGENERATOR RG-2A & -2B
353. GAS COOLER HX-11C & -11D
354. CHARCOAL ADSORBERS
355. OFF GAS CHILLER UNITS CR-7A & -7B
356. HVAC PANEL
357. STORAGE AREA CRANE PENDANT CONTROL STATION
358. STORAGE AREA CRANE PWR-CRA-1 & -2
359. TRUCK LOADING CRANE
360. SOLID HANDLING/DRUM CASK STORAGE AREA
361. TRUCK
362. SWIPE TOOL
363. BLOWER
364. CONTAINER WASHDOWN SMEAR & TESTING STATION
365. NITROGEN BOTTLES
366. CONTAINER CAPPING STATION
367. CONTAINER FILLING STATION
368. VIEWER PWR-VD-1
369. SOLID RADWASTE CONTROL PANEL
370. DECON STA CONTROL PANEL
371. HYDRAULIC BALER MWR-BL-1
372. FLUSH DOWN FUNNEL
373. DOLLY HOIST
374. DECONTAMINATION AREA
375. EMBEDDED CONDUIT
376. DETERGENT DRAIN FILTER
377. EXPANSION TANK
378. AIR HANDLING UNIT WOA-AH-3
379. HOPPER
380. WASTE PROCESSING PUMP CF-P-9
381. GLYCOL TANK OG-TK-2
382. GLYCOL PUMP
383. OFF GAS REFRIGERATION MACHINE
384. PRE-FILTER
385. AFTER FILTER
386. DECON SOLUTION CONCENTRATOR VAPOR BODY
387. DECON SOLUTION CONCENTRATOR HEATING ELEMENT
388. DECON SOLUTION CONCENTRATOR COND RETURN TANK
389. POWDEX & PRECOAT STORAGE AREA
390. RPS ROOM #1 & #2
391. VALVE ROOM
392. RADWASTE CONTROL ROOM
393. CONTAMINATED TOOL ROOM
394. REMOTE SHUTDOWN ROOM
395. SWITCHGEAR ROOM #2
396. M/G SET
397. STATIC SWITCH & INVERTER PANEL IN-1
398. INVERTER BY PASS TRANSFORMER IN-3
399. INVERTER FEEDER TRANSFORMER
400. CRITICAL DISTRIBUTION PANEL
401. TRANSFORMERS
402. BATTERY RACK
403. REACTOR PROTECTION SYS PANEL
404. MAIN DISTRIBUTION PANEL
405. TRANSFORMER NEUTRAL RESISTOR COMPARTMENT
406. SWITCHGEAR
407. EQUIPMENT REMOVAL PLUG
408. CONCENTRATOR WASTE MEASURING TK MWR-TK-27
409. CENTRIFUGE FU-94A & B
410. COND DEMIN CONTROL PANEL
411. RADWASTE CONTROL PANEL
412. CHEMICAL SOLUTION TANK MWR-TK-1
413. CONDENSATE PRECOAT TANK CF-TK-4
414. PRECOAT PUMP CF-P-4
415. CHEMICAL SOLUTION PUMP MWR-P-1
416. WASTE PRECOAT PUMP CF-P-13
417. WASTE PRECOAT TANK CF-TK-3
418. CHEMICAL ADDITION PUMPS
419. CHEMICAL ADDITION TANK
420. WASTE FILTER AID TANK CF-TK-7
421. WASTE FILTER AID PUMP CF-P-18
422. FLOOR DRAIN FILTER AID PUMP FDR-P-19
423. FUEL POOL PRECOAT PUMP CF-P-5
424. FUEL POOL PRECOAT TANK CF-TK-5
425. RESIN TANK CF-TK-17
426. CLEAN-UP PRECOAT TANK RWCU-TK-2
427. CLEAN-UP PRECOAT PUMP RWCU-P-4
428. DUST EVACUATOR RWCU-EX-80
429. HOLDING PUMP P-10A THRU -10F
430. FLOOR DRAIN FILTER HOLD PUMP FDR-P-17
431. WASTE FILTER HOLD PUMP EDR-P-12
432. FUEL POOL HOLD PUMP P-2A & -2B
433. CLEAN-UP HOLD PUMP P-3A & -3B
434. DECON SOL CONC DEAER FEED PUMP P-3A & B
435. DECON CONC BOTTOM RECYCLE PUMP P-11TA & B
436. HEALTH PHYSICS OFFICE
437. AIR LOCK
438. CONDENSATE FILTER DEMINERALIZER
439. FLOOR DRAIN FILTER FDR-FU-19
440. WASTE COLLECTOR FILTER EDR-DM-9
441. FUEL POOL FILTER DEMIN
442. CLEAN-UP FILTER DEMINERALIZER
443. WASTE DEMINERALIZER EDR-DM-29
444. FLOOR DRAIN DEMINERALIZER FDR-DM-18
445. POLISHING DEMINERALIZER MWR-DM-40
446. RADIO CHEMISTRY LABORATORY
447. DECON SOL CONC EVAP AS-EV-1A & 1B
448. DECON SOL CONC EVAP DRAIN TANK
449. SUMP
450. MECHANICAL EQUIPMENT ROOM
451. AIR HANDLING UNITS WOA-AH5 & WMA-AH6
452. HOT WATER HEATER WMH-HX-1
453. FILTER UNITS FU-1A, -1B, -1C & -54B
454. RWHV CONTROL PANEL
455. HEATING & VENT UNIT
456. SAMPLING AREA
457. DECON CONC CONDENSER
458. HOT INSTRUMENT SHOP
459. HOT MACHINE ROOM
460. EXHAUST FILTER
461. EXHAUST FAN
462. CONTROL ROOM
463. TERMINAL CABINETS
464. BENCHBOARD
465. RELAY CABINETS
466. COMPUTER
467. FILTER DEMINERALIZER REMOVAL ROOM
468. DECONTAMINATION STATION
469. RESIN ADDITION TANK CF-TK-34
470. CHILLERS CR-51A & -51B
471. WATER PUMP P-51A & -51B
472. SUPERVISOR CONTROL PANEL
473. BRIDGE CRANE
474. A.C. UNITS WRA-AC61
475. DELUGE STATION
476. RWCU SYSTEM CONTROL PANEL P026
477. FUEL POOL DEMINERALIZER FPC-CA-1
478. DC BATTERY CHARGER
479. SAMPLING ELECTRONIC PANEL SR 12
480. EXHAUST PLENUM
481. VACUUM PUMP & TANK
482. DECON. SOLN CONC EVAP BLWDN COOLER
483. FUME HOODS SR-10 & SR-17
484. TEMPERATURE BATH SR 11
485. COUNTING ROOM
486. JANITORS CLOSET & MISC STORAGE ROOM
487. GAS SAMPLER RACKS
488. GAS MONITOR RACK
489. RADIANT HEATER
490. AIR WASHER PUMPS
491. H&V UNIT WASHERS
492. AIR COMPRESSORS AG 51 & AG 52
493. HVAC PANEL
494. EXHAUST FANS (FOR TURB. GEN. BLDG)
495. FIRE DISPLAY PANEL
496. UNIT HEATER WRA-SUH-1, 2, 3, 4 & 5
497. SAMPLE RACKS

DIESEL GEN. BLDG.

500. DIESEL GENERATOR ENG-1A & B
501. HPCS DIESEL GENERATOR ENGINE
502. DIESEL OIL DAY TANK TK-5A, B & TK-4
503. SWITCHGEAR
504. MOTOR CONTROL CENTER
505. DIESEL GENERATOR PANEL
506. AIR INTAKE PANEL
507. EXHAUST FAN
508. H&V CONTROL PANEL
509. DC BATTERY CHARGER & RACK
510. TRANSFORMER
511. AIR COMPRESSOR
512. AIR RECEIVER AR-11A & B
513. ELECTRIC UNIT HEATERS
514. DIESEL OIL TANK
515. FUEL OIL TANK
516. CN TANK CN-TK-1
517.
518. AIR INTAKE FILTERS
519. AIR HANDLING UNIT
520. EXHAUST SILENCER
521. DIESEL GEN. AIR STARTING SKID
522. PREFILTERS DOA-FL-11
523. AIR INTAKE SILENCER

SERVICE BLDG.

600. DEMIN WATER STORAGE TANK DW-TK-1
601. ACID STORAGE TANK CF-TK-1
602. CAUSTIC STORAGE TANK CF-TK-2
603. POTABLE WATER STORAGE TANK PWG TK 1
604. NEUTRALIZATION TANK CF-TK-3
605. HOT WATER TANK DW-TK-2
606. CLEARWELL FW-TK-1
607. CLEARWELL TRANSFER PUMPS
608. POTABLE WATER PUMPS
609. DEMIN WATER TRANSFER PUMPS
610. CHILLED WATER PUMPS
611. WASTE TRANSFER PUMPS
612. CONDENSATE PUMP SET SMCO-CU-1
613. POTABLE WATER HEATER SPWH-HX-1
614. HEAT EXCHANGER PACKAGE SHW-HTP-51
615. DUPLEX CARBON FILTERS
616. GRAVITY FILTERS
617. FLOW SPLITTER BOX
618. DEMINERALIZERS
619. GRAPHIC CONTROL PANEL
620. WATER CHILLER SCH-CR-51
621. MOTOR CONTROL CENTER
622. NEUTRALIZATION SUMP
623. DUST COLLECTOR WITH SKIMMER SEA-DC1
624. CHLORINE ROOM
625. STORAGE AREA
626. WATER TREATMENT LABORATORY
627. MACHINE SHOP
628. BRIDGE CRANE
629. ROOF VENTILATORS RV-1 & -2
630. STEAM UNIT HEATER SRA-SUH-1
631. GRAVITY ROOF VENT SEA-GVT-1
632. INSTRUMENT RACK
633. HVAC ROOM
634. HEATING & VENTILATING ROOM
635. MULTIZONE HVAC UNIT SMA-MZ-51
636. EXHAUST FAN
637. SUPPLY FAN
638. ELECT UNIT HEATER SRA-EUH-51
639. FLOOR DRAIN SUMP
640. RECEPTION AREA
641. LOBBY
642. MEN'S LOCKER ROOM
643. HEALTH PHYSICS ROOM
644. LOUVER HOUSE
645. SUMP PUMPS FD-P-19A & -19B
646. SKIMMER SEA-FU-1
647. DUST COLLECTOR SEA-DC1
648. PLANT SERVICE WATER CHLORINATOR
649. SURFACE GRINDER
650. SHAPER
651. RADIAL ARM DRILL

MISC. EQUIPMENT

700. ELEVATOR
701. COVERED HATCH
702. OPEN HATCH
703. RAILROAD
704. CRANE RAIL
705. MONORAIL
706. ROOF
707. MANHOLE

MAKE-UP WATER PUMP HOUSE

800. TOWER MAKE UP PUMP TMU-P-1A, -1B & -1C
801. FAN COIL UNIT PRA-FN-91A & -91B
802. INSTRUMENT RACK IR-29 & -IR-30
803. JET PUMP PWO-P5
804. HVAC RACK MWRV-1 & MWRV-2
805. AIR HANDLING UNIT PRA-FC91A & 91B
806. AIR COMPRESSOR TMU-C-1A & -1B
807. AIR TANK TMU-TK-1A & -1B
808. DRYER TMU-DY-1
809. AIR HANDLING UNIT PMA-AH 81A & 81B
810. ELECT UNIT HEATER PRA-EUH-92A & -92B
811. BACKWASH VALVE TMU-V 19A & -19B
812. DISCH VALVE TMU-V-1A, -1B & -1C
813. SLUICE GATE VALVE TMU-V-7A & -7B
814. BATTERY RACK EXHAUST HOOD E B1 3 & -4
815. POTABLE WATER PRESS. TANK PWH-HX-81
816. ELECT DUCT HEATER PMA EHC 81A & -81B
817. EXH. PCV DUCT FAN PEA-FN 81A & -81B
818. EXHAUST FAN PEA-FN-82
819. PRESSURING TANK PWO TK-81
820. XFMR TR-72, TR-82, TR-72-T & TR 82-B
821. 4.16 KV SWITCHGEAR SM-72 & SM-82
822. NEUTRAL GROUND RESISTOR NR-T7 72 & T8 82
823. ISOLATION VALVE TMU-V-20 & -21
824. HYPO CHLORINATOR
825. SUPERVISORY PANEL
826. DISCH VALVE TMU-V-16A, -16B & -16C

SPRAY PONDS IA & IB

850.
851.
852.
853.
854.
855.
856.
857.
858.
859.

STANDBY SERVICE WATER PUMP HOUSES 1A & 1B

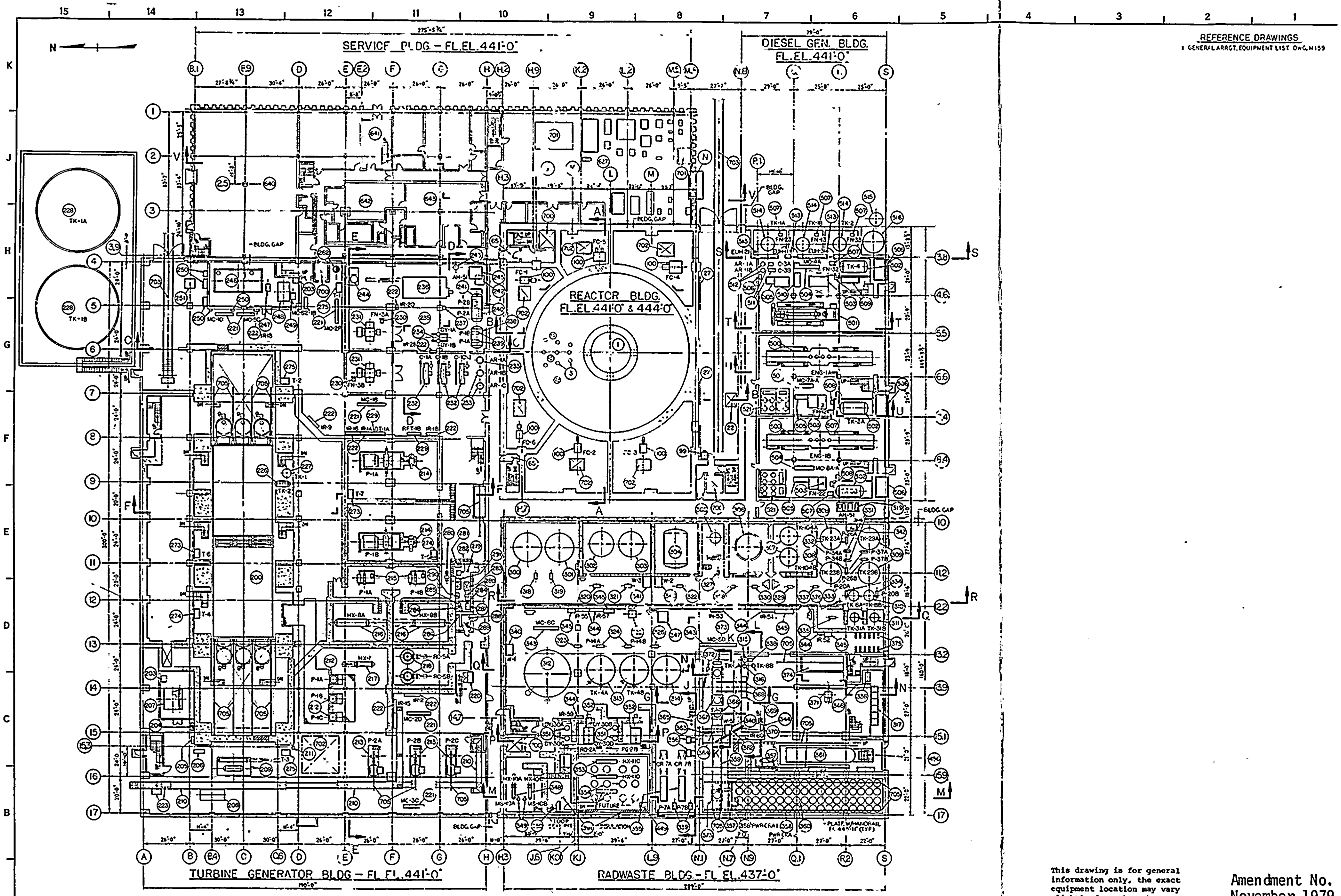
900. STANDBY SERVICE WTR PUMPS SW-P-1A & -1B
901. PUMP CHAMBER ACCESS 1A, 1B
902. DIESEL SERVICE WTR PUMP (1B-1A ONLY)
903. ELECT UNIT HTRS PRA-EUH-1A, 2A, 3A, 1B, 2B & -3B
904. FAN COIL UNITS PRA-FC-1A AND -1B
905. FANS POA-FN-2A AND -2B
906. INSTRUMENT PANELS IR-21, 24, 26 & 22 & 25
907. SUPERVISORY CONTR. PANELS 51, 53 & 52
908. DISTRIBUTION PANELS PP-7A, 7B & -8A & -8B
909. SUMPS
910. VALVE PITS 1A & 1B
911. TRANSFORMERS TR-7A-F & TR-8A-F
912. LIGHTING PANELS LP-7A-F & LP-8A-F
913. ELECTRIC VAULT
914. STOP LOGS
915. SCREENS

Amendment No. 8
February 1980

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PROJECT NO. 2

GENERAL ARRANGEMENT EQUIPMENT LIST

FIGURE 1.2-2



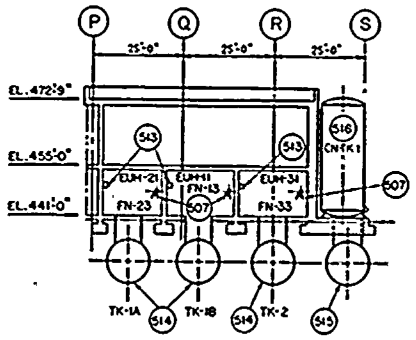
This drawing is for general information only, the exact equipment location may vary slightly from that shown.

Amendment No. 7
November 1979

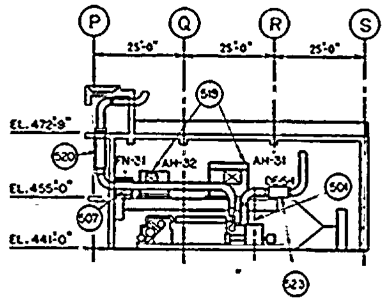
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	GENERAL ARRANGEMENT - GROUND FLOOR PLAN	FIGURE 1.2-3

REFERENCE DRAWINGS

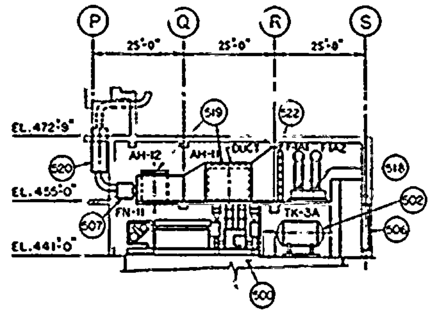
1. GENERAL ARRGT. EQUIPMENT LIST DWG. M159



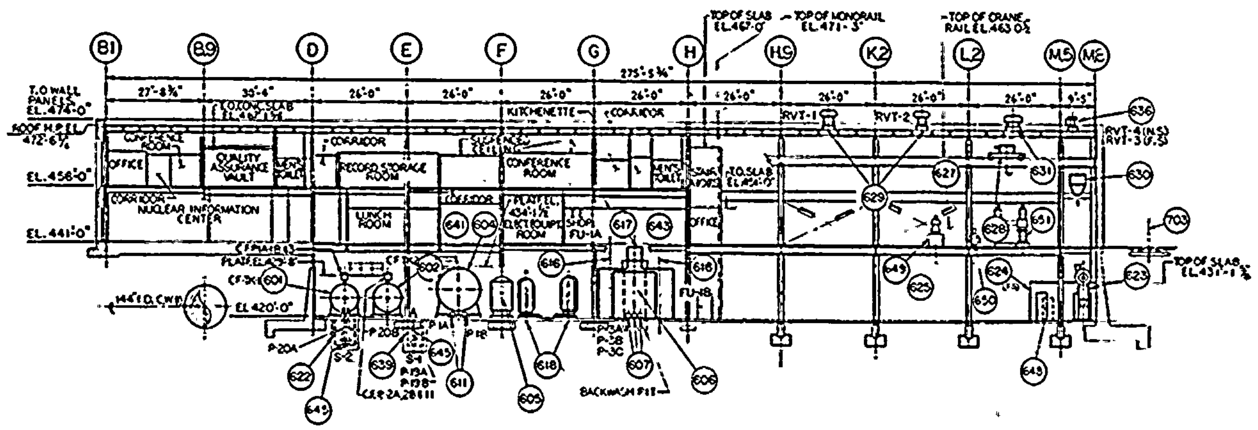
DIESEL GEN. BLDG.
SECTION S-S



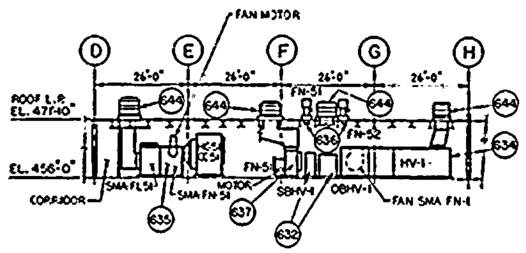
DIESEL GEN. BLDG.
SECTION T-T



DIESEL GEN. BLDG.
SECTION U-U



SERVICE BLDG.
SECTION V-V



SERVICE BLDG.
SECTION W-W

This drawing is for general information only, the exact equipment location may vary slightly from that shown.

Amendment No. 7
November 1979

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	GENERAL ARRANGEMENT - DIESEL GEN. & SERVICE BLDG, SECTIONS	FIGURE 1.2-12

1.4.6 MAJOR CONTRACTORS

1.4.6.1 Fishbach/Lord

Fischbach/Lord is responsible for the major electrical installation at WPPSS Nuclear Project No. 2, consisting of raceways, conduit, cable, terminators, and electrical equipment. They were formed as a joint venture, solely for this project, in 1974.

1.4.6.2 Pittsburgh-Des Moines Steel Company

Pittsburgh-Des Moines Steel Company is responsible for engineering, fabrication and installation of materials in the WNP-2 Primary Containment Vessel.

1.4.6.3 Wright-Schuchart-Harbor (WSH)/Boecon (Boeing Construction)/GERI (General Energy Resources Inc.) (WBG)

WBG was formed as a joint venture October 1, 1977 to be responsible for installation of major mechanical equipment, power and process piping for WPPSS Nuclear Project No. 2. They are completing the internal installation of NSSS piping.

1.4.7 CONSULTING ENGINEER - R. W. BECK AND ASSOCIATES

The independent consulting firm of R. W. Beck and Associates is the consulting engineer for Washington Public Power Supply System's Nuclear Project No. 2. This firm was also a consulting engineer for Hanford No. 1. Having extensive experience in preparing engineering feasibility and financing studies and reports necessary for the success of utility and civic improvement projects, the firm is well qualified for employment as a consulting engineer and was chosen as a result of its experience.

The duties of the consulting engineer are briefly summarized as follows: prepare estimates of plant capability, energy potential, usability within area loads and resources, the cost of power and energy output of the project, and generally determine the feasibility of the project. These duties will include assisting in preparation of a Bond Resolution, preparation of an enginering report, schedules for investment of funds, schedules for debt service payments, and other engineering services necessary to facilitate the financing of the project.

TABLE 1.4-1

COMMERCIAL NUCLEAR REACTORS COMPLETED, UNDER CONSTRUCTION, OR IN DESIGN BY GENERAL ELECTRIC

STATION	UTILITY	RATING (MWe)	YEAR OF ORDER	YEAR OF STARTUP
Dresden 1	Commonwealth Edison	200	1955	1960
Humboldt Bay	Pacific G&E	69	1958	1963
Kahl	Germany	15	1958	1961
Garigliano	Italy	150	1959	1964
Big Rock Point	Consumers Power	70	1959	1965
JPDR	Japan	11	1960	1963
KRB	Germany	237	1962	1967
Tarapur 1	India	190	1962	1969
Tarapur 2	India	190	1962	1969
GKN	Holland	52	1963	1968
Oyster Creek	JCP&L	640	1963	1969
Nine Mile Point 1	Niagara Mohawk	625	1963	1969
Dresden 2	Commonwealth Edison	809	1965	1970
Pilgrim	Boston Edison	664	1965	1972
Millstone 1	NUSCO	652	1965	1970
Tsuruga	Japan	340	1965	1970
Nuclenor	Spain	440	1965	1971
Fukushima 1	Japan	439	1966	1971
BKW KKM	Switzerland	306	1966	1972
Dresden 3	Commonwealth Edison	809	1966	1971
Monticello	Northern States	545	1966	1971
Quad Cities 1	Commonwealth Edison	800	1966	1972
Browns Ferry 1	TVA	1098	1966	1974
Browns Ferry 2	TVA	1098	1966	1975
Quad Cities 2	Commonwealth Edison	800	1966	1972
Vermont Yankee	Vermont Yankee	514	1966	1972
Peach Bottom 2	Philadelphia Electirc	1065	1966	1974
Peach Bottom 3	Philadelphia Electric	1065	1966	1974
Fitzpatrick	PASNY	821	1966	1975
Bailly	NIPSCO	660	1967	----
Shoreham	LILCO	819	1967	----
Cooper	Nebraska PPD	778	1967	1974
Browns Ferry 3	TVA	1098	1967	1977
Limerick 1	Philadelphia Electric	1055	1967	----
Hatch 1	Georgia	786	1967	1975
Fukushima 2	Japan	762	1967	1974
Brunswick 1	Carolina P&L	821	1968	1977
Brunswick 2	Carolina P&L	821	1968	1975
Arnold	Iowa ELP	569	1968	1975
Fermi 2	Detroit Edison	1056	1968	----
Limerick 2	Philadelphia Electric	1055	1969	----
Hope Creek 1	PSE&G	1067	1969	----
Hope Creek 2	PSE&G	1067	1969	----

TABLE 1.4-1 (Continued)

STATION	UTILITY	RATING (MWe)	YEAR OF ORDER	YEAR OF STARTUP
Zimmer	CCDPP	810	1969	----
Chinshan	Taiwan	610	1969	1977
Caorso 1	Italy	827	1969	1975
Hatch 2	Georgia	795	1970	1979
La Salle 1	Commonwealth Edison	1078	1970	----
La Salle 2	Commonwealth Edison	1078	1970	----
Susquehanna 1	Pennsylvania P&L	1050	1970	----
Lusquehanna 2	Pennsylvania P&L	1050	1970	----
Chinshan 2	Taiwan	610	1970	1978
WPPSS 2	WPPSS	1103	1971	----
Nine Mile Point 2	Niagra Mohawk	1100	1971	----
Grand Gulf 1	Midsouth	1250	1971	----
Grand Gulf 2	Midsouth	1250	1971	----
Kaiseraugst	Switzerland	915	1971	1978
Fukushima 6	Japan	1135	1971	1976
Tokai 2	Japan	1135	1971	1976
Riverbend 1	Gulf States	940	1972	----
Riverbend 2	Gulf States	940	1972	----
Perry 1	Cleveland Electric	1205	1972	----
Perry 2	Cleveland Electric	1205	1972	----
Hartsville A-1	TVA	1233	1972	----
Hartsville B-1	TVA	1233	1972	----
Hartsville A-2	TVA	1233	1972	----
Hartsville B-2	TVA	1233	1972	----
Laguna Verde 1	Mexico	660	1972	1977
Leibstadt	Switzerland	940	1972	1978
Kuosheng 1	Taiwan	992	1972	1978
Kuosheng 2	Taiwan	992	1972	1979
Clinton 1	Illinois Power	950	1973	----
Clinton 2	Illinois Power	950	1973	----
Montague 1	NUSCO	1150	1973	----
Allens Creek 1	Houston L&P	1200	1973	----
Skagit 1	Puget SD	1288	1973	----
Skagit 2	Puget SD	1288	1973	----
Barton 3	Alabama	1220	1973	----
Blackfox 1	Oklahoma	1150	1973	----
Blackfox 2	Oklahoma	1150	1973	----
Cofrentes	Spain	975	1973	1977
Laguna Verde 2	Mexico	660	1973	1978
Enel 6	Italy	982	1974	1980
Enel 8	Italy	982	1974	1980

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The dominant topographic features in the area are the Rattlesnake Hills, 13 to 15 miles west southwest, 3200 feet above the elevation of the plant site; Gable Mountain, approximately 10 miles northwest of the site and about 670 feet above the site grade; and the steep river cut bluffs forming the east bank of the Columbia River, approximately 3.5 miles east of the site (Figure 2.1-1).

2.1.1.3 Boundaries for Establishing Effluent Release Limits

An area encompassing approximately one square mile has been established as the limit of the restricted area for which effluent concentrations have been calculated in conformance with 10 CFR Part 20 (Table 11.3-9). This area is shown in Figure 2.1-3 as the nearly square area surrounding the WNP-2 plant and conforms for the most part to the property boundary. Prior to completion of WNP-1 and WNP-4, WNP-2's east restricted area boundary will be located 0.4 miles from site center (dotted line Figure 2.1-3). This places all WNP-1/4 construction activities, including parking lots, outside of WNP-2 restricted area. Once WNP-1 and WNP-4 construction is completed, the east boundary will be located 0.5 miles from site center which is a common restricted area boundary with WNP-1 and WNP-4. The distance between the WNP-2 release points and the restricted boundary is approximately 800 meters in those sectors (SE, ESE) having the highest calculated /Qs. This distance has been used to estimate the maximum expected concentration at the boundary for routine releases.

The restricted area includes WNP-2 buildings, meteorological tower, access road, and railroad spur. The Supply System is developing plans for an Emergency Response/Plant Support Facility to be located in the southwest corner of the restricted area. One main railroad line crosses the restricted area. The Wye Burial Ground (discussed in 2.2.2.2) is also within the restricted area. Since no person will be approaching the plant except properly authorized personnel, and distances are too great for pedestrian traffic, and the plant site itself is being fenced; only the access road and railroad are considered localities requiring control for emergency purposes. This entire restricted area is within the DOE Hanford Site and within the Supply System exclusion area as described in 2.1.2.1.

2.1.2 EXCLUSION AREA AUTHORITY AND CONTROL

2.1.2.1 Authority

The Washington Public Power Supply System has leased 1089 acres, within the DOE Hanford Site, from the Department of Energy to be used for WNP-2. A letter from the DOE Richland Operations office to the Managing Director of the Supply System (Reference 2.1-1) advises that the Department of Energy has the authority to sell or lease land on the Hanford Site and the letter further states: "This Authority is contained in Section 120 of the Atomic Energy Community Act of 1955, as amended, and Section 161G of the Atomic Energy Act of 1954, as amended. There is also general federal disposal authority available under the Federal Property Administrative Services Act of 1949, as amended."

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In several of the monthly summary reports, the computer programs as applied to dummy data have been compiled as called for in the Quality Assurance Manual (Reference 2.3-23) for the purpose of documenting proper programming and proper computer performance.

These computer computations have been verified with hand calculations made with the dummy data. The computational programs for x/Q were similarly tested.

2.3.3.2.4 Meteorological Monitoring Program During Plant Operation

The Supply System Meteorological Measurements Program (MMP) treats WNP-2 and WNP-1/4 as an integrated whole. As WNP-2 fuel load is scheduled prior to WNP-1/4 fuel load, the WNP-1/4 MMP will incorporate the procedures applied to WNP-2. The instruments and data acquired are described in 2.3.3.1. This data forms the primary input data which will be relayed to the control room and site computers, as required, on a real-time basis. Data is also multiplexed to the WNP-1/4 control room, the FFTF, and the PSP&L Skagit-Hanford site required by contract. The data is available to indicated locations as five-minute average analog values and are converted to digital values for CRT and printout displays with various analog meter displays also available. These digitized, electronically averaged, five-minute data will be processed into 15-minute averages for utilization in Supply System dispersion models. Longer period averages will also be computed for trend analysis and report generation. These data will be routed to satisfy display and processing requirements of the onsite technical support centers (TSC) and the emergency operations facility (EOF). The primary meteorological tower data will be stored on tape at the tower and also stored for 24 hours in raw and processed form by the plant data acquisition system. Instrument calibrations and maintenance procedures will be implemented to meet the data recovery and system accuracy requirements of Regulatory Guide 1.23. The backup system will be sited near the EOF after appropriate consideration of local topography and the final EOF building configuration. Instrumentation, maintenance, calibration, and processing of sensor data will be identical to that of the primary system. Sensor data obtained from the backup system will be ten-meter, five-minute averaged windspeed, wind direction, Sigma Theta, temperature, dewpoint, a temperature difference (over a to-be-determined height), and a five-minute precipitation total. This system is designed to meet or exceed a data unavailability of 0.01 and backup system data access of less than five minutes. All sensor data will be interactively accessable as detailed in the WNP-2 Emergency Preparedness Plan. Spatial data acquisitions are planned from a network of approximately twenty 10-meter towers operated by Battelle Pacific Northwest Laboratories for the Department of Energy. Data will also be obtained as available from the 400-meter HMS tower and auxiliary systems operated by Battelle. Terrain data requirements per Regulatory Guide 1.23 will be satisfied by selecting the appropriate 10-meter tower data following written and automated selection procedures based on the current meteorological situation. Where economically feasible, the Supply System will acquire any additional data required for the safety of the public. Data exchange with state and federal agencies will be incorporated in the MMP to meet their requirements. The accuracy, calibration, and reliability of all data not directly controlable by the Supply System will be determined by the private/governmental controlling agency.

2.3.3.3 Other Meteorological Measurement Programs Considered for the Data Comparisons

2.3.3.3.1 WNP-2 Temporary Tower

A temporary 23-foot onsite tower was used during the period April 1, 1972 through August 31, 1974, to obtain data input for WNP-2 environmental studies and to provide a comparative overlap with the initially measured permanent tower data.

The temporary tower was located in the vicinity of the permanent towers with its base at approximately 448 feet MSL. Wind data from the temporary tower were obtained at the 23-foot level while temperature data were acquired at the three-foot level. Wet bulb data from the temporary tower were established from techniques and data contained in the U. S. Department of Commerce, Weather Bureau Office Document, Relative Humidity and Dewpoint Table. As a special quality assurance program was not initiated for the temporary tower installation, it is not possible to assert that this tower's data complied with the requirements contained in Regulatory Guide 1.23.

2.3.3.3.2 Hanford Meteorological Station

The Hanford Meteorology Station (HMS) is on a plateau in south central Washington. The plateau slopes downward toward the Columbia River, about 10 miles north of the station and about 300 feet lower in elevation. Elevation of the station is 733 feet MSL. The nearest city is Richland, about 25 miles southeast. There is no local vegetation which can interfere with the HMS.

TABLE 2.5-10

GROUNDWATER OBSERVATIONS

ELEVATION OF WATER TABLE (FT., MSL)

Boring No.	4/17/71	4/26/71	5/3/71	5/10/71	5/17/71	5/26/72	6/26/72	7/9/72
B-1				378.7	378.7	379.5	379.6	379.5
B-2	377.6	378.3						
B-3	377.2	377.7	378.1	378.1	378.1			
B-4	377.4	378.4	378.5					
B-5			377.0					
B-6	377.0	377.0	377.7					
B-7				378.6	378.6	379.3	379.8	379.9
B-8	377.6	377.8	378.3					
B-9	371.3	372.1	373.2	373.9	374.0	379.4	379.4	379.4
B-10		378.2	378.6					
B-11						379.8*	379.8*	379.9*
B-13							379.8	379.8
B-15						379.8	379.7	379.8
B-16						378.6	378.8	378.8
B-17						379.7	379.9	379.9
B-22						380.0	380.0	380.0

* Based on assumed ground elevation 439.0 MSL

TABLE 2.5-11

SUMMARY OF FOUNDATION CRITERIA

Structure	Length (ft)	Width (ft)	Foundation Elevation (MSL)	Estimated Area Load DL + LL (tsf)	Estimated Area Load DL + LL + EQ (tsf)	Foundation Type
Reactor Building (I)	157	147	406	5.70	20.5	Mat
Radwaste & Control Bldg. (I)	212	163	430	3.5	11.5	Mat
Diesel Generator Bldg. (I)	124	60	436	3.8*	4.6*	Strip Footing
Condensate Storage Tanks (I)	115	65	436	0.8	1.2	Mat
Spray Ponds (I)	250	250	417	0.25	3.0	Strip Footing & Slab
Service Building	280	80	435-418	4.2*	5.9*	Spread Footing
Turbine Generator Bldg.	304	193	415	3.4	9.9	Mat

(I) Seismic Category I Structure
* Footing Stress

TABLE 2.5-12

SUMMARY OF ESTIMATED SETTLEMENTS[1]

Structure	Area Loading (DL + LL tsf)	Maximum[2] Total	Maximum Differential	Max. Post Construction[3]	Maximum Diff. Post Construction[3]
Reactor Building (I)	5.70	2.1	0.8	0.5	0.2
Radwaste & Control Bldg. (I)	3.5	2.0	1.0	0.5	0.2
Diesel Generator Bldg. (I)	3.8[4]	1.5	0.8	0.4	0.2
Condensate Storage Tanks (I)	0.8	0.3	0.2	0.1	0.02
Spray Ponds (I)	0.25	0.2	0.1	0.1	0.05
Turbine Generator Bldg.	3.4	2.3	1.5	0.6	0.4
Service Building	4.2[4]	1.5	1.1	0.4	0.3

[1]Settlements in inches based on an elastic analysis using estimated foundation loads furnished by Burns and Roe, Inc. and the moduli values presented on Figure 2.5-67.

[2]Maximum settlement in inches from time of finished excavation to completion and occupancy of completed structures.

[3]Based on 75 percent of settlement occurring during construction.

[4]Footing stress.

(I) Seismic Category I Structure

TABLE 2.5-13

ADDITIONAL SETTLEMENTS OF SEISMIC CATEGORY I STRUCTURES DUE TO SSE

Structure	Elevation Elevation (ft)	Static Foundation Pressure (tsf)	Increase in Pressure Due to SSE (tsf)	Estimated Settlements (in)	Estimated Differential Settlements (in)
Reactor Building	406	5.70	14.8	0.12 0.23*	0.06 0.12*
Radwaste & Control Building	430	3.5	8.0**	0.06 0.13*	0.03 0.06*
Diesel Generator Building	436	3.8	0.8	0.01 0.02*	0.05 0.01*
Condensate Storage Tanks	436	0.8	1.2	0.01 0.02*	0.005 0.01*
Spray Ponds	417	0.25	3.0	0.02 0.05*	0.01 0.02*

* Based on Lower Dynamic Modulus Value ** Maximum

NOTES:
1. Duration of SSE assumed about 22 seconds.
2. Stress distributions are based on wave propagation theory included in Richart, P.E., Jr., et al., "Vibration of Soils and Foundation", Prentice-Hall, Inc., New Jersey, 1969.
3. Elastic moduli are based upon the upper and lower limit of the range of moduli for dynamic analysis, Subsection 2.5.4.7.

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and regulatory requirements are observed, specified materials are used, correct procedures are utilized, qualified personnel are provided and that the finished parts and components meet the applicable specifications for safe and reliable operation. These records are available so that any desired item of information is retrievable for reference. These records will be maintained during the life of the operating license.

The detailed quality assurance program developed by the applicant and its contractors satisfies the requirements of Criterion 1.

For further discussion see the following sections:

a.	Principle Design Criteria	1.2
b.	Plant Description	1.2
c.	Classification of Structures, Components and Systems	3.2
d.	Quality Assurance	17.0

3.1.2.1.2 Criterion 2 - Design Bases for Protection Against Natural Phenomena

Structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami and seiches without loss of capability to perform their safety functions. The design basis for these structure, systems, and components shall reflect: (1) appropriate consideration of the most severe of natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena and (3) the importance of the safety functions to be performed.

3.1.2.1.2.1 Evaluation Against Criterion 2

The design criteria adopted for structures, systems and components considers the magnitude and the probability of occurrence of natural phenomena at the specific site. The designs are based on the most severe natural phenomena recorded for the site with an appropriate margin to account for uncertainties in the historical data. Detailed discussion of the various phenomena considered and the design criteria developed are presented in the FSAR sections listed below.

The design criteria developed meet the requirements of Criterion 2.

For further discussion, see the following sections:

a.	Meteorology	2.3
b.	Hydrologic Engineering	2.4
c.	Geology and Seismology	2.5
d.	Classification of Structures, Components and Systems	3.2
e.	Wind and Tornado Design Loadings	3.3
f.	Water Level (Flood) Design	3.4
g.	Missile Protection	3.5
h.	Seismic Design	3.7
i.	Design of Seismic Category I Structures	3.8
j.	Mechanical Systems and Components	3.9
k.	Seismic Qualification of Category I Instrumentation and Electrical Equipment	3.10
l.	Enviornmental Design of Mechanical and Electrical Equipment	3.11

3.1.2.1.3 Criterion 3 - Fire Protection

Structures, systems and components important to safety shall be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions. Noncombustible and heat resistant materials shall be used wherever practical throughout the unit, particularly in locations such as the containment and control room. Fire detection and fighting systems of appropriate capacity and

TABLE 3.2-1

EQUIPMENT CLASSIFICATION

Principal Component (1)	Scope of Supply (2)	Safety Class (3)	Location (4)	Quality Group Classification (5)	Quality Class (6)	Seismic Category (7)	Comments
1. Reactor System							
.1 Reactor vessel	GE	1	C	A	I	I	
.2 Reactor vessel support Skirt	GE	1	C	N/A	I	I	
.3 Reactor vessel appurtances pressure retaining portions	GE	1	C	A	I	I	
.4 CRD housing supports	GE	2	C	N/A	I	I	
.5 Reactor internal structures, engineered safety features	GE	2	C	N/A	I	I	
.6 Reactor internal structures, other	GE	G	C	N/A	N/A	N/A	
.7 control rods	GE	2	C	N/A	I	I	
.8 Control rod drives	GE	2	C	N/A	I	I	
.9 Core support structure	GE	2	C	N/A	I	I	
.10 Power range detector hardware	GE	2	C	B	I	I	
.11 Fuel assemblies	GE	1	C	N/A	I	I	
.12 Reactor Vessel Stabilizer	GE	2	C	N/A	I	I	
2. Nuclear Boiler system (Figure 3.2-2)							
.1 Vessels, level instrumentation condensing chambers	GE	1	C	A	I	I	
.2 Vessels, air accumulators	P	2	C	B	I	I	
.3 Piping, relief valve discharge from relief valve to suppression pool	P	3	C	C	I	I	
.4 Piping, relief valve discharge within suppression chamber and suppression pool	P	2	C	B	I	I	(35)
.5 Piping, main steam and feedwater within outermost isolation valve	GE/P	1	C,R	A	I	I	
.6 Pipe supports, main steam	GE	1	C,R	A	I	I	

TABLE 3.2-1 (Continued)

Principal Component (1)	Scope of Supply (2)	Safety Class (3)	Location (4)	Quality Group Classification (5)	Quality Class (6)	Seismic Category (7)	Comments
.7 Pipe restraints, main steam	P	2	C,R	N/A	I	I	
.8 Piping, other within outermost isolation valves	P	1	C,R	A	I	I	(12)
.9 Safety/relief valves	GE	1	C	A	I	I	
.10 Valves, main steam isolation valves	GE	1	C,R	A	I	I	
.11 Valves, other, isolation valves and within containment	P	1	C	A	I	I	
.12 Valves, instrumentation beyond outermost isolation valves	P	2	R	B	I	I	(12)
.13 Mechanical modules, instrumentation, with safety function	GE	2	C,R	N/A	I	I	
.14 Electrical modules with safety function	GE	2	C,R	N/A	I	I	
.15 Cable, with safety function	P	2	C,R,W	N/A	I	I	
3. Reactor Recirculation System	(Figure 3.2-3)						
.1 Piping	GE	1	C	A	I	I	(12)
.2 Pipe suspension, recirculaton line	GE	1	C	N/A	I	I	
.3 Pipe restraints, recirculation line	GE	2	C	N/A	I	I	
.4 Pumps	GE	1	C	A	I	I	
.5 Valves	GE	1	C	A	I	I	(12)
.6 Motor, pump	GE	2	C	N/A	I	I	
.7 Electrical modules, with safety function	GE	2	C,R	N/A	I	I	
.8 Cable with safety function	P	2	C,R,W	N/A	I	I	
.9 LFMG Sets	GE	3	T	N/A	II	II	

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TABLE 3.2-1 (Continued)

Principal Component (1)	Scope of Supply (2)	Safety Class (3)	Location (4)	Quality Group Classification (5)	Quality Class (6)	Seismic Category (7)	Comments
4. CRD Hydraulic System (Figure 3.2-4)							
.1 Valves, scram discharge volume lines	GE	2	R	B	I	I	(12)
.2 Valves, insert and withdraw lines	GE	2	R	B	I	I	(8)
.3 Valves, other	P	G	R	D	II	II	(12 & 32)
.4 Piping discharge volume lines	P	2	R	B	I	I	
.5 Piping insert and withdraw lines	GE/P	2	C,R	B	I	I	
.6 Piping, other	P	G	R	D	II	II	(12 & 32)
.7 Hydraulic control unit	GE	2	R	Special	I	I	(14)
.8 Electrical modules, with safety function	GE	2	R	N/A	I	I	
.9 Cables, with safety function	P	2	C,R,W	N/A	I	I	
5. Standby Liquid Control System (Figure 3.2-5)							
.1 Standby liquid control tank	GE	2	R	B	I	I	
.2 Pump	GE	2	R	B	I	I	
.3 Pump Motor	GE	2	R	N/A	I	I	
.4 Valves, explosive	GE	1	R	A	I	I	
.5 Valves, isolation and within containment	P	1	C	A	I	I	
.6 Valves, beyond isolation valves	P	2	R	B	I	I	(12)
.7 Piping, within isolation valves to reactor vessel	P	1	C,R	A	I	I	(12)
.8 Piping, beyond isolation valves	P	2	R	B	I	I	(12)
.9 Electrical modules, with safety function	GE	2	C	N/A	I	I	(12)
.10 Cable, with safety function	P	2	C,R,W	N/A	I	I	(12)

TABLE 3.2-1 (Continued)

	Principal Component (1)	Scope of Supply (2)	Safety Class (3)	Location (4)	Quality Group Classification (5)	Quality Class (6)	Seismic Category (7)	Comments
6.	Neutron Monitoring System							
	.1 Piping, TIP	GE	2	C	B	I	I	
	.2 Electrical modules, IRM and APRM	GE	2	C,R	N/A	I	I	
	.3 Cable, IRM and APRM	P	2	C,R,W	N/A	I	I	
	.4 Valves, Isolation Tip Subsystem	GE	2	C,R	B	I	I	(12)
	.5 Power Range Detector Hardware	GE	2	R	B	I	I	(12)
7.	Reactor Protection							
	.1 Electrical modules	GE	2	C,R,T	N/A	I	I	
	.2 Cable	P	2	C,R,T,W	N/A	I	I	
8.	Leak Detection System							
	.1 Temperature element	GE	2	C,R	N/A	I	I	(15)
	.2 Differential temperature switch		2	C,R	N/A	I	I	(15)
	.3 Differential flow indicator	GE	2	C,R	N/A	I	I	(15)
	.4 Pressure switch	GE	2	C,R	N/A	I	I	(15)
	.5 Differential pressure indicator switch		2	C,R	N/A	I	I	(15)
	.6 Differential flow summer	GE	2	C,R	N/A	I	I	(15)
9.	Process Radiation Monitors							
	.1 Electrical modules, main steam line and building ventilation monitors	GE	2	C,R,T,W	N/A	I	I	
	.2 Cable, main steam line and reactor building ventilation monitors	P	2	C,R,T,W	N/A	I	I	

TABLE 3.2-1 (Continued)

Principal Component (1)	Scope of Supply (2)	Safety Class (3)	Location (4)	Quality Group Classification (5)	Quality Class (6)	Seismic Category (7)	Comments
10. RHR System (Figure 3.2-6)							
.1 Heat exchangers, primary side	GE	2	R	B	I	I	
.2 Heat exchanger, secondary side	GE	3	R	C	I	I	
.3 Piping, within outermost isolation valves, reactor coolant pressure boundary	P	1	C,R	A	I	I	
.4 Piping, other	P	2	R	B	I	I	
.5 Pumps	GE	2	R	B	I	I	
.6 Water leg pumps	P	2	R	B	I	I	
.7 Pump motors	GE	2	R	N/A	I	I	
.8 Valves, isolation Reactor Coolant Pressure Boundary	P	1	C,R	A	I	I	
.9 Valves, other	P	2	R	B	I	I	(12)
.10 Mechanical modules	GE	2	R	B	I	I	
.11 Electrical modules with safety function	GE	2	R	N/A	I	I	
.12 Cable, with safety function	P	2	C,R,W	N/A	I	I	
11. Low Pressure Core Spray (Figure 3.2-7)							
.1 Piping, within outermost isolation valves to reactor vessel	P	1	C,R	A	I	I	(12)
.2 Piping, beyond outermost isolation valves	P	2	R	B	I	I	(12)
.3 Pumps	GE	2	R	B	I	I	
.4 Water leg pumps	P	2	R	B	I	I	
.5 Pump motors	GE	2	R	N/A	I	I	
.6 Valves, isolation, Reactor Coolant Pressure Boundary	P	1	C	A	I	I	(12)

TABLE 3.2-1 (Continued)

Principal Component (1)	Scope of Supply (2)	Safety Class (3)	Location (4)	Quality Group Classification (5)	Quality Class (6)	Seismic Category (7)	Comments
11. Low Pressure Core Spray (Figure 3.2-7) (Continued)							
.7 Valves, other	P	2	C,R	B	I	I	(12)
.8 Electrical modules with safety function	GE	2	R	N/A	I	I	
.9 Cable, with safety function	P	2	R,W	N/A	I	I	
12. High Pressure Core Spray (Figure 3.2-7)							
.1 Piping, within outermost isolation valve	P	1	C,R	A	I	I	(12)
.2 Piping, return test line to condensate storage tank beyond second isolation valve	P	G	R,O	D	II	II	(32)
.3 Piping, beyond outermost isolation valve, other	P	2	R	B	I	I	(12)
.4 Pump	GE	2	R	B	I	I	
.5 Water leg pumps	P	2	R	B	I	I	
.6 Pump motor	GE	2	R	N/A	I	I	
.7 Valves, beyond diesel shutoff valves	P	3	P	C	I	I	
.8 Valves, isolation, Reactor Coolant Pressure Boundary	P	1	C	A	I	I	
.9 Valves, beyond isolation valves, motor operated	GE	2	R	B	I	I	(12)
.10 Valves, other	P	2	R,P	B	I	I	
.11 Electrical modules, with safety function	GE	2	R	N/A	I	I	
.12 Electrical auxiliary equipment	GE	3	DG	N/A	I	I	
.13 Cable with safety function	P	2	W,R	N/A	I	I	
(HPCS Emergency Power Supply - see 38a)							

TABLE 3.2-1 (Continued)

Principal Component (1)	Scope of Supply (2)	Safety Class (3)	Location (4)	Quality Group Classification (5)	Quality Class (6)	Seismic Category (7)	Comments
13. RCIC System (Figure 3.2-81)							
.1 Piping, within outermost isolation valves Reactor Coolant Pressure Boundary	P	1	C,R	A	1	1	(12)
.2 Piping, beyond outermost isolation valves, except as noted in 3	P	2	R	B	1	1	(12 & 23)
.3 Piping, return test line to condensate storage tank beyond second stop valve; drip pot discharge valve to condenser; condenser to vacuum tank and to the condensate pump discharge; and vacuum pump discharge to the outboard check valve break flange	P	G	R	D	11	11	(12 & 32)
.4 Pumps	GE	2	R	B/D	1	1	(39
.5 Water leg pumps	P	2	R	B	1	1	
.6 Valves, isolation and Coolant Pressure Boundary	P	1	C	A	1	1	(12)
.7 Valves, other	P	2	R	B/D	1	1	(13 & 39)
.8 Turbine	GE	2	R	N/A	1	1	
.9 Electrical modules, with safety function	GE	2	R	N/A	1	1	
.10 Cable, with safety function	P	2	R,W	N/A	1	1	
14. Fuel Service Equipment							
.1 Fuel preparation machine	GE	3	R	N/A	1	1	
.2 General purpose grapple	GE	3	R	N/A	1	1	
15. Reactor Vessel Service Equipment							
.1 Steam line plugs	GE	3	R	N/A	1	1	
.2 Dryer and separator sling and head strongback	GE	3	R	N/A	1	1	
16. In-Vessel Service Equipment							
.1 Control rod grapple	GE	3	C	N/A	1	1	

TABLE 3.2-1 (Continued)

Principal Component (1)	Scope of Supply (2)	Safety Class (3)	Location (4)	Quality Group Classification (5)	Quality Class (6)	Seismic Category (7)	Comments
17. Refueling Equipment							
.1 Refueling equipment platform assembly	GE	3	C	N/A	I	I	
.2 Refueling Bellows	P	G	C,R	D	II	I	(33)
18. Storage Equipment							
.1 Fuel storage racks	GE/P	3	R	N/A	I	I	
.2 Defective fuel storage container	GE	3	R	N/A	I	I	
19. Radwaste System (Figures 11.2-2, 3.2-9, 3.2-10, 11.2-3, 11.2-4a thru 11.2-4c, 11.4-1a, 11.4-1b)							
.1 Tanks, Atmospheric	GE/P	G	W	C	II	II	(16, 24 & 38)
.2 Heat exchangers	GE/P	G	W	C	II	II	(16 & 24)
.3 Piping and valves forming part of containment boundary	P	2	C,R	B	I	I	
.4 Piping, other	P	G	W	C	II	II	(16 & 38)
.5 Pumps	GE/P	G	W	C	II	II	(16, 24 & 38)
.6 Valves, flow control and filter system	GE/P	G	W	C	II	II	(16, 24 & 38)
.7 Valves, other	P	G	W	C	II	II	(12, 16, 24 & 38)
.8 Mechanical modules	GE/P	G	W	C	II	II	(16 & 24)
.9 Radioactive Equipment & Floor Drains and other radwaste piping and valves upstream of collector tanks	P	G	R,T,W	D	II	II	(32)
.10 Instrumentation and control boards	GE/P	G	W	N/A	II	II	
.11 Concentrator	GE	G	W	C	II	II	
.12 Plant discharge line	GE/P	G	W	D	II	II	(37)
20. Reactor Water Cleanup System (Figure 3.2-11)							
.1 Vessels, filter/demineralizer	GE	G	W	C	II	II	
.2 Heat exchangers	GE	G	W	C	II	II	
.3 Piping, within outermost isolation valves	P	1	C	A	I	I	(12)
.4 Piping, beyond outermost containment isolation valves	P	G	R,W	C	II	II	(12 & 32)
.5 Pumps	GE	G	R	C	II	II	(12 & 32)
.6 Valves, isolation valves Reactor Coolant Pressure Boundary	P/GE	1	C,R	A	I	I	(12)

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TABLE 3.2-1 (Continued)

Principal Component (1)	Scope of Supply (2)	Safety Class (3)	Location (4)	Quality Group Classification (5)	Quality Class (6)	Seismic Category (7)	Comments
.7 Valves, beyond outermost containment isolation valves	GE/P	G	R,W	C	II	II	(12 & 32)
.8 Mechanical modules	GE	G	R,W	C	II	II	(32)
21. Fuel Pool Cooling and Clean-up System (Figure 3.2-12)							(18)
.1 Vessels, filter/demineralizers	P	G	W	C	II	II	
.2 Vessels, other	P	G	W	C	II	II	
.3 Heat exchangers	P	G	R	C	I	I	(32)
.4 Piping	P	G	R,W	C	I-Cooling II-Cleanup	I-Cooling II-Cleanup	(32)
.5 Pumps	P	G	R	C	I	I	(32)
.6 Makeup System (normal)	P	G	R	C	II	II	(18 & 32)
.7 RHR Connection	P	3	R	C	I	I	
.8 Makeup System (emergency)	P	3	R	C	I	I	
.9 Piping, suppression pool to outer isolation valves	P	2	R	B	I	I	
22. Control Room Panels							
.1 Electrical modules with safety function	GE	2	W	N/A	I	I	
.2 Cable, with safety function	GE/P	2	W	N/A	I	I	
23. Local Panels and Racks							
.1 Electrical modules, with safety function	GE	2	R	N/A	I	I	
.2 Cable, with safety function	P	2	R	N/A	I	I	
24. Off-Gas System (Figure 11.3-2)							
.1 Tanks	GE	G	T,W	C	II	II	(16)
.2 Heat exchangers	GE	G	T,W	C	II	II	(16)
.3 Piping	P	G	T,W,O	C	II	II	(16)
.4 Pumps	GE	G	T,W	C	II	II	(16)
.5 Valves	P	G	T,W	C	II	II	(16)

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TABLE 3.2-1 (Continued)

Principal Component (1)	Scope of Supply (2)	Safety Class (3)	Location (4)	Quality Group Classification (5)	Quality Class (6)	Seismic Category (7)	Comments
.6 Mechanical modules, with safety function	GE	G	T,W	C	II	II	(16 & 12)
.7 Pressure vessels	GE	G	T,W	C	II	II	(16)
25. Standby Service Water System (Figure 3.2-13)							
.1 Piping	P	3	P,R,DG,O	C	I	I	
.2 Pumps	GE	3	P	C	I	I	
.3 Pump motors	GE	3	P	N/A	I	I	
.4 Valves	P	3	P,R,DG,O	C	I	I	
.5 Electrical modules, with safety function	P	3	P,R,DG,O,W	N/A	I	I	
.6 Cable, with safety function	P	3	P,R,DG,O,W	N/A	N/A	I	
26. Turbine Plant Service Water (Figure 9.2-1)							
.1 Piping and Valves	P	G	T,R,O,P,W	D	II	II	(32)
.2 Pumps	P	G	P	D	N/A	II	
27. Reactor Building Closed Cooling Water System (Figure 3.2-14)							
.1 Heat Exchangers	P	G	R	D	II	II	(32)
.2 Pumps	P	G	R	D	II	II	(32)
.3 Tanks	P	G	R	D	II	II	(32)
.4 Piping and Valves Inside Containment	P	G	C	C	II	II	(32)
.5 Containment Isolation Valves and Associated Piping	P	2	C,R	B	I	I	
.6 Piping and Valves in Reactor Building	P	G	R	D	II	II	(32)
.7 Piping and Valves Other	P	G	W	D	II	II	(32)

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TABLE 3.2-1 (Continued)

Principal Component (1)	Scope of Supply (2)	Safety Class (3)	Location (4)	Quality Group Classification (5)	Quality Class (6)	Seismic Category (7)	Comments
28. Primary Containment Cooling System (Figure 3.2-15)							
.1 Piping and Valves up to outermost isolation valves, containment purge and exhaust	P	2	C,R	B	I	I	
29. Standby Gas Treatment System (Figure 3.2-16)							
.1 Filter Units	P	2	R	B	I	I	
.2 Fans	P	2	R	B	I	I	
.3 Piping and Valves	P	2	R	B	I	I	
30. Primary Containment Atmospheric Control System (Figure 3.2-17)							
.1 Piping and Valves	P	2	C,R	B	I	I	
.2 Equipment	P	2	R	B	I	I	
31. Other HVAC (Figures 3.2-18 to 20)							
.1 Reactor Building (non-essential)	P	G	R	N/A	II	II	(32)
.2 Reactor Building (essential)	P	3	R	N/A	I	I	
.3 Turbine Building	P	G	G	N/A	II	II	(28)
.4 Radwaste Building	P	G	W	N/A	II	II	(28)
.5 Control Room, Critical Switchgear Area, Cable Spreading Area (non-essential)	P	G	W	N/A	II	II	(32)

TABLE 3.2-1 (Continued)

Principal Component (1)	Scope of Supply (2)	Safety Class (3)	Location (4)	Quality Group Classification (5)	Quality Class (6)	Seismic Category (7)	Comments
.6 Control Room, Critical Switchgear Area, Cable Spreading Area (essential)	P	3	W	N/A	I	I	
.7 Diesel Generator Bldg.	P	3	DG	N/A	I	I	(29)
.8 Standby Service Water Pumphouse	P	3	P	N/A	I	I	(29)
32. Condensate Storage and Transfer (Figure 9.2-9)							
.1 Condensate Storage Tank	P	G	O	C	II	II	(20)
.2 Piping and Valves	P	G	O,T,R,W	D	II	II	(32)
.3 Pumps	P	G	O	D	II	II	
33. Instrument and Sample Lines			See note 12				
34. Fuel Storage Facilities							
.1 Fuel Pool/Dryer Separator Liner	P	3	R	N/A	I	I	
.2 Storage Racks and Supports	GE	3	R	N/A	I	I	
35. Building Cranes							
.1 Reactor Building	P	3	R	N/A	I	I	
.2 Turbine Building	P	G	T	N/A	II	II	
.3 Radwaste Building	P	G	W	N/A	II	II	
.4 Standby Service Water Pumphouse	P	G	P	N/A	I		
.5 Miscellaneous Areas	P	G	P,W,T,S	N/A	II	II	
36. Instrument and Service Air (Figure 9.3-1)							
.1 Piping and Valves	P	G	R,W,T,O	D	II	II	(32)
.2 Compressors	P	G	T	D	II	II	
.3 Vessels	P	G	T	D	II	II	
37. Containment Instrument Air System (Figure 3.2-21)							
.1 Piping and Valves Inside Containment to and including Outboard Isolation Valve	P	2	C,R	B	I	I	
.2 Piping and Valves to Main Steam Relief Valves	P	2	R	B	I	I	
.3 Other Piping and Valves	P	G	R	D	II	II	(32)
.4 Compressors	P	G	R	D	II	II	(32)
.5 Receiver	P	G	R	D	II	II	(32)
.6 Piping and Valves Outside Containment Isolation Valves to and including solenoid pilot valves controlling supply of nitrogen from the Nitrogen Bottles	P	3	R	C	I	I	

TABLE 3.2-1 (Continued)

Principal Component (1)	Scope of Supply (2)	Safety Class (3)	Location (4)	Quality Group Classification (5)	Quality Class (6)	Seismic Category (7)	Comments
38. a. Diesel Generator Systems	(HPCS)						
.1 Day Tanks	P	3	DG	C	I	I	
.2 Piping and Valves, Fuel Oil System	P	3	DG	C	I	I	
.3 Pumps, Fuel Oil System	P	3	DG	C	I	I	
.4 Diesel-Generators	GE	2	DG	N/A (40)	I	I	
.5 Electrical Modules with Safety Functions	GE	2	DG	N/A	I	I	
.6 Cable, with Safety Functions	P	3	DG	N/A	I	I	
.7 Diesel Fuel Storage Tanks	P	3	DG	C	I	I	
.8 Diesel-Generators Service Water Supply	P	3	P	C	I	I	
.9 DSA Diesel Starting Air	P	3	DG	D (34)			
.10 Diesel Intake Exhaust Piping	P	3	DG	D (34)			
38. b. Standby AC Power Systems (Other Than HPCS)							
.1 Storage and Day Tanks	P	3	DG	C	I	I	
.2 Piping and Valves Diesel Oil	P	3	DG	C	I	I	
.3 Pumps Diesel Oil	P	3	DG	C	I	I	
.4 Diesel-Generators	P	2	DG	N/A (40)	I	I	
.5 Electrical Modules with Safety Function	P	3	DG	N/A	I	I	
.6 Diesel Cooling Water Supply	P	3	DG	C	I	I	
.7 Cable with Safety Function	P	3	DG	N/A	I	I	
.8 Diesel Intake/Exhaust Air Piping	P	3	DG	D (34)	I	I	
.9 Diesel Starting Air	P	3	DG	D (34)			
39. Auxiliary AC Power System							
.1 Essential Components	P	2	W,R,DG	N/A	I	I	
.2 Nonessential Components	P	G	W,R,T,O	N/A	II	II	(32)
40. Auxiliary 125/250 Volt DC Power System							
.1 Batteries	P	2	W	N/A	I	I	
.2 Battery Charges	P	3	W	N/A	I	I	
.3 Cables	P	2	W,R	N/A	I	I	
.4 Modules	P	2	W,R	N/A	I	I	

TABLE 3.2-1 (Continued)

Principal Component (1)	Scope of Supply (2)	Safety Class (3)	Location (4)	Quality Group Classification (5)	Quality Class (6)	Seismic Category (7)	Comments
41. 24 Volt DC Power System							
.1 Batteries	P	2	W	N/A	I	I	
.2 Battery Chargers	P	2	W	N/A	I	I	
.3 Cables	P	2	W,R	N/A	I	I	
.4 Modules	P	2	W,R	N/A	I	I	
42. 120 Volt Critical Power Supply System							
.1 Equipment	P	2	W,R	N/A	I	I	
43. Power Conversion System (Figures 3.2-23, 3.2-24)							
.1 Main Steam Piping from outermost isolation valves up to turbine stop valves	P	2	R,T	B	I	I	(19)
.2 Main steam branch piping to 1st valve capable of timely actuation	P	2	T	B	I	I	(19)
.3 Main turbine bypass piping up to bypass valve	P	G	T	D	II	II	
.4 First Valve that is either normally closed or capable of automatic closure in branch piping connected to main steam and turbine bypass piping	P	G	T	B	I	I	(19)
.5 Turbine stop valves, turbine control valves and turbine bypass valves	P	G	T	D	II	II	(9) (36)
.6 Main steam leads from turbine control valve to turbine casing	P	G	T	D	II	II	
.7 Feedwater and condensate system beyond outermost isolation valve	P	G	R,T	D	II	II	(32)
.8 Turbine Generator	P	G	T	D	II	II	
.9 Condenser	P	G	T	D	II	II	
.10 Air Ejection Equipment	P	G	T	D	II	II	
.11 Feedwater Treatment System	P	G	T	D	II	II	
.12 Turbine Bypass System beyond Turbine Bypass Valve	P	G	T	D	II	II	
.13 Turbine Gland Sealing System Components	P	G	T	D	II	II	
.14 Piping, Valves, other	P	G	T	D	II	II	
.15 Equipment, other	P	G	T	D	II	II	

TABLE 3.2-1 (Continued)

Principal Component (1)	Scope of Supply (2)	Safety Class (3)	Location (4)	Quality Group Classification (5)	Quality Class (6)	Seismic Category (7)	Comments
44. Circulating Water and Cooling Tower Makeup Water System(s) (See Figure 10.4-3)							
.1 Piping and Valves	P	G	P	D	II	II	(31)
.2 Pumps	P	G	P	D	II	II	
.3 Cooling Tower Fans	P	G	P	D	II	II	
45. Main Steam Isolation Valves Leakage Control System (Figure 3.2-25)							
.1 Piping and Valves Within Primary Containment and Out Through the Outermost Isolation Valves	P	1	R,C	A	I	I	
.2 Piping and Valves Beyond the Outermost Isolation Valves	P	2	R	B	I	I	
.3 Blowers	P	2	R	N/A	I	I	
46. Containment Vessel	P	2	R	B	I	I	
47. Buildings							
.1 Reactor Building	N/A	2	R	N/A	I	I	
.2 Turbine Building	N/A	G	T	N/A	II	II	(26)
.3 Radwaste Control Building	N/A	3/G	W	N/A	I/II	I/II	(27)
.4 Diesel Generator Building	N/A	3	DG	N/A	I	I	
.5 Spray Ponds and Standby Service Water Pumphouse	N/A	3	P	N/A	I	I	
.6 Service Building	N/A	G	S	N/A	II	II	
.7 Cooling Towers	N/A	G	O	N/A	II	II	
.8 Makeup Water Pumphouse	N/A	G	O	N/A	I	II	(31)
.9 Circulation Water Pumphouse	N/A	G	O	N/A	II	II	
.10 Air Intake Structures No. 1 and No.2	N/A	3	O	N/A	I	I	
48. Containment/Drywell Atmosphere Monitoring System	P	3	R	A	I	I	

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TABLE 3.2-1 (Continued)

Principal Component (1)	Scope of Supply (2)	Safety Class (3)	Location (4)	Quality Group Classification (5)	Quality Class (6)	Seismic Category (7)	Comments
49. Drywell Insulation							
.1 Insulation on Piping which is within the Drywell	P	G	R	N/A	I	I	
50. Instrumentation and Control Equipment							
.1 Safety-Related Instrumentation and Control Systems	P	1	C,R,T DG	A	I	I	(39)

BLANK

Notes:

1. A module is an assembly of interconnected components which constitute an identifiable device or piece of equipment. For example, electric modules include sensors, power supplies, and signal processors; and mechanical modules include turbines, strainers, and orifices.

2. GE - General Electric; P - Plant Owner (Supply System)

3. 1, 2, 3, G - Safety classes defined in 3.2.3.

4. A - Auxiliary building
   C - Part of, or within, Primary containment
   L - Offsite locale
   R - Reactor building
   S - Service building
   T - Turbine building
   M - Any other location
   O - Outdoors onsite
   P - Pump house
   W - Radwaste and Control building
   DG - Diesel Generator building

5. A, B, C, D - USNRC quality groups defined in Regulatory Guide 1.26, Revision 3. The equipment is constructed in accordance with the codes listed in Table 3.2-2, as minimum requirements.

   N/A - Quality Group Classification not applicable to this equipment.

6. I - The equipment meets the quality assurance requirements of 10 CFR Part 50, Appendix B, in accordance with the quality assurance program described in Chapter 17.

   II - The equipment is constructed in accordance with the quality assurance requirements as defined in 3.2.4.

   N/A - Quality Assurance requirements not applicable to this equipment.

7. I - Is constructed in accordance with the seismic requirements of Seismic Category I structures and equipment as described in 3.7, Seismic Design.

   II - The seismic requirements for the safe shutdown earthquake are not applicable to the equipment. The approaches outlined in the Uniform Building Code will be followed where applicable.

Notes (Continued)

N/A - Seismic requirements as described for Seismic Category I and II structures and equipment are not applicable to this structure or equipment.

8. The control rod drive insert and withdraw lines from the drive flange up to and including the first valve on the hydraulic control unit is in Safety Class 2.

9. All cast pressure retaining parts of a size and configuration for which volumetric examination methods are required are examined by radiographic methods by qualified personnel. Ultrasonic examination to equivalent standards may be used as an alternate to radiographic methods. Examination procedures and acceptance standards are at least equivalent to those specified as supplementary types of examination in ANSI B31.1.0 Code, Paragraph 136.4.3.

10. DELETED

11. Not Used.

12. a. Lines 3/4-inch and smaller which are part of the reactor coolant pressure boundary are Quality Group B or higher and Seismic Category I.

    b. All instrument lines which are connected to the reactor coolant pressure boundary and are utilized to actuate and monitor safety systems are Quality Group B from the outer isolation valve or the process shutoff valve (root valve) to the sensing instrumentation.

    c. All instrument lines which are connected to the reactor coolant pressure boundary and are not utilized to actuate and monitor safety systems are Quality Group D from the outer isolation valve or the process shutoff valve (root valve) to the sensing instrument.

Notes (Continued)

d. All other instrument lines:

- through the root valve are of the same classification or higher as the system to which they are attached;
- beyond the root valve, if used to actuate a safety system, are of the same classification as the system to which they are attached;
- beyond the root valve, if not used to actuate a safety system are Quality Group D.

e. All sample lines from the outer isolation valve or the process root valve through the remainder of the sampling system are Quality Group D.

13. The RCIC turbine does not fall within the applicable design codes. To ensure that the turbine is fabricated to the standards commensurate with its safety and performance requirements, General Electric has established specific design requirements for this component which are as follows:

a. All welding is qualified in accordance with Section IX, ASME Boiler and Pressure Vessel Code;

b. All pressure containing castings and fabrications are hydrotested to 1.5 times design pressure;

c. All high pressure castings are radiographed according to:

1. ASTM E-94
2. E-142 maximum feasible volume
3. E-71, 186 or 280 severity level 3;

d. As-cast surfaces are magnetic particle or liquid penetrant tested according to ASME, Section III, Paragraph NB-2575 or NB-2576;

Notes (Continued)

e. Wheel and shaft forgings are ultrasonically tested according to ASTM-A-388;

f. Butt-welds are radiographed according to ASME Section III, IX-3300, and magnetic particle or liquid penetrant tested according to ASME Section III, IX-3500, or IX-3600;

g. Notification is made on major repairs, and records maintained thereof;

h. Record system and traceability according to ASME Section III, NA-4900;

i. Control and identification according to ASME Section III, NA-4400;

j. Procedures conform to ASME Section III, NA-4400;

k. Inspection personnel are qualified according to ASME Section III, Appendix IV, Paragraph IX-400.

14. The hydraulic control unit (HCU) is a General Electric factory assembled engineered module of valves, tubing, piping, and stored water which controls a single control rod drive by the application of precisely timed sequences of pressure and flows to accomplish slow insertion or withdrawal of the control rods for power control, and rapid insertion for reactor scram.

Although the hydraulic control unit, as a unit, is field installed and connected to process piping, many of its internal parts differ markedly from process piping components because of the more complex functions they must provide. Thus, although the codes and standards invoked by Quality Groups A, B, C, D pressure integrity quality levels clearly apply to all levels to the interfaces between the HCU and the connecting conventional piping components (e.g., pipe nipples, fittings, simple hand valves, etc.), it is considered that they do not apply to the specialty parts (e.g., solenoid valves, pneumatic components, and instruments).

Notes (Continued)

The design and construction specifications for the HCU do invoke such codes and standards as can be reasonably applied to individual parts in developing required quality levels, but these codes and standards are supplemented with additional requirements for these parts and for the remaining parts and details. For example, (a) all welds are LP inspected, (b) all socket welds are inspected for gap between pipe and socket bottom, (c) all welding is performed by qualified welders, (d) all work is done per written procedures. Quality Group D is generally applicable because the codes and standards invoked by that group contain clauses which permit the use of manufacturer's standards and proven design techniques which are not explicitly defined within the codes of Quality Group A, B, or C. This is supplemented by the QC techniques described above.

15. Only equipment associated with a safety action (e.g., isolation) need conform to a safety function.

16. Chapter 15 conservatively analyzes a postulated simultaneous failure of all the radwaste tanks in the radwaste building. The analysis assumes that one percent of the iodine is released to the atmosphere and, at the time of failure, all tanks are filled to capacity (this condition is not normally expected). The analysis evaluates the possible control room, site boundary, and low population zone exposures to the whole body and thyroid. The results of the analysis indicate, in the light of the requirements of Regulatory Guide 1.29, Revision 1, that the radwaste system is properly classified and changes are not required.

17. DELETED

18. The Seismic Category I FPC system normally receives makeup from the Seismic Category II condensate storage tank. Should this normal supply be unavailable, makeup is available from the Seismic Categroy I standby service water system. Likewise, the normal source of cooling water to the FPC heat exchangers is from the Seismic Category II RCC system. When the RCC is unavailable,

Notes (Continued)

the standby service water system is available. In addition, the RHR system is also available as the supplementary source of cooling by means of removable spoolpieces during cold shutdown under core off-load conditions. The above complies with Regulatory Guides 1.26, Revision 3 and 1.29, Revision 1.

The cleanup portion is automatically isolated from the cooling portion of the system by Seismic Category I valves on low fuel pool level (see 9.1.3).

19. The main steam line extending from the outermost containment isolation valve up to but not including the turbine main steam stop valve, and connected piping of 2-1/2 inches or larger nominal pipe size up to and including the first isolation valve, is designed by use of an appropriate seismic system analysis for the SSE and OBE. The power conversion system structures are constructed in accordance with applicable codes for steam power plants. The turbine building, interacting with main steam lines and branch lines, is designed as a modified non-Category I seismic structure as described in 3.8.4.1.3.

20. The condensate storage tanks are designed, fabricated, and tested to meet ASME Code, Section III, Subsection ND-3800. In addition, the specification for this tank requires 100 percent surface examination of the side wall to bottom joint, and 100 percent volumetric examination of the side wall weld joints.

21. Not used.

22. These lines meet the requirements of Quality Group B except that hydrostatic testing of the containment spray piping is not required.

23. The RCIC turbine exhaust line from the isolation valve to the suppression pool meets all the requirements of Quality Group B except that hydrostatic testing of this portion of piping is not required.

24. Equipment, piping, and valves which are part of the radwaste system but not used for processing radioactive fluids are designed to Quality Group D standards.

Notes (Continued)

25. Not used.

26. Portions of the turbine building that support or interact with main steam piping are designed to Seismic Category I.

27. Those portions of the radwaste and control building that house systems or components necessary for safe shutdown of the reactor are designed to Quality Class I and Seismic Category I requirements. Those portions of the radwaste building housing equipment containing significant quantities of radioactive material are designed to Seismic Category I requirements.

28. Lavatory exhaust systems are designed to Quality Assurance Class G.

29. Nonessential equipment and components are designed to Seismic Category II and Quality Assurance Class II.

30. The high pressure core spray suction piping from the condensate storage tank provides the initial source of makeup water to the high pressure core spray system for safety injection. Consequently, this piping has been upgraded by full volumetric examination of every weld.

31. The makeup water pumphouse is designed to withstand the design basis tornado. The design also considers the possible effects of tornado generated missiles. The tower makeup water piping, valves, and cabling located underground are provided with adequate earth cover to be resistant to tornado generated missiles or are protected by tornado resistant structures.

32. Nonessential piping systems, HVAC, cable trays, and system components in the reactor building, primary containment, the control building, diesel generator building, the standby service water pumphouses, and the radwaste building corridor are supported as Seismic Category I systems regardless of service. All hangers and supports in these systems are fabricated and installed in accordance with Quality Class I requirements.

TABLE 3.2-1 (Continued)

Notes (Continued)

33. Although the refueling bellows are designed to withstand the SSE without rupture, they may be plastically deformed.

34. All inspection records shall be maintained for the life of the plant.

35. This piping has been voluntarily upgraded from Safety Class 3 to Safety Class 2 and from Quality Group Classification C to Quality Group Classification B.

36. The following qualification is met with respect to the certification requirements:

    a. The manufacturer of the turbine stop valves, turbine governor valves, turbine bypass valves, and mainsteam leads from turbine control valve to turbine casting utilized quality control procedures.

    b. A certification has been obtained from the manufacturer of these valves and steam leads that the quality control program so defined has been accomplished.

37. Up to and including the last stop valve, this line meets requirements of Quality Group C.

38. Equipment, piping, and valves which are part of the radwaste solids handling system are designed to Quality Group D standards.

39. Equipment classification is commensurate with the quality group classification of the associated piping.

TABLE 3.2-2

CODE GROUP DESIGNATIONS - INDUSTRY CODES AND STANDARDS

FOR MECHANICAL COMPONENTS - NOTES, (a, d)

ASME Section III Code
Applicable Subsection

Quality Group Classification	Section III Code Classes	Vessels and Heat Exchangers	Pumps, Valves and Piping	Metal Containment Components	Storage Tanks 0-15	Storage Tanks Atmospheric
A	1	NA & NB TEMA C	NA & NB Note (b)	-	-	-
B	2 or MC	NA & NC TEMA C	NA & NC Note (b)	- NA & NE	NA & NC API-620 & Note (g)	NA & NC or D100, B96.1, or API-620 & Note (h)
C	3	NA & ND TEMA C	NA & ND Note (b)	- -	NA & ND or API-620 & Note (f)	NA & ND or D100, B96.1, or API-650 & Note (f)
D		ASME Section VIII Div. 1 TEMA C	Piping & Valves B31.1.0(i) Pumps Note (c)	-	API-620 or equivalent (e)	API-650 AWWA-D100 ANSI B96.1 or equivalent

Notes:

(a) With options and additions as necessary for service conditions and environmental requirements.

(b) For pumps classified A, B, or C; applicable subsections NB, NC, or ND; respectively, in ASME Code, Section III is used as a guide in calculating the thickness of pressure-retaining portions of the pump and in sizing cover bolting.

(c) For pumps classified Group D, and operating above 150 psig and 212°F Section VIII, Division 1 is used as a guide in calculating the wall thickness for pressure-retaining parts and in sizing the cover bolting.

(d) Components of the reactor coolant pressure boundary meet the requirements of 10CRF50, Section 50.55a, "Codes and Standards", except as shown in Table 5.2-5 and discussed in 5.2.1.1. All components satisfy codes and addenda in effect at the time of component order or LATER.

(e) Tanks are designed to meet the intent of API, AWWA, and/or ANSI 96.1 Standards as applicable.

(f) Nondestructive tests examination requirements per ASME Code, Section VIII, Division 1.

(g) 100% volumetric examination of the sidewall and roof weld joints for plates over 3/16" thick and 100% surface examination of weld joints for plates 3/16" thick or less of the sidewall to bottom and sidewall to roof joints. These examination requirements are performed in accordance with the rules of ASME Section III, Class 2.

(h) 100% volumetric examination of the sidewall weld joints for plates over 3/16" thick and 100% surface examination sidewall to bottom joints. These examination requirements are performed in accordance with the rules of ASME Code, Section III, Class 2.

(i) Welds not totally conforming to B31.1 are evaluated and dispositioned on a case-by-case basis considering (1) the function of the system, (2) the risk of failure, and (3) the consequences of failure for safety and plant availability.

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3.3 WIND AND TORNADO LOADINGS

3.3.1 WIND LOADINGS

3.3.1.1 Design Wind Velocity

All structures are designed to withstand a basic wind velocity (fastest mile), including gusts, of 100 mph at an elevation of 30 feet above the site grade. This wind velocity exceeds the basic wind velocity having a statistically derived probable period of recurrence of 100-years in this geographical area, as specified in the American Society of Civil Engineers Task Committee Report, "Wind Forces on Structures" (1).

The Hanford region experiences high wind speeds due to squall lines, frontal passages, strong pressure gradients and thunderstorms. The Hanford Reservation has experienced only one recorded tornado (June 1948) and has not been known to be affected by typhoons. No complete statistics are readily available which present frequency of occurrence of high winds produced or accompanied by a particular meteorological event. However, the highest winds produced by any cause are tabulated for the Hanford Meteorological Station (HMS) in Tables 2.3-5 and 2.3-6. Figure 2.3-4 indicates the return probability of any peak wind gust, again due to any cause. The 100 mph design speed given in 3.3.1.1 is conservative for the WNP-2 site for the following reasons:

a. Peak wind gusts measured at the 50-foot HMS tower level, as reported in Tables 2.3-5 and 2.3-6, have never exceeded 80 mph.

b. The statistically derived 100-year return period peak gust (Figure 2.3-4) at an elevation of 50-feet is 86 mph based on HMS records.

Recurrence intervals, data sources and the history of occurrence of high winds, hurricanes and tornadoes in the vicinity of the site are discussed in detail in 2.3.2.2.

3.3.1.2 Determination of Applied Forces

The basic wind velocity of 100 mph is applied in accordance with Table 1(a) of reference 3.3-1, including the variation in wind velocity with height and drag coefficients. Considering a gust factor of 1.0 and drag coefficient of 1.3 and V as the specific wind velocity at a particular height above grade given in Table 1(a) of reference 3.3-1, the total combined average wind pressure p is given by

$$p = 1.3 \times 0.002558 \, V^2$$

For example, at a height of 30 feet with V = 100 mph, p = 33 psf.

The above chosen gust factor is adequate for the WNP-2 site for the following reasons:

> In reference 3.3-1, the wind gust factor is defined as gust velocity divided by the velocity of the fastest mile of wind. Whereas the gust factor can not be less than 1.0, it is implied in 3.3.1.1 that the factor is unity since the 100 mph fastest mile wind accounts for wind gusts. A factor greater than 1.0 is not warranted at WNP-2 since the statistically derived peak wind gust considered in 3.3.1.1 is less than the assumed site basic wind velocity. Additional considerations regarding gust factors and fastest mile velocities are presented in 2.3.1.2.1.4.

The following total combined wind pressures are used in the design of structures:

Height Above Grade	Wind Speed, V (mph) *	Wind Pressure, p (psf)
less than 50 ft.	100	33
50 to 149 ft.	120	48
150 to 400 ft.	140	65

*Table 1 (a), reference 3.3-1.

3.5 MISSILE PROTECTION

The objectives of missile protection design are to ensure that the plant can be brought to and kept in a safe shutdown mode and to prevent off-site radiological consequences assuming an additional single component failure.

Design against generated missiles involves an initial selection process to define the postulated missiles; then a damage assessment to evaluate the effects of the postulated missiles, and finally, if necessary to ensure safe shutdown, the provision of barriers or physical modifications of systems and components to preclude damage.

Structures housing systems and components essential for safe shutdown are designed to withstand externally generated missiles so that essential systems and components are not damaged by such missiles or by the secondary effects of such missiles.

The implementation of criteria for protection of safety-related systems from the effects of internally-generated missiles, as defined herein, is based on an evaluation of systems, equipment, and components which had been physically arranged as of mid-1976. Upon substantial completion of the physical arrangement of all systems, equipment and components, and upon subsequent re-evaluation of the availability of safe shutdown systems under the postulated accident conditions, an updated description of the protection provided against internally generated missiles will be furnished by ammendment to this FSAR.

3.5.1 MISSILE SELECTION AND DESCRIPTIONS

3.5.1.1 Internally Generated Missiles (Outside Containment)

3.5.1.1.1 Systems Available for Safe Shutdown

Systems available outside containment to facilitate safe shutdown include: HPCS, LPCS, RHR, SSW, RCIC, CRD and the feedwater system. These systems and their function are described in 3.6.1.18. The instrumentation for these systems is described in 7.3.

Figures 3.5-1 through 15 illustrate the location of these systems. Information pertaining to applicable seismic category, quality group classification and FSAR reference sections is provided in Table 3.5-1.

3.5.1.1.2 Ability of Structures, Systems, and Components to Withstand Missile Effects

Postulated missiles are determined as discussed in 3.5.1.1.3.

The design objectives defined above are implemented through the separation and redundancy of safety related systems to ensure that, in the event of a postulated accident involving a missile and an additional single failure, that plant will maintain function of sufficient systems essential to ensure a safe shutdown. The methodology used to evaluate and to ensure the adequacy of the redundancy and separation of plant safety systems subject to postulated internal missiles is as follows:

a. Based on the missile location and orientation, the target areas are predicted. Trajectories are selected to encompass the most adverse conditions. The essential systems within that region are assumed damaged and not available for a safe shutdown.

b. Determine the systems which are available after the worst postulated missile accident and an additional single failure to warn, start, operate, and control the essential systems. An evaluation is then made to determine whether these remaining systems are sufficient to achieve safe reactor shutdown.

c. Conformance with a and b involves the examination of each postulated missile for potential damage. Deleterious missile events (i.e., penetration of structures), basically depend on mass, velocity, kinetic energy and frontal area of the missile. These relationships for the several different types of missile generation are listed below:

(1) Piston Type Missiles

The velocity of a piston-type missile is calculated by assuming that the work done will be converted into kinetic energy of the missile with no losses of energy due to friction or air resistance.

Work is the integral of force times displacement, while the kinetic energy of the missile is one half the product of the missile mass times the square of the missile velocity. Assuming the applied force constant (PA_o) equate the kinetic energy to the work done (Reference 3.5-1).

Subsequently, the missile velocity is obtained by the expression:

$$V = \left[\frac{2\ PA_oL}{m}\right]^{1/2} \qquad \text{(Reference 3.5.1)}$$

where:

V = the initial velocity at the end of a piston stroke (ft./sec.)

P = pressure of the fluid (psi)

A_o = crossectional area of the piston (in^2)

L = length of the strike in ft.

m = mass of missile ($lb\text{-}sec^2/ft$)

(2) Jet Propelled Missiles

Postulated jet-propelled missiles propelled by fluid escaping from a pressurized system in which there is essentially no lateral containment of the fluid. The escaping jet will not only impinge on the missile, but will also flow around and past the missile.

The velocity of this type of postulated missile is estimated by (Reference 3.5.-1):

$$\left(1 - \frac{V}{V_f}\right) - \text{Log}_e\left(1 - \frac{V}{V_f}\right) = K_1 - \frac{K_2}{N_o + X\ \text{Tan}\ B}$$

where:

$$K_1 = \left(1 - \frac{V_o}{V_f}\right) - \text{Log}_e \left(1 - \frac{V_o}{V_f}\right) + \frac{K_2}{N_o}$$

$$K_2 = \frac{A_o A_m P_f}{m \pi \text{ (Tan B)}}$$

V = missile velocity a distance X (fps)

V_f = jet velocity, (fps)

N_o = radius of throat (ft)

P_f = density of the Jet fluid (lb-sec^2/ft^4)

X = distance travelled (ft)

B = angle of jet expansion, degrees from normal

V_o = initial velocity of missiles

A_o = throat area (ft^2)

A_m = cross sectional area of missile (ft^2)

m = mass of missile (lb-sec^2/ft)

(3) Stored Strain Energy Missiles

Stored strain energy missiles are assumed to convert all the strain energy at which they fall into kinetic energy. The velocity is calculated from the following formula (Reference 3.5-1):

$$V = \left(\frac{g}{EW}\right)^{1/2} .S$$

where:

V = missile velocity (ft/sec)

E = modulus of elasticity (lb/ft^2)

W = specific weight of missile (lb/ft^3)

S = ultimate stress in the missile before failure (lb/ft^2)

g = acceleration of gravity (ft/sec^2)

(4) Rotating Machinery

A variety of missiles from rotating machinery can be treated by considering each as a rotating block. Because it is part of a rotating structure, the block is considered to be initially rotating about its axis of revolution at a speed, ω, radians per second. The kinetic energy of the block is given by (Reference 3.5-4):

$$KE = 1/2 \left[Rcg^2 + K^2 \right] \left(\frac{w}{g} \right) \omega^2, \quad ft - \#$$

where:

Rcg is the radius to the center of gravity (CG) of the rotating block, measured from the initial axis of rotation in the machinery, ft.

K is the radius of gyration of the rotating block, about the CG axis of the rotating block.

w is the block weight, lb.

g is acceleration of gravity, ft/sec^2

ω is the angular velocity, rad/sec.

In this expression the Rcg term gives the kinetic energy due to translation, while the K term gives the kinetic energy due to rotation of the block about its cg axis.

Missile velocity relationships in conjunction with applied penetration equations such as the Petry (Reference 3.5-2), Stanford (Reference 3.5-3), Modified National Defense Research Committee (Reference 3.5-14) and the Ballistic Research Laboratory (Reference 3.5-1) equations are used to conservatively predict the damage incurred in a missile event. The penetration analysis and barrier design is described in 3.5.3.

When the separation and redundancy of the systems is not adequate, or when a redundant system is not available, the following measures are taken to ensure safe shutdown:

a. The component is investigated to determine if its inherent design features can plausibly eliminate the component as a postulated credible missile.

b. The orientation of the postulated missile is changed so that systems necessary for safe shutdown are not damaged.

c. Missile ejection is prevented.

d. Missile barriers are provided.

e. It is shown that the component will not be damaged by the postulated missile.

3.5.1.1.3 Missile Selection

Components outside primary containment associated with high energy piping systems defined in 3.6.1.1 which are considered as candidates for postulated missiles are as follows:

a. Valve bonnets

b. Valve stems

c. Thermowells

d. Bolts

e. Pressure relief valve parts

f. HVAC fans

Other candidates for postulated missiles include components of rotating equipment such as motors, shafts and impellers.

These are discussed in detail below.

3.5.1.1.3.1 Valves

The inherent design of valves postulated as credible missiles affecting safe shutdown have been investigated to determine their potential to generate missiles.

These valves have been found not to be credible sources of missiles because of the reserve strength in their bonnet to valve connections. As a further precaution, the valves in most cases are oriented not to affect safety related equipment.

Valve stems, which were evaluated as candidates for potential missiles, are provided with backseats or flared interior ends. These provisions act as interferences which effectively eliminate the possibility of valve stem ejection even if the stem threads fail, since the backseats or flared ends would not penetrate the bonnets. Additional interferences for the stems are encountered with some air and motor operated valves. The operators of air and motor operated valves sit on top of the valve and thereby provide additional interference for the missile. Therefore, valve stems have been found not to be credible sources of missiles.

Pressure retaining parts of valves are designed in accordance with the ASME Code Section III which provides for adherence to conservative limitations on design stresses, or by the ANSl 31.1 Code which has similar restrictions and limitations.

Bolted valve bonnets are not postulated as credible missiles since the simultaneous failure of most retaining bolts is necessary to initiate such an event.

Screwed on valve bonnets and retaining ring type valve bonnets are not postulated as credible missiles because of their substantial reserve strength in the bonnet-to-valve body connection.

3.5.1.1.3.2 Thermowells and Sample Probes

Thermowells and sample probes have been examined in accordance with investigative procedures discussed in 3.5.1.1.2 and were found to present no potential hazards as postulated missiles affecting safe shutdown.

3.5.1.1.3.3 Bolts

Failure of bolts is unlikely because of the restrictions on their allowable stresses which are monitored by torquing procedures. The ASME Code and the ANSI Code generally limit the allowable stress in these bolts from 20% to 30% of yield. Single bolts are postulated as internally generated missiles. The effects of these missiles have been evaluated in accordance with the procedures discussed in 3.5.1.1.2 and were found to present no potential hazards as postulated missiles affecting safe shutdown.

3.5.1.1.3.4 High Speed Rotating Equipment

Rotating equipment, such as components of pumps and motors, is shielded by means of their individual housings and by locating equipment in separate rooms. These postulated missiles do not present potential hazards.

Fans and parts thereof have been investigated to determine their potential of generating missiles that may adversely affect the safe shutdown of the plant. Where necessary, barriers are provided to protect systems necessary for plant safe shutdown.

3.5.1.2 Internally Generated Missiles (Inside Containment)

3.5.1.2.1 Systems Available for Safe Shutdown

Figures 3.5-16 through 32 describe the mechanical and instrumentation locations of systems available for a safe shutdown. Each system (LPCS, HPCS, RHR, ADS, CRD and Primary Containment Vessel) is color coded to specify the location of structures, systems or components. In addition, the reactor protection system and isolation valves inside containment are available for safe shutdown of the plant and to prevent offsite radiological consequences. Information pertaining to applicable seismic category, quality group classification and reference sections in the FSAR, where these systems are described, is provided in Table 3.5-2.

3.5.1.2.2 Ability of Structures, Systems and Components to Withstand Missile Effects

Postulated missiles are determined as discussed in 3.5.1.2.3.

The most effective means to meet the design objectives of 3.5 is by separation and redundancy of essential systems. The formulae and techniques used to evaluate the protection provided by plant layout is conducted in the same manner as described in 3.5.1.1.2.

An example of mechanical and instrumentation lines which constitute systems available for a safe shutdown in the HPCS system. The representation of the instrumentation lines necessary to actuate the HPCS system is given in Figures 3.5-29 and 30. Sets A and B are located at opposite sides of the reactor pressure vessel. It has been determined that due to this separation, a postulated missile will not damage both sets of lines. Functions of the instrumentation lines inside the primary containment necessary to actuate the HPCS System is thereby maintained. A discussion of the instrumentation functions is given in Chapter 7.

The mechanical redundancy and physical separation of the HPCS system with the LPCS/ADS systems is illustrated in Figures 3.5-17, 18, 19 and 20. The possibility of one missile incapacitating both sets of systems is not considered credible.

3.5.1.2.3 Missile Selection

Components inside primary containment associated with high energy piping systems which are considered as candidates for postulated missiles are as follows:

a. Valve bonnets

b. Valve stems

c. Thermowells and sample probes

d. Valve bonnet retaining bolts

e. Pressure relief valve parts

In addition, the following components of rotating equipment have been considered as candidates for postulated missiles:

f. Recirculation motor-pump shaft

g. Recirculation pump motor

h. Recirculation pump impeller

i. HVAC fans

These are discussed in detail below.

3.5.1.2.3.1 Valves

Valves have been investigated as discussed in 3.5.1.1.3.1, and it was found that the ability to shut down the plant is not affected.

3.5.1.2.3.2 Thermowells and Sample Probes

Thermowells and sample probes have been examined as discussed in 3.5.1.1.3.2, and it was found that the ability to shutdown the plant is not affected.

3.5.1.2.3.3 Bolts

Bolt failures are unlikely to occur for reasons discussed in 3.5.1.1.3.3, and it was found that the ability to shut down the plant is not affected.

3.5.1.2.3.4 High Speed Rotating Equipment

a. Recirculation Pump and Motor

The most substantial piece of NSSS rotating machinery is the recirculation pump and motor. This potential missile source is covered in detail in reference 3.5-4.

It is concluded in reference 3.5-4 that destructive pump overspeed is highly improbable. If it occurred it could result in failure of certain pump and motor components having the potential to become missiles. A careful examination of the pump and motor structure shows that rotor or shaft failure will not result in ejection of motor-generated missiles, and impeller missiles cannot penetrate the pump case. Reference 3.5-4 concludes that in the unlikely event of impeller failure resulting in ejection of missiles through ruptured pipe, penetration of containment by missiles fragments is highly improbable. Evaluation of the effects on safety-related systems of impeller fragments which might be ejected from openings in ruptured pipe is not evaluated because of the extreme improbability of this event, and because the effects would not be more severe than the assumed consequences of jet impingement due to pipe breaks inside containment is discussed in 3.6.

b. Fans as Potential Missiles

The fans inside primary containment are designed such that the casing will restrain any possible missile. Therefore, fans and parts thereof are not considered as possible sources of missiles.

3.5.1.2.4 Falling Objects

Structural elements, equipment, and components inside containment which could be considered as potential falling objects are supported to satisfy Seismic Category I requirements. The only exceptions to this are the monorail hoists inside containment which are not analyzed for Seismic I loading conditions, but are chained in place while not in use to ensure that they do not become falling objects which could damage safety systems. On this basis, falling objects are not postulated in the methodology described in 3.5.1.1.2. The physical separation and redundancy of safe shutdown systems as described in 3.5.1.2.2 also assures that falling objects do not present a threat to these systems.

3.5.1.2.5 Secondary Missiles Generated by Postulated Primary Missiles

The design objectives for providing protection against postulated primary missiles inside primary containment are implemented through physical separation and redundancy of safety systems, as discussed in 3.5.1.2.2.

The potential for the failure of safety systems inside primary containment caused by secondary missiles generated by postulated primary missiles impinging on a component or structure inside primary containment depends on the mass, velocity, trajectory, and other physical characteristics of the postulated secondary missile. These in turn depend on similar parameters which define the postulated primary missile, as well as the assumed failure mechanism which results in secondary missile formation. The conclusions to be drawn from any such analysis would be questionable, in view of the many assumptions involved. For this reason, the methodology used in evaluating the effects of primary missiles, as described in 3.5.1.1.2, is not appropriate for secondary missiles. The plant design features which provide protection against primary missiles and assurance that primary missile formation will not occur, serve to eliminate or at least minimize the potential for failure of safety systems caused by secondary missiles. These design features include the following:

a. Physical separation of redundant systems.

b. Reorientation of postulated primary missiles.

c. Prevention of primary missile ejection.

d. Provision of missile barriers.

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3.5.1.3 Turbine Missiles

Regulatory Guide 1.115 (Reference 3.5-5), initially issued in 1976, required applicants for construction permits and operating licenses to demonstrate an acceptably low probability of damage to essential systems from postulated turbine missiles, either through appropriate placement and orientation of the turbine, or by use of structural barriers. Subsequently, a study was performed by Burns and Roe, Incorporated for the WNP-2 plant which concluded that the radiation shielding walls on the operating floor in the turbine building, and the reinforced concrete walls housing essential systems in the reactor building and control building, provide adequate protection against postulated turbine missiles.

In December 1979, the Washington Public Power Supply System (Reference 3.5-24) and other utilities were advised by the NRC of a potential problem concerning cracking in low pressure turbine discs manufactured by Westinghouse. In February 1980, a disc on the Westinghouse low pressure turbine at the Yankee Rowe plant failed, and although none of the disc fragments penetrated the turbine shell, there was extensive damage to the turbine. Investigations by Westinghouse at various operating plants has indicated the observed cracking in Westinghouse turbines can be attributed to a stress corrosion mechanism.

To account for this potential failure mechanism in turbine missile probability calculations, Westinghouse developed a methodology for estimating the probabilities of disc rupture as a function of crack initiation, crack propogation with time, and critical crack depth (Reference 3.5-21). Using this methodology, Westinghouse provided a probability study, giving missile generation probabilities for each low pressure turbine disc on WNP-2, based on actual material properties of the disc, as a function of turbine operating time between inservice inspections. Probabilities are also calculated for missile formation due to fatigue failure, but this failure mode is shown to be much less likely than failure due to stress corrosion cracking.

Using the missile generation probabilities (Reference 3.5-23) and missile weights, velocities, and geometries (Reference 3.5-22) provided by Westinghouse, missile strike and damage probabilities for safety-related targets in the WNP-2 plant were calculated. It is concluded that the probability of damage to safety-related systems is acceptably low, due to: (a) the protection provided by reinforced concrete structural barriers, and (b) periodic inspections of turbine discs during refueling outages to detect and monitor cracks, with associated corrective action as required.

$$V_r = (V_i^2 - V_p^2)^{1/2}$$

where:

V_r = residual missile velocity after perforation

V_i = incident missile velocity

V_p = incident missile velocity required to just perforate the barrier, calculated using the modified NDRC formula

Any turbine missile striking the northwest corner of the reactor building refueling floor is assumed to land directly in or bounce into the spent fuel pool. This is unacceptable from the standpoint of damage to stored fuel and resulting radiologic release, so P_3 is assumed to be 1 for any such strike.

The overall damage probability for M postulated missiles and N target elements is then calculated by:

$$P4 = P1 \cdot P2 \cdot P3 = \sum_{i=1}^{N} \sum_{j=1}^{M} P1_j \cdot P2_{ij} \cdot P3_{ij}$$

This computation is carried out by computer, and the results, i.e., damage probability as a function of inservice inspection interval (quantified in terms of turbine operating time), are shown on Figure 3.5-53. Inservice inspections for crack detection and monitoring of crack propogation will be performed during refueling outages at a frequency corresponding to an acceptably low turbine missile damage probability or, alternatively, at a frequency corresponding to an upper limit on postulated crack depth, using fracture mechanics methodology to postulate crack growth rates and critical crack size. Inspection frequency will be established following NRC review of Westinghouse topical reports on this matter, prepared on behalf of the Westinghouse Turbine Owners' Group.

3.5.1.3.5 Turbine Overspeed Protection System

A single failure in the overspeed sensing and turbine trip systems will not prevent overspeed protection from operating. The turbine generator is equipped with a digital electrohydraulic control system. The turbine control system includes steam admission valves, emergency stop valves, crossover intercept valves, and initial pressure regulator. Furher description of existing systems are available in 10.2.

3.5.1.3.6 Inspection and Testing

The inspection and testing requirements for the turbine generator system are discussed in 10.2.2.

3.5.1.3.7 Turbine Characteristics

For information characterizing the Westinghouse turbines used in WNP-2, refer to Westinghouse Report covering the effects of a high pressure turbine rotor fracture and low pressure turbine disc fractures at designed overspeed, (Reference 3.5-6) and 10.2.3. Therein, the low pressure disc materials, manufacturing processes and operating conditions are stated.

3.5.1.4 Missiles Generated by Natural Phenomena

The consideration of potential missiles injected or suspended in a tornado wind stream is based on "Tornado Design Considerations for Nuclear Power Plants" by Bates and Swanson, presented at the annual meeting of the American Nuclear Society, November 1967 (Reference 3.5-8) and on "Tornado Protection Provided for the Spent Fuel Pool" by D. R. Miller and W.A. Williams (Reference 3.5-12).

All Seismic Category I and safety-related structures and components are designed to include the effects of missiles generated by the design basis tornado described in 3.3.2. Missiles are categorized as either external or internal missiles. External missiles are materials and/or items usually found outside and in the immediate vicinity of the buildings, whereas internal missiles are materials and/or items found inside the buildings. The missiles listed below encompass the range of potential missiles expected to be found in the vicinity of the site. Description, properties and impact velocities of these design basis tornado generated external missiles are also tabulated below. Concrete penetration depths are tabulated in Table 3.5-5. The basis for evaluating missile penetration is discussed in 3.5.3. The protection provided for external and internal missiles is discussed in 3.5.1.4.1 and 3.5.1.4.2, respectively.

The plant structures, systems, equipment and components that are required to bring the plant to a safe shutdown condition, or whose failure could lead to off-site radiological consequences under accident conditions, are protected from external (outdoor) missiles by barrier structures or redundant systems as follows:

a. The exposed exterior walls of safety related structures are designed to protect internal structures, systems and components. Structures with such exposed exterior walls are described in 3.8.4 and shown on figures referred to therein. Figure 3.5-36 illustrates exterior walls subjected to tornado-generated missile impact.

b. The standby service water (SSW) pipelines and electrical lines connecting the SSW pumphouses and the reactor and diesel generator buildings are located below grade and are protected from external missiles by sufficient Quality Class I earth cover of high relative density.

c. The two standby service water (SSW) pumphouses and the valve boxes along the cooling tower makeup water lines are tornado-hardened.

d. As described in 3.8.4.1.5 and 3.3.2.3, the spray ponds (except spray headers) are below grade and are protected from external missiles by sufficient Quality Class I earth backfill of high relative density. The spray headers are not required to be protected from tornado missiles.

e. The critical electrical trays in the corridor between the turbine generator building and the radwaste and control building are protected from possible missiles by the cantilever wall on column line 17 (Figure 3.5-37) and the additional 10'-0" high cantilever barrier wall immediately east of it. The 10'-0" high barrier wall provides missile protection for the door at elevation 441'-0" on column line 17. Although the trays are above the door level and do not require missile protection provided by the 10'-0" high wall, the protection is provided, as shown on Figure 3.5-37.

f. All openings for heating, ventilation, and air conditioning system fresh air intakes (FAI) and exhausts (EXH), in buildings housing safety-related equipment, are protected against externally generated missiles by means of shield walls as indicated in Table 3.5-6. Examples are the louvered openings above the floor elevation 572'-0" in the north and south walls of the reactor building. These openings are protected by a labyrinth of missile shield walls immediately inside the opening.

3.5.3 BARRIER DESIGN PROCEDURES

The barrier design objectives emphasize missile containment and structural integrity without secondary missile generation.

3.5.3.1 Concrete Barriers

Concrete missile barriers are designed in accordance with the modified Petry equation (Reference 3.5-2). In all cases, except for barriers exposed to turbine missiles, a concrete thickness of twice the penetration thickness determined for an infinitely thick slab is provided to prevent perforation, spalling, or scabbing. For discussion of turbine generated missiles see 3.5.1.3.

3.5.3.2 Steel Barriers

The Ballistic Research Laboratories Formula (Reference 3.5-1) is used to determine penetration depths of missiles into steel barriers.

The overall response of barriers subject to impact are investigated by the use of general energy equations given in "Introduction to Structural Dynamics," J. M. Biggs (Reference 3.5-9). Upon determination of penetration depth and duration of impact, an effective dynamic force is computed. The additional calculation of the natural period of the target structure and the selection of a ductility ratio facilitates the determination of the required structural resistance. In this manner, missile impact is translated to an equivalent static load in an effort to quantify bending moments and shear. The detailed method used for predicting the overall response of missile barriers, including the forcing function method of determining ductility in structural elements and the basis for the ductility ratios used in the calculations, is provided in Appendix C of the report "Protection Against Pipe Breaks Outside Containment" (Reference 3.5-13) that was presented to and approved by the NRC.

3.5.3.3 Earth Barriers

When the protective barrier is of earthen origin, the soil penetration studies are based on alternate techniques. Buried safety-related piping and electrical systems required for a safe shutdown are ensured adequate protection from tornado generated missiles. Analysis of potential damage is performed using the "Tornado Design Considerations for Nuclear Power Plants" by Bates and Swanson, 1967 (Reference 3.5-8). The analysis procedure neglects soil interlocking under a suddenly applied load and ignores lateral soil resistance. A five-foot embedment depth is calculated to be acceptable to ensure pipe integrity.

3.5.3.4 Applications

Examples of barrier design are as follows:

Steel covers for manholes containing cabling for safety-related equipment required for safe shutdown are designed to withstand tornado generated missile impact and associated wind pressure. These 2'-9" circular steel plates are designed using conventional elastic analysis and design methods for determining stress and strain. The design adopted uses two 1-1/8-inch plates of ASTM A 514 steel plate to prevent penetration and blowout.

The reactor building railroad airlock exterior doors and the standby service water pumphouse exterior equipment doors are designed and certified by the manufacturer to withstand the effects of tornado generated exterior missiles as described in 3.5.1.4.

All other doors in Seismic Category I and safety-related structures are not designed to withstand the effects of the missiles described in 3.5.1. These doors are backed up, wherever missile protection is required, with reinforced concrete walls forming a labyrinth behind the door. Similarly, louvers in exterior walls, which are vulnerable to missile penetration, are backed up by reinforced concrete plenums or walls.

Based upon the selection and description of missiles cited in 3.5.1, the interaction of missiles with structural elements is determined and the results are given in Table 3.5-5. The tabulations assume the missiles to impact at the most vulverable point of a structure or component (e.g., at the center of a slab).

The reactor protection system motor generator sets flywheels located in the critical DC switchgear rooms at elevation 467'-0" in the radwaste building were analyzed and determined to be credible missile sources, with the potential consequences affecting the safe shutdown of the plant. Barriers were constructed around these flywheels of steel and aluminum honeycomb material, which were designed to contain the credible missiles (see 3.5.1.1.5).

3.5-11 Regulatory Guide 1.14, Rev. 1, "Reactor Coolant Pump Flywheel Integrity", August 1975.

3.5-12 Miller, D. R. and Williams, W. A., Tornado Protection for the Spent Fuel Pool, General Electric Company, APED-5696, November 1968.

3.5-13 "Protection Against Pipe Breaks Outside Containment", Burns and Roe, Inc., Hempstead, New York, Report No. WPPSS-74-2-R3, April, 1974.

3.5-14 "A Review of Procedures for the Analysis and Design of Concrete Structures to Resist Missile Impact Effects" R.P. Kennedy, Nuclear and Systems Sciences Group, Holmes and Narver, Inc., September 1975.

3.5-15 "Analysis of the Probability of the Generation and Strike of Missiles from a Nuclear Turbine" March, 1974 by Westinghouse Electric Corporation Steam Turbine Division Engineering.

3.5-16 NUREG-75/087, USNRC Standard Review Plan, Section 3.5.1.6, November 1975.

3.5-17 Oldfield, G. V., WPPSS, personal communication with Lou Rosgen, Control Tower Chief, Tri-Cities Airport, Federal Aviation Administration, January 14, 1980.

3.5-18 Oldfield, G. V., WPPSS, personal communication with Bill Granston, Area Specialist, Seattle Air Route Traffic Control Center, Federal Aviation Administration, January 15, 1980.

3.5-19 Seattle Sectional Aeronautical Chart, 18th Edition, U.S. Department of Commerce, NOAA, Washington, D. C., January 24, 1980.

3.5-20 "List of Accidents Showing Impact Severity and Angle in Third Display, U. S. Civil Aviation, 1978", National Transportation Safety Board, Washington, D.C.

3.5-21 "Methodology for Calculating the Probability of a Missile Generation from Rupture of a Low Pressure Turbine Disc," Westinghouse Electric Corporation, CT-24076, Revision 1, July 1980.

3.5-22 "Turbine Missile Report (HP296-LP281-LP281-LP-281)," Westinghouse Electric Corporation, CT-24869, Revision O, December 1980.

3.5-23 "Turbine Missile Report, Results of Probability Analysis of Disc Rupture and Missile Generation," Westinghouse Electric Corporation, CT-24870, Revision 1, March 1981.

3.5-24 "Cracking in Low Pressure Turbine Discs," IE Information Notice No. 79-37, letter from R. H. Engelken, NRC, to N. O. Strand, Washington Public Power Supply System, dated December 28, 1979.

3.5-25 "Structural Analysis and Design of Nuclear Plant Facilities," Chapter 6 (Design Against Impulse and Impact Loads), ASCE Manuals and Reports on Engineering Practice No. 58, 1980.

3.6.2.2.3.4 Materials and Proportions of Structural Shapes

The materials and proportions of structural shapes for energy absorbing members are in accordance with recommendations for dynamic member design as documented in References 3.6-6 and 3.6-7.

3.6.2.3 Dynamic Analysis Methods to Verify Integrity and Operability

3.6.2.3.1 Dynamic Analysis Methods for Jet Impingement Effects

The procedure for analyzing the dynamic effects of jet impingement has been extracted from "Prediction of Blowdown Thrust and Jet Forces" by F. J. Moody (reference 3.6-8).

The computer code RELAP3 (See 3.12.11 and Reference 3.6-9) with required geometric input data is run to obtain the exit plane thermodynamic state and mass flow rate. Specifically, the quantities output by RELAP3 are:

M	- mass flow rate	lb_m/sec
$\bar{v}$	- specific volume	ft^3/lb_m
P_E	- exit pressure	lb_f/ft^2

The reaction load on the piping system is given by:

$$\frac{T}{A_E} = (P_E - P_\infty) + \frac{G_E^2 \bar{v}_E}{g_c} \qquad \text{Eq. 3.6.2.3.1-1}$$

Where:

$\frac{T}{A_E}$	=	thrust per unit area	lb_f/ft^2
P_∞	=	receiver pressure	lb_f/ft^2
G_E	=	mass flux	$lb_m/sec\ ft^2$
P_E	=	exit pressure	lb_f/ft^2
$\bar{v}_E$	=	specific volume at exit	ft^3/lb
g_c	=	Newton's constant	$32.174 \frac{ft\text{-}lb_m}{lb_f\ sec^2}$

(T/A_E) yields the thrust reaction load on the piping system subject to the assumption that the vapor to liquid velocity ratio is unity. By conservation of forward momentum, the jet force per unit area (F_j/A_E) equals the thruse force per unit area (T/A_E). To determine the effect of the fluid jet on targets located some distance L_T, from the break, the following procedure is used.

Classify target distance L_T, as less than, equal to, or greater than the distance required for full jet expansion L_∞.

Where:

$$L_\infty = \frac{D_E}{2}\left[\left(\frac{A_\infty}{A_E}\right)^{1/2} - 1\right] \qquad \text{Eq. 3.6.2.3.1-2}$$

$$\frac{A_\infty}{A_E} = \left[\frac{G_E^2}{g_c}\right]\left[\frac{\bar{v}_\infty}{T/A_E}\right] \qquad \text{Eq. 3.6.2.3.1-3}$$

$$\bar{v}_\infty = f\ (P_\infty,\ h_E) \qquad \text{Eq. 3.6.2.3.1-4}$$

where:

A_∞	-	area of jet at full expansion	ft^2
A_E	-	area of exit	ft^2
D_E	-	diameter of exit	ft
G_E	-	mass flux	$lb_m/sec.\ ft^2$
g_c	-	Newton's Constant	$32.174\ \frac{ft\text{-}lb_m}{lb_f\ sec^2}$
h_E	-	exit plane enthalpy	BTU/lb
L_∞	-	distance to full expansion	ft
P_∞	-	receiver pressure	lb_f/ft^2

T - thrust

$\bar{v}_\infty$ - specific volume at full expansion

Assuming the kinetic energy of the fully expanded jet to be insignificant, the following relation holds between vessel stagnation enthalpy and fully expanded jet enthalpy:

$$h_o = h_\infty \qquad \text{Eq. 3.6.2.3.1-5}$$

Therefore,

$$x_\infty = \frac{h_o - h_{f_\infty}}{h_{fg_\infty}} \qquad \text{Eq. 3.6.2.3.1-6}$$

where:

h_o - stagnation enthalpy at full expansion, BTU/lb_m

h_{f_∞} - liquid enthalpy at full expansion, BTU/lb_m

h_{fg_∞} - vaporization enthalpy at full expansion, BTU/lb_m

x_∞ - quality at full expansion

Then,

$$\bar{v}_\infty = \bar{v}_{f_\infty} + x_\infty \bar{v}_{fg_\infty} \qquad \text{Eq. 3.6.2.3.1-7}$$

where:

$\bar{v}_{f_\infty}$ - specific volume of liquid at full expansion, ft^3/lb_m

$\bar{v}_{fg_\infty}$ - specific volume of vaporization at full expansion ft^3/lb_m

$\bar{v}_\infty$ - specific volume at full expansion, ft^3/lb_m

From equations 3.6.2.3.1-6 and 3.6.2.3.1-7, subject to the assumption of equation 3.6.2.3.1-5, equations 3.6.2.3.1-2 and 3.6.2.3.1-3 can be solved for L_∞.

For $L_T < L_\infty$, property variations are assumed linear from A_E to A_∞ for area and from P_E to P_∞ for pressure.

The jet impingement load F_j, is as follows with F_j, a constant:

$$F_{jT} = F_j \times \frac{A_T}{A_L} \qquad \text{Eq. 3.6.2.3.1-8}$$

where:

A_T - is the area of target which is intercepted by the jet.

A_L - is the jet area at the target distance calculated as:

$$A_L = (A_\infty - A_E)\ \frac{L_T}{L_\infty} + A_E \qquad \text{Eq. 3.6.2.3.1-9}$$

for $0 \leq L_T \leq L_\infty$

For $L_T < L_\infty$

$$D_j = \frac{L_T}{L_\infty}\ D_\infty \quad \text{for } L_\infty \leq L_T$$

where:

D_j - diameter of jet at L_T, ft.

L_T - distance to target, ft.

D_∞ - diameter at full expansion, ft.

The jet force on the target is:

$$F_{jT} = \frac{4F_j A_T}{\Pi\ D_j^{\ 2}} \qquad \text{Eq. 3.6.2.3.1-10}$$

where A_T, is the area target which is intercepted by the jet.

(NOT USED)

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2		FIGURE 3.6-3

TABLE 3.8-8

PRIMARY CONTAINMENT VESSEL

SIZES FOR CABLE TYPE TESTS

FOR ELECTRICAL PENETRATIONS

Cable Type	Test	FSAR Paragraph	Size
600 & 1000 V control	Thermal & Radiation Aging	3.8.6.7.3e(1)	1/c #14 AWG 7/c #12 AWG
	LOCA Simulation	3.8.6.7.3e(2)	7/c #12 AWG
600-8000 volts Power	Thermal & Radiation Aging	3.8.6.7.3e(1)	1/c #4/o
	LOCA Simulation	3.8.6.7.3e(2)	1/c #2/o
Instrumentation	Thermal Aging & Radiation and LOCA Simulation	3.8.6.7.3e(1) and (2)	Shielded 2/c #16 AWG
Coaxial, Triaxial and other special cable	Thermal & Radiation Aging and LOCA Simulation	3.8.6.7.3e(1) and (2)	Sample of actual cable configuration is used
Thermocouple Extension Cable	Thermal & Radiation Aging and LOCA Simulation	3.8.6.7.3e(1) and (2)	One twisted pair #20 AWG

TABLE 3.8-9

LIST OF APPLICABLE CODES, STANDARDS, SPECIFICATIONS

AND

NRC REGULATORY GUIDES

REFERENCE NUMBER	DESIGNATION	TITLE	EDITION
1A	ACI 318-71	Building Code Requirements for Reinforced Concrete	Feb. 9, 1971
1B	ACI 318-63	Building Code Requirements for Reinforced Concrete	June 1963*
2A	ACI 301-72	Specifications for Structural Concrete for Buildings	May 1972
2B	ACI 301-66	Specifications for Structural Concrete for Buildings	1966
3	ACI 347-68	Recommended Practice for Concrete Formwork	March 1968
4	ACI 605-72	Recommended Practice for Hot Weather Concreting	1972
5A	ACI 211.1-70	Recommended Practice for Selecting Proportions for Normal Weight Concrete	1970
5B	ACI 211.1-74	Recommended Practice for Selecting Proportions for Normal Weight Concrete	1974

* Used ACI 318-63, Method No. 2, for bending moment and shear coefficients in the design of two-way slabs.

TABLE 3.8-9 (Continued)

REFERENCE NUMBER	DESIGNATION	TITLE	EDITION
7	ACI 315-74	Manual of Standard Practice for Detailing Reinforced Concrete Structures	1971
8	ACI 306-66	Recommended Practice for Cold Weather Concreting	1966
9	ACI 609-72	Recommended Practice for Consolidation of Concrete	March 1972
10	ACI 322-72	Building Code Require-ments for Structural Plain Concrete	1972
11	ACI 308-71	Recommended Practice for Curing Concrete	1971 Title 69-1
12	ACI 212	Guide for Use of Admixtures in Concrete	ACI Journal Sept. 1971 Title 68-56
13	ACI 214-65	Recommended Practice for Evaluation of Com-pression Test Results of Field Concrete	1965
14	ACI 311-64	Recommended Practice for Concrete Inspection	1964
15	ACI SP-2	Manual of Concrete Inspection	1968 (5th Edition)
16	Report by ACI Com-mittee 304	Placing Concrete by Pumping Methods	ACI Journal May 1971 Title 68-33
17	Report by ACI Com-mittee 437 Subcommittee 1	Strength Evaluation of Existing Concrete Structures	ACI Journal Nov. 1967 Title 64-61

TABLE 3.8-9 (Continued) Page 3 of 8

REFERENCE NUMBER	DESIGNATION	TITLE	EDITION
18	AISC-69	Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings	Feb. 12, 1969
19	AISC-68	Specification for the Design of Light Gauge Cold-Formed Steel Structural Members	1968
20	AWS D1.1-72	Structural Welding Code	1972**
21	AWS D12.1-61	Recommended Practice for Welding Reinforcing Steel, Metal Inserts, and Connection in Reinforced Concrete Construction	1961

** As part of the WNP-2 Quality Verification Program, visual reinspection of selected structural steel welds, including radial and structural framing systems, steam tunnel beams, and pipe hangers (AISC scope only) was performed under Supply System procedure QVI-09, Attachment 2.*** This procedure included alternative acceptance criteria to AWS D1.1.

These alternative acceptance criteria were established by the Architect/Engineer and determined to be acceptable based on specific knowledge of the design and the significance of these types of minor deficiencies. The criteria were implemented in order to provide a conservative and practical basis for performing a reinspection of the structural steel. Sacrificial shield wall and pipe whip restraint weld reinspections were performed to AWS D1.1.

*** Transmitted to NRC via letter G02-83-249, G. D. Bouchey to A. Schwencer, "WNP-2 Project Visual Examination Acceptance Criteria for Reverification Inspection of Welded Structures", dated March 23, 1983.

TABLE 3.8-9 (Continued)

REFERENCE NUMBER	DESIGNATION	TITLE	EDITION
24	ASME	1974 ASME Boiler & Pressure Vessel Code, Section XI, "Inservice Inspection of Nuclear Reactor Coolant Systems"	Summer 1975 Addenda
25	ASTM	Annual Books of ASTM Standards	1972
26	ANSI B31.1.0	Standard Code for Pressure Piping, Power Piping	Latest Edition
27	API Spec. No. 620	Specification for Welded Steel Storage Tanks	Feb. 1970
28	UBC	Uniform Building Code	1970
29	NEC	National Electric Code	Latest Edition
30	CRD-C-588	U.S. Corps. of Engineers Specification for Expansive Grouts	Latest Edition
31	CRD-C-589	U.S. Corp. of Engineers Methods of Sampling and Testing Expansive Grouts	Latest Edition
32	CRSI	Manual of Standard Practice	1972

TABLE 3.8-9 (Continued)

REFERENCE NUMBER	DESIGNATION	TITLE	EDITION
33	ANSI 45.2.5-74	Supplementary Quality Assurance Requirements for Installations, Inspection and Testing of Structural Concrete and Structural Steel During the Construction Phase of Nuclear Power Plants	1974
34	----	Steiger Occupational Safety and Health Act	Latest Edition
35	NRC Regulatory Guide 1.10	Mechanical Cadweld Splices in Reinforcing Bars of Category I Concrete Structures (Revision 1)	Jan. 2, 1973
36	NRC Regulatory Guide 1.12	Instrumentation for Earthquakes (Revision 1)	April, 1974
37	NRC Regulatory Guide 1.13	Fuel Storage Facility Design Basis	March 10, 1971
38	NRC Regulatory Guide 1.15	Testing of Reinforcing Bars for Category I Concrete Structures (Revision 1)	Dec. 28, 1972
39			
40	NRC Regulatory Guide 1.26	Quality Group Classification and Standards (Revision 3)	Sept. 1974
41	NRC Regulatory Guide 1.27	Ultimate Heat Sink for Nuclear Power Plants (Revision 1)	March 1974
42	NRC Regulatory Guide 1.29	Seismic Design Classition (Revision 1)	August 1973
43	NRC Regulatory Guide 1.31	Control of Stainless Steel Welding (Revision 1)	June 1973

TABLE 3.8-9 (Continued)

REFERENCE NUMBER	DESIGNATION	TITLE	EDITION
44	Not Used		
45	NRC Regulatory Guide 1.55	Concrete Placement in Category I Structures (Revision 0)	June 1973
46	ASME	1971 Boiler and Pressure Vessel Code, Section XI	Summer of 1972 Addenda
47	ASME	1971 ASME Boiler and Pressure Vessel Code, Section VIII	Summer of 1972 Addenda
48	ASME	1971 Code Interpretations Case Number 1177-7	
49	EJMA	Standards of the EJMA	Latest Editions
50	SSPC	Painting Specifications	Latest Editions
51	ANSI N101.4	Protective Coating Applied to Nuclear Facilities, Quality Assurance	Latest Edition
52	10 CFR Part 50, Appendix A	General Design Criterion 2, "Design Bases for Protection Against Material Phenemona"	July 15, 1971
53	10 CFR Part 50, Appendix A	General Design Criterion 4, "Environmental and Missile Design Bases"	July 15, 1971
54	NRC Regulatory Guide 1.94	Quality Assurance Requirements for Installation; Inspection and Testing of Structural Concrete and Structural Steel During the Construction Phase of Nuclear Power Plants (Revision 1)	April 1976

TABLE 3.8-9 (Continued) Page 8 of 8

EXPLANATION OF ABBREVIATIONS

ACI - American Concrete Institute

NRC - Nuclear Regulatory Commission

AISC - American Institute of Steel Construction

AISI - American Iron and Steel Institute

ANSI - American National Standards Institute

API - American Petroleum Institute

ASME - American Society of Mechanical Engineers

ASTM - American Society for Testing and Materials

AWS - American Welding Society

CRSI - Concrete Reinforcing Steel Institute

NEC - National Electric Code

UBC - Uniform Building Code

EJMA - Expansion Joint Manufacturers Association

SSPC - Steel Structure Painting Council

NOTE: All of the previously referenced Codes and Standards may not appear as direct references in the construction specifications. However, if they do not appear as such, they were nonetheless utilized by the A/E either in preparing the specification or in design.

TABLE 3.9-2 (v) (Continued)

Criteria	Loading	Primary Stress Type	Allowable Stress (psi)	Calculated Stress (psi)
Primary Stress Limit - The allowable primary membrane stress is based on the ASME Boiler and Pressure Vessel Code, Section III, for Class I vessels, for type 304 stainless steel. For normal and upset condition: S_m = 16,660 psi @ 575°F	Normal and upset condition loads 1. Design pressure 2. Struck rod scram loads 3. Operational basis earthquake, with housing lateral support installed.	Maximum membrane stress intensity occurs at the tube to tube weld near the center of the housing for normal upset and emergency conditions.	16,660 16,660	11,900 14,480
For faulted conditions: $S_{limit} = 1.5 \times 1.2 \times S_m$ = 29,990 psi Note: Analyzed to emergency conditions limits.	Emergency conditions loads 1. Design pressure 2. Struck rod scram loads 3. Design basis earthquake, with housing lateral support installed.		29,990	22,030

TABLE 3.9-2(w)

JET PUMPS

CRITERIA	LOADING COMBINATIONS	STRESS TYPE	ALLOWABLE STRESS (PSI)	CALCULATED STRESS (PSI)
PRIMARY MEMBRANE PLUS BENDING STRESS BASED ON ASME B&PV CODE SECTION III, SUBSECTION NG.				
FOR SERVICE LEVELS A & B (NORMAL AND UPSET) CONDITION: FOR TYPE 304 S.S. @ 550°F S_m = 16,800 psi S_{limit} = 1.5 S_m psi	NORMAL LOADS(1) OBE SRV	PRIMARY MEMBRANE PLUS BENDING	25,200	6,618
FOR SERVICE LEVEL C (EMERGENCY) CONDITION: FOR TYPE 304 S.S. @ 550°F S_m = 16,800 psi S_{limit} = 2.25 S_m psi	NORMAL LOADS(1) LOCA SRV	PRIMARY MEMBRANE PLUS BENDING	37,800	6,946
FOR SERVICE LEVEL D (FAULTED) CONDITION: FOR TYPE 304 S.S. @ 550°F S_m = 16,800 psi S_{limit} = 3.6 S_m psi	NORMAL LOADS (2) LOCA SSE	PRIMARY MEMBRANE PLUS BENDING	60,840	54,450(3)

(1) Design internal pressure, hydraulic and pressure reaction loads.

(2) Design external pressure, hydraulic and pressure reaction loads

(3) Riser brace only. Stresses on other components are much lower.

DELETED

TABLE 3.9-2 (x)

(This Table is not used)

3.10 SEISMIC AND DYNAMIC QUALIFICATION OF SAFETY-RELATED INSTRUMENTATION AND ELECTRICAL EQUIPMENT

3.10.1 SEISMIC AND DYNAMIC QUALIFICATION CRITERIA

3.10.1.1 Safety-Related Equipment Identification

Table 3.2-1 is a list of the Seismic Category I equipment arranged by system.

A list of all engineered safety feature systems and associated Class 1E equipment has been prepared. All parameters required to perform the qualification evaluation have been determined, including normal and accident operational requirements, operating data, and manufacturers' data. The location of the equipment has been verified by plant walk down to insure the appropriateness of response spectra. The Class 1E equipment list is being periodically updated and kept current in the Supply System computer.

Class 1E is defined per IEEE 323-1974 as follows:

The safety classification of the electric equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or otherwise are essential in preventing significant release of radioactive material to the environment.

Instrumentation for the operator to follow the course of an accident was also defined as Class 1E. This includes instrumentation identified as a result of TIM-2 Lessons Learned and Regulatory Guide 1.97. The list also includes equipment supporting structures.

Table 3.10-1 is a sub-set of that list, showing the level 1 and 2 equipment which has use codes 1, 2, and 4. (See notes to Table 3.10-1 for explanation.) The equipment is listed by equipment piece number (EPN). The complete list is available at any time.

The equipment furnished by General Electric Company, our NSSS contractor, was purchased under Contract 2 and 59. Any equipment which shows a 59 or any number beginning in 02 in the contract column in Table 3.10-1 was purchased from General Electric. The remainder was supplied by BOP contractors and monitored by Burns and Roe, Inc., our architect/engineer.

3.10.1.2 Criteria for Acceptability

The original equipment seismic qualification requirement for Washington Public Power Supply System Nuclear Project Number 2 (WNP-2) was described in the PSAR. These requirements specified that NSSS & BOP equipment be designed and tested to good industry practices. IEEE 344-1971 represented the established industry practiced at that time and equipment purchases were made to these requirements.

In March 1979 first questions to our FSAR were received which notified the Supply System that the NRC would review our equipment seismic qualification to upgraded criteria. This criteria was defined as IEEE 344-1975 as supplemented by Regulatory Guides 1.100 and 1.92 and Standard Review Plan Section 3.9.2 and 3.10. A meeting of lead BWR plants was held at NRC offices in Bethesda to further define the NRC's expectations of the licensees. At this meeting it became clear that the staff required a complete review (reevaluation) of the seismic/hydrodynamic load basis along with reevaluation of past equipment qualification documentation be performed by the licensees. The NRC staff would then assemble a Seismic Qualification Review Team (SQRT) to conduct a site visit to audit the Qualification Program and equipment installation.

The Supply System has undertaken an agressive equipment qualification program to assure all Class 1E equipment will perform their safety function during seismic/hydrodynamic loading conditions postulated to occur at WNP-2. This program includes:

a. Identification of Class 1E equipment.

b. Definition of seismic and hydrodynamic loads.

c. Collecting of seismic qualification documentation.

d. Reevaluation of the seismic qualification documentation to current criteria.

e. Identification of document deficiencies.

f. Corrective action or identified deficiencies.

All Seismic Category I instrumentation and electrical equipment was designed to withstand the effects of the safe shutdown earthquake (SSE) whose motion is described in 3.7.1.

The safety-related (Class 1E) instrumentation and electrical equipment have been reevaluated in order to assure performance of their safety function during and after OBEs, SSE, and/or the hydrodynamic loads which result from a loss of coolant accident or other design basis event.

Hydrodynamic loads as described in Revision 3 to the "Plant Design Assessment Report for SRV and LOCA Loads" (DAR) were limited to equipment located within containment or pipe mounted equipment located between containment and the first anchor point outside containment. For that equipment the hydrodynamic response spectra was added by absolute sum to the response due to the SSE computed using the finite element soil-structure interaction analysis as described in the responses to Questions 130.053, 130.055, and 130.056. These questions were raised at the NRC Structural Engineering Branch meeting held at Burns and Roe, Woodbury in September 1981.

The equipment effected by hydrodynamic loads is designated in Table 3.10-1 with a "Y" (yes) in the column headed by H. L. (hydrodynamic loads).

The equipment located in other buildings was reevaluated for the motion caused by the SSE. That motion is defined by the lumped mass-stick model analysis described in 3.7.1.

The reevaluation has been based on IEEE 344-1975, "IEEE Guide for Seismic Qualification of Class I Electric Equipment for Nuclear Power Generating Stations," as supplemented by Regulatory Guide 1.100 and Section 3.10 of NUREG-0800, "Standard Review Plan". There are four exceptions to the use of these criteria. These are as follows:

a. Interim criteria have been established to re-evaluate equipment mounted on piping systems whose analyses have not been completed. The interim criteria are to use the peak of the applicable 0.5% damping floor response spectrum above 8 hertz as input acceleration for analysis or for Sine Dwell Testing. The piping systems are being designed, in turn, not to respond to frequencies less than 8 hertz. When the piping analyses are completed the computed acceleration of the equipment will be compared to the interim acceleration criteria to verify the interim criteria as conservative.

b. Equipment which was qualified by testing using single frequency motion was reevaluated using the following criteria to establish its adequacy.

1. If the equipment is rigid (no reasonant frequency below the ZPA of the applicable response spectra) the test input acceleration must be greater than the accleration corresponding to the ZPA of the response spectrum of the mounting point of the equipment.

2. If the equipment has only one natural frequency, the response acceleration to the test motion must be calculated at the appropriate damping ratio. To account for cross coupling, the required response acceleration is calculated by multiplying the acceleration corresponding to the equipment's natural frequency found on the applicable response spectrum by the square root of 2 (1.41). If test response acceleration exceeds the required response acceleration, the test motion is considered adequate for requalification of the equipment.

3. If the equipment has multiple resonant frequencies, it must be tested at each of them. The response to each test must be calculated at each resonant frequency. That is, the response to a test at one frequency is calculated at that frequency and at all other resonant frequencies. The responses are then combined using the square-root-of-the-sum-of-the-squares (SRSS) method. The test motion is considered adequate if the SRSS of the response accelerations to every test is greater than 1.4 times the SRSS of the accelerations found at the resonant frequencies on the applicable response spectrum.

4. If the equipment has closely spaced modes, the criteria of (3), above, is used except the responses to the closely spaced modes combined by the absolute sum rather than SRSS.

c. For equipment which is panel or rack mounted, the maximum transmissibility of the panel or rack is found by a combination of testing and analysis. The ZPA of the applicable response spectrum is then multiplied by this transmissibility to find the required acceleration for the equipment. Test accelerations of the equipment are then compared with the calculated required acceleration to establish qualification of the equipment.

d. IEEE 344-1975 references IEEE 323-1974. Section 6.3.5 of IEEE 323-1974 recommends thermal and radiation aging before vibration testing. It has not been shown that normal service condition environmental aging reduces equipment's ability to withstand a seismic event. The Electric Power Research Institute (EPRI) is running tests to find if a relationship exists. The Supply System is monitoring those tests. If those tests show that this relationship exists for particular equipment we will reconsider normal service aging effects for that equipment.

For Class 1E equipment located in harsh environments which has not been previously environmentally qualified (see 3.11) aging will be considered prior to seismic/hydrodynamic testing. For all other equipment consideration of aging will not be required prior to IEEE 344-1975 testing.

All of the equipment which is shown in Table 3.10-1 as qualified has been qualified by testing, by analysis, or by a combination of testing and analysis. The list shows the method of qualification.

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Each tested piece of equipment has been shown to be operable during and after the test. The test specimens were checked for spurious operation during testing. If there were spurious operations, it was determined that they had no detrimental effects on the safety function of the equipment.

Operability by analysis was demonstrated only if moving parts coming into contact with other objects was the only mode of failure. In those cases operability was shown with deflection calculations showing that a gap still remained at maximum load. Also, it was shown that accepted stress limits were not exceeded.

The damping valves used in analyses are those specified in Regulatory Guide 1.61 unless another was justified and documented.

In the analyses performed, horizontal and vertical loads are assumed to occur simultaneously in the most unfavorable combinations. Normal operating loads are also combined with the accident loads to produce the most severe stress combination. The "no loss of function" stresses are limited to 90% of the materials minimum yield strength with an SSE added to hydrodynamic loads and the normal operating loads.

3.10.1.2.1 Cable Tray and Conduit Supports

Regardless of cable tray or conduit function, all supports located in Seismic Category I structures are designed to Seismic Category I requirements, with the exception of supports for field routed trays and conduits containing cabling for the communication system and all AC lighting outside of the main control room. All supports are qualified by dynamic analysis using appropriate seismic response spectra. The design considers both dead loads (loads which do not change magnitude and/or position), live loads (loads which do change magnitude and/or position) and SSE acceleration loads. Tray and conduit cable loadings (lbs/ft.) are accounted for in support design, based on maximum permissible raceway loading for the types of cable utilized.

Routing of trays and conduits containing cabling for the communication system and all AC lighting outside of the main control room will be reviewed and inspected prior to fuel loading to assure that failure of the support system cannot result in these trays and conduits impacting on Class 1E equipment.

3.10.1.2.2 Decision Criteria

3.10.1.2.2.1 Structurally Simple Equipment

Class 1E equipment determined to be structurally simple so that it can be modeled as a one degree of freedom system is qualified by analysis. Natural period for horizontal vibrations of the equipment represented by a single degree of freedom dynamic model is determined using the values of the equivalent mass and spring constant.

Equivalent horizontal static loads are determined for SSE (plus hydrodynamic loads where applicable) from the horizontal response curves using the previously determined natural period of the equipment and applicable damping coefficients. The horizontal coefficient is then determined which, when multiplied with the weight, produces the equivalent horizontal static load. A similar procedure is utilized to determine the vertical equipment response.

Should the vendor elect not to calculate the natural period of vibration for the equipment, equivalent horizontal and vertical static loads are determined for both the SSE and OBE, using the peak values for the floor response spectra for the appropriate damping coefficients.

3.10.1.2.2.2 Structurally Complex Equipment

Class 1E equipment determined to be structurally complex such that it cannot be modeled as a single degree of freedom system may also be qualified by analysis. The equivalent SSE horizontal loads (plus hydrodynamic loads where applicable) are determined using a dynamic modal analysis of the equipment represented as a multi-degree of freedom system. Horizontal floor response spectra for the particular equipment location and appropriate damping coefficients are used as input to determine the horizontal equipment response. A similar procedure is utilized to determine the vertical equipment response.

For Class 1E equipment determined to be structurally so complex that it cannot be modeled realistically, and yet can respond as a multi-degree of freedom system, the equivalent horizontal and vertical static loads may be determined for both SSE and OBE using twice the peak values of the seismic response curves for the appropriate damping coefficients. This compensates for potential multi-degree of freedom system response.

Regulatory Guide 1.44, Control of the Use of Sensitized Stainless Steel

All wrought austenitic stainless steel was purchased in the solution heat treated condition. Heating above 800°F was prohibited (except for welding) unless the stainless steel was subsequently solution annealed. Purchase specifications restricted the maximum weld heat input to 110,000 Joules per inch, and the weld interpass temperature to 350°F maximum. Welding was performed in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. These controls were employed to avoid severe sensitization and comply with the intent of Regulatory Guide 1.44.

Regulatory Guide 1.71, Welder Qualification for Areas of Limited Accessibility

There are very few restrictive welds involved in the fabrication of items described in this section, and a limited number of field welds were required since this application utilized the shop installed internals approach. For the shop installed internals, mock-up welding was performed on the welds with most difficult access. Mock-ups were examined with radiography or by sectioning.

4.5.2.5 Contamination, Protection, and Cleaning of Austenitic Stainless Steel

Exposure to contaminant was avoided by carefully controlling all cleaning and processing materials which contact stainless steel during manufacture and construction. Any inadvertent surface contamination was removed to avoid potential detrimental effects.

Special care was exercised to insure removal of surface contaminants prior to any heating operation. Water quality for rinsing, flushing, and testing was controlled and monitored.

The degree of cleanliness obtained by these procedures meets the requirements of Regulatory Guide 1.37.

4.5.3 CONTROL ROD DRIVE HOUSING SUPPORTS

The American Institute of Steel Construction (AISC) Manual of Steel Construction, "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings," was used in designing the CRD housing support system. However, to provide a structure that absorbs as much energy as practical without yielding, the allowable tension and bending stresses used were 90% of yield and the shear stress used was 60% of yield. These design stresses are 1.5 times the AISC allowable stresses (60% and 40% of yield, respectively).

For purposes of mechanical design, the postulated failure resulting in the highest forces is an instantaneous circumferential separation of the CRD housing from the reactor vessel, with the reactor at an operating pressure of 1086 psig (at the bottom of the vessel) acting on the area of the separated housing. The weight of the separated housing, control rod drive, and blade, plus the pressure of 1086 psig acting on the area of the separated housing, gives a force of approximately 32,000 lb. This force is used to calculate the impact force, conservatively assuming that the housing travels through a 1-in. gap before it contacts the supports. The impact force (109,000 lb) is then treated as a static load in design. The CRD housing supports are designed as Category I (seismic) equipment in accordance with 3.2.

All CRD housing support subassemblies are fabricated of ASTM A36 structural steel, except for the following items:

Grid	ASTM A-441
Disc springs	Schnerr, Type BS-125-71-8
Hex bolts and nuts	ASTM A-307
6 x 4 x 3/8 tubes	ASTM A-500 Grade B

Since there are no additives in the BWR coolant, leakage would expose materials to high purity, demineralized water. Exposure to demineralized water would cause no detrimental effects.

5.2.3.3 Fabrication and Processing of Ferritic Materials

5.2.3.3.1 Fracture Toughness

Fracture toughness requirements for the ferritic materials used for piping and valves (no ferritic pumps in RCPB) of the reactor coolant pressure boundary were as follows:

Safety/Relief Valves were exempted from fracture toughness requirements because Section III of the 1971 ASME Boiler and Pressure Vessel Code did not require impact testing on valves with inlet connections of 6 inches or less nominal pipe size.

Main Steam Isolation Valves were also exempted because the Code existing at the time of the purchase order, April 1971, did not require brittle fracture testing on ferritic pressure boundary components when the system temperature was in excess of 250°F at 20% of the design pressure.

Main Steam Piping was tested in accordance with and met the fracture toughness requirements of paragraph NB-2300 of the 1972 Summer Addenda to ASME Code, Section III, the applicable code at the time of the purchase order, September 1972.

5.2.3.3.1.1 Compliance with Code Requirements

The ferritic pressure boundary material of the reactor pressure vessel was qualified by impact testing in accordance with the 1971 Edition of Section III ASME Code and Addenda to and including the Summer 1971 Addenda. From an operational standpoint, this Code would require that for any significant pressurization (taken to be more than 20% of Code hydrostatic test pressure = 312 psig) the minimum metal temperature of all vessel shell and head material be 100°F (NDTT +60°F).

5.2.3.3.2 Control of Welding

5.2.3.3.2.1 Control of Preheat Temperature Employed for Welding of Low Alloy Steel
Regulatory Guide 1.50

The use of low alloy steel is restricted to the reactor pressure vessel. Other ferritic components in the reactor coolant pressure boundary are fabricated from carbon steel materials.

Preheat temperatures employed for welding of low alloy steel meet or exceed the recommendations of ASME Section III, Subsection NA. Components were either held for an extended time at preheat temperature to assure removal of hydrogen, or preheat was maintained until post-weld heat treatment. The minimum preheat and maximum interpass temperatures were specified and monitored.

5.2.3.3.2.2 Control of Stainless Steel Weld Cladding of Low Alloy Steel Components
Regulatory Guide 1.43

Regulatory Guide 1.43 does not apply to BWR components.

5.2.3.3.2.3 Control of Electroslag Weld Properties
Regulatory Guide 1.34

No electroslag welding was performed on BWR components.

5.2.3.3.2.4 Welder Qualification for Areas of Limited Accessibility
Regulatory Guide 1.71

Welder qualification for areas of limited accessibility is discussed in C.2 and C.3.

5.2.3.3.3 Nondestructive Examination of Ferritic Tubular Products

Wrought tubular products were supplied in accordance with applicable ASTM/ASME material specifications. These specifications require a hydrostatic test on each length of tubing or pipe.

These components met the requirements of the ASME Codes existing at the time of placement of order which predate Regulatory Guide 1.66.

5.2.3.4 Fabrication and Processing of Austenitic Stainless Steels

5.2.3.4.1 Avoidance of Stress Corrosion Cracking

5.2.3.4.1.1 Avoidance of Significant Sensitization

All austenitic stainless steel was purchased in the solution heat treated condition in accordance with applicable ASME and ASTM specifications. Carbon content was limited to 0.08% maximum, and cooling rates from solution heat treating temperatures were required to be rapid enough to prevent sensitization.

Welding heat input was restricted to 110,000 joules per inch maximum, and interpass temperature to 350°F. High heat welding processes such as block welding and electroslag welding were not permitted. All weld filler metal and castings were required by specification to have a minimum of 5% ferrite.

Whenever any wrought austenitic stainless steel was heated to temperatures over 800°F, by means other than welding or thermal cutting, the material was re-solution heat treated.

These controls were used to avoid severe sensitization and to comply with the intent of Regulatory Guide 1.44, "Control of the Use of Sensitized Stainless Steel".

5.2.3.4.1.2 Process Controls to Minimize Exposure to Contaminants

Exposure to contaminants capable of causing stress corrosion cracking of austenitic stainless steel components was avoided by carefully controlling all cleaning and processing materials which contact the stainless steel during manufacture and construction.

Special care was exercised to insure removal of surface contaminants prior to any heating operations. Water quality for cleaning, rinsing, flushing, and testing was controlled and monitored. Suitable packaging and protection was provided for components to maintain cleanliness during shipping and storage.

The degree of surface cleanliness obtained by these procedures meets the requirements of Regulatory Guides 1.44 and 1.37.

5.2.3.4.1.3 Cold Worked Austenitic Stainless Steels

Austenitic stainless steels with a yield strength greater than 90,000 psi are not used.

5.2.3.4.2 Control of Welding

5.2.3.4.2.1 Avoidance of Hot Cracking

All austenitic stainless steel filler materials were required by specification to have a minimum of 5% ferrite. This amount of ferrite is considered adequate to prevent hot cracking in austenitic stainless steel welds.

An extensive test program performed by General Electric Company, with the concurrence of the Regulatory Staff, has demonstrated that controlling weld filler metal ferrite at 5 percent minimum produces production welds which meet the requirements of Regulatory Guide 1.31, "Control of Stainless Steel Welding." A total of approximately 400 production welds in five BWR plants were measured and all welds met the requirements of the Interim Regulatory Position to Regulatory Guide 1.31.

5.2.3.4.2.2 Electroslag Welds
Regulatory Guide 1.34

Electroslag welding was not employed for reactor coolant pressure boundary components.

5.2.3.4.2.3 Welder Qualification for Areas of Limited Accessibility
Regulatory Guide 1.71

Welder qualification for areas of limited accessibility is discussed in C.2 and C.3.

drywell atmosphere. Temperatures within the drywell are monitored at various elevations. Also the temperature of the inlet and exit air to the atmosphere is monitored. Excessive temperatures in the drywell, increased drain sump pumping rate, and drywell high pressure are annunciated by alarms in the control room and, in certain cases, cause automatic isolation of the containment. In addition, low reactor vessel water level will isolate the main steam lines. The systems within the drywell share a common area; therefore, their leakage detection systems are common. Each of the leakage detection systems inside the drywell is designed with a capability of detecting leakage rates less than those established by the plant technical specifications.

5.2.5.1.2 Detection of Abnormal Leakage Outside the Primary Containment

Outside the drywell, the piping within each system monitored for leakage is in compartments or rooms, separate from other systems where feasible, so that leakage may be detected by area temperature indications. Each leakage detection system discussed below is designed to detect leak rates that are less than those established by the plant technical specifications. The method used to monitor for leakage for each RCPB component may be seen in Table 5.2-9.

a. Ambient and Differential Room Ventilation Temperature

A differential temperature sensing system is installed in each room containing equipment that is part of the reactor coolant pressure boundary. These rooms are the RCIC, RHR, and reactor water cleanup systems equipment rooms, and main steam line tunnel. Temperature sensors are placed in the inlet and outlet ventilation ducts. Other sensors are installed in the equipment areas to monitor ambient temperature. A differential temperature switch between each set of sensors and/or ambient temperature switch initiates an alarm and isolation when the temperature reaches a preset value. Annunciator and remote readouts from temperature sensors are indicated in the control room.

b. Reactor Building Sump Flow Measurement

Instrumentation monitors and indicates the amount of leakage into the reactor building floor drainage system. The normal leakage collected in the system consists of leakage from the reactor water cleanup and CRD systems, and from other miscellaneous vents and drains. Normal leakage is determined during preoperational tests as discussed in Chapter 14.

c. Visual and Audible Inspection

Accessible areas are inspected periodically and the temperature and flow indicators discussed above are monitored regularly as required by the plant technical specifications. Any instrument indication of abnormal leakage will be investigated.

d. Differential Flow Measurement (Cleanup System Only)

Because of the arrangement of the reactor water cleanup system, differential flow measurement provides an accurate leakage detection method. The flow from the reactor vessel is compared with the flow back to the vessel. An alarm in the control room and an isolation signal are initiated when higher flow out of the reactor vessel indicates that a leak may exist.

5.2.5.2 Leak Detection Devices

a. Drywell Floor Drain Sump Measurement

The normal design leakage collected in the floor drain sump consists of leakage from the control rod drives, valve flange leakage, floor drains, closed cooling water system and drywell cooling unit drains.

b. Drywell Equipment Drain Sump

The equipment drain sump collects only identified leakage. This sump receives condensate drainage from pump seal leakoff, reactor vessel head flange vent drain, and valve packing leak off. Collection in excess of background leakage would indicate reactor coolant leakage.

i. Valve Packing Leakage

Valve stem packing leaks of power-operated valves in the nuclear boiler system, reactor water cleanup system, high pressure core spray, low pressure core spray, reactor core isolation cooling system, residual heat removal system, and recirculation system are detected by monitoring packing leakoff for high temperature and are annunciated by an alarm in the control room.

5.2.5.3 Indication in Control Room

Leak detection methods are discussed in 5.2.5.1. Details of the leakage detection system indications are included in 7.6.1.3.

5.2.5.4 Limits for Reactor Coolant Leakage

5.2.5.4.1 Total Leakage Rate

The total leakage rate consists of all leakage, identified and unidentified, that flows to the drywell floor drain and equipment drain sumps. The criterion for establishing the total leakage rate limit is based on the makeup capability of the RCIC system.

The equipment sump and the floor drain sump collect all leakage. The equipment sump is drained by one 50 gpm pump and the floor drain sump is drained by two 50 gpm pumps. The total leakage rate limit is established at 30 gpm, 25 gpm identified and 5 gpm unidentified. The total leakage rate limit is low enough to prevent overflow of the drywell sumps.

5.2.5.4.2 Normally Expected Leakage Rate

The pump packing glands, valve stems, and other seals in systems that are part of the reactor coolant pressure boundary and from which normal design leakage is expected are provided with drains or auxiliary sealing systems. Nuclear system valves and pumps inside the drywell are equipped with double seals. Leakage from the primary recirculation pump seals is piped to the equipment drain sump as shown in Figure 5.4-2b. Leakage in the discharge lines from the main steam safety/relief valves is monitored by temperature sensors that transmit a signal to the control room. Any temperature increase above the drywell ambient temperature detected by these sensors indicates valve leakage.

Thus, the leakage rates from pumps, valve seals, and the reactor vessel head seal are measurable during plant operation. These leakage rates, plus any other leakage rates measured while the drywell is open, are defined as identified leakage rates.

5.2.5.5 Unidentified Leakage Inside the Drywell

5.2.5.5.1 Unidentified Leakage Rate

The unidentified leakage rate is the portion of the total leakage rate received in the drywell sumps that is not identified as previously described. A threat of significant compromise to the nuclear system process barrier exists if the barrier contains a crack that is large enough to propagate rapidly (critical crack length). The unidentified leakage rate limit must be low because of the possibility that most of the unidentified leakage rate might be emitted from a single crack in the nuclear system process barrier.

An allowance for leakage that does not compromise barrier integrity and is not identifiable is made for normal plant operation.

The unidentified leakage rate limit is established at 5 gpm rate to allow time for corrective action before the process barrier could be significantly compromised. This 5 gpm unidentified leakage rate is a small fraction of the calculated flow from a critical crack in a primary system pipe (Figure 5.2-13). Safety limits and safety limit settings are discussed in Chapter 16.

5.2.5.5.2 Sensitivity and Response Times

Sensitivity, including sensitivity tests and response time of the leak detection system are covered in Table 7.6-7.

5.2.5.5.3 Length of Through-Wall Flaw

Experiments conducted by GE and Battelle Memorial Institute, (BMI), permit an analysis of critical crack size and crack opening displacement (5.2.6 Ref. 5.2-4). This analysis relates to axially oriented through-wall cracks.

a. Critical Crack Length

Satisfactory empirical expressions have been developed to fit test results. A simple equation which fits the data in the range of normal design stresses (for carbon steel pipe) is:

5.3.1.4.1.3 Regulatory Guide 1.43, Control of Stainless Steel Weld Cladding of Low-Alloy Steel Components

Reactor pressure vessel specifications require that all low alloy steel be produced to fine grain practice. The requirements of the regulatory guide are not applicable to BWR vessels.

5.3.1.4.1.4 Regulatory Guide 1.44, Control of the Use of Sensitized Stainless Steel

Controls to avoid severe sensitization are discussed in 5.2.3.4.1.1.

5.3.1.4.1.5 Regulatory Guide 1.50, Control of Preheat Temperature for Welding Low-Alloy Steel

Preheat controls are discussed in 5.2.3.3.2.1.

5.3.1.4.1.6 Regulatory Guide 1.71, Welder Qualification for Areas of Limited Accessibility

Qualification for areas of limited accessibility is discussed in 5.2.3.3.2.4.

5.3.1.4.1.7 Regulatory Guide 1.99, Effects of Residual Elements on Predicted Radiation Damage to Reactor Pressure Vessel Materials

Predictions for changes in transition temperature and upper shelf energy were made in accordance with the requirements of Regulatory Guide 1.99.

5.3.1.5 Fracture Toughness

5.3.1.5.1 Compliance with Code Requirements

The ferritic pressure boundary material of the reactor pressure vessels was qualified by impact testing in accordance with the 1971 edition of Section III ASME Code and Summer 1971 Addenda. From an operational standpoint, the minimum temperature limits for pressurization defined by the Summer 1972 Addenda, Appendix G, Protection Against Nonductile Failure, are used as the basis for compliance with ASME Code Section III.

5.3.1.5.2 Compliance with 10 CFR 50 Appendix G

A major condition necessary for full compliance to Appendix G is satisfaction of the requirements of the Summer 1972 Addenda to Section III. This is not possible with components which were purchased to earlier Code requirements. For the extent of the compliance, see Table 5.3-1a.

Ferritic material complying with 10 CFR 50 Appendix G must have both drop weight tests and Charpy V-notch (CVN) tests with the CVN specimens oriented transverse to the maximum material working direction to establish the RT_{NDT}. The CVN tests must be evaluated against both an absorbed energy and a lateral expansion criteria. The maximum acceptable RT_{NDT} must be determined in accordance with the analytical procedures of ASME Code Section III, Appendix G. Appendix G of 10 CFR 50 requires a minimum of 75 ft-lb upper shelf CVN energy for beltline material. It also requires at least 45 ft-lb CVN energy and 25 mils lateral expansion for bolting material at the lower of the preload or lowest service temperature.

By comparison, material for the WNP-2 reactor vessels was qualified by either drop weight tests or longitudinally oriented CVN tests (both not required), confirming that the material nil-ductility transition temperature (NDTT) is at least 60°F below the lowest service temperature. When the CVN test was applied, a 30 ft-lb energy level was used in defining the NDTT. There was no upper shelf CVN energy requirement on the beltline material. The bolting material was qualified to a 30 ft-lb CVN energy requirement at 60°F below the minimum preload temperature.

From the previous comparison it can be seen that the fracture toughness testing performed on the WNP-2 reactor vessel material cannot be shown to comply with 10 CFR 50 Appendix G. However, to determine operating limits in accordance with 10 CFR 50 Appendix G, estimates of the beltline material RT_{NDT} and the highest RT_{NDT} of all other material were made, and are discussed in 5.3.1.5.2.2. The method for developing these operating limits is also described therein.

On the basis of the last paragraph on page 19013 of the July 17, 1973, Federal Register, the following is considered an appropriate method of compliance.

AMENDMENT NO. 17
July 1981

Transients are treated by items a and c; item b above results from an excessive leak past isolation valves. E12-F055 and RHR-RV-95 are sized to maintain upstream piping at 500 psig and 10 percent accumulation with E12-F051 or E12-F087 fully open and a reactor pressure equal to the lowest Nuclear Boiler safety/relief valve spring set point. E12-F036 are sized to maintain upstream pressure at 75 psig and 10 percent accumulation with both PCV E12-F065 A&B failed open. E12-F005, F025, F088, and F030 are set at the design pressure specified in the process data drawing plus 10 percent accumulation. RHR-RV-98 is installed across E12-F009 to prevent thermal overpressurization between E12-F008 and E12-F009.

Redundant interlocks prevent opening valves to the low pressure suction piping when the reactor pressure is above the shutdown range. These same interlocks initiate valve closure on increasing reactor pressure.

A pressure interlock prevents connecting the discharge piping to the primary system whenever the pressure difference across the discharge valve is greater than the design differential. In addition a high pressure check valve will close to prevent reverse flow if the pressure should increase. Relief valves in the discharge piping shall be sized to account for leakage past the check valve.

5.4.7.1.4 Design Basis With Respect to General Design Criteria 5

The RHR system for this unit does not share equipment or structures with any other nuclear unit.

5.4.7.1.5 Design Basis for Reliability and Operability

The design basis for the Shutdown Cooling mode of the RHR system is that this mode is controlled by the operator from the control room. The only operation performed outside of the control room for a normal shutdown is manual operation of a local flushing water admission valve, which is the means of assuring that the suction line of the shutdown portions of the RHR system is filled and vented.

Two separate shutdown cooling loops are provided; and although both loops are required for shutdown under normal circumstances, the reactor coolant can be brought to 212°F in less than 20 hours with only one loop in operation. With the exception of the shutdown suction, shutdown return, and steam supply and condensate discharge lines, the entire RHR system is part of the ECCS and containment cooling systems, and is therefore designed with redundancy, flooding protection, piping protection, power separation, etc. required of such systems. (See 6.3 for an explanation of the design bases for ECCS systems.) Shutdown suction and discharge valves are required to be powered from both offsite and standby emergency power for purposes of isolation and shutdown following a loss of offsite power. In the event either of the two shutdown supply valves fail to operate, the design basis for this plant is that an operator is sent to open the valve by hand. If this is not feasible, the shutdown line is isolated using manual valve E12-F113 and repairs are made to the shutdown valves so that they can be opened to supply shutdown suction to the RHR pumps. Residual heat is absorbed by the main condenser or by the suppression pool with pool cooling by the RHR system while repairs are in process.

5.4.7.1.6 Design Basis for Protection from Physical Damage

The RHR system is designed to the requirements of Table 3.2-1. With the exception of the common shutdown cooling line, redundant components of the RHR system are physically located in different quadrants of the reactor building, and are supplied from independent and redundant electrical divisions. Further discussion on protection from physical damage is provided in Chapter 3.

5.4.7.2 Systems Design

5.4.7.2.1 System Diagrams

All of the components of the RHR system are shown in the P&ID Figure 5.4-13. A description of the controls and instrumentation is presented in 7.3.1.1.1, "Emergency Core Cooling Systems (ECCS) Instrumentation and Controls".

A process diagram and process data are shown in Figures 5.4-14a through 5.4-14c. All of the sizing modes of the system are shown in the process data. The FCD for the RHR system is provided in Chapter 7.

Interlocks are provided: (1) to prevent drawing vessel water to the suppression pool; (2) to prevent opening vessel suction valves above the suction line design pressure, or the discharge line design pressure with the pump at shutoff head; (3) to prevent inadvertant opening of drywell spray valves while in shutdown; (4) to prevent opening low pressure steam supply valve F087 when vessel pressure is above line design rating; and (5) to prevent pump start when suction valve(s) are not open.

CHAPTER 6

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b. Concrete Reactor Pedestal

The reactor pedestal is coated with a prime coat of Keeler and Long 6548 epoxy primer (lead free), a coat of Keeler and Long 6548S epoxy surfacer in thickness required to produce a smooth surface, and a coat of Keeler and Long 7475 epoxy finish.

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c. Sacrificial Shield Wall, Miscellaneous Steel Mechanical Equipment and Low Temperature Piping (70^{o} to $350^{o}F$).

The subject surfaces are coated with a prime coat of Keeler and Long 7107 epoxy primer and one coat of Keeler and Long 7475 epoxy finish.

d. Diaphragm Floor

The diaphragm floor between the wetwell and drywell is coated with Keeler and Long 6548 epoxy primer, 6548 tinted, and 7475 epoxy enamel finish coat.

e. Suppression Chamber (Wetwell)

1) The vessel above the water level from elevation 472'-0" is coated with one coat of Dimetcote 6 (inorganic zinc).

2) The vessel below elevation 472'-0" to the concrete floor is coated with two coats of Amercoat 90 (modified phenolic epoxy).

3) All structural steel and seismic bracing below elevation 472'-0" is coated with two coats of Amercoat 90.

4) All structural steel and bracing above elevation 472'-0" is coated with either one coat of Dimetcote 6 or two coats of Amercoat 90.

5) The downcomer external surfaces below elevation 472'-0" and all internal surfaces are coated with two coats of Amercoat 90. The downcomer external surfaces above elevation 472'-0" are coated with either one coat of Dimetcote 6 or two coats of Amercoat 90.

6) The concrete pedestal, concrete columns and concrete floors are coated with a multi-coating (3/16" maximum thickness) of Nu-Klad 110 AA epoxy surfacer followed by two coats of Amercote 90. At concrete and steel interfaces and at concrete floor/column interfaces, the above system will include fiberglass cloth to add coating strength.

f. High Temperature Piping and NSSS Vendor Equipment and Piping

This equipment was coated with corrosion resistant metal primers and finish coats suitable for the environmental conditions of the component or piping.

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g. Stainless Steel Piping and Components

Stainless steel piping and components have no protective coatings.

In general protective coatings, except NSSS vendor supplied equipment and valve contracts placed prior to issuance of Regulatory Guide 1.54 Rev. 0, 6/73, have been applied in accordance with the guidelines included in ANSI N101.4-1972, "Quality Assurance for Protective Coatings Applied to Nuclear Facilities". In addition, the coatings used meet the requirements of ANSI N101.2-1972 for the design basis accident and are resistant to an integrated radiation exposure of 5. to 7.8 x 10^9 rads from a cobalt 60 source at an intensity of 6 x 10^5 rads/hr.

In repairing protective coating surfaces the maximum total coating thickness is in accordance with the manufacturers recommendations. Film thickness is checked using a non-destructive dry film thickness gauge. Repair areas are tested for pin holes and holidays with a nondestructive holiday detector of less than 100 volts, such as Tinker and Razor Model M-1.

6.1.3 POST-ACCIDENT CHEMISTRY

Since the water chemistry conditions of the reactor coolant are similar to suppression pool water with the exception being the addition of activation, corrosion, and fission products no appreciable pH changes are expected to occur.

There are no soluble acids and bases within the primary containment.

is made in Table 1.3-4. The water stored in the suppression pool is capable of condensing the steam displaced into the wetwell through the downcomer vents, and the amount of water is sufficient so as not to require any operator action for at least ten minutes immediately following initiation of a LOCA. In addition, the design allows the water from any pipe break within the primary containment to drain back to the suppression pool. This "closed loop" ensures a continuous, adequate supply of water for core cooling.

c. Negative Loading

The primary containment is designed for the following negative loadings:

1. A drywell pressure of 2.0 psi below reactor building pressure

2. A wetwell pressure of 2.0 psi below reactor building pressure

3. An upward pressure across the diaphragm floor of 6.4 psid.

The nine 24" wetwell-to-drywell (WW-DW) and the three 24" reactor building-to-wetwell (RB-WW) vacuum breaker lines are sized to ensure that the above negative loadings are not exceeded. The vacuum breaker systems are described in 3.8.2.1.3.

The primary containment is designed for a total external pressure of 4 psid; however, since the compressed insulation between the concrete biological shield and the containment exerts a uni form 2 psid external pressure - half of the total external pressure differential allowed - the drywell pressure may be no less than 2 psi below the reactor building pressure.

d. Environmental Conditions

The means to maintain the required environmental conditions inside the primary containment during normal operation is discussed in 6.2.1.1.8. With the exception of energy removal from the suppression pool, there are no requirements for environmental controls during a LOCA. All equipment required to mitigate the consequences of an accident is designed to perform the required functions for the required duration of time in the accident environment. The equipment accident environment is listed in Table 3.11-2.

Reflective metal insulation, manufactured, and installed in panels, is used exclusively within the primary containment.

The panels used for the pipes are typically two feet long, three to four-inch thick, and cover half of the pipe's circumference. These panels have 24 gauge stainless steel sheets which fully encase the six mil aluminum sheets. The panels used for the RPV are larger, typically 2' X 6', and are encased by 18 gauge stainless steel.

All panels on piping covering areas which require inservice inspection, such as welds, are fastened by quick release buckle bands. Nonremovable insulation panels around pipes are fastened, one to another, using self taping screws.

The fasteners have been designed to be weaker than the panels; therefore, it is postulated that some panels near a pipe break will be blown away but that the panels themselves will not be sheared open.

The insulation panels that have blown off constitute a credible debris source within the primary containment following a LOCA and seismic event. All equipment within the primary containment, if not designed to Seismic I standards, is at least supported so as to remain fastened during a seismic event.

Large pieces of debris are not considered to have deleterious effects on the containment systems. The grating (see Figure 6.2-24) at the 501'-0" elevation, which covers approximately 80 percent of the primary containment cross-sectional area, would stop the majority of the loose insulation panels. Any of the remaining panels could be pressed against the outer perimeter of the jet deflectors, but it is not considered credible that the panel could enter the actual downcomer vent. Partial blockage of several jet deflectors would have an insignificant effect on the containment vent system.

signal to open at the appropriate time to assure that acceptable fuel design limits are not exceeded in the event of a loss-of-coolant accident. The check valves are located as close as practicable to the RPV. The normally closed check valves protect against containment overpressurization in the event of pipe rupture between the check valve and containment wall by preventing high energy reactor water from entering the primary containment. Once the system is in operation, the low energy of the influent fluid (220°F maximum) excludes any possibility of containment overpressurization should a break occur.

6.2.4.3.2.1.1.4 Control Rod Drive Lines

The control rod drive system insert and withdraw lines penetrate the drywell; however, these insert and withdraw lines are not part of the reactor coolant pressure boundary since they do not directly communicate with the reactor coolant. The classification of these lines is quality group B, and they are therefore designed in accordance with ASME Section III, Class 2. The basis to which the CRD insert and withdraw lines are designed is commensurate with the safety importance of maintaining pressure integrity of these lines.

The control rod drive insert and withdraw lines can be isolated by the solenoid valves outside the primary containment. These lines that extend outside the primary containment are small and terminate in a system that is designed to prevent out-leakage. Solenoid valves normally are closed, but open on rod movement and during reactor scram. In addition, a ball check valve located in the control rod drive flange housing automatically seals the insert line in the event of a break. Containment overpressurization will not result from a line break in the containment since these lines contain small volumes at low energy levels. See Note 4 of Table 6.2-16 for further discussion.

The CRD return line to the reactor pressure vessel has been deleted.

6.2.4.3.2.1.1.5 RHR and RCIC Lines

The RHR head spray and RCIC lines meet outside the containment to form a common line which penetrates the drywell and discharges directly into the reactor pressure vessel. The testable check valve inside the drywell is normally closed and has position indication lights in the main control room to verify its position. The testable check valve is located as close as practicable to the reactor pressure vessel. Two types of valves, a check valve and a remote manual block valve, are located outside the containment. The check valve assures immediate isolation of the containment in the event of a line break. The block valve on the RHR line receives an automatic isolation signal while the block valve on the RCIC line is remote manually actuated to provide long-term leakage control.

6.2.4.3.2.1.1.6 Standby Liquid Control System Lines

The standby liquid control system line penetrates the drywell and connects to the reactor pressure vessel. In addition to a simple check valve inside the drywell, a check valve together with explosive actuated valves are located outside the drywell. Since the standby liquid control line is a normally closed, nonflowing line, rupture of this line is extremely remote. The explosive actuated valves function as third isolation valves. These valves provide an absolute seal for long-term leakage control as well as preventing leakage of sodium pentaborate into the reactor pressure vessel during normal reactor operation.

6.2.4.3.2.1.1.7 Reactor Water Cleanup System

The reactor water cleanup (RWCU) pumps, heat exchangers, and filter demineralizers are located outside the drywell. The return line from the filter demineralizers connects to the feedwater line outside the containment between the block valve and the outside containment feedwater check valve. Isolation of this line is provided by the feedwater system check valve inside the containment and a check valve and motor-operated gate valve outside the containment. The motor-operated gate valve functions as a third isolation valve.

During the postulated loss-of-coolant accident, it is desirable to maintain reactor coolant makeup. For this reason, valves which automatically isolate upon signal are not included in the design of the system. Consequently, a third valve is required to provide long-term leakage control. Should a break occur in the reactor water cleanup return line, the check valves would prevent significant loss of inventory and offer immediate isolation, while the outermost isolation valve would provide long-term leakage control.

6.2.4.3.2.1.1.8 Recirculation Pump Seal Water Supply Line

The recirculation pump seal water line extends from the recirculation pump through the drywell and connects to the CRD supply line outside the primary containment. The seal water line forms a part of the reactor coolant pressure boundary. The recirculation pump seal water line is 3/4 in. Class B from the recirculation pump through the outboard motor operated isolation valve. From this valve to the CRD connection the line is Class D. Should this line be postulated to fail, the flow rate through the broken line has been calculated to be substantially less than that permitted for a broken instrument line.

6.2.4.3.2.1.2 Effluent Lines

Effluent lines which form part of the reactor coolant pressure boundary and penetrate containment are equipped with at least two isolation valves; one inside the drywell and the other outside, located as close to the containment as practicable.

Table 6.2-16 also contains those effluent lines that comprise the reactor coolant pressure boundary and which penetrate the containment.

6.2.4.3.2.1.2.1 Main Steam, Main Steam Drain Lines and RHR Shutdown Cooling Lines

The main steam lines extend from the reactor pressure vessel to the main turbine and condenser system, and penetrate the primary containment. The main steam drain lines also penetrate the containment and the MSIV-LCS taps off these drain lines. The RHR steam supply line and RCIC turbine steam line connect to the main steam line inside the drywell and penetrate the primary containment. For these lines, isolation is provided by automatically actuated block valves, one inside the containment common to both the RHR steam supply line and the RCIC turbine steam line, and one for each line just outside the containment. The RHR shutdown cooling effluent line is provided with automatically actuated block valves.

6.2.4.3.2.1.2.2 Recirculation System Sample Lines

A sample line from the recirculation system penetrates the drywell. The sample line is 3/4 in. diameter and designed to

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ASME Section III, Class 1. A sample probe with a 1/8 in. diameter hole is located inside the recirculation line inside the drywell. In the event of a line break, the probe acts as a restricting orifice and limits the escaping fluid. Two automatic valves which fail close are provided, one inside and one outside the containment.

6.2.4.3.2.1.3 Conclusion on Criterion 55

In order to assure protection against the consequences of accidents involving the release of radioactive material, pipes which form the reactor coolant pressure boundary have been shown to provide adequate isolation capabilities on a case-by-case basis. In all cases, a minimum of two barriers were shown to protect against the release of radioactive materials.

In addition to meeting the isolation requirements stated in Criterion 55, the pressure-retaining components which comprise the reactor coolant pressure boundary are designed to meet other appropriate requirements which minimize the probability or consequences of an accidental pipe rupture. The quality requirements for these components ensure that they are designed, fabricated, and tested to the highest quality standards of all reactor plant components. The classification of components which comprise the reactor coolant pressure boundary are designed in accordance with the ASME Boiler and Pressure Vessel Code, Section III, Class 1.

It is, therefore, concluded that the design of piping system which comprise the reactor coolant pressure boundary and penetrate containment satisfies Criterion 55. For further discussion, see the following:

a. Quality Group Classification, Table 3.2-1.

b. Containment and Reactor Vessel Isolation Control System - 7.3.1.1.2.

6.2.4.3.2.2 Evaluation Against Criterion 56

Criterion 56 requires that lines which penetrate the containment and communicate with the containment interior must have two isolation valves; one inside the containment, and one outside unless it can be demonstrated that the containment isolation provisions for a specific class of lines are acceptable on some other basis.

Table 6.2-16 includes those lines that penetrate the primary containment and connect to the drywell and suppression chamber. Although a word for word comparison with Criterion 56 in some cases is not practical, it is possible to demonstrate adequate isolation provisions on some other defined basis.

6.2.4.3.2.2.1 Influent Lines to Suppression Pool

6.2.4.3.2.2.1.1 LPCS, HPCS, and RHR Test Lines

The LPCS, HPCS, and RHR test lines have test isolation capabilities commensurate with the importance to safety of isolating these lines. Each line has a normally closed motor-operated valve located outside the containment. Containment isolation requirements are met on the basis that the test lines are normally closed, low-pressure lines constructed to the same quality standards as the containment. Furthermore, the consequences of a break in these lines result in no significant safety consideration.

The test return lines are also used for suppression chamber return flow during other modes of operation. In this manner the number of penetrations are reduced, minimizing the potential pathways for radioactive material release. Typically, pump minimum flow bypass lines join the respective test return lines downstream of the test return isolation valve. The bypass lines are isolated by motor-operated valves with a restricting orifice downstream of the motor-operated valve.

6.2.4.3.2.2.1.2 RCIC Turbine Exhaust, Vacuum Pump Discharge and RCIC Pump Minimum Flow Bypass

These lines which penetrate the containment and discharge to the suppression pool are equipped with a motor-operated, remote manually actuated gate valve located as close to the containment as possible. In addition, there is a simple check valve upstream of the gate valve which provides positive actuation for immediate isolation in the event of a break upstream of this valve. The gate valve in the RCIC turbine exhaust is designed to be locked open in the control room and interlocked to preclude opening of the inlet steam valve to the turbine while the turbine exhaust valve is not in a full open position. The RCIC vacuum pump discharge line is also normally open but has no requirement for interlocking with steam inlet to the turbine. The RCIC pump minimum flow bypass line is isolated by normally closed, valve with a check valve installed upstream.

6.2.4.3.2.2.1.3 RHR Heat Exchanger Vent Lines

The RHR heat exchanger vent lines discharge through the RHR heat exchanger relief valve discharge lines and the RHR loop A and loop B test lines to the suppression pool. Two globe valves in each vent line provide the system pressure boundary and are used to control venting during the RHR heat exchanger filling and draining operations. The outboard globe valve in each line is also considered as, and meets the criteria for, a containment system isolation valve. Both valves are normally closed, remotely controlled motor-operated globe valves. Each vent line is also equipped with a manual block valve and the test connections necessary for Type C testing of the isolation valve.

6.2.4.3.2.2.1.4 RHR Relief Valve Discharge Lines

The RHR relief valve discharge to the suppression pool has no valve other than the relief valve. This relief valve will not be opened during normal operation and, therefore, can be considered as normally closed and adequate under the same criteria as the suppression chamber spray line explained in 6.2.4.3.2.2.3.4.

6.2.4.3.2.2.2 Effluent Lines From Suppression Chamber

The RHR, RCIC, LPCS, and HPCS suction lines contain motor-operated, remote manually actuated, gate valves which provide assurance of isolating these lines in the event of a break. These valves also provide long-term leakage control. In addition, the suction piping from the suppression chamber is considered an extension of containment since it must be available for long-term usage following a design basis loss-of-coolant accident, and as such, is designed to the same quality standards as the containment. Thus, the need for isolation is conditional. The ECCS discharge line fill system (ECCS waterleg pumps) takes suction from the respective ECCS pump effluent line from the suppression pool downstream of the isolation valve. The ECCS discharge line fill system suction line has a manual valve for operational purposes. This system is isolated from the containment by the respective ECCS pump suction valve from suppression pool as listed in Table 6.2-16.

from the control room. These valves provide assurance of isolating these lines in the event of a break and also provide long-term leakage control. In addition, the piping is considered an extension of containment boundary since it must be available for long-term usage following a design basis loss-of-coolant accident, and, as such, is designed to the same quality standards as the primary containment.

6.2.4.3.2.2.3.2 Containment Purge and Containment Drain Lines

The drywell and suppression chamber purge and containment drain lines have isolation capabilities commensurate with the importance to safety of isolating these lines. Each line has two air-operated spring closing valves located outside the primary containment. Containment isolation requirements are met on the basis that the purge and drain lines are low pressure lines constructed to the same quality standards as the containment. The isolation valves for the purge lines are designed to be locked closed in the main control room. These isolation valves are interlocked to preclude opening of the valves while a containment isolation signal exists as noted in Table 6.2-16.

Stainless steel grilles are installed across the supply and vent openings to prohibit debris from entering the purge lines thus preventing the isolation valves from seating.

6.2.4.3.2.2.3.3 Drywell and Suppression Chamber Air Sampling Lines

The radiation monitor lines penetrate the primary containment and are used for continuously sampling containment air during normal operation as part of the leak detection system. The supply lines are equipped with two automatic solenoid-operated isolation valves located outside, and as close as possible to, the containment. The return lines are equipped with an automatic solenoid-operated valve outside of containment and a check valve inside of containment. Further information on these lines is provided in Table 6.2-16.

The hydrogen monitoring lines penetrate the primary containment and are used to continuously monitor the primary containment air during the post-LOCA accident period. These lines are equipped with check or excess flow check valves located outside and as close as possible to the containment. Containment isolation requirements are met on the basis that these lines are low pressure lines constructed to the same quality standards as the containment lead to Class 1E essential instruments. Furthermore, the consequences of a break in these lines result in no significant safety consideration.

6.2.4.3.2.2.3.4 Suppression Chamber Spray Lines

The suppression chamber spray lines penetrate the containment to remove energy by condensing steam and cooling noncondensible gases in the suppression chamber. Each line is equipped with a normally closed motor-operated valve located outside, and as close as possible to, the primary containment. This normally closed valve receives an automatic isolation signal.

Containment isolation requirements are met on the basis that the spray header injection lines are closed low pressure lines constructed to the same quality standards as the containment. The requirements for use of a single isolation valve, as described in 6.2.4.3.2.2.1.1, are also satisfied.

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6.2.4.3.2.2.3.5 Reactor Building to Wetwell (RB-WW) Vacuum Relief Lines

The RB-WW vacuum relief penetrations, three in total, are each equipped with a positive closing swing check valve in series with an air-operated butterfly valve. The air operator on the swing check valve is used only for testing. The air operated butterfly valve is controlled by a differential pressure indicating switch which senses the pressure difference between the suppression chamber and the reactor building. When the negative pressure in the suppression chamber exceeds the instrument setpoint, the butterfly valve opens. Seismic Category I stainless steel grilles are installed across the swing check valve openings to prohibit debris from entering and preventing the valves from seating. The arrangement of valves and instruments is shown in Figure 3.2-15. See Table 6.2-15 for differential pressure indicating switch characteristics.

6.2.4.3.2.2.3.6 Reactor Recirculation (RRC) Flow Control Valve Hydraulic Lines

The four hyudraulic control lines to each of the RRC system flow control valves contain two isolation valves per line located outside the drywell. Both isolation valves are solenoid-operated and close automatically upon receipt of an isolation signal. The hydraulic lines and their isolation valves are discussed in Note 28 of Table 6.2-16.

6.2.4.3.2.2.4 Conclusion on Criterion 56

In order to assure protection against the consequences of accidents involving release of significant amounts of radioactive materials, pipes that penetrate the containment have been demonstrated to provide isolation capabilities on a case-by-case basis in accordance with Criterion 56.

In addition to meeting isolation requirements, the pressure retaining components of these systems are designed to the same quality standards as the containment.

6.2.4.3.2.3 Evaluation Against Criterion 57

Lines penetrating the primary containment for which neither Criterion 55 nor Criterion 56 govern comprise the closed system isolation valve group.

the pressure temperature manifold skid maintains the desired nitrogen system pressure.

For containment makeup, flow control is provided by a variable orifice followed by a flow totalizer. Estimated flow requirements, based on containment leakage of 0.5% per Table 6.2-1, is less than 75 cfh. The gas is introduced into the containment via 3/4" penetrations fitted with suitable containment isolation valves (Figure 6.2-31b).

6.2.5.7.3 Safety Evaluation

Since the inerting system is not safety-related, it is designed and constructed in accordance with ASME Section VIII, and system piping is designed and fabricated in accordance with ANSI B31.1, Seismic Category II. (System piping supports are Seismic Category I inside Seismic Category I structures.) The only exception is that portion of the piping system from and including the outer isolated valve to the penetration (Figures 6.2-31b and 6.2-31s) which are ASME III Class 2, Safety Class 2 and Seismic Category I.

Nitrogen addition to the containment can be terminated from the control room. A motor-operated valve is provided on the makeup line for high flow requirements and a solenoid-operated valve is provided on the piping connected to the TIP and CIA systems. In addition, the interlock between containment pressure switches and the air-operated valves of the makeup lines will close these valves if containment pressure reaches 0.75 psig.

TABLE 6.2-16

PRIMARY CONTAINMENT ISOLATION

LINE DESCRIPTION	Pent. No.	FSAR Fig. Nos.	GDC	Code Gp. (12)	Valve No.	Valve Type	Loc.	Pwr. to Open (5)	Pwr. to Close (5)	Iso. Sig. (9)	Back Up	Norm Pos. (10)	Shut-down Pos.	Post LOCA	Fail. Pos. (6)	Vlv. Sz. (14)	Close. Time (7) (11)	Dist. to Pent.	Leads to ESF Sys.	Proc. Fld.	Leak Bar. (13)	Term. Zone (13)	Pot. By-pass Leak. (SCFH)	Notes
MS Line A	18A	3.2-2 3.2-25 6.2-31J	55	A	MS-V-22A	AO Globe	I	Air	Air/ Spr	A,C, G,D, P	RM	O	O/C	C	C	26	3-10	-	No	S	Valves	T.B.	No	1, 15
					MS-V-28A	AO Globe	O	Air	Air/ Spr	A,C, G,D, P	RM	O	O/C	C	C	26	3-10	4	No	S	Valves	T.B.	No	1, 15
					MS-V-67A	MO Gate	O	AC	AC	A,C, G,D, P	RM	O	C	C	AS-IS	1-1/2	Std	5	No	S	Valves	T.B.	No	15
					MSLC-V-3A	MO Gate	O	AC	AC	30	RM	C	C	O	AS-IS	1-1/2	Std	10	Yes	S	Valves	R.B.	No	
MS Line B	18B	3.2-2 3.2-25 6.2-31J	55	A	MS-V-22B	AO Globe	I	Air	Air/ Spr	A,C, G,D, P	RM	O	O/C	C	C	26	3-10	-	No	S	Valves	T.B.	No	1, 15
					MS-V-28B	AO Globe	O	Air	Air/ Spr	A,C, G,D, P	RM	O	O/C	C	C	26	3-10	4	No	S	Valves	T.B.	No	1, 15
					MS-V-67B	MO Gate	O	AC	AC	A,C, G,D, P	RM	O	C	C	AS-IS	1-1/2	Std	5	No	S	Valves	T.B.	No	15
					MSLC-V-3B	MO Gate	O	AC	AC	30	RM	C	C	O	AS-IS	1-1/2	Std	10	Yes	S	Valves	R.B.	No	
MS Line C	18C	3.2-2 3.2-25 6.2-31J	55	A	MS-V-22C	AO Globe	I	Air	Air/ Spr	A,C, G,D, P	RM	O	O/C	C	C	26	3-10	-	No	S	Valves	T.B.	No	1, 15
					MS-V-28C	AO Globe	O	Air	Air/ Spr	A,C, G,D P	RM	O	O/C	C	C	26	3-10	4	No	S	Valves	T.B.	No	1, 15
					MS-V-67C	MO Gate	O	AC	AC	A,C, G,D, P	RM	O	C	C	AS-IS	1-1/2	Std	5	No	S	Valves	T.B.	No	15
					MSLC-V-3C	MO Gate	O	AC	AC	30	RM	C	C	O	AS-IS	1-1/2	Std	10	Yes	S	Valves	R.B.	No	

TABLE 6.2-16 (Continued)

LINE DESCRIPTION	Pent. No.	FSAR Fig. Nos.	GDC	Code Gp. (12)	Valve No.	Valve Type	Loc.	Pwr. to Open (5)	Pwr. to Close (5)	Iso. Sig. (9)	Back Up	Norm Pos. (10)	Shut-down Pos.	Post LOCA	Fail. Pos. (6)	Vlv. Sz. (14)	Close. Time (7) (11)	Dist. to Pent.	Leads to ESF Sys.	Proc. Fld.	Leak Bar. (13)	Term. Zone (13)	Pot. By-pass Leak. (SCFH)	Notes
MS Line D	180	3.2-2 3.2-25 6.2-31J	55	A	MS-V-220	AO Globe	I	Air	Air/ Spr	A,C, G,D, P	RM	O	O/C	C	C	26	3-10	-	No	S	Valves	T.B.	No	1, 15
					MS-V-280	AO Globe	O	Air	Air/ Spr	A,C, G,D, P	RM	O	O/C	C	C	26	3-10	4	No	S	Valves	T.B.	No	1, 15
					MS-V-670	MO Gate	O	AC	AC	A,C, G,D, P	RM	O	C	C	AS-IS	1-1/2	Std	5	No	S	Valves	T.B.	No	15
					MSLC-V-30	MO Gate	O	AC	AC	30	RM	C	C	O	AS-IS	1-1/2	Std	10	Yes	S	Valves	R.B.	No	
MS Line Drain	22	3.2-2 6.2-31f	55	A	MS-V-16	MO Gate	I	AC	AC	A,C, G,D, P	RM	O	C	C	AS-IS	3	Std	-	No	S	Valves	T.B.	.19	
					MS-V-19	MO Gate	O	DC	DC	A,C, G,D, P	RM	O	C	C	AS-IS	3	Std	6	No	S				

TABLE 6.2-16 (Continued)

LINE DESCRIPTION	Pent. No.	FSAR Fig. Nos.	GDC	Code Gp. (12)	Valve No.	Valve Type	Loc.	Pwr. to Open (5)	Pwr. to Close (5)	Iso. Sig. (9)	Back Up	Norm Pos. (10)	Shut-down Pos.	Post LOCA	Fail. Pos. (6)	Vlv. Sz. (14)	Close. Time (7) (11)	Dist. to Pent.	Leads to ESF Sys.	Proc. Fld.	Leak Bar. (13)	Term. Zone (13)	Pot. By-pass Leak. (SCFH)	Notes
DW Service Line	92	9.2-4 6.2-31L	56	B	DW-V-157	Gate	I	Manual	Manual	-	-	LC	LC	LC	-	2	-		No	W	Valves	S.B.	.13	
					DW-V-156	Gate	O	Manual	Manual	-	-	LC	LC	LC	-	2	-	5						
RHR Condensing Mode Steam Supply	21	3.2-8 6.2-31e	55	A	RCIC-V-63	MO Gate	I	AC	AC	K	RM	O	O/C	O/C	AS-IS	10	16	-	Yes	S	Valves	R.B.	No	
					RCIC-V-76	MO Globe	I	AC	AC	K	RM	C	C	C	AS-IS	1	5	-						
					RCIC-V-64	MO Gate	O	DC	DC	X	RM	C	C	C	AS-IS	10	16	2						
RCIC Turbine Steam Supply	45	3.2-8 6.2-31e	55	A	RCIC-V-63	MO Gate	I	AC	AC	K	RM	O	O/C	O/C	AS-IS	10	16	-	No	S	Valves	R.B.	No	
					RCIC-V-76	MO Globe	I	AC	AC	K	RM	C	C	C	AS-IS	1	5	-						
					RCIC-V-8	MO Gate	O	DC	DC	X	RM	O	O/C	O/C	AS-IS	4	Std	2						
RCIC Pump Minimum Flow	65	3.2-8 6.2-31h	56	B	RCIC-V-19	MO Globe	O	DC	UC	33	RM	C	C	O/C	AS-IS	2	5	7	No	W	Valves	R.B.	No	22
RCIC Turbine Exhaust	4	3.2-8 6.2-31n	56	B	RCIC-V-68	MO Gate	O	DC	DC	35	RM	O	O	O/C	AS-IS	10	Std	10	No	S	Valves	R.B.	No	22
			56	B	RCIC-V-40	Check	O	Process	Process	-	-	O	C	O/C	-	10	-	12	No	S	Valves	R.B.	No	
RCIC Turbine Exhaust Vacuum Breaker	116	3.2-8 6.2-31l	56	B	RCIC-V-110	MO Gate	O	DC	DC	N	RM	O	O	O/C	AS-IS	2	Std	9	No	A	Valves	R.B.	No	17
					RCIC-V-113	MO Gate	O	DC	DC	N	RM	O	O	O/C	AS-IS	2	Std	5						
RCIC Vacuum Pump Discharge	64	3.2-8 6.2-31q	56	B	RCIC-V-69	MO Gate	O	UC	DC	36	RM	O	O	O/C	AS-IS	1-1/2	Std	3	No	W	Valves	R.B.	No	22
			56	B	RCIC-V-28	Check	O	Process	Process	-	-	C	O	O/C	-	1-1/2	-	5	No	W	Valves	R.B.	No	
RCIC Pump Suction from Suppression Pool	33	3.2-8 6.2-31n	56	B	RCIC-V-31	MO Gate	O	DC	DC	32	RM	C	O	O/C	AS-IS	8	Std	2	No	W	Valves	R.B.	No	48
RPV Head Spray	2	3.2-8 6.2-31o	55	A	RCIC-V-66	Check	I	Process	Process	-	-	C	O	O/C	-	6	-	-	No	W	Valves	R.B.	No	3
					RCIC-V-13	MO Gate	O	DC	DC	34	RM	C	O/C	O/C	AS-IS	6	15	2	No	W	Valves	R.B.	No	
					RHR-V-23	MO Globe	O	DC	DC	L,U, H,R	RM	C	O/C	C	AS-IS	6	Std	7	Yes	W	Valves	R.B.	No	

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TABLE 6.2-16 (Continued)

LINE DESCRIPTION	Pent. No.	FSAR Fig. Nos.	GDC	Code Gp. (12)	Valve No.	Valve Type	Loc.	Pwr. to Open (5)	Pwr. to Close (5)	Iso. Sig. (9)	Back Up	Norm Pos. (10)	Shut-down Pos.	Post LOCA	Fail. Pos. (6)	Vlv. Sz. (14)	Close. Time (7) (11)	Dist. to Pent.	Leads to ESF Sys.	Proc. Fld.	Leak Bar. (13)	Term. Zone (13)	Pot. By-pass Leak. (SCFH)	Notes
Drywell Spray Loop A	11A	3.2-6 6.2-31g	56	B	RHR-V-16A	MO Gate	O	AC	AC	46	RM	C	C	O/C	AS-IS	16	10	26	Yes	W	Valves	R.B.	No	17, 24
					RHR-V-17A	MO Gate	O	AC	AC	46	RM	C	C	O/C	AS-IS	16	10	24						
Drywell Spray Loop B	11B	3.2-6 6.2-31g	56	B	RHR-V-16B	MO Gate	O	AC	AC	46	RM	C	C	O/C	AS-IS	16	10	12	Yes	W	Valves	R.B.	No	17, 24
					RHR-V-17B	MO Gate	O	AC	AC	46	RM	C	C	O/C	AS-IS	16	10	2						
LPCI Loop A	12A	3.2-6 6.2-31L	55	A	RHR-V-41A	Check	I	Process	Process	-	-	C	C	O/C	-	14	-	-	Yes	W	Valves	R.B.	No	3, 24
					RHR-V-42A	MO Gate	O	AC	AC	46	RM	C	C	O/C	AS-IS	14	27	21						
LPCI Loop B	12B	3.2-6 6.2-31L	55	A	RHR-V-41B	Check	I	Process	Process	-	-	C	C	O/C	-	14	-	-	Yes	W	Valves	R.B.	No	3, 24
					RHR-V-42B	MO Gate	O	AC	AC	46	RM	C	C	O/C	AS-IS	14	27	20						
LPCI Loop C	12C	3.2-6 6.2-31L	55	A	RHR-V-41C	Check	I	Process	Process	-	-	C	C	O/C	-	14	-	-	Yes	W	Valves	R.B.	No	3, 24
					RHR-V-42C	MO Gate	O	AC	AC	46	RM	C	C	O/C	AS-IS	14	27	20						
Shutdown Cooling Return Loop A	19A	3.2-6 6.2-31m	55	A	RHR-V-50A	Check	I	Process	Process	-	-	C	O	C	-	12	-	-	Yes	W	Valves	R.B.	No	3
					RHR-V-123A	MO Gate	I	AC	AC	F,L U,M, R	RM	C	O/C	C	AS-IS	1	STD	-						
					RHR-V-53A	MO Globe	O	AC	AC	M,L, U,R	RM	C	O	C	AS-IS	12	40	5						
Shutdown Cooling Return Loop B	19B	3.2-6 6.2-31m	55	A	RHR-V-50B	Check	I	Process	Process	-	-	C	O	C	-	12	-	-	Yes	W	Valves	R.B.	No	3
					RHR-V-123B	MO Gate	I	AC	AC	F,L U,M, R	RM	C	O/C	C	AS-IS	1	STD	-						
					RHR-V-53B	MO Globe	O	AC	AC	M,L, U,R	RM	C	O	C	AS-IS	12	40	2						
Shutdown Cooling Suction	20	3.2-6 6.2-31k	55	A	RHR-V-9	MO Gate	I	AC	AC	L,U, M,R	RM	C	O	C	AS-IS	20	40	-	Yes	W	Valves	R.B.	No	
					RHR-V-8	MO Gate	O	AC	AC	L,U, M,R	RM	C	O	C	AS-IS	20	40	14						
					RHR-V-209	Check	I	Process	Process	-	-	C	C	C	-	3/4	-	-	No	W	Valves	R.B	No	

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TABLE 6.2-16 (Continued)

LINE DESCRIPTION	Pent. No.	FSAR Fig. Nos.	GDC	Code Gp. (12)	Valve No.	Valve Type	Loc.	Pwr. to Open (5)	Pwr. to Close (5)	Iso. Sig. (9)	Back Up	Norm Pos. (10)	Shut-down Pos.	Post LOCA	Fail. Pos. (6)	Vlv. Sz. (14)	Close. Time (7) (11)	Dist. to Pent.	Leads to ESF Sys.	Proc. Fld.	Leak Bar. (13)	Term. Zone (13)	Pot. By-pass Leak. (SCFH)	Notes
RHR Loop A:	47	3.2-6	56	B																				
pump test line		6.2-31p			RHR-V-24A	MO Globe	O	AC	AC	F,V	RM	C	C	C	AS-IS	18	Std	12	Yes	W	Valves	R.B.	No	2, 18, 24
discharge header relief					RHR-RV-25A	Relief	O	PP	Spring	-	-	C	C	C	-	2	-	33	Yes	W	Valves	R.B.	No	18, 19
heat exch. steam relief					RHR-RV-55A	Relief	O	PP	Spring	-	-	C	C	C	-	10	-	22	Yes	S	Valves	R.B.	No	18, 19
heat exch. condensate					RHR-V-11A	MO Gate	O	AC	AC	F,V	RM	C	O/C	C	AS-IS	4	-	18	Yes	W	Valves	R.B.	No	18
heat exch. condensate relief					RHR-RV-36	Relief	O	PP	Spring	-	-	C	C	C	-	8	-	20	Yes	W	Valves	R.B.	No	18, 20
pump minimum flow					RHR-FCV-64A	MO Globe	O	AC	AC	38	RM	C	C	O/C	AS-IS	3	15	22	Yes	W	Valves	R.B.	No	48
heat exch. thermal relief					RHR-RV-1A	Relief	O	PP	Spring	-	-	C	C	C	-	1-1/2	-	188	Yes	W	Valves	R.B.	No	18, 19
heat exch. vent					RHR-V-73A	MO Globe	O	AC	AC	39	RM	C	O/C	C	AS-IS	2	Std	175	Yes	A	Valves	R.B.	No	18
FDR system inter-tie					RHR-V-121	Gate	O	Manual	Manual	-	-	LC	C	LC	-	3	-	6	No	W	Valves	R.B.	No	
CAC system Loop A drain					RHR-V-134A	MO Gate	O	AC	AC	37	RM	C	C	O/C	AS-IS	2	Std	44	Yes	W	Valves	R.B.	No	18
pump A suction relief					RHR-RV-88A	Relief	O	PP	Spring	-	-	C	C	C	-	1	-	30	Yes	W	Valves	R.B.	No	18
RHR Loop B	48	3.2-6	56	B																				
pump test line		6.2-31p			RHR-V-24B	MO Globe	O	AC	AC	F,V	RM	C	C	C	AS-IS	18	Std	12	Yes	W	Valves	R.B.	No	2, 18, 24
discharge header relief					RHR-RV-25B	Relief	O	PP	Spring	-	-	C	C	C	-	2	-	30	Yes	W	Valves	R.B.	No	18, 19
heat exch. steam relief					RHR-RV-55B	Relief	O	PP	Spring	-	-	C	C	C	-	10	-	20	Yes	S	Valves	R.B.	No	18, 19
pump A&B suction relief					RHR-RV-5	Relief	O	PP	Spring	-	-	C	C	C	-	2	-	20	Yes	W	Valves	R.B.	No	18, 19

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TABLE 6.2-16 (Continued)

LINE DESCRIPTION	Valve No.	Valve Type	Loc.	Pwr. to Open (5)	Pwr. to Close (5)	Iso. Sig. (9)	Back Up	Norm Pos. (10)	Shut-down Pos.	Post LOCA	Fail. Pos. (6)	Vlv. Sz. (14)	Close. Time (7) (11)	Dist. to Pent.	Leads to ESF Sys.	Proc. Fld.	Leak Bar. (13)	Term. Zone (13)	Pot. By-pass Leak. (SCFH)	Notes
heat exch. condensate	RHR-V-11B	MO Gate	O	AC	AC	F,Y	RM	C	O/C	C	AS-IS	4	Std	15	Yes	W	Valves	R.B.	No	18
pump minimum flow	RHR-FCV-64B	MO Globe	O	AC	AC	38	RM	C	C	O/C	AS-IS	3	15	22	Yes	W	Valves	R.B.	No	18
flush line relief	RHR-RV-30	Relief	O	PP	Spring	-	-	C	C	C	-	2	-	34	Yes	W	Valves	R.B.	No	18, 19
heat exch. thermal relief	RHR-RV-1B	Relief	O	PP	Spring	-	-	C	C	C	-	1-1/2	-	189	Yes	W	Valves	R.B.	No	18, 19
heat exch. vent	RHR-V-73B	MO Globe	O	AC	AC	39	Manual	C	O/C	C	AS-IS	2	Std	190	Yes	A	Valves	R.B.	No	18
CAC system Loop B drain	RHR-V-134B	MO Gate	O	AC	AC	37	Manual	C	C	O/C	AS-IS	2	Std	44	Yes	W	Valves	R.B.	No	18
pump B suction relief	RHR-RV-88B	Relief	O	PP	Spring	-	-	C	C	C	-	1	-	30	Yes	W	Valves	R.B.	No	18

LINE DESCRIPTION	Pent. No.	FSAR Fig. Nos.	GDC	Code Gp. (12)	Valve No.	Valve Type	Loc.	Pwr. to Open (5)	Pwr. to Close (5)	Iso. Sig. (9)	Back Up	Norm Pos. (10)	Shut-down Pos.	Post LOCA	Fail. Pos. (6)	Vlv. Sz. (14)	Close. Time (7) (11)	Dist. to Pent.	Leads to ESF Sys.	Proc. Fld.	Leak Bar. (13)	Term. Zone (13)	Pot. By-pass Leak. (SCFH)	Notes
RCC Inlet Header	5	3.2-14 6.2-31t	56	B	RCC-V-104	MO Gate	O	AC	AC	F,A	-	O	O	C	AS-IS	10	Std	5	No	W	Valves	R.B.	No	17
					RCC-V-5	MO Gate	O	AC	AC	F,A	-	O	O	C	AS-IS	10	Std	3						
RCC Outlet Header	46	3.2-14 6.2-31o	56	B	RCC-V-21	MO Gate	O	AC	AC	F,A	-	O	O	C	AS-IS	10	Std	3	No	W	Valves	R.B.	No	
					RCC-V-40	MO Gate	I	AC	AC	F,A	-	O	O	C	AS-IS	10	Std	-						
Suppression Pool Cleanup Suction	100	3.2-12 6.2-31l	56	B	FPC-V-153	MO Gate	O	AC	AC	F,A	RM	C	C	C	AS-IS	6	Std	2	No	W	Valves	R.B.	No	17,48
					FPC-V-154	MO Gate	O	AC	AC	F,A	RM	C	C	C	AS-IS	6	Std	7						48
Suppression Pool Cleanup Return	101	3.2-12 6.2-31o	56	B	FPC-V-156	MO Gate	O	AC	AC	F,A	RM	C	C	C	AS-IS	6	Std	3	No	W	Valves	R.B.	No	17,48
					FPC-V-149	Globe	O	Manual	Manual	-	-	LC	LC	LC	-	6	-	41						48
RWCU From Reactor	14	3.2-11 6.2-31k	55	A	RWCU-V-1	MO Gate	I	AC	AC	A,J, E,W	RM	O	O	C	AS-IS	6	Std	-	No	W	Valves	Rad. W.	.35	
					RWCU-V-4	MO Gate	O	DC	DC	A,J, E,Y,W	RM	O	O	C	AS-IS	6	Std	4						
RRC Pump A seal Water	43A	3.2-3 6.2-31c	56	B	RRC-V-13A	Check	I	Process	Process	-	-	O	O	O	-	3/4	Std	-	No	W	Valves	R.B.	No	
					RRC-V-16A	MO Gate	O	AC	AC	45	RM	O	O	O	AS-IS	3/4	Std	2						
RRC Pump B seal water	43B	3.2-3 6.2-31c	56	B	RRC-V-13B	Check	I	Process	Process	-	-	O	O	O	-	3/4	Std	-	No	W	Valves	R.B.	No	
					RRC-V-16B	MO Gate	O	AC	AC	45	RM	O	O	O	AS-IS	3/4	Std	2						
RRC Sample Line	77Aa	3.2-3 6.2-31d	55	A	RRC-V-19	SO Globe	I	AC	Spring	A,C,	RM	C	C	C/O	C	3/4	<5	-	No	W	Valves	T.B.	.05	
					RRC-V-20	AO Globe	O	Air	Spring	A,C,	RM	C	C	C/O	C	3/4	Std							

TABLE 6.2-16 (Continued)

LINE DESCRIPTION	Pent. No.	FSAR Fig. Nos.	GDC	Code Gp. (12)	Valve No.	Valve Type	Loc.	Pwr. to Open (5)	Pwr. to Close (5)	Iso. Sig. (9)	Back Up	Norm Pos. (10)	Shut-down Pos.	Post LOCA	Fail. Pos. (6)	Vlv. Sz. (14)	Close. Time (7) (11)	Dist. to Pent.	Leads to ESF Sys.	Proc. Fld.	Leak Bar. (13)	Term. Zone (13)	Pot. By-pass Leak. (SCFH)	Notes
Drywell Equipment Drain	23	3.2-9 6.2-31k	56	B	EDR-V-19	AO Gate	O	Air	Spring	F,A	RM	O	O	C	C	3	Std	2	No	W	Valves	R.B.	No	17
					EDR-V-20	AO Gate	O	Air	Spring	F,A	RM	O	O	C	C	3	Std	4						
Drywell Floor Drain	24	3.2-10 6.2-31k	56	B	FDR-V-3	AO Gate	O	Air	Spring	F,A	RM	O	O	C	C	3	Std	2	No	W	Valves	R.B.	No	17
					FDR-V-4	AO Gate	O	Air	Spring	F,A	RM	O	O	C	C	3	Std	3						
Decontamination Soltn. Supply Header	94	3.2-10	NA	B	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	Blanked Close	R.B.	No	
Decontamination Soltn. Return Header	95	3.2-10	NA	B	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	Blanked Close	R.B.	No	
CIA for Safety Relief Valve Accumulators	56	3.2-21 6.2-31c	56	B	CIA-V-21	Check	I	Process	Process	-		C	C	C	-	3/4	-	-	No	A	Valves	R.B.	No	
					CIA-V-20	MO Globe		AC	AC	41	RM	O	O	O	AS-IS	3/4	Std	10						
CIA Line A for ADS Accumulators	89B	3.2-21 6.2-31c	56	B	CIA-V-31A	Check	I	Process	Process	-		C	C	C	-	1/2	-	-	No	A	Valves	R.B.	No	
					CIA-V-30A	MO Globe		AC	AC	42	RM	O	O	O	AS-IS	1/2	Std	15						
CIA Line B for ADS Accumulators	91	3.2-21 6.2-31c	56	B	CIA-V-31B	Check	I	Process	Process	-		C	C	C	-	1/2	-	-	No	A	Valves	R.B.	No	
					CIA-V-30B	MO Globe		AC	AC	42	RM	O	O	O	AS-IS	1/2	Std	15						
CRD Insert Lines (185 separate lines)	9	3.2.4	56	B						See Note 4														
CRD Withdrawal lines (185 separate lines)	10	3.2.4	56	B						See Note 4														

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TABLE 6.2-16 (Continued)

LINE DESCRIPTION	Pent. No.	FSAR Fig. Nos.	GDC	Code Gp. (12)	Valve No.	Valve Type	Loc.	Pwr. to Open (5)	Pwr. to Close (5)	Iso. Sig. (9)	Back Up	Norm Pos. (10)	Shut-down Pos.	Post LOCA	Fail. Pos. (6)	Vlv. Sz. (14)	Closo. Time (7) (11)	Dist. to Pent.	Leads to ESF Sys.	Proc. Fld.	Leak Bar. (13)	Term. Zone (13)	Pot. By-pass Leak. (SCFH)	Notes
Air line for testing RHR-V-50A	42d	6.2-31r 3.2-6	56	B	PI-VX-42d	Globe	0	Manual	Manual	-	-	LC	LC	LC	-	1	-	<7	No	A	Valves	R.B.	No	25
					PI-VX-216	Globe	0	Manual	Manual	-	-	LC	LC	LC	-	1	-	<7						
Air line for testing RHR-V-50B	69c	6.2-31r 3.2-6	56	B	PI-VX-69c	Globe	0	Manual	Manual	-	-	LC	LC	LC	-	1	-	<7	No	A	Valves	R.B.	No	25
					PI-VX-221	Globe	0	Manual	Manual	-	-	LC	LC	LC	-	1	-	<7						
Air line for testing RHR-V-41A	61f	6.2-31r 3.2-6	56	B	PI-VX-61f	Globe	0	Manual	Manual	-	-	LC	LC	LC	-	1	-	<7	No	A	Valves	R.B.	No	25
					PI-VX-219	Globe	0	Manual	Manual	-	-	LC	LC	LC	-	1	-	<7						
Air line for testing RHR-V-41B	548f	6.2-31r 3.2-6	56	B	PI-VX-548f	Globe	0	Manual	Manual	-	-	LC	LC	LC	-	1	-	<7	No	A	Valves	R.B.	No	25
					PI-VX-218	Globe	0	Manual	Manual	-	-	LC	LC	LC	-	1	-	<7						
Air line for testing RHR-V-41C	62f	6.2-31r 3.2-6	56	B	PI-VX-62f	Globe	0	Manual	Manual	-	-	LC	LC	LC	-	1	-	<7	No	A	Valves	R.B.	No	25
					PI-VX-220	Globe	0	Manual	Manual	-	-	LC	LC	LC	-	1	-	<7						
Air line for testing LPCS-V-6	78d	6.2-31r 3.2-7	56	B	PI-VX-78d	Globe	0	Manual	Manual	-	-	LC	LC	LC	-	1	-	<7	No	A	Valves	R.B.	No	25
					PI-VX-222	Globe	0	Manual	Manual	-	-	LC	LC	LC	-	1	-	<7						
Air line for testing HPCS-V-5	78e	6.2-31r 3.2-7	56	B	PI-VX-78e	Globe	0	Manual	Manual	-	-	LC	LC	LC	-	1	-	<7	No	A	Valves	R.B.	No	25
					PI-VX-223	Globe	0	Manual	Manual	-	-	LC	LC	LC	-	1	-	<7						
Air line for testing RCIC-V-66	54a	6.2-31r 3.2-8	56	B	PI-VX-54Aa	Globe	0	Manual	Manual	-	-	LC	LC	LC	-	1	-	<7	No	A	Valves	R.B.	No	25
					PI-VX-217	Globe	0	Manual	Manual	-	-	LC	LC	LC	-	1	-	<7						
Air line for testing WW-DW vacuum relief valves	82e	6.2-31r 9.3-1	56	B																				
					CAS-VX-82e	Globe	0	Manual	Manual	-	-	LC	LC	LC	-	1	-	-						
					CAS-V-453	SO Globe	0	AC	Spring	C,F	-	C	C	C	C	1	<5	5	No	A	Valves	R.B.	No	44
Air line for maintenance	93	9.3-1 6.2-31t	56	B	-	Pipe Cap	1	-	-	-	-	C	C	C	-	2	-	-	No	A	Cap & Valve	S.B.	No	
					SA-V-109	Gate	0	Manual	Manual	-	-	LC	LC	LC	-	2	-	1						
Tip lines	27a-e		54		C51J004	SO Ball	0	AC	AC	L,F	RM	C	C	C	C	3/8	<5	2	No	A	Valves	R.B.	No	29
					C51J004	Shear	0	-	Explosive	43	-	O	O	O	O	3/8	-	2						

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TABLE 6.2-16 (Continued)

LINE DESCRIPTION	Pent. No.	FSAR Fig. Nos.	GDC	Code Gp. (12)	Valve No.	Valve Type	Loc.	Pwr. to Open (5)	Pwr. to Close (5)	Iso. Sig. (9)	Back Up	Norm Pos. (10)	Shut-down Pos.	Post LOCA	Fail. Pos. (6)	Vlv. Sz. (14)	Close. Time (7) (11)	Dist. to Pent.	Leads to ESF Sys.	Proc. Fld.	Leak Bar. (13)	Term. Zone (13)	Pot. By-pass Leak. (SCFH)	Notes
Radiation Monitor (S-SR-20) Supply Line	85a 85c	6.2-31s 3.2-15	56	B	PI-VX-250	SO Gate	0	AC	Spring	F,A	RM	0	0	C	C	1	<5	-	No	A	Valves	R.B.	No.	17
					PI-VX-251	SO Gate	0	AC	Spring	F,A	RM	0	0	C	C	1	<5	-						
Radiation Monitor (S-SR-20) Return Line	72f	6.2-31s 3.2-15	56	B	PI-VX-253	SO Gate	0	AC	Spring	F,A	RM	0	0	C	C	1	<5	-	No	A	Valves	R.B.	No.	
					PI-CVX-72f	Check	I	Process	Process	-	-	0	0	C	-	1	-	-						
Radiation Monitor (S-SR-21) Supply Line	29a 29c	6.2-31s 3.2-15	56	B	PI-VX-256	SO Gate	0	AC	Spring	F,A	RM	0	0	C	C	1	<5	-	No	A	Valves	R.B.	No.	17
					PI-VX-257	SO Gate	0	AC	Spring	F,A	RM	0	0	C	C	1	<5	-						
Radiation Monitor (S-SR-21) Return Line	73e	6.2-31s 3.2-15	56	B	PI-VX-259	SO Gate	0	AC	Spring	F,A	RM	0	0	C	C	1	<5	-	No	A	Valves	R.B.	No.	
					PI-CVX-73e	Check	I	Process	Process	-	-	0	0	C	-	1	-	-						
All instrument lines from reactor	-		55	A	-	EF Check	0	Spring	EF	-	-	0	0	0	-	3/4 & 1	-	-		-	Valves	R.B.	No.	27
						Globe	0	Manual	Manual	-	-	0	0	0	-	3/4 & 1	-	-						
All instrument lines from primary containment	-		56	B	-	EF Check	0	Spring	EF	-	-	0	0	0	-	1 & 1-1/2	-	-		-	Valves	R.B.	No.	27
						Globe	0	Manual	Manual	-	-	0	0	0	-	1 & 1-1/2	-	-						
Instrument lines (Hydrogen monitors) return to containment	-	3.2-15	56	B	-	Check	0	Process	Process	-	-	C	C	0	-	1	-	-	Yes	A, S	Valves	R.B.	No.	27
						Globe	0	Manual	Manual	-	-	0	0	0	-	1	-	-						

TABLE 6.2-16 (Continued)

ABBREVIATIONS/LEGEND

Valve Type

AO	air operated
MO	motor operated
PC	positive closing
EHO	electro-hydraulic operated

Location

I	inside containment
O	outside containment

Power to Open/Close

AC	AC electrical power
DC	DC electrical power
pro	Process, process flow
PP	process fluid overpressurization
spr	spring
EF	excess flow

Normal Position

O	open
C	close

Process fluid

W	water
A	air
S	steam
H	hydraulic fluid

Termination Zone

TB	turbine building
RB	reactor building
Rad W	radwaste building
SB	service building

TABLE 6.2-16 (Continued)

15. Leakage control system provided, see 6.7.

16. Bypass leakage of secondary containment is not considered during design basis LOCA, see 6.2.3.2.

17. Both containment isolation valves are located outside of containment based on NRC SRP 6.2.4, Section II, paragraph 6.d.. Valve operability will be improved because the environmental conditions are better outside the primary containment from the standpoint of humidity, radiation, pressure and temperature transients, and post-LOCA pipe whip and jet impingement.

18. These lines connect to systems outside of the containment which meet the requirements for a closed system as stated by NRC SRP 6.2.4, Section II, paragraph 6.e. These systems are considered an extension of the primary containment. Any leakage out of these systems will be processed by the standby gas treatment system.

19. Relief valve setpoint greater than 77.5 psig (1.5 times containment design pressure).

20. Relief valve setpoint is 75 psig.

21. Cannot be reshut after opening without disassembly.

22. See 6.2.4.3.2.2.1.2.

23. See 6.2.4.3.2.2.2.

24. Due to redundancy within the emergency core cooling systems, some subsystems may be secured during the long-term cooling period. In addition, RHR loops A and B have several discharge paths (LPCI, Drywell Spray, Suppression Chamber Spray, Suppression Pool Cooling) which the operator may select during the 30-day post-LOCA period.

25. Deleted.

26. The disc on the check valve is maintained in the close position during normal operation by means of a spring actuated lever arm and magnets embedded in the periphery of the disc. The magnetic and spring forces maintain the disc shut until the differential force to open the valve exceeds 0.2 psid. The check valves have position

TABLE 6.2-16 (Continued)

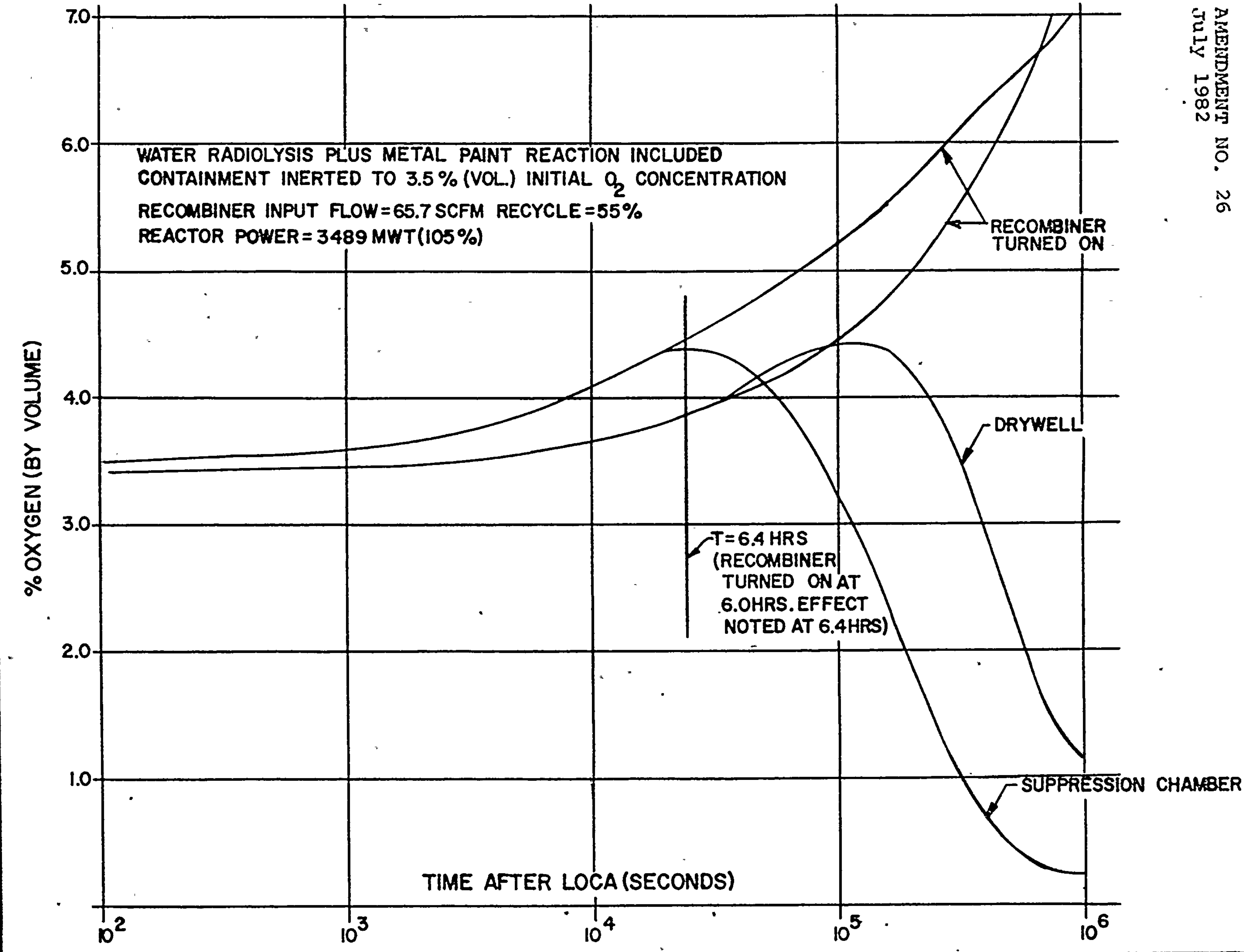
indication lights which can alert the operators to the fact that the check valve is not fully closed. The operator can then remotely shut the valve by means of a pneumatic operator. The operating switch is spring-return to neutral so the vacuum breaker function will not be impaired. The air supply to these valves is Quality Class I.

27. Instrument lines that penetrate primary containment conform to Regulatory Guide 1.11. The lines that connect to the reactor pressure boundary include a restricting orifice inside containment, are Seismic Category I and terminate in instruments that are Seismic Category I. The instrument lines also include manual isolation valves and excess flow check valves or equivalent (see hydrogen monitor return lines). These penetrations will not be Type C tested since the integrity of the lines are continuously demonstrated during plant operations where subject to reactor operating pressure. In addition, all lines are subject to the Type A test pressure on a regular interval. Leaktight integrity is also verified with completion of functional and calibration surveillance activities as well as by visual inspection during daily operator patrols as applicable.

28. Penetrations X-76 and X-77 contain lines for the hydraulic control of the reactor recirculation flow control valve. These lines contain hydraulic fluid used to position the reactor recirculation flow control valve.

    These lines inside of the containment are Seismic Category I and Quality Group B. Each line is provided with two fail-closed solenoid-operated isolation valves which receive an automatic isolation signal on high drywell pressure or reactor vessel low water level.

    Both isolation valves are located outside containment to improve valve reliability because of more favorable environmental conditions (i.e., potential damage to the solenoid valves resulting from humidity, radiation, pressure and temperature transients, and post-LOCA pipe whip and jet impingement is greatly reduced). Also, this location allows for ease of maintenance and manual override operation, if required.



WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PROJECT NO. 2

DRYWELL AND SUPPRESSION CHAMBER OXYGEN CONCENTRATION AFTER LOCA AS A FUNCTION OF TIME

FIGURE 6.2-26

NOTES ON TYPE C TESTING (ISOLATION VALVE LEAKAGE TESTING):

1. TYPE C TESTING IS PERFORMED BY APPLYING A DIFFERENTIAL PRESSURE IN THE SAME DIRECTION AS SEEN BY THE VALVES DURING CONTAINMENT ISOLATION.

2. TYPE C TESTING IS PERFORMED BY PRESSURIZING BETWEEN THE TWO-PIECE DISK GATE VALVE.

3. TYPE C TESTING IS PERFORMED BY PRESSURIZING BETWEEN THE ISOLATION VALVES. THE TEST YIELDS CONSERVATIVE RESULTS SINCE THE INBOARD GLOBE VALVE IS PRESSURIZED UNDER THE SEAT DURING THE TEST; WHEREAS, DURING CONTAINMENT ISOLATION, IT IS PRESSURIZED ABOVE THE SEAT.

4. TYPE C TESTING IS PERFORMED BY PRESSURIZING BETWEEN THE ISOLATION VALVES. THE TEST YIELDS EQUIVALENT RESULTS FOR THE INBOARD GATE OR BUTTERFLY VALVE.*

5. TYPE C TESTING IS PERFORMED BY PRESSURIZING THE ISOLATION VALVE IN THE OPPOSITE DIRECTION AS WHEN THE VALVE PERFORMS CONTAINMENT ISOLATION. SINCE THE ISOLATION VALVE IS A GATE VALVE, THE TEST YIELDS EQUIVALENT RESULTS.*

6. TYPE C TESTING IS PERFORMED BY PRESSURIZING BETWEEN THE ISOLATION VALVES. THE TEST YIELDS EQUIVALENT RESULTS FOR THE INBOARD GATE VALVE.* THE ONE-INCH GLOBE VALVE WILL HAVE TEST PRESSURE APPLIED UNDER THE SEAT; HOWEVER, THE DIFFERENCE BETWEEN TESTING A ONE-INCH GLOBE VALVE OVER OR UNDER THE SEAT IS CONSIDERED NEGLIGIBLE.

7. TYPE C TESTING IS PERFORMED BY PRESSURIZING BETWEEN THE ISOLATION VALVES. THE ONE-INCH GLOBE VALVE WILL HAVE TEST PRESSURE APPLIED OVER THE SEAT FOR THE INBOARD ISOLATION VALVE AND UNDER THE SEAT FOR THE OUTBOARD ISOLATION VALVE. THE DIFFERENCE BETWEEN TESTING UNDER AND OVER THE SEAT FOR A ONE-INCH GLOBE VALVE IS CONSIDERED NEGLIGIBLE.

8. TYPE C TESTING WILL BE PERFORMED ON ALL TEST CONNECTION VALVES THAT ARE LOCATED BETWEEN CONTAINMENT ISOLATION VALVES AND CONSIDERED PART OF THE CONTAINMENT ISOLATION SYSTEM.

* THE GATE AND BUTTERFLY VALVES ARE BECAUSE OF SYMMETRY OF DESIGN AND BECAUSE OF CONSTRUCTION EQUALLY LEAK TIGHT IN EITHER DIRECTION. THIS FACT HAS BEEN CONFIRMED BY REVIEW OF LEAKAGE TEST DATA AND OTHER INFORMATION SUPPLIED BY THE VALVE MANUFACTURERS.

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	NOTES ON TYPE C TESTING	FIGURE 6.2-31a

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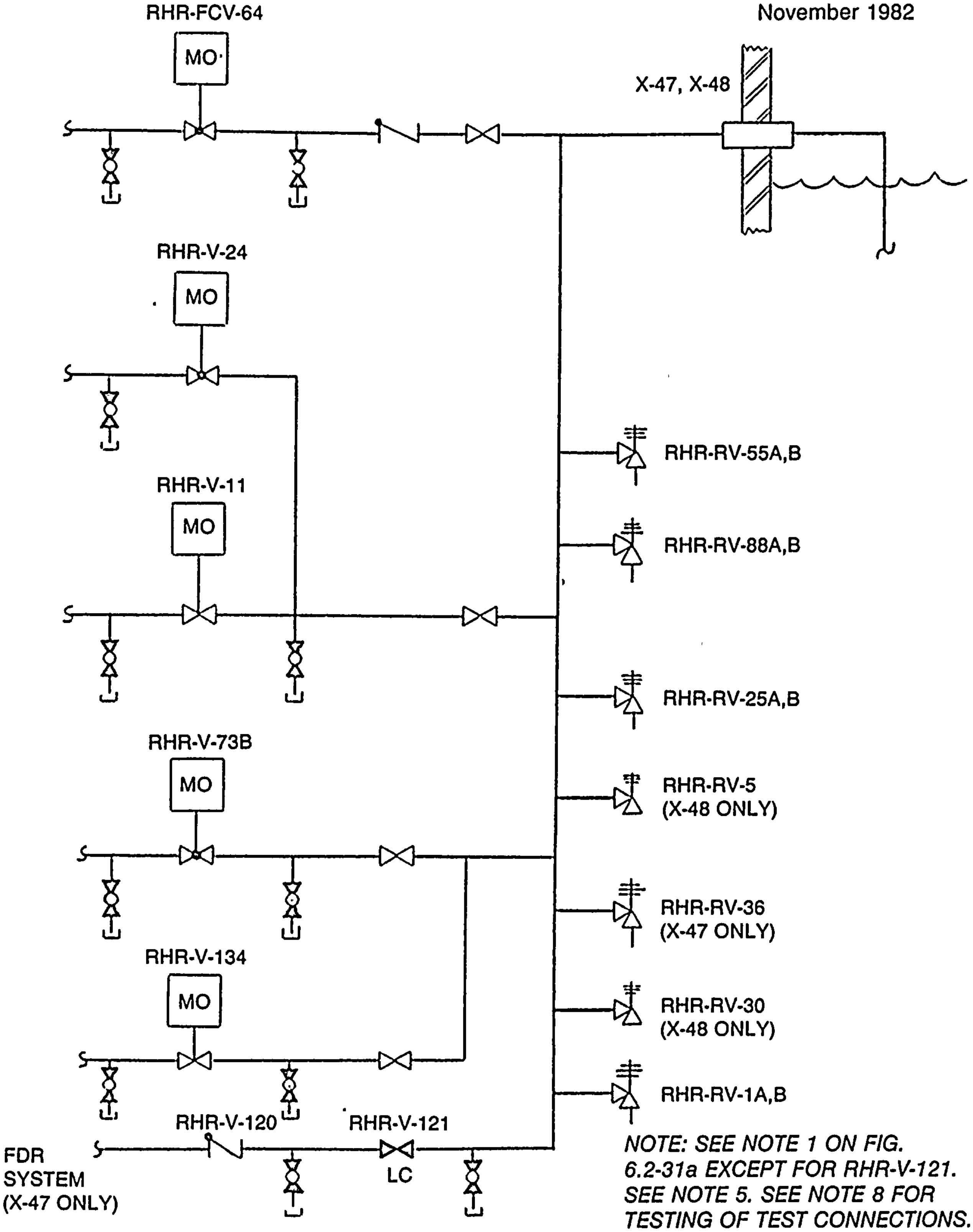

NOTE: SEE NOTE 1 ON FIG. 6.2-31a EXCEPT FOR RHR-V-121. SEE NOTE 5. SEE NOTE 8 FOR TESTING OF TEST CONNECTIONS.

RHR COMBINED RETURN LINE TO SUPPRESSION POOL

WASHINGTON PUBLIC POWER **SUPPLY SYSTEM** NUCLEAR PROJECT NO. 2	ISOLATION VALVE ARRANGEMENT FOR PENETRATIONS X-47 AND X-48	FIGURE 6.2-31p

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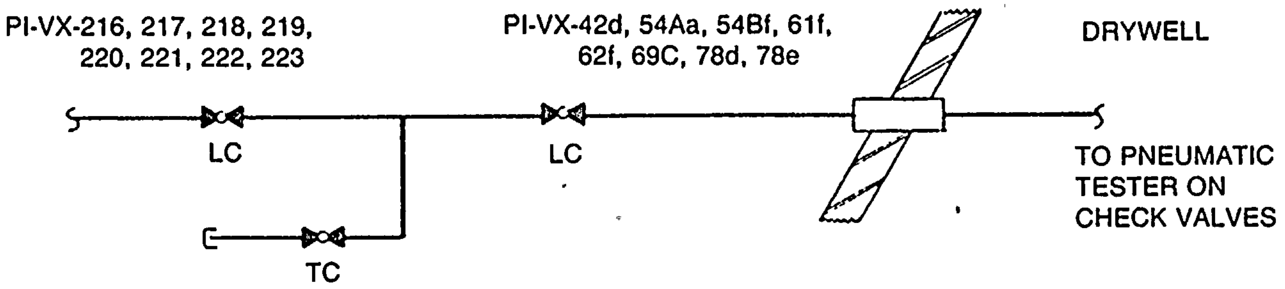
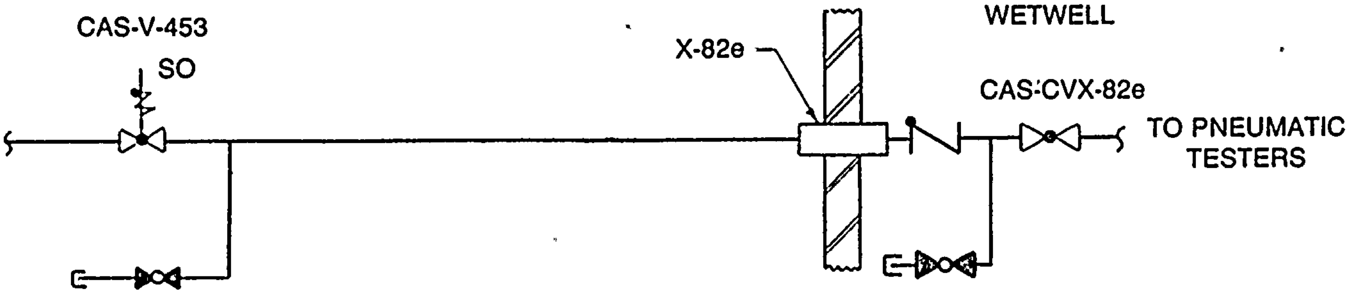


NOTE: SEE NOTES 7 AND 8 ON FIG. 6.2-31a

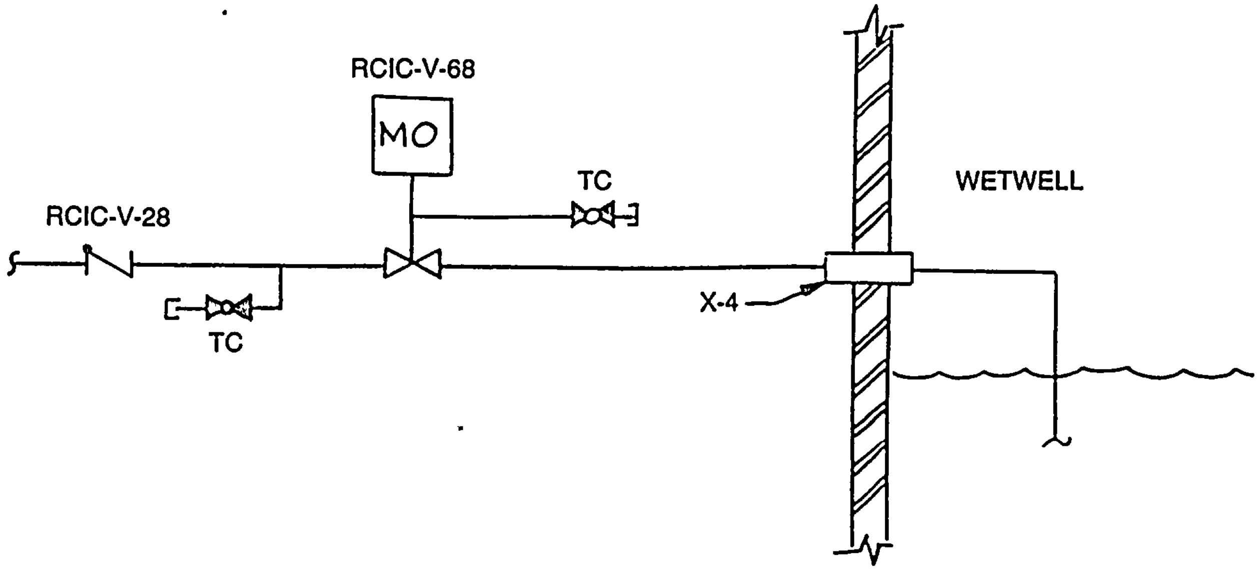
X-42d AIR LINE FOR TESTING RHR-V-50A
X-54Aa AIR LINE FOR TESTING RCIC-V-66
X-54Bf AIR LINE FOR TESTING RHR-V-41B
X-61f AIR LINE FOR TESTING RHR-V-41A
X-62f AIR LINE FOR TESTING RHR-V-41C
X-69c AIR LINE FOR TESTING RHR-V-50B
X-78d AIR LINE FOR TESTING LPCS-V-6
X-78e AIR LINE FOR TESTING HPCS-V-5



NOTE: SEE NOTES 1 AND 8 ON FIG. 6.2-31a

N_2/AIR SUPPLY FOR TESTING WETWELL TO DRYWELL VACUUM BREAKERS

WASHINGTON PUBLIC POWER **SUPPLY SYSTEM** NUCLEAR PROJECT NO. 2	**ISOLATION VALVE ARRANGEMENT FOR PENETRATIONS X-42d, 54Aa, 54Bf, 61f, 62f, 69c, 78d, 78e, & 82e**	**FIGURE** **6.2-31r**



NOTE: SEE NOTE 2 ON FIG. 6.2-31a

X-4 RCIC TURBINE EXHAUST

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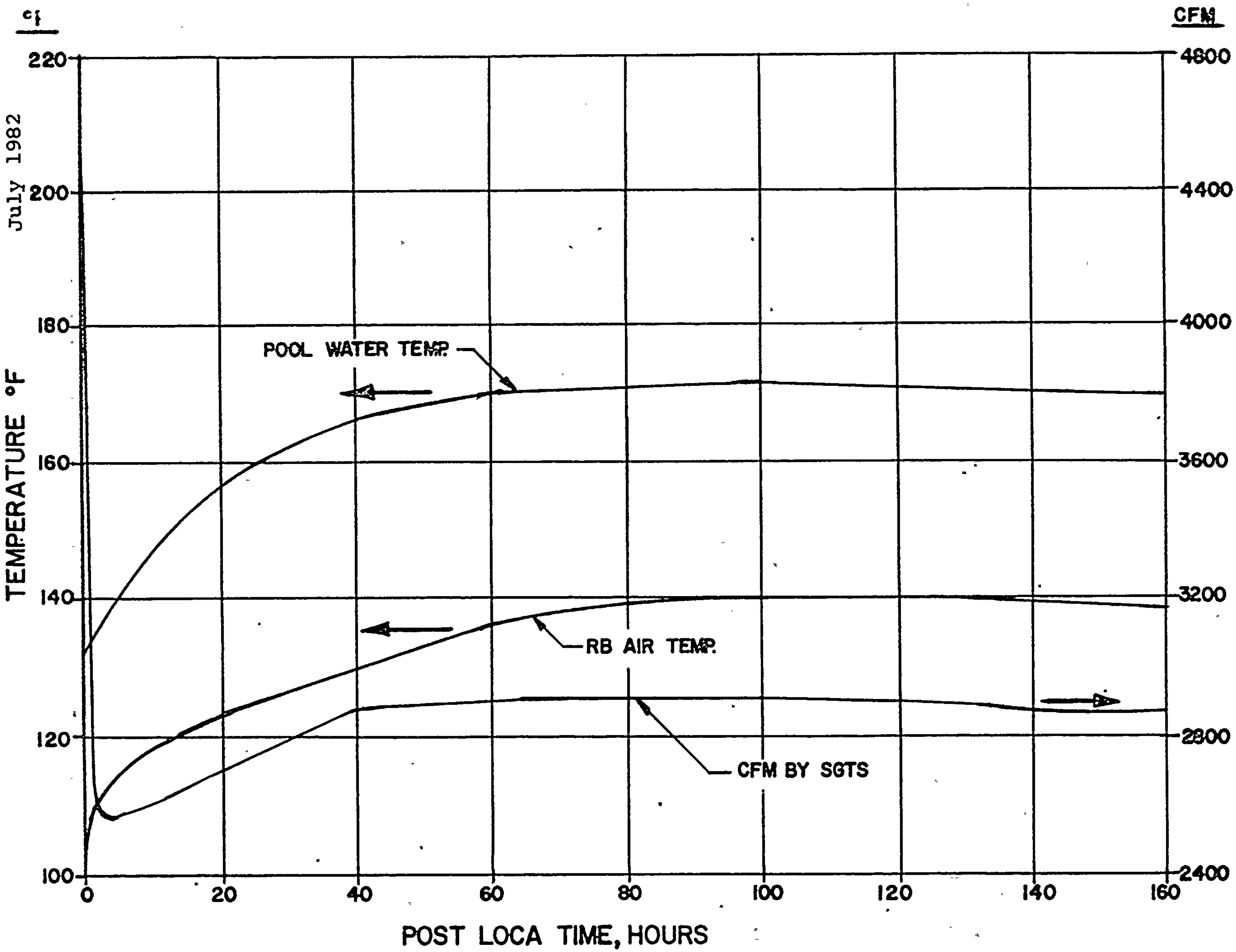

FIGURE 6.2-42

LONG TERM POST LOCA SECONDARY CONTAINMENT TEMPERATURE TRANSIENT

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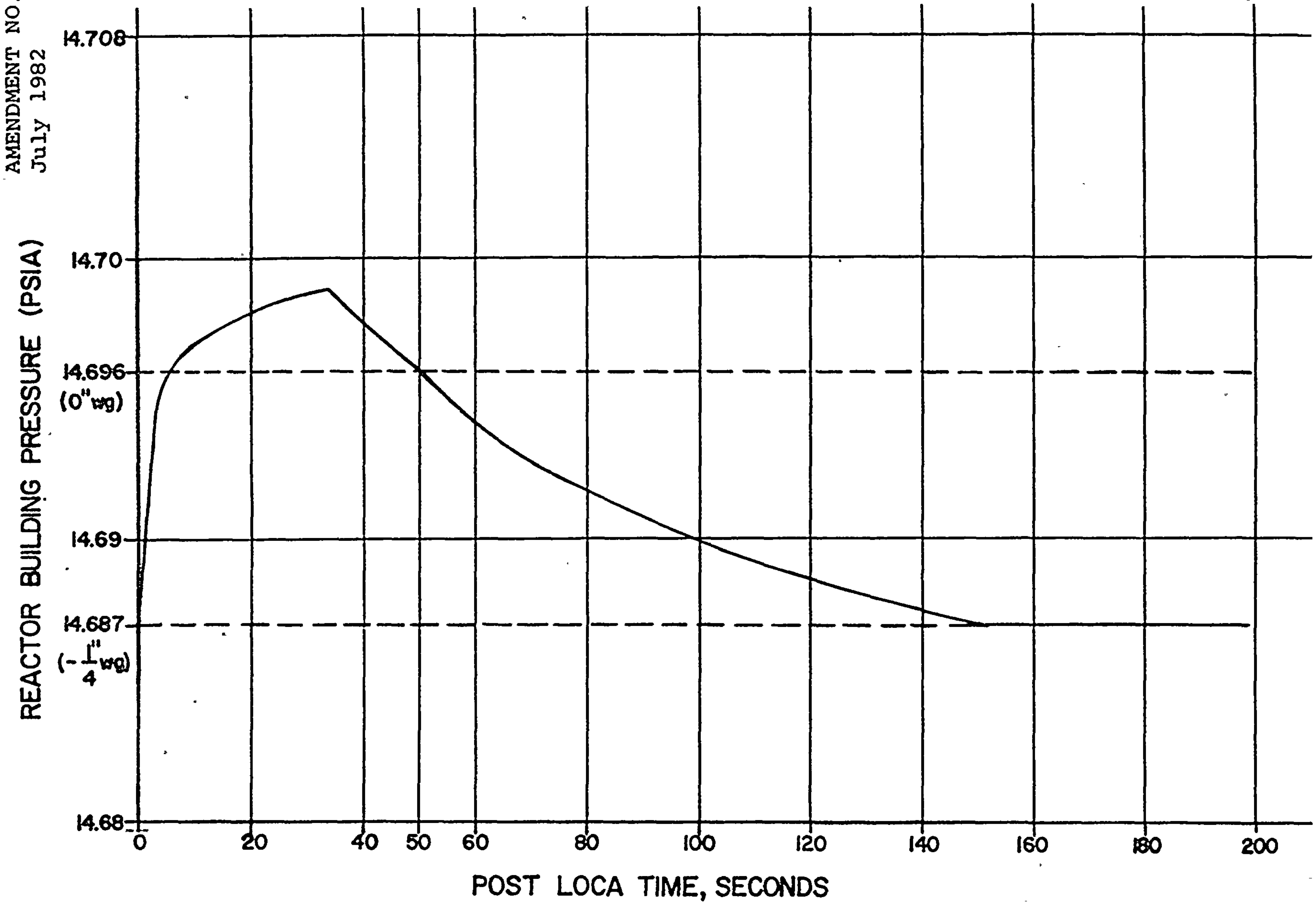

SHORT TERM POST LOCA SECONDARY CONTAINMENT PRESSURE TRANSIENT

FIGURE 6.2-43

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PROJECT NO. 2

7.1.2.3 Conformance to IEEE Standards

The following is a discussion of those IEEE Standards which apply equally to all safety-related systems described in Chapter 7. Those IEEE Standards which do not apply equally to all safety-related systems are discussed for each system in the analysis portion of 7.2, 7.3, 7.4, 7.5, and 7.6:

a. Conformance to IEEE 308-1974 - Class IE Power Systems for Nuclear Power Generating Stations

Conformance to IEEE 308-1974 is described in 8.3.

b. Conformance to IEEE 317-1972 - Electric Penetration Assemblies in Containment Structures

All containment electrical penetration assemblies used for Class 1E circuits are designed to withstand, without loss of containment integrity, the maximum postulated overcurrent vs. time conditions, assuming a single failure of the circuit primary overcurrent protection apparatus. Refer also to 7.1.2.3.D (IEEE 336) and 3.8.6 and 8.1.5.2.

c. Conformance to IEEE 323-1971 - Qualifying Class IE Equipment for Nuclear Power Generating Stations

Written procedures and responsibilities are developed for the design and qualification of all Class 1 electric equipment. This includes preparation of specifications, qualification procedures, and documentation. Qualification testing or analysis is accomplished prior to release of the engineering design for production. Standards manuals are maintained containing specifications, practices, and procedures for implementing qualification requirements, and an auditable file of qualification documents is available for review. Refer to Chapter 17 and 3.10 and 3.11 for a complete description of conformance.

d. Conformance to IEEE 336-1971 - Installation, Inspection and Testing Requirements for Instrumentation and Electric Equipment During the Construction of Nuclear Power Generating Stations

Where applicable, purchase and contract specifications define installation, inspection, and testing requirements for plant instrumentation and controls.

e. Conformance to IEEE 338-1975 - Periodic Testing of Nuclear Power Generating Stations

Conformance to IEEE 338 is presented on a system basis in the analysis portions of 7.2, 7.3, 7.4, 7.5, and 7.6 as part of the discussion of Regulatory Guide 1.22 compliance.

f. Conformance to IEEE 344-1971 - Seismic Qualification of Class IE Equipment

All safety-related instrumentation and control equipment is classified as Seismic Category I, designed to withstand the effects of the safe shutdown earthquake (SSE) and remain functional during normal and accident conditions. Qualification and documentation procedures used for Seismic Category I equipment and systems are identified in 3.10 and Table 3.2-1.

g. Conformance to IEEE 379-1972 - Application of Single Failure Criterion to Nuclear Power Generating Stations

The extent to which the single failure criteria of IEEE 379 is satisfied is specifically covered for each system in the analysis of IEEE 279, paragraph 4.2 in 7.2, 7.3, 7.4, 7.5, and 7.6.

h. Conformance to IEEE 384-1974 - Independence of Class IE Equipment and Circuits

The safety-related systems described in 7.2, 7.3, 7.4, 7.5, and 7.6 meet the independence and separation criteria for redundant systems in accordance with IEEE 279, paragraph 4.6.

The electrical power supply, instrumentation, and control wiring for redundant safety-related circuits are physically separated to preserve redundancy and ensure that no single credible event will prevent completion of the protective function. Credible events include, but are not limited to, the effects of short circuits, pipe rupture, pipe whip, high pressure jets, missiles, fire, earthquake, and falling objects, and are considered in the basic plant design.

The independence of tubing, piping, and control devices for safety-related controls and instrumentation is achieved by physical space or barriers between separation groups of the same protective function.

The criteria and bases for the independence of safety-related instrumentation and controls, electrical equipment, cable, cable routing, marking and cable derating, are discussed in

8.3.1.4. Fire detection and protection in the areas where wiring is installed is described in 9.5.1.

i. Conformance to IEEE 387-1972 - Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations

Design and qualification testing of the standby power system used to furnish electrical power to safety loads conforms to IEEE 387 to ensure that system requirements for redundancy, single failure criteria, adequate capacity, capability and reliability are adequately met. The standby power source as an integrated system component satisfies the requirements of IEEE 308 as discussed in 8.3.

7.1.2.4 Conformance to Regulatory Guides

The following is a discussion of Regulatory Guides which apply equally to all safety-related systems described in Chapter 7. Those Regulatory Guides which do not apply equally to all safety-related systems are discussed for each system in the applicable analysis portion of 7.2, 7.3, 7.4, 7.5, and 7.6, and Appendix C.

a. Conformance to Regulatory Guide 1.11 (2/17/72)

All instrument lines penetrating or connected directly to the primary containment atmosphere, which are part of safety-related systems, meet the requirements of Regulatory Position C.1. This is accomplished by redundancy, independence, and by allowing for safety system testability, by line orificing or sizing and by including automatic line shutoff capability if line integrity is lost. Refer also to 6.2.4.3.1.

All other instrument lines that penetrate primary containment or are connected directly to the containment atmosphere meet Regulatory Position C.2.

b. Conformance to Regulatory Guide 1.29 (6/7/72)

All safety-related instrumentation and control equipment is classified as Seismic Category I, designed to withstand the effects of the safe shutdown earthquake (SSE) and remain functional during normal and accident conditions. Qualification and documentation procedures used for Seismic Category I equipment and systems are identified in 3.10 and Table 3.2-1.

c. Conformance to Regulatory Guide 1.30 (8/11/72)

The quality assurance requirements of IEEE 336-1971 (see discussion above) are applicable during the plant design and construction phases and will also be implemented as an operation QA program during plant operation in response to Regulatory Guide 1.30. The specific requirements of Regulatory Guide 1.30 are met as discussed in Chapter 17.

d. Conformance to Regulatory Guide 1.40 (3/16/73)

There are no safety-related continuous duty motors installed inside the primary containment.

e. Conformance to Regulatory Guide 1.47 (1973)

Each safety-related system described in 7.2, 7.3, 7.4, and 7.6 is provided with an automatically or operator initiated system level bypass and inoperability annunciator.

Each system level annunciator is located on the panel containing the controls for the specific system.

In addition to system level annunciation, component level indicators are provided near the system lever annunciator to indicate the cause of the system bypass or inoperability.

A switch is provided for manual actuation of each system level annunciator to allow display of those bypass or inoperable conditions which are expected to occur at a frequency less than once per year, and are not automatically indicated.

Typically, the following bypasses or inoperabilities cause actuation of system level (and component level) annunciation for the affected system:

1. Pump motor breaker not in operate position;

2. Loss of pump motor control power;

3. Loss of motor-operated valve control power/motive power;

4. Logic power failure;

5. Logic in test;

6. Position of remote-manual valves which do not receive automatic alignment signals;

7. Bypass or test switches actuated.

Auxiliary supporting system inoperability or bypass resulting in the loss of other safety-related systems will cause actuation of system level annunciators for the auxiliary supporting system as well as those safety-related systems affected.

f. Conformance to Regulatory Guide 1.63 (10/73)

All containment electrical penetration assemblies used for Class 1E circuits are designed to withstand, without loss of containment integrity, the maximum postulated overcurrent vs. time conditions, assuming a single failure of the circuit primary overcurrent protection apparatus. Refer also to 7.1.2.3.d (IEEE 336) and 3.8.6 and 8.1.5.2.

g. Conformance to Regulatory Guide 1.68 (11/73)

The conformance to plant preoperational and initial startup test program requirements is discussed in 14.2.7.

h. Conformance to Regulatory Guide 1.73 (1/74)

Auxiliary equipment associated with valve operators are tested in accordance with the requirements of the guide. Designed service conditions are implemented. in the tests. Conservative values of the environmental variables during and after a design basis accident are used in the tests to assure that the testing is carried out under more severe environmental conditions than those expected.

i. Conformance to Regulatory Guide 1.75 (1/74)

Regulator Guide 1.75 is not applicable to the WNP-2 design, however, a complete description of the WNP-2 physical and electrical separation criteria is discussed in 8.3.1.4.

j. Conformance to Regulatory Guide 1.80 (6/74)

The conformance to plant preoperational testing of instrument air systems is discussed in 14.2.7.3 and 14.2.12.1.34.

k. Conformance to Regulatory Guide 1.89 (11/74)

Regulatory Guide 1.89 is not applicable to the WNP-2 design however qualification of Class 1E equipment is discussed in 3.11.2.

7.1.2.5 Instrument Errors

The design of each safety-related system considers instrument drift, setability and repeatability in the selection of instrumentation and controls in the determination of setpoints. Adequate margin between safety limits and instrument setpoints is provided to allow for instrument error. The safety limits, setpoints, and margins are listed in Chapter 16, Technical Specification. Refer also to Tables 7.2-1, 7.3-1 thru 5, 7.4-1 and 7.6-4, 7.6-6, 7.6-8 through 7.6-12. Refer also to Chapter 16, "Technical Specifications". The amount of instrument error is determined by test and experience. The setpoint is selected based on these known errors. The surveillance frequency is increased on instrumentation that demonstrates a tendency to drift.

4. Fires

To protect the RPS in the event of a postulated fire, the RPS trip logics have been divided into four separate sections within two separate RPS panels. The sections within a panel are separated by fire barriers. If a fire were to occur within one of the sections or in the area of one of the panels, the RPS functions would not be prevented by the fire. The use of separation and fire barriers ensures that, even though some portion of the system may be affected, the RPS will continue to provide the required protective action.

Within the control room PGCC (underfloor cable routing ducts) heat detectors and products of combustion detectors are provided to initiate a halon fire suppression system.

Throughout main plant areas redundant RPS cables are routed in separate wireways sufficiently separated from each other such that a fire cannot effect more than one RPS division.

5. LOCA

The following RPS system components are located inside the drywell and would be subjected to the effects of a design basis loss-of-coolant accident (LOCA):

a) Neutron monitoring system (NMS) cabling from the detectors to the main control room.

b) MSIV (inboard) position switches.

c) Reactor vessel pressure and reactor vessel water level instrument taps and sensing lines, which terminate outside the drywell.

During reactor operation, a test and calibration of the individual EHC oil line pressure sensors associated with turbine control valve fast closure when the plant is operating above 30% of rated power may be accomplished by valving one sensor out-of-service at a time and introducing a test pressure input.

Testing and calibration of the main steam line high radiation monitors can be performed during full power operation by removing the individual monitors and inserting them into a calibration source.

The APRMs are calibrated to reactor power by using a reactor heat balance and the TIP system to establish the relative local flux profile. LPRM gain settings are determined from the local flux profiles measured by the TIP system once the total reactor heat balance has been determined.

The gain adjustment factors for the LPRMs are produced as a result of the process computer nuclear calculations involving the reactor heat balance and the TIP flux distributions. These adjustments, when incorporated into the LPRMs permit the nuclear calculations to be completed for the next operating interval and establish the APRM calibration relative to reactor power.

During reactor operation, one manual scram pushbutton may be depressed to test the proper operation of the switch and trip logic relay. Once the RPS has been reset, the other switches may be depressed to test their operation one at a time. For each such operation, a control room annunciation will be initiated and the process computer will print the identification of the pertinent trip.

Operation of the reactor mode switch from one position to another may be employed to confirm certain aspects of the RPS trip channels during periodic test and calibration at shutdown only. During tests of the trip channels, proper operation of the mode switch contacts can be easily verified by noting that certain sensors are connected into the RPS logic and that other sensors are bypassed in the RPS logic in an appropriate manner of the given position of the mode switch.

In the startup and run modes of plant operation, procedures may be used to confirm that scram discharge volume high water level trip channels cannot be bypassed as a result of the operating bypass switch. In the shutdown and refuel modes of plant operation, a similar procedure may be used to bypass all four scram discharge volume trip channels. Due to the discrete "on-off" nature of the bypass function, calibration is not meaningful.

Administrative control must be exercised to valve one turbine first stage pressure sensor out-of-service for the periodic test. During this test, a variable pressure source may be introduced to operate the sensor at the set point value. When the condition for bypass has been achieved on an individual sensor under test, the control room annunciator for this bypass function will be initiated. If the RPS trip channel associated with this sensor had been in its tripped state, the process computer will log the return to normal state for the RPS trip logic. When the plant is operating above 30% of rated power, testing of the turbine stop valve and governor valve fast closure trip channels will confirm that the bypass function is not in effect.

Operation of the reset switch following a trip of one RPS trip system will confirm that the switch is performing its intended function. Operation of the reset switch following trip of both RPS trip systems will confirm that all portions of the switch and relay logic are functioning properly since half of the control rods are returned to a normal state for one actuation of the switch.

A manual scram switch permits each individual trip logic, trip actuator, and trip actuator logic to be tested on a periodic basis. Testing of each process sensor of the protection system affords an opportunity to verify proper operation of these components. Calibration of the time response of the trip channel relays and trip actuators may be accomplished by connection of external test equipment.

b. Regulatory Guide 1.53 (6/73) Application of the SingleFailure Criterion to Nuclear Power Plant Protection Systems

See IEEE 279-1971, Para. 4.2, 7.2.2.2.

c. Regulatory Guide 1.62 (10/73) Manual Initiation of Protective Actions

Means are provided for manual initiation of the RPS at the system level through the use of four armed pushbutton switches located on the control room benchboard.

Operation of two switches (one in each trip system) accomplishes the initiation of all actions performed by the automatic initiation circuitry.

Placing the reactor mode switch in the "shutdown" position will also cause a system level initiation.

3. RHR System Leak Detection

4. Reactor Water Cleanup System Leak Detection

5. Drywell/Reactor Bldg. Leak Detection

a. Leak Detection System Function

The leak detection system instrumentation and controls is designed to monitor leakage from the reactor coolant pressure boundary and initiate alarms and/or isolation when predetermined limits are exceeded. Refer to 5.2.5.

b. Leak Detection System Operation

Schematic Arrangements of system mechanical equipment and operator information displays are shown in Figure 7.6-1 (LDS IED). LDS component control logic is shown in Figures 7.3-14 (RHR FCD), 7.4-2 (RCIC FCD), 7.3-10 (NUC. BLR. FCD). Instrument specifications are listed in Tables 7.6-7 and 7.6-8. Plant Layout Drawings and Electrical Schematics are identified in 1.7.

Systems or parts of systems which contain water or steam and which are in direct communication with the reactor vessel, are provided with leakage detection systems.

Each of the required leakage detection systems inside the primary containment is designed with a capability to detect leakage less than established leakage rate limits. Refer to Chapter 16, "Technical Specifications".

Major components within the primary containment that by nature of their design are sources of leakage (e.g., pump seals, valve stem packing, equipment warming drains), are collected ultimately in an equipment drain sump located in the reactor building and thereby identified.

Equipment associated with systems within the primary containment (e.g., vessels, piping, fittings) share a common volume. Steam or water leaks from such equipment are collected ultimately in the floor drain sumps located in the reactor building and identified.

Each of the sumps is protected against overflowing to prevent leaks of an identified source from masking those from unidentified sources.

Outside the primary containment, the piping within each system monitored for leakage is in compartments or rooms separate from other systems wherever feasible so that leakage may be detected by sump level, ambient or differential area temperature or high process flow.

Sensors, wiring, and associated equipment of the leak detection system which are associated with the isolation valve logic are designed to withstand the conditions that follow a design basis loss-of-coolant accident. (See Tables 3.11-1, 3.11-2, and 3.11-3.)

The operator is kept aware of the status of the leak detection system variables through meters and recorders which indicate the measured variables in the control room. If a trip occurs, the condition is annunicated in the control room.

1. RCIC System Leak Detection

The steam lines of the RCIC system are monitored for leaks by the leak detection system. Leaks from the RCIC will cause a change in at least one of the following monitored parameters: sensed equipment and pipe routing area temperatures, steam flow rate, or steam pressure. If the monitored variables indicate that a leak may exist, the detection system initiates an RCIC isolation signal.

The RCIC leak detection system consists of the following:

a) equipment area and pipe routing area high ambient and differential temperature,

b) high flow rate (differential pressure) through the steam line,

c) the turbine exhaust diaphragm high pressure,

d) low steam line inlet pressure.

Outputs from all four monitoring circuits are used to generate the RCIC auto-isolation signals (one for each division) to isolate the inboard and outboard isolation valves.

The following is a description of each RCIC leak detection method:

a. RCIC Area Temperature Monitoring

The RCIC area ambient and differential temperature monitoring circuits are similar to those described for the main steam line tunnel temperature monitoring system. (See 7.3.1.1.2.b).

Two redundant temperature monitoring channels are provided. Each redundant instrument provides input to one of two logic channels (Division 1 or 2).

Using 1 out of 2 logic, any RCIC equipment area or pipe routing high area ambient or high differential temperature initiates an isolation of the RCIC system.

A bypass/test switch is provided in each logic channel for the purpose of testing the temperature monitor without initiating RCIC system isolation.

Diversity is provided by RCIC steam line flow and pressure monitoring.

b. RCIC Flow Rate Monitoring

The steam line flow rate from the reactor vessel leading to the RCIC turbine is monitored by two redundant differential pressure switches. In the presence of a leak, the flow rate monitor responds by generating the auto-isolation signal. See 7.4.1.1.b.

High flow in the steam line initiates isolation of the RCIC system.

Diversity is provided by ambient temperature, differential temperature and RCIC steam line pressure monitoring.

c. RCIC Turbine Exhaust Diaphragm Pressure Monitoring

The RCIC turbine exhaust diaphragm pressure is monitored by four redundant pressure switches. In the presence of a leak, the RCIC system responds by generating the isolation signal. See 7.4.1.1.b.

Using 2 out of 2 logic high turbine exhaust diaphragm pressure initiates isolation of the RCIC system.

Diversity is provided by ambient temperature and differential temperature.

d. RCIC Pressure Monitoring

The steam line pressure from the reactor vessel leading to the RCIC turbine is monitored by four redundant pressure switches. In the presence of a leak, the RCIC system responds by generating the auto-isolation signal. See 7.4.1.1.b.

Using 2 out of 2 logic low pressure in the steam line initiates isolation of the RCIC system.

Diversity is provided by ambient temperature, differential temperature and RCIC steam line flow monitoring.

2. RHR System Leak Detection

The steam line to the RHR heat exchangers is monitored for leaks by the leak detection system. Leaks from the RHR system are detected by equipment area ambient and differential temperature monitoring, shutdown cooling suction flow rate, and by steam line flow rate in the common RHR/RCIC steam line. If the monitored parameters indicate that a leak exists, the LDS initiates an RHR isolation signal.

The RHR leak detection system consists of the following:

a) equipment area high ambient and differential temperature,

b) high flow rate through the common RCIC/RHR steam line, (refer to discussion in 7.6.1.3.B.1.b)

c) shutdown cooling suction line high flow rate.

Outputs from all three circuits are used to generate the RHR auto-isolation signal (one for each division) to isolate the inboard and outboard isolation valves.

The following is a description of each RHR leak detection method:

a. RHR Area Temperature Monitoring

The RHR area temperature monitoring circuit is similar to the one described for the main steam line tunnel temperature monitoring system (See 7.3.1.1.2.b).

Two redundant temperature monitoring channels are provided. Each redundant instrument provides input to one of two logic channels (Division 1 or 2).

Using 1 out of 2 logic, high RHR area ambient or differential temperature initiates an RHR isolation signal closing the RHR inboard and outboard isolation valves.

A bypass/test switch is provided in each logic channel for the purpose of testing the temperature monitor without initiating RHR system isolation.

Replacement of IRM and LPRM detectors must be accomplished during plant shutdown. Repair of the remaining portions of the neutron monitoring system may be accomplished during plant operation by appropriate bypassing of the defective instrument channel. The design of the system facilitates rapid diagnosis and repair.

22. Identification of Protection Systems (IEEE 279-1971, Paragraph 4.22)

Each cabinet containing safety system components is labeled with the system designation and the particular redundant portion is listed on a distictively colored marker plate. Cabling outside the cabinets is identified specifically as belonging to a particular safety system. See 8.3.1.3. Redundant racks are identified by the identification marker plates.

7.6.2.4 Conformance to NRC Regulatory Guides

The following is a discussion of conformance to those Regulatory Guides which apply specifically to the safety-related systems discussed in 7.6. Refer to 7.1.2.3 for a discussion of Regulatory Guides which apply equally to all safety-related systems.

a. Regulatory Guide 1.22 (2/72) - Periodic Testing of Protection System Actuation Functions

The APRMS are calibrated to reactor power by using reactor heat balance and the (TIP) system to establish the relative local flux profile. LPRM gain settings are determined from the local flux profiles measured by the TIP system once the total reactor heat balance has been determined.

The gain-adjustment-factors for the LPRMs are produced as a result of the process computer nuclear calculations involving the reactor heat balance and the TIP flux distributions. These adjustments, when incorporated into the LPRMs permit the nuclear calculations to be completed for the next operating interval and establish the APRM calibration relative to reactor power.

The IRMs are calibrated by comparison with the APRMs.

The proper operation of the sensors and the logics associated with the leak detection systems is verified during the leak detection system preoperational test and during inspection tests that are provided for the various components during plant operation. Each temperature switch, both ambient and differential types which provide isolation signals, is connected to one element of a dual thermocouple element.

Each temperature switch contains a trip light which illuminates when the temperature exceeds the set point. To verify the thermocouple (sensor) input, a comparison of the redundant sensor readings, one from each trip channel, and the recorded channel is made. The recorded channel monitors the second of the dual thermocouples. The first element is part of the division one trip channel. To test the temperature trips a simulated trip level signal is input to the device from an external source. In addition, keylock test switches are provided so that instrument and logic channels can be tested without sending an isolation signal to the system involved. Thus, a complete system check can be confirmed by checking actuation of the trip logic relay associated with each temperature switch.

RWCU differential flow leak detection alarm units are tested by inputting an electrical signal to simulate a high differential flow. Alarm and indicator lights monitor the status of the trip circuit.

All other system instrumentation is tested and calibrated during normal reactor operation by valving out the instrumentation and supplying a test pressure source.

b. Regulatory Guide 1.45 (5/73)

The leakage to the primary reactor containment from identified sources such as valve stem packing, recirculation pump seal, fuel storage pool, head seal, etc. is separated so that flow rates are monitored separately from unidentified leakage and total flow rate can be established and monitored. The leakage from the main steam line safety/relief valves is identified leakage because of the location of the sensors which detect this leakage, but the leakage is not completely separated from unidentified sources. Separation of this leakage is not required since any leak from the main steam line safety/relief valves would not be from a crack or break in the line so there would be no identified leakage from the S/R valve lines during plant operation which necessitates separation from unidentified leakage. The leakage to the reactor containment from unidentified sources is collected and this flow rate is monitored with an accuracy of better than one gallon per minute.

The following required detection methods are used to monitor unidentified leakage:

1. Sump level and flow monitoring;

2. Airborne particulate radioactivity monitoring;

3. Airborne gaseous radioactivity monitoring.

Provisions are made to monitor systems connected to the RCPB for signs of intersystem leakage, including radioactivity monitoring of process fluids (Process Rad System) and reactor vessel water level monitoring (NSSS).

The sensitivity and response time of each system for detection of unidentified leakage is one gallon per minute in less than one hour, except for the airborne particulate radioactivity and airborne gaseous activity monitoring channels, which have sensitivities of 10^{-9} Ci/cm^3 and 10^{-6} Ci/cm^3 respectively, which are the sensitivities suggested for these channels by Regulatory Guide 1.45.

The leakage detection system is qualified for operation following an OBE. The particulate radioactivity monitoring channel is qualified for operation following an SSE.

Indicators and alarms for each leakage detection subsystem are provided in the main control room. At the site, procedures for converting various indications e.g., temp, Δt, and pressure, to a flow rate measurement will be provided by means of conversion curves wherever meaningful.

Major components within the drywell that by nature of their design are sources of leakage (e.g., sump seals, valve stem packing), are contained and piped to an equipment drain sump and thereby identified.

Equipment associated with systems within the drywell (e.g., vessels, piping, fittings) share a common free volume, therefore, their leakage detection systems are common. Steam or water leaks from such equipment are collected ultimately in an area drain sump.

Each of the sumps are protected against overflowing leaks from one source masking those from another.

As added back-up to the unidentified leakage drain system, the main steam lines within the steam tunnel inside the containment are monitored by temperature detectors within the tunnel.

c. Regulatory Guide 1.53 (6/73) - Application of the Single-Failure Criterion to Nuclear Power Plant Protection Systems

See IEEE 279-1971, Paragraph 4.2, 7.6.2.3.

d. Regulatory Guide 1.62 (10/73) - Manual Initiation of Protective Actions

The FPC system is manually initiated from the main control room by actuation of system pump and valve controls.

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8.3 ONSITE POWER SYSTEMS

8.3.1 AC POWER SYSTEMS

8.3.1.1 Description

Principal elements of the WNP-2 auxiliary AC electrical systems are illustrated in Figures 8.1-9a through 8.1-9d. Four (4) auxiliary transformers are provided.

Normal auxiliary power is provided by two (2) normal auxiliary transformers fed from the main generator 25 kV isolated phase bus. The startup transformer is connected to the BPA 230 kV H. J. Ashe Switchyard. These auxiliary systems each have the capacity to carry the full plant auxiliary load. A backup transformer is provided to supply all Division 1 and 2 plant ESF loads. This transformer is supplied from the BPA Benton Switchyard via a 115 kV line to the plant. The transformer steps down the 115 kV supply to 4.16 kV and is connected by cables through circuit breakers to the 4.16 kV Class 1E switchgear buses SM-7 and SM-8.

8.3.1.1.1 4.16 kV and 6.9 kV Distribution System

The auxiliary transformers step down the available voltage as required to supply the 4.16 kV and 6.9 kV auxiliary switchgear buses. During normal operation, all load is carried by the normal auxiliary transformers. The startup transformer is used while the 25 kV main generator is being started and synchronized with the system. When this is acomplished, all auxiliary load is transferred (live load transfer) to the normal auxiliary transformers. The startup transformer remains energized from the 230 kV offsite powerline to permit the auxiliary load to be automatically transferred back to it if power from either normal auxiliary transformer is lost. It is possible to operate the plant with auxiliary loads carried by the startup transformer.

The 4.16 kV non-Class 1E switchgear buses SM-1, SM-2, and SM-3 are fed from the secondary windings of the dual secondary winding normal auxiliary transformer (TR-N1) or from the 4.16 kV "Y" winding of the dual secondary winding startup transformer (TR-S). These buses supply the large non-Class 1E auxiliary motors and substations, and the Class 1E switchgear buses SM-4, SM-7, and SM-8.

The 6.9 kV non-Class 1E switchgear buses are fed from the single secondary winding normal auxiliary transformer (TR-N2) or from the 6.9 kV "X" winding of the dual secondary winding startup transformer (TR-S). These buses supply the non-Class 1E reactor recirculation pumps, cooling tower substations and auxiliary substations.

The 6.9 kV and 4.16 kV auxiiary switchgear buses are arranged for distribution of power through a switchgear assembly of air circuit breakers. The switchgear is of metal-clad, indoor design and has 3-pole air circuit breakers (draw-out type) with stored energy mechanisms fed from the plant DC systems.

Normal source power failure is detected by relays in the unit trip protective system and by undervoltage relays. Automatic transfer facilities are provided so that failure of normal supply causes immediate tripping of the normal supply circuit breakers and simultaneous closing of the startup transformer supply circuit breakers. The startup transformer circuit breakers are interlocked to close only after the normal source curcuit breakers have opened, thus preventing closing into a fault; this provides virtually continuous feed to the Class 1E and non-Class 1E switchgear buses of all divisions.

Upon loss of both normal and startup sources, or if the startup source is lost when the main generator is out of service, the tie breakers between the 4.16 kV Class 1E and the 4.16 kV non-Class 1E switchgear buses are automatically opened, thereby shedding all loads supplied via the 4.16 kV non-Class 1E buses. The 4.16 kV Class 1E bus undervoltage signals cause trip of all 4.16 kV feeder breakers except those breakers supplying 480 V substations. The Division 1 and 2 4.16 kV Class 1E buses (SM-7,8) are then automatically transferred to the 115/4.16 kV backup transformer for supply of load. In the event this source is also unavailable, these buses would be automatically transferred to the onsite standby sources (Division 1 and 2 diesel generators). Reapplication of load is on a time priority basis. The loading sequence for buses SM-7 and SM-8, as shown in Tables 8.3-1 and 8.3-2 and Figures 8.3-16c and 8.3-17c, is accomplished through the use of electro-mechanical time delay relays. The Division 3 (HPCS) 4.16 kV Class 1E bus (SM-4) cannot be connected to the backup source; loss of the normal/startup sources causes automatic transfer of this load to the Division 3 onsite standby source (Division 3 diesel generator). Load shedding and load sequencing are not required in this division.

In the event of sustained bus undervoltage (87.3% of nominal bus voltage lasting more than 8 seconds), the second level of undervoltage protection automatically trips the feeder breaker connecting the normal/startup sources to their respective 4.16 kV Class 1E buses. For Divisions 1 and 2 this action results in loss of bus voltage, thereby starting the diesel generators, initiating load shedding and energizing the three bus transfer timers mentioned in the primary undervoltage scheme above. In this case, however, the first two-second timer is bypassed. The second two-second timer permits closing of the backup source breaker and the five-second timer permits closing of the diesel generator breker assuming a failure of the backup source breaker to close. Closure of the backup source and diesel generator breakers is permitted if the source voltage is at least 94% of normal.

Should the degraded voltage condition exist on the backup power source while the source is supplying the load, the second level undervoltage relays would then isolate that source, again initiating the sequence of events described for the secondary undervoltage sensing scheme above. However, closing of backup feeder breakers, as part of that sequence of events, is blocked.

For Division 3, the second level of undervoltage protection trips the normal/startup source breaker, thereby causing a loss of bus voltage. From this point on, the primary undervoltage relay takes over and the ensuing sequence of events will be the same as in the case of the loss of offsite power discussed above.

When the Class 1E buses SM-7 and SM-8 are being fed from the turbine generator, the possibility of sustained undervoltage is not considered credible due to response characteristics of the voltage regulator and protection equipment for the unit.

The scheme described assures a power source within the acceptable voltage limits for the Class 1E loads at all times. Circuit design allows for testing of the individual relays, one at a time, without disrupting the protective function.

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8.3.1.1.2 480 Volt Distribution System

Power for 480 V auxiliaries is supplied from unit substations consisting of 6.9 kV/480 V or 4.16 kV/480 V transformers and associated metal clad switchgear. Non-Class 1E 4.16 kV buses SM-1, 2 and 3, supply separate 480 V substations, each with its own power transformer and switchgear.

Class 1E 480 V substations supplying ESF loads are arranged as independent radial systems with each 480 V bus fed by its own power transformer. Each 480 V Class 1E bus is independent of the other 480 V buses; there are no crossties. The 480 V auxiliaries required during emergency conditions are supplied from 480 V Class 1E buses SL-71 and SL-73 (Division 1) and SL-81 and SL-83 (Division 2). The HPCS 480 V auxiliaries are supplied from an independent transformer and Class 1E bus MC-4A (Division 3). Power supplies to all Class 1E auxiliary systems are arranged so that alternate or redundant auxiliary systems are supplied from 4.16 kV switchgear buses of separate Class 1E divisions.

The 480 V substations supply 460 V motor loads larger than 100 HP and all motor control center loads. Switchgear for 480 V substations is of the indoor metal clad type with draw-out circuit breakers operated from the plant DC system. Phase to ground fault currents are limited to a maximum of 10 amperes by use of neutral ground resistors in all substation transformer neutral ground connections. All substation transformer neutral ground connections and switchgear branch feeder circuits are equipped with ground detection devices and alarms.

The 480 V motor control centers feed motors 100 HP and less (in general), control power transformers, heaters, motor-operated valves, all other small electrically operated auxiliaries and all lighting. Control centers are isolated in separate load groups corresponding to divisions established by the 480 V substation units. Branch circuit protection for all loads is provided by fused disconnect switches equipped with current limiting fuses, with the exception of subfeeders to other small motor control centers and all HPCS motor control center (MC-4A) branch circuits. Molded case circuit breakers are utilized for these feeders to other MCCs and for all loads fed by MC-4A. Class 1E motor control centers are shown on the auxiliary one-line diagram (Figures 8.3-1a through 8.3-1f).

8.3.1.1.3 120/240 Volt (Non-Class 1E) Plant Uninterruptible Power System

The non-Class 1E plant uninterruptible power system supplies 120/240 V AC to station services where uninterruptible power is required, such as for plant, computer and plant instrumentation (e.g., DEH cabinet). This source of power is necessary for plant operational loads, but does not supply ESF loads. Power is distributed via a single phase, three wire, grounded neutral system.

Failure of the non-Class 1E uninterruptible power system has no adverse effect on station safety since no ESF loads are supplied from this system.

The plant uninterruptible power system receives its power from a static inverter-static switch arrangement fed both from a 250 V DC station battery (float source) and from a 480 V AC Class 1E MCC (preferred source) as shown on Figure 8.3-2. During faults on the uninterruptible power system the static switch will automatically transfer loads to a regulated alternate source, which supplies sufficient fault current to blow the circuit fuse and clear the fault.

A manual bypass siwtch is also provided to bypass the entire plant uninterruptible power system and transfer load to an unregulated bypass source. This will allow for maintenance and inspection of the system.

8.3.1.1.4 120/208 Volt Non-Class 1E Instrumentation Power System

Power is supplied to non-Class 1E plant instrumentation at 120/208 V AC via a three phase, four wire, grounded neutral distribution system. This distribution system supplies power to the 115 V AC transversing incore probe (TIP) of the neutron monitoring system and other non-Class 1E instrumentation loads.

Failure of the noncritical instrumentation power system has no adverse effect on station safety since no ESF loads are supplied from this system.

Alarm and fault detection equipment is provided to alert the operator of possible trouble. All equipment associated with the 120/208 V non-Class 1E instrumentation power system is readily accessible for inspection and maintenance on a routine basis in accordance with the manufacturer's recommendation.

a. Each diesel generator starts immediately upon recipt of a 4.16 kV Class 1E bus (SM-7, 8) primary undervoltage relay signal or LOCA signals (reactor low water level and/or high drywell pressure).

b. Upon sustained loss of 4.16 kV Class 1E bus voltage, the bus is automatically isolated from the upstream non-Class 1E system. All loads on the bus are tripped, except for those small loads shown in Tables 8.3-1 and 8.3-2 as part of the initial load block fed by the 480 V unit substation.

c. After each diesel generator has attained approximately normal frequency and voltage, its breaker closes (if 4.16 kV Class 1E bus voltage has not been re-established via the offsite system sources) thus immediately starting all loads belonging to the first block for which "starting required" signals are available for engineered safety feature actuation signals.

d. The starting of subsequent load blocks are delayed by time relays in accordance with Tables 8.3-1 and 8.3-2. Diesel generator capacity is such that units are capable of maintaining all required loads established by the loading schedules.

e. Limitation of diesel generator loading is maintained during the entire period the units are required to operate, since the Class 1E loads capable of being connected to the units exceed unit capability. However, as indicated in the loading schedules (Tables 8.3-1 and 8.3-2), the maximum loads automatically connected to the Division 1 and Division 2 diesel generating units (3860kW and 3382kW, respectively) do not exceed unit ratings (4400kw each). Loading beyond these values would require positive operator action to manually apply loads.

f. Maximum voltage dip projected to occur on the Class 1E buses (SM-7,8) as a result of motor starting during periods when emergency plant load is being supplied by the diesel generators is 85 percent of nominal bus voltage. The duration of voltage dip is expected to be very short lived - in the order of 2 to 5 seconds. Since the Class 1E bus primary undervoltage relays are set at 69 percent of nominal bus voltage, initiation of load shedding as a result of voltage dip due to motor starting will not occur. Since the Class 1E bus secondary undervoltage relays are set at 87.3 percent of nominal bus voltage (90.8 percent of motor nominal voltage) with a definite time delay of 8 seconds, they will not initiate any undesirable tripping action.

c. Incomplete sequence

d. Emergency stop pushbutton

e. Generator loss of excitation

f. Reverse current

g. Generator overcurrent

h. Generator overvoltage

i. High jacket water temperature

j. Low lube oil pressure

During a synchronizing test, the diesel generator is protected from overcurrent resulting from the non-Class 1E loads connected to the upstream buses, in the event of a loss of startup transformer power. The overcurrent protection results in isolation of the diesel generator emergency bus from the upstream non-Class 1E loads without disconnecting the diesel generator from the emergency bus.

The Division 1 and 2 standby diesel generator control circuits are detailed in Figures 8.3-25a through 8.3-25d (general DC control), 8.3-26a and 8.3-26b (excitation control) and 8.3-27 (governor control).

The diesel generator incomplete sequence (fail to start) relay (K4) indicated in Figure 8.3-25b is designed to shut the generating unit down and lock it out in the event the normal starting cycle is not completed within a predetermined time. The relay is actuated if speed sensing instrumentation indicates that the unit requires in excess of fifty (50) seconds to accelerate to 150 rpm (regardless of the cause), or upon failure of the cranking motors to disconnect when the unit is running.

8.3.1.1.8.1.9 Surveillance

Surveillance instrumentation is provided to monitor the status of the standby diesel genrating system. Provisions for surveillance are an essential requirement in the design, manufacturing, installation, testing, operation, and maintenance of the diesel generators. Such surveillance not only provides continuous monitoring of the status of the standby diesel generating system, so as to indicate readiness to perform intended functions, but also serves to facilitate testing and maintenance of the equipment. Periodic surveillance procedures are also implemented to check setpoints of protective relays to ensure a reliable operation. Annunciation is provided both locally (diesel generator control panels) and in the main control room. Table 8.3-11 indicates the annunciation furnished for the Divisions 1 and 2 diesel generating systems.

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When operating in the standby mode, conditions rendering the diesel generating units incapable of responding to emergency start signals are intentionally limited, as indicated in 8.3.1.1.8.1.8. Table 8.3-11, items 1 through 7 (inclusive), indicates all conditions which render the units incapable of responding, including both diesel generating unit and distribution system problems. Local, disabling diesel generator incomplete sequence and differential current conditions are annunciated indirectly (and distinctly from any nondisabling alarms) via the unit lockout (item 6) and fail to start (item 9) alarms. Item 21 indicates that the unit has been started automatically upon receipt of emergency start signals. The remaining items indicate nondisabling diesel generator problems which do not cause unit trip.

During test mode operation, an expanded set of disabling conditions are permitted to prevent unit start or initiate unit trip as indicated on 8.3.1.1.8.1.8. However, in the event of receipt of emergency start signals while the units are in the test mode, automatic control circuitry transfers the diesel generators to the standby mode, starts (if not operating at the time) the diesel generators and eliminates from the trip circuitry those signals not permitted to disable the unit in the standby mode.

Main control room annunciation is designed to permit the control room operator to accurately monitor the status of the standby diesel generating system at all times and during all modes of operation. Any condition which renders the deisel generators incapable of operation is annunciated via Table 8.3-11 Items 1-9. The difference between the standby mode and all other modes is that the number of unit tripping signals permitted to actually operate (via the unit lockout relay) is limited in the standby mode.

Diesel generating unit controls reset automatically (time delayed) following nonemergency manual stops initiated at the local control stations.

8.3.1.1.8.1.10 Instrumentation and Control Systems

Power supply source for the instrumentation and control systems for each diesel generator is independent in accordance with the divisional separation criteria detailed in 8.3.1.4 and 8.3.2.4. Each diesel generator set includes the following instrumentation:

8.3.1.2 Analysis

8.3.1.2.1 Compliance to Criteria

8.3.1.2.1.1 General

Compliance with General Design Criterion 17 is assured for the onsite power systems by having sufficient independence, redundancy and testability to perform the required safety functions assuming a single failure. Independence is discussed in 8.3.1.4 and testability is covered in 8.3.1.2.2. Redundancy in the onsite auxiliary AC power system is provided via the formation of redundant safety-related (Class 1E) electrical load groups (Division 1 and 2) in conformance with General Design Criterion 17, IEEE Std. 308-1974 and NRC Regulatory Guide 1.6 (Rev. 0). This redundancy extends from the onsite standby power sources through 4.16 kV buses, station service transformers, 480 V buses, MCC's, distribution cables, switchgear and protective devices.

The Division 3 power system is a separate and independent safety-related (Class 1E) power system serving the only HPCS system.

No essential electrical component of one Class 1E electrical division is dependent for its emergency power supply on electrical equipment or devices which are common to the power supply of another division. The onsite auxiliary AC power system standby sources consist of three diesel generator sets. Each of the diesel generators feeds one of the Class 1E divisions. The onsite auxiliary power system redundancy is based on the capability of either of the two redundant (Division 1 and 2) onsite power sources and their associated load groups, in conjunction with the Division 3 onsite power source and associated load group, to bring the reactor to a safe cold shutdown condition and/or to mitigate the consequences of a design basis accident.

The electrical separation and independence of redundant (Division 1 and 2) portions of the safety-related auxiliary power systems conform to IEEE Standard 308-1974, General Design Criterion 17 and Regulatory Guide 1.6, Revision 0, except that these diesel generators have tandem diesel engines. Reliability equivalent to a single diesel engine generator set is achieved, as shown by prototype testing (discussed in 8.3.1.1.9).

Division 1, 2 and 3 4.16 kV Class 1E buses (SM-7, 8, and 4 respectively) are normally supplied from separate 4.16 kV non-Class 1E buses (SM-1, 3 and 2 respectively) as indicated in Figures 8.1-9a through 8.1-9d. Class 1E circuit breakers which automatically open on a loss of offsite power are provided on the 4.16 kV tie lines between the Class 1E and non-Class 1E buses.

As protection against failures of the redundant standby AC power sources due to a single event, there are no electrical interconnections between the circuits needed to start, load, and maintain operation of each standby diesel generator.

All principal power circuits have both overload and short circuit protection provided by protective relays circuit breakers or by fuses.

Physical separation is provided between the independent electrical divisions as described in 8.3.1.4.

Design of the onsite power systems is not in strict accordance with NRC Regulatory Guide 1.75, Revision 0, since the WNP-2 CP issue date precedes the regulatory guide issue date. However, WNP-2 design does provide independence between equipment and circuits of redundant Class 1E electrical divisions, and between Class 1E and non-Class 1E equipment and circuits where practicable in satisfaction of 10 CFR Part 50 requirements.

Non-Class 1E loads required to operate during a loss of offsite power are connected to the Class 1E power supplies. These connections do not degrade the Class 1E power supplies, based on the following:

a. Connection of non-Class 1E loads to Class 1E power supplies is via Class 1E isolation devices. These devices are either a circuit breaker shunt tripped on LOCA or one or two overcurrent devices in series such as fuses or circuit breakers. The overcurrent devices trip on overload currents (except for 4 kV motor

8.3.1.2.1.2 Reactor Protection System (RPS) Power system

The RPS Power System is not an Engineered Safety Feature, component, or system. The system itself fails in a failsafe mode. That is, it de-energizes and thus causes a shutdown action. In addition, redundant electrical protection devices are utilized for isolation as indicated in 8.3.1.1.6. However, design considerations are taken to ensure power supply availability commensurate with the needs of the equipment serviced by it. Redundancy of equipment ensures a high degree of availability.

8.3.1.2.1.3 Redundant (Division 1 and Division 2) Standby AC Power Supplies

Upon loss of normal and offsite sources of power to the 4.16 kV switchgear buses, the 4.16 kV Class 1E portion of the auxiliary AC power system is automatically isolated. All 4.0 kV motor and selected 460 V motor loads are automatically shed from their respective buses to allow for the sequential loading of the standby diesel generators. See 8.3.1.1.1.

The diesel generators start automatically and are automatically connected to the Class 1E 4.16 kV buses. Electrical loads necessary for an emergency reactor shutdown or shutdown in the event of a LOCA, are automatically and sequentially reconnected to these safety-related buses. The automatic diesel starting and loading sequence is designed to provide power to engineered safety feature (ESF) components required in the event of a design basis accident within the time period specified for their operation in Chapter 15.

The two diesel generators supplying power to Division 1 and Division 2 ESF components are sized and designed in accordance with NRC Regulatory Guide 1.9, Revision 0. Their ratings are based upon continuous load rating greater than the sum of the loads requiring power at any one time.

The sequencing of large loads at five (or more) second intervals ensures that diesel generator voltage and frequency limits (80 percent and 95 percent respectively) are maintained. Also, engine overspeed settings and other design parameters remain in accordance with NRC Regulatory Guide 1.9, Revision 0, as discussed in 8.3.1.1.8.1.

The Division 1 and 2 portions of the onsite AC power system also satisfy Regulatory Guide 1.32, Revision 2, not only in their adherence to IEEE Standard 308-1974, but also as follows:

a. Offsite power is available from either offsite source within a few seconds if the plant main generator source is lost.

b. Electrical and physical independence of standby power sources is in accordance with Regulatory Guide 1.6 as described in 8.3.1.1.8.1.

c. The selection of the diesel generator capacities has been made in accordance with Regulatory Guide 1.9 as further described in 8.3.1.1.8.1.

8.3.1.2.1.4 HPCS (Division 3) Standby AC Power Supply

8.3.1.2.1.4.1 Compliance with Criterion GDC 17

The HPCS AC power supply is Class 1E and is designed with sufficient capacity and independence to ensure that core cooling, containment integrity, and other vital functions are maintained in the event of a postulated accident. The design of the onsite and offsite electrical power systems provides compatible independence and redundancy to ensure high availability of power supply to the emergency core cooling system, even assuming a single failure.

Electrical power from the transmission network to the HPCS bus SM-4 is provided via the 230 kV startup auxiliary transformer. A loss of normal voltage at 4.16 kV bus SM-4 results in automatic starting of the HPCS diesel generator, trippiing of the normal supply breaker and closing of the generator breaker as described in 8.3.1.1.8.2.7.

8.3.1.2.1.4.2 Compliance with Criterion GDC 18

The auxiliary electrical system is designed to permit inspection and testing of all important areas and features, especailly those that have a safety function and whose operation is not normally required. As detailed in Chapter 16, periodic component tests will be supplemented by extensive functional

c. The start and load reliability test satisfies the following requirements: A total of 69 valid start and loading tests with no failure or 128 valid start and loading tests with a single failure is to be performed. Failure of the unit to succesfully complete this series of tests as prescribed requires a review of the system design adequacy, the cause of the failure to be corrected, and the tests continued until 128 valid tests are achieved without exceeding the one failure. The start and load test is conducted as follows:

   1. Engine cranking is started upon receipt of the start signal, and the diesel generator set accelerates to specified frequency and voltage within the required time interval.

   2. Immediately following, the diesel generator set accepts a single step load consisting of the main HPCS pump motor load (fully loaded) or larger motor load (fully loaded) and additional loads (inductive and/or resistive) as required to total at least 100% of the continuous rating of the diesel generator unit.

   3. At least 90 percent of these tests are performed with the diesel generator set initially at "warm standby", based on jacket water and lube oil temperatures at or below values recommended by the engine manufacturer. After load is applied the diesel generator set continue to operate until jacket water and lube oil temperatures are within plus or minus 10°F (5-1/2°C) of the normal engine operating temperatures for the corresponding load.

   4. The other 10 percent of these tests are performed with the engine initially at normal operating temperature equilibrium (defined as jacket water and lube oil temperature within ±10°F (5-1/2°C) of normal operating temperatures as established by the engine manufacturer for the corresponding load).

If the cause for failure to start or accept load in accordance with the preceding sequence falls under any of the categories listed below, that particular test is disregarded, and the test sequence resumed without penalty following identification of the cause for the unsuccessful attempt.

1. Unsuccessful start attempts which can definitely be attributed to operator error including setting of alignment control switches, rheostats, potentiometers, or other adjustments that may have been changed inadvertently prior to that particular start test.

2. A starting and/or loading test performed for verification of a schedule maintenance procedure required during this series of tests. This maintenance procedure is defined prior to conducting the start and load acceptance qualification tests and then becomes part of the normal maintenance schedule after installation.

3. Failure of any of the temporary service systems such as DC power source, output circuit breaker, load, interconnecting piping and any other temporary setup which is not part of the permanent installation.

4. Failure to carry load which is definitely attributed to loadings in excess of required loading.

8.3.1.2.1.4.5 Conformance With Regulatory Guide 1.9 (Revision 0)

The HPCS system diesel generating unit conforms to the requriements of Regulatory Guide 1.9 (Revision 0), with the exception of voltage and frequency limits, as described below.

The unit conforms to Position 1 of the guide in that the continuous rating of the diesel generator is greater than the maximum coincidental steady-state loads requiring power at any time (see Table 8.3-3). Intermittent loads such as motor-operated valves are not considered for long-term loads.

The unit conforms to Position 2 of the guide in that the 2000-hour (2850 kW) and 90% of the 30-minute (2727 kW) ratings both exceed the maximum coincidental load indicated in Table 8.3-3.

The unit conforms to Position 3 of the guide in that the load requirements will be verified by preoperational tests.

The HPCS diesel generator unit is considered as a justifiable departure from strict conformance to Position 4 of the guide regarding voltage and frequency limits during the initial loading transient. The HPCS system consists of one large pump and motor combination which represents more than 90% of the total load; consequently, limiting the momentary voltage drop to 25% and the momentary frequency drop to 5% would not significantly enhance the reliability of HPCS operation. To meet these regulatory guide requirements, a diesel generator unit approximately two to three times as large as that required to carry the continuous rated load would be necessary. However, the frequency and voltage overshoot requirements of Regulatory Guide 1.9 (Revision 0) are met. A prototype testing program on an installed unit, as described in 8.3.1.2.1.4.4, has verified the following functions:

a. System fast-start capabilities

b. Load carrying capability

c. Load rejection capability

d. Ability of the system to accept and carry the required loads

e. The mechanical integrity of the diesel engine generator unit and all of the major system auxiliaries

The above engine generator capabilities will be further verified by preoperational testing in conformance with Regulatory Guide 1.106, Revision 1, including errata. At least 5 of the 69 start and loading tests will be made using the actual generator loads.

The design of the HPCS diesel generator conforms with the applicable sections of IEEE criteria for Class 1E "Electrical Systems for Nuclear Power Generation Station," IEEE Standard 308-1971.

The generator has the capability of providing power to start the required loads with operationally acceptable voltage and frequency recovery characteritics. A partial or complete load rejection will not cause the diesel engine to trip on overspeed.

The HPCS Power Supply Topical Report (NEDO-10905-3) decribes the prototype and reliability test requirements.

The calculated HPCS diesel generator transient response is indicated in Figure 8.3-28. NEDO-10905-3 provides an analysis showing the conservatism of calculated response compared to that obtained from actual tests.

8.3.1.2.1.4.6 Conformance with Regulatory Guide 1.29

The HPCS power supply system is capable of performing its function when subjected to the effects of design bases natural phenomena at its location. In particular, it is designed in accordance with the Seismic Category I criteria and housed in a safty class structure.

8.3.1.2.1.4.7 Conformance With Regulatory Guide 1.32

The design of the HPCS diesel generator conforms with the applicable sections of IEEE criteria for Class 1E, "Electrical Systems for Nuclear Power Generation Stations," IEEE Standard 308-1971.

8.3.1.2.1.4.8 Conformance With Regulatory Guide 1.47

See 7.1.

8.3.1.2.1.4.9 Conformance With Regulatory Guide 1.62

Manual controls are provided to permit the operator to select the most suitable distribution path from the power supply to the load. An automatic start signal will override the test mode. Provision is made for control of the system from the control room as well as from an external location.

8.3.1.2.1.4.10 Conformance With IEEE Standard 279-1971

See 7.3.2.1.2 for a discussion of compliance of the HPCS with IEEE Standard 279-1971.

8.3.1.2.1.4.11 Conformance With IEEE Standard 308-1971

The HPCS electrical system components supplying power to the Class 1E electrical equipment are designed to meet their functional requirements under the conditions produced by the design basis events. Equipment of different divisions is physically separated to maintain independence and to minimize the possibility of a common mode failure. HPCS Class 1E equipment is located in Seismic Category I structures.

Surveillance of the HPCS Class 1E electrical system is in compliance with the standard.

8.3.1.2.1.4.12 Conformance with IEEE Standard 344-1971

The HPCS power supply unit components are seismically qualified to IEEE Standard 344-1971. Refer to 3.10.

8.3.1.2.1.4.13 Conformance to IEEE Standard 387-1972

The HPCS power supply unit is completely independent from other standby power supply units and meets the applicable requirements of IEEE Standard 387-1972.

The HPCS diesel generator unit is designed to:

a. Operate in its service environment during and after any design basis event without support from the preferred power supply;

b. Start, accelerate, and be loaded with the design load within an acceptable time:

   1. from the normal standby condition,

   2. with no cooling available, for a time equivalent to that required to bring the cooling equipment into service with energy from the diesel generator unit, and

3. on a restart with an initial engine temperature equal to the continuous rating, full load engine temperature;

c. Carry the design load for 2000 hours;

d. Maintain voltage and frequency within limits that will not degrade the performance of any of the loads composing the design load below their minimum requirements, including the duration of transients caused by load application or load removal;

e. Withstand any anticipated vibration and overspeed conditions. There is no flywheel coupled with the HPCS diesel generator. The generator and exciter are designed to withstand 25% overspeed without damage.

The HPCS diesel generator has continuous and short-term ratings consistent with the requirements of Section 5.1 of the standard.

Mechanical and electrical system interactions between the HPCS diesel generator unit and other units of the standby power supply, the nuclear plant, the conventional plant, and the Class 1E electrical systems are coordinated so that the HPCS diesel generator units' design function and capability are realized for any design basis event except failure of the HPCS diesel generator unit.

The qualification requirements of IEEE Standard 323-1971 are met by test and on operating experience on similar equipment in similar environment in other plants.

8.3.1.2.2 Tests and Inspection

The auxiliary AC power system is designed to permit periodic testing and inspection of the system as a whole and of the operability and functional performance of the components in accordance with General Design Criterion 18. Preoperational testing, as described in Chapter 14, will be performed to verify that all components, automatic and manual controls, and sequences of operation of the standby power system function as required. Preoperational testing of redundant portions of the onsite electrical power system to verify proper load group assignments is performed in accordance with NRC Regulatory Guide 1.41, Revision 0.

Table 8.3-19 indicates the voltage values expected at the various levels of the Class 1E portions of the auxiliary AC distribution system under a degraded (69% of nominal, based upon 4.16 kV voltage sensors) value of input voltage (2870 V).

It should be noted that critical (Class 1E) plant controls and vital instrumentation are supplied by redundant (Division 1 and 2) divisions of the 120/240 V AC Class 1E uninterruptible power supply system. This system supplies loads via inverters, with static transfer to an alternate AC supply in case of circuit faults or loss of inverter voltage. The alternate supply line voltage is regulated within ±10% of normal in accordance with the NSSS vendor's requirements. A manual bypass switch is provided for maintenance of the inverter or static switch.

Table 8.3-17 indicates the various monitors and alarms (annunciators/computer) provided to monitor system voltages.

8.3.1.3 Physical Identification of Safety-Related (Class 1E) Equipment

Each safety-related electrical equipment or cable is tagged with an equipment number. In addition, a division identification marker is provided along with the equipment number which indicates the assignment to one of seven divisions (Divisions 1, 2, 3, 4, 5, 6, and 7). This division marker is inscribed with color coded characters on a color coded background as shown in Tables 8.3-25 and 8.3-26. Assignment of equipment to the seven divisions is given in Table 8.3-7.

All Class 1E cables external to the power generation control complex (PGCC) prefixed by 1, 2, 3, 4, 5, 6, or 7 are tagged every 15 feet and at their terminations with a unique identifying cable number except for upgraded cables as noted in 8.3.1.4.2.3. Non-Class 1E cables, as well as cables associated by proximity to Class 1E cables, are identified with a unique cable number at their terminations, pullpoints, entrance and exit to raceways, and every 100 feet. Non-Class 1E cables that are powered from Class 1E are identified every 15 feet (except in conduit) except for upgraded cables as noted in 8.3.1.4.2.3. In addition to thyubgi cable numbers, color coded division identifiers are provided either as part of the cable marker or as a separate marker. See Table 8.3-25.

Prior to cable installation, conduit is similarly tagged with a unique conduit number, in addition to the division marking characters shown in Table 8.3-25, at 15 foot intervals, at discontinuities, at pull boxes, at points of entrance and exit of rooms, and at origin and destination equipment. Conduits containing cables operating above 600 volts are also tagged to indicate the operating voltage.

Trays are tagged prior to cable installation with unique tray node identification numbers, and the division marking characters indicated in Table 8.3-25, supplemented by another character (H, P, C, S, R) which indicates the voltage level (6.9 kV, 4.16 kV, Control, Signal, RPS) of the cables contained in the tray. Non-Class 1E tray sections (a tray section is defined by two adjacent nodes) that contain prime cables (see 8.3.1.4.1.13.c) are identified with an additional prime marker. Trays containing cables operating above 600 volts are tagged to indicate the operating voltage level.

Switchgear, transformers, distribution panels, batteries, chargers, and other electrical equipment are tagged with the equipment number indicated on the single line diagrams (e.g., SM-8-85, MC-8A, etc.) as well as the division marking characters indicated in Table 8.3-25.

Safety-related cables within the power generation control complex (PGCC) and under floor PGCC raceways are tagged with identification numbers every 10 feet, and division markers every 5 feet. The tagging characteristics are shown in Table 8.3-26.

Cable routing information is provided in Tables 8.3-8, 8.3-20, 8.3-21, and 8.3-22. This illustrates the computer program used for identification and routing of cables in trays. Routing information for cables in conduits is provided in raceway layout drawings. Table 8.3-9 indicates sample cable routing schedules. Actual cable tray drawings for the reactor, control and radwaste buildings are shown in Figures 8.3-9 through 8.3-14, inclusive.

A list of Class 1E components and equipment (see 8.3.1.4.1.1 for definition) is provided to facilitate identification of safety-related components and their circuits.

Class 1E circuits and associated circuits within equipment enclosures are not uniquely identified. They are identified with the same division as the equipment except that all intruding divisional circuits and prime circuits are identified by an additional striped marker as shown in Tables 8.3-25 and 8.3-26.

8.3.1.4 Independence of Redundant Systems

The physical independence of electrical systems complies with the requirements of IEEE Standard 279-1971, IEEE Standard 308-1974 (IEEE Standard 308-1971 for the HPCS system), General Design Critria 3 and 17, and Regulatory Guide 1.6, Revision D. See Table 7.1-3 for a matrix of the applicability of codes and standards to the various safety-related systems. The physical separation of mechanical equipment including piping and instrumentation tubing is not included in this section. However, sufficient separation between redundant plant protection system equipment is provided such that the capability of the protection systems to mitigate the consequences of any design basis accident and bring the reactor to a cold shutdown condition is assured. See 3.1.

8.3.1.4.1 Definitions

8.3.1.4.1.1 Class 1E

Class 1E is defined as the safety classification of the electrical equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or are otherwise essential in preventing significant release of radioactive material to the environment.

8.3.1.4.1.2 Safety-Related Electrical and Instrumentation Systems and Equipment

These items are those electrical and instrumentation systems and equipment which are relied upon to prevent or mitigate the consequences of accidents and malfunctions originating within the reactor coolant pressure boundary. Safety systems from an electrical aspect consist of those electrical and instrumentation circuits and components designated as Class 1E that are necesary for the systems listed in Table 7.1-1 to perform their safety function, and include the reactor protection system, the nuclear steam supply shutoff system, and the engineered safeguards systems. The Class 1E cables within the NSSS power generation control complex (PGCC) are defined by codes as listed on Table 8.3-21 and Figure 8.3-30.

8.3.1.4.1.3 Reactor Protection System (RPS)

The reactor protection system is the overall complex of instrument channels, trip system and trip actuators, and wiring which generates a reactor trip (scram) signal to initiate a reactor trip when a monitored parameter (or group of parameters) exceeds a setpoint value indicating the approach

a. Where installed in cable trays, raceways, and PGCC floor ducts (see definition (a), 8.3.1.4.1.13).

1. They are uniquely identified as associated or as Class 1E circuits and remain with, or are physically separated the same as, those Class 1E circuits with which they are associated.

2. They are identified in accordance with item 1 above from the Class 1E equipment up to and including an isolation device. Beyond the isolation device, such a circuit is not considered an associated circuit and does not conform to item 1 above, provided it does not again become associated with a Class 1E system.

3. They are analyzed or tested to demonstrate that Class 1E circuits are not degraded below an acceptable level.

b. Where installed in cabinets and equipment, external to trays, raceways, and PGCC floor ducts, (item (a) above), see definitions b and c, 8.3.1.4.1.13.

1. Associated Circuit Definition b - Circuits which become associated due to sharing of enclosures with Class 1E circuits are not separated; they are analyzed to show that the Class 1E circuits are not degraded below an acceptable level.

2. Associated Circuit Definition c (prime circuits) - Non-Class 1E circuits which receive power from Class 1E power sources comply with the same separation requirements placed on Class 1E circuits. For example, a Division A non-Class 1E circuit whose power source is a Division 1 bus, is separated from a Division 2 Class 1E circuit or a Division B non-Class 1E circuit whose power source is a Division 2 bus.

8.3.1.4.2.1.3.3 Non-Class 1E Cables/Circuits

Non-Class 1E cables are assigned numbers prefixed by "A" or "B" and are routed in non-Class 1E raceways. They are procured to the same requirements as Class 1E cables, except for a few vendor supplied cables designated in the computerized cable schedule as type Z. These non-Class 1E cables are tagged in accordance with Tables 8.3-25 and 8.3-26.

The isolation of non-Class 1E circuits from Class 1E circuits or associated circuits is achieved by complying with at least one of the following requirements.

a. Non-Class 1E circuits are physically separated from Class 1E circuits and associated circuits by the minimum separation requirements specified for redundant Class 1E divisions or they become associated circuits.

b. Non-Class 1E circuits are electrically isolated from Class 1E circuits and associated circuits by the use of isolation devices, shielding and wiring techniques, physical separation, or an appropriate combination, or they become associated circuits.

c. The effects of lesser separation or the absence of isolation between the non-Class 1E circuits and the Class 1E circuits or associated circuits are analyzed to demonstrate that Class 1E circuits are not degraded below an acceptable level or they become associated circuits.

d. Non-Class 1E low energy (instrumentation and control circuits) are not required to be physically separated or isolated from associated circuits provided: (1) the non-Class 1E circuits are not routed with associated cables of a redundant division; or (2) they are analyzed to demonstrate that Class 1E circuits are not degraded below an acceptable level. As part of the analysis, consideration is given to potential energy and identification of the circuits involved.

Since power cables (see 8.3.1.4.2.1.1.1) are not considered to be low energy circuits, the analysis applied to non-Class 1E-to-Class 1E/associated separation described above does not apply. Non-Class 1E power cables routed in open raceways (trays) are separated from all Class 1E/associated cables (see 8.3.1.4.1.13) with the same requirements specified for separation of redundant Class 1E cables. For other than open raceways, additional information is provided in 8.3.1.4.4.

8.3.1.4.2.1.4 Cable Segregation by Routing

The physical separaton distances required between raceways external to the PGCC are identified in 8.3.1.4.3.8. The physical arrangement of the PGCC raceways are described in 8.3.1.4.3.6.3. Outside the PGCC thirty-four independent raceway systems are provided for cabling. These include dedicated raceways assigned to each of the Class 1E divisions. The raceways for Divisions 1, 2, and 3 utilize open-type ladder trays for power and control. Trays for instrumentation raceways for Divisions 4, 5, 6, and 7 are totally enclosed. Raceways exist for non-Class 1E cabling crossovers between Division A and Division 1 raceways and similarly between Division B and Division 2 raceways. For cables external to the PGCC, cable numbers listed in the computerized cable schedule are assigned a compatibility that corresponds to a raceway. The compatibility number is identical to the cable number prefix and the divisional assignment of the raceway except for the following: Division A prefixed cables are assigned a compatibility of 1 if routing in Division 1 raceways is required and Division B prefixed cables are assigned a compatibility of 2 if routing in Division 2 raceways is required (see Table 8.3-8): within the PGCC isolated floor ducts for Divisions 1, 2, 3, and nondivisional are provided for cable routing in accordance with Tables 8.3-20, 8.3-21 and 8.3-22. The routing of cables in raceways is in accordance with the following:

a. Cable splices are not normally designed into the cable system (except for cables entering containment at electrical penetrations). If required they are not permitted in cable trays, but are made in conduit fittings or metallic electrical boxes.

b. All cabling for use in Class 1E systems, and for associated circuits, is designed to resist combustion as described in 8.3.3. Cable flame retardance characteristics and routing arrangement eliminate (insofar as practical) the potential for fire damage to cables and the spread of fire between redundant divisions.

c. Power cable ampacities are based on NEMA WC51-1972 using a tray fill of 2 inches out of a 3-inch usable depth and corrected for ambient temperature. A further group derating factor is applied to account for unforseen as-built conditions. The above tray fill of 2 inches is approximately 50% of the usable tray cross-sectional area.

d. In general, hazardous areas are avoided to limit circuit failures to failures or faults internal to the electric equipment or cables. Where hazardous areas cannot be avoided an analysis is provided. See 8.3.1.4.2.2.

e. In the cable spreading and main control room areas, 120 V AC (or below) and 125 V DC (or below) branch circuits from distribution panels to the control boards and terminal cabinets are routed in conduit (see Table 8.3-24). The only power cables in these areas are the 460 V AC feeders to the control room emergency lighting panel step-down transformers; these cables are routed in conduit.

f. The underground cables for Class 1E systems complies with NRC General Design Criteria 1, 2, 3, 4, and 17, as well as IEEE Standard 308-1974 and the following:

1. Underground cables between manholes are run in concrete encased plastic ducts which serve non-Class 1E systems, and in reinforced concrete encased steel ducts to Class 1E systems.

2. The minimum horizontal separation at the peripheries of redundant underground ducts is 18 inches. There is no underground cross-overs of these duct banks.

3. Underground ducts for Class 1E cables are Quality Class 1 and Seismic Class 1. Cables are fire retardant type, and where splices are necessary in manholes because of the length of pull, waterproofing is utilized.

In limited access areas such as the switchyard, a single conduit may contain non-Class 1E cables of both non-Class 1E divisions provided they are not both prime circuits. Where access to a local device is via a single conduit, the conduit is considered as an extension of the device enclosure, and cable separation by service is not maintained.

8.3.1.4.2.2 Physical Separation Criteria

Physical separation as a protection against single failures of redundant Class 1E power control and instrumentation systems (Divisions 1 to 7) is provided. Where the use of separate safety class structures is not feasible, spatial separation is the preferred method of achieving separation. Methods of maintaining physical separation are as follows:

a. In general, non-safety equipment, components, or piping are not installed above safety equipment. Where installation above safety equipment cannot be avoided, the supports are installed to Seismic Class 1 requirements or analysis is made to demonstrate that failure will not impair the overall function of the safety system.

b. Where Class 1E equipment or cabling is located or routed in areas where there is a potential for internally generated missiles, pipe whip, or flood, a protective barrier is provided or an analysis is performed to assure that a loss of plant capability to mitigate the consequences of an accident or to bring it to a safe shutdown condition cannot occur.

c. Fire barriers are provided between redundant electrical equipment including raceways whenever the physical separation distances in 8.3.1.4 are not met. Raceways penetrating fire-rated walls, floors or ceilings, or pressure boundries are sealed with a fire-rated fire stop.

d. Refer to Appendix F for compliance with 10CFR50 Appendix R.

8.3.1.4.2.3 Administrative Controls for Ensuring Separation Criteria

The quality assurance procedures described in IEEE Standard 336-1971 are employed during the design and installation of the cable system to ensure compliance with the design criteria. Design drawings and cable lists are prepared, reviewed, and approved for construction and updated in the field. Each cable and raceway is identified in the computer program, and the identification includes the applicable separation classification. Cable routing programs ensure that cables of particular separation groups are routed through the appropriate raceways. Cables are installed in accordance with written procedures which specify quality requirements, inspection, and documentation requirements for all cable pulls. Upon completion of Class 1E cable pulling, an electrical quality control inspector initials the cable pull slip and verifies that the cables have been installed in accordance with the design documents.

In some cases it has been necessary to upgrade certain cables from a non-Class 1E status to either a Class 1E or prime cable status. Post installation procedures exist to upgrade such cables. These cables are evaluated on an individual basis and allowed to deviate from the normal installation procedures.

The following briefly describes the upgrading procedure for various categories of cables:

a. Non-Class 1E cables upgraded to Class IE

   1. Cable indentification tags are revised at all terminations, pullpoints, entrance, and exits to raceways.

   2. Cable installation records are reviewed to provide assurance that these cables are routed in Class 1E raceways and installed to Class 1E requirements. Otherwise, megger and continuity tests are performed, termination and routing is reinspected to Class 1E requirements, and documentation is prepared verifying the upgrade.

b. Non-Class 1E cables upgraded to prime cables

   1. Same upgrade as 1.a above.

   2. Routing and termination is reinspected to Class 1E requirements and documentation is prepared verifying the upgrade.

8.3.1.4.2.4 System Separation Criteria

8.3.1.4.2.4.1 Fail-Safe Cabling

Fail-safe (deenergized to operate) wiring outside of the main protection system cabinets is run in rigid or flexible conduits and/or totally enclosd trays used for no other wiring and are conspicuously identified at all junction or pull boxes. IRM, LPRM input, and RPS scram group output cables are combined in the same wireway provided that the four divisional separation (Divisions 4, 5, 6, and 7) are maintained (see Table 8.3-22).

8.3.1.4.2.4.2 Scram Solenoid Cabling

Wires from both RPS trip system trip actuators to a single group of scram solenoids are run in a single conduit; however, a single conduit does not contain wires to more than one group of scram solenoids. Wiring for two solenoids on the same control rod is run in the same conduit (see Figure 8.3-41).

8.3.1.4.2.4.3 NMS and Inboard Isolation Valve Cabling

Cables through the primary containment penetrations are so grouped that failure of all cabling in a single penetration cannot prevent a scram. (This applies specifically to the neutron monitoring cables and the main steam isolation valves position switches cables, see Figures 8.3-41 and 8.3-42.)

8.3.1.4.2.4.4 RPS Power Supplies

Power supplies to systems which de-energize to operate require only that separation which is deemed prudent to ensure reliable operation. Therefore, the protection system motor generator sets are not required to comply with Class 1E separation requirements.

8.3.1.4.2.4.5 Four Division Separation

Wiring for the four RPS scram group outputs and the NMS LPRM inputs is routed as four separate divisions (see Tables 8.3-20, 8.3-21, and 8.3-22 and Figures 8.3-41 and 8.3-42).

8.3.1.4.2.5 Equipment and Circuits Requiring Separation

Equipment and circuits are identified on documents and drawings in a distinctive manner.

8.3.1.4.2.6 Compliance to Regulatory Guide 1.75, Revision 1

This regulatory guide is not applicable to WNP-2 since the WNP-2 construction permit date precedes the regulatory guide issue date. However, the actual plant design does provide a technically acceptable alternative to the requirements of the guide. Independence between equipment and circuits of redundant Class 1E electrical divisions is provided to satisfy 10CFR50 requirements.

Deviations to the guide are listed below:

a. Paragraph c.1 of Regulatory Guide 1.75 Revision 1, excludes the use of fault current actuated circuit interrupting devices as an isolation device. |

WNP-2 uses overcurrent actuated circuit breakers and fuses. Justification for this deviation is provided in 8.3.1.4.1.12 and 8.3.2.2.1.1.

b. Paragraph 4.5 of IEEE 384, as endorsed by Regulatory Guide 1.75, Revision 1, Paragraph C.4, states that associated circuits should meet all the same requirements as those placed upon Class 1E circuits. Some WNP-2 cables, which are associated by the IEEE 384 definition, may be partially routed in non-Class 1E raceways as well as Class 1E raceways. These cables, when routed in the non-Class 1E trays, are not considered associated based on analysis. They meet all the pull/termination documentation requirements placed upon Class 1E cables when they are bulk pulled with Class 1E cables. When they are not bulk pulled, they are installed to the same installation parameters as Class 1E by procedure, except that verification documentation for sidewall pressure, pulling tension, and minimum bend radius may not be available.

c. Paragraphs 4.6.1 and 4.6.2 of IEEE 384 as endorsed by Regulatory Guide 1.75, Revision 1, require that non-Class 1E circuits be separated from Class 1E associated circuits by the same minimum separation required between redundant Class 1E circuits, unless the non-Class 1E circuits are classified as associated. As discussed in (b) above, some circuits that would be classified as "associated" by the IEEE 384 definition are partially routed in non-Class 1E raceways and, therefore, are not separated from non-Class 1E circuits. Class 1E physical separation is not necessarily maintained between the non-Class 1E and Class 1E raceways, except as noted in 8.3.1.4.2.1.3.3.d.

Inside enclosures, non-Class 1E circuits are not separated from Class 1E circuits and thus would be termed "associated" by Regulatory Guide 1.75. These circuits are Category 1C and treated as non-Class 1E, except for prime circuits which do meet Class 1E separation requirements. Justification for this deviation is described in 8.3.1.4.4.1.3.

d. Paragraphs 5.1.3 and 5.1.4 of IEEE 384 as endorsed by Regulatory Guide 1.75, Revision 1, required a minimum separation of 1-inch between enclosed raceways of redundant divisions. This requirement is not met in WNP-2 though the raceways are not physically touching. Justification for this deviation is based on Wyle Lab tests No. 56719 and No. 56669 for the Susquehanna Steam Electric Station. These tests demonstrate that rigid steel conduits and some specific heat-resistant sleeving materials qualify as barriers against potential damage due to an electrical fault in one of the circuits requiring separation.

e. Paragraph 5.6.3 of IEEE 384 as endorsed by Regulatory Guide 1.75, Revision 1, requires identification of internal wiring to distinguish between redundant Class 1E wiring and between Class 1E and non-Class 1E wiring. At WNP-2 the panel or enclosure is assigned to a given Class 1E division if the majority of the contained wiring belongs to this division. Circuits associated to this division and non-Class 1E wiring in the panel are not identified. However, if Class 1E wiring for a redundant division or wiring associated by connection to the redundant division are also present in the same panel, then these wires are identified by color coded tags as shown in Tables 8.3-25 and 8.3-26.

8.3.1.4.3 Physical And Spatial Separation Details

Each Class 1E component is assigned to one of seven Class 1E divisions. Class 1E components of one division are separated from Class 1E components of the other divisions except as noted in Table 8.3-21 for the NSSS PGCC. Class 1E components are physically separated and protected from non-Class 1E high-energy components such that loss of Class 1E redundancy cannot result from a design basis event.

Structures are designed to provide protection from the effects of wind loadings, tornadoes, external missiles, flooding, and earthquakes. All Class 1E equipment, components, and raceways, and their supports, are designed to Seismic Category I requirements (refer to 3.10 for discussion of seismic capability).

8.3.1.4.3.1 Standby Generating Units and Auxiliaries

The standby diesel generator sets are located in separate equipment rooms in the diesel generator building. Auxiliaries and local controls for each diesel generator set, separated the same as the units themselves, are also located in this building. Each unit is provided with an independent air supply.

8.3.1.4.3.2 DC Power Systems

The Class 1E DC power systems include batteries, chargers, and associated equipment. Equipment for redundant systems is located in separate rooms. For further description see 8.3.2.

8.3.1.4.3.3 Switchgear

Separate electrical equipment rooms are provided in the radwaste/control building for redundant 4.16 kV and 480 V Class 1E Divisions 1 and 2 switchgear as shown on Figure 8.1-7. The Division 3 4.16 kV Class 1E switchgear and 480 V Class 1E MCC are located in the diesel generator building.

8.3.1.4.3.4 Motor Control Centers and Distribution Panels

Motor control centers, distribution panels, and miscellaneous electrical equipment of redundant divisions are either spatially separated or are located in separate rooms of safety class structures.

8.3.1.4.3.6.3 PGCC Cable Assembly and Routing

The cable assembly within the power generation control complex is designed around the following variables: engineered system designation, circuit signal classification, PGCC separation classification based on power supply, and finally, the origination/destination which provides the routing and length (see Table 8.3-21). Each PGCC cable is precut, assembled (with lugs and connectors at either end as required), and installed in the panel/floor module shipping section. Special cable and routing requirements are shown on Table 8.3-22. The cable jacket and conductor insulation for the cables within the PGCC is either Raychem Flamtrol, General Electric Vulkene/Geoprene, or Tefzel. The fire suppression system has been provided to limit any off-gasing/smoke that could result from a cable fire.

Cable routing consists of two categories: field interface terminations (fits) and system interface terminations (sits). Fits cables are routed between termination cabinets and PGCC control panels, while sits cables are routed between PGCC control panels and do not interface with BOP field cable (see Figure 8.3-30).

8.3.1.4.3.7 Separation Within Panels

Separation of wiring in panels and instrument racks for redundant divisions of Class 1E circuits is accomplished by mounting redundant equipment on physically separated panels or control boards wherever practicable. Where locating control devices on separate panels is considered prohibitive for manual operation of equipment for optimum equipment arrangement, and where no single credible event in a single panel could disable two sets of redundant control circuits, both devices are located in the same panel. Where control devices of redundant systems are mounted in the same panel, physical separation (six inches), barriers, or isolation devices are provided. Wherever wiring of two redundant divisions exists in a single panel section, separated or isolated terminal boards and wiring preclude the possibility of fire propagation from one division of wiring to another. This separation is adequate since the material used in the construction of panel board, devices, and wiring are of a fire retardant nature.

In a few instances it is necessary for a single device such as a relay to be connected to wiring from redundant safety divisions. In such cases the intruding division wiring is routed immediately away from the device to attain the required 6-inch separation or to the extent where a barrier can be installed.

8.3.1.4.3.8 Spatial Separation Details for Raceways

The minimum separation distances for trays and conduits in general and specific areas are described in this section.

8.3.1.4.3.8.1 General Plant Areas

Raceways of redundant divisions are separated by physical distance. Figures 8.3-29a through 8.3-29d indicate the minimum separation distances for parallel runs of trays and conduits of redundant divisions. In general areas the minimum separation distance between open cable trays of redundant divisions or between an open tray of one division and a conduit or enclosed raceway of a redundant division routed above the tray is three feet free air space (horizontally) and five feet free air space (vertically). However, if no automatic area fire detection and extinguishing system exists, and the lower tray is the highest tray in a tier of three or more, the minimum vertical free air space for separation is eight feet. The minimum separation distance between an open cable tray of one division and a conduit of a redundant division where the conduit is routed below the open tray is one inch. Where equipment arrangement precludes maintaining the minimum separation distance, covers or barriers are provided between trays of redundant divisions. Circuits of redundant divisions can also be run in solid enclosed raceways, such as totally enclosed trays or rigid steel conduit, where the minimum established distance for open trays is not maintained.

In cases of crossover of one open tray over another of a redundant division where the minimum vertical separation criteria established in the above is not maintained, barriers consisting of solid steel covers on bottom trays and solid bottom in top trays are provided. These covers extend to each side of both tray edges by a minimum distance equal to three times the width of the widest tray involved in either division. The length of the protective covers is taken along the tray centerline. See Figure 8.3-29d. At crossovers, a minimum vertical separation of one inch is provided between the top of the bottom tray and the bottom of the top tray.

In the case of an enclosed raceway routed below an open tray of a redundant division, the minimum separation distance is one inch and a solid bottom or barrier extending 12 inches beyond the sides of the enclosed raceway is provided for the open tray. If the enclosed raceway is above the open tray, a one-inch vertical separation and a tray cover or barrier extending 12 inches beyond the sides of the enclosed raceway is required. See Figures 8.3-29a and 8.3-29d.

c. Some sensing equipment for the reactor protection system and the nuclear steam supply shutoff system are located in the turbine building which is a non-Category I structure. The sensors, cables, and raceways are Class 1E. Failure of the sensors due to seismic effects on the non-Category I structure in which the sensors are mounted does not prevent the system from performing its intended function. This is accomplished by the use of backup sensing devices which are mounted in Category I structures.

8.3.1.4.4 Associated Circuit Analysis

Non-Class 1E control and instrumentation cables as depicted in Table 8.3-27 illustrate the various circuit configurations that result in associated circuits within the designed cable and raceway systems (see Table 8.3-20). These non-Class 1E cables which become associated by connection or proximity to a Class 1E circuit are representative of the three part definition of associated circuits in 8.3.1.4.1.13. Associated cables as depicted in Tables 8.3-20 and 8.3-27 are routed in compatible divisional trays. These cables are uniquely identified and remain with or are physically separated the same as those Class 1E circuits with which they are associated except at cable end points inside enclosures.

8.3.1.4.4.1 Categories of Associated Circuits Treated as Non-Class 1E

The following categories of circuits are treated as non-Class 1E circuits. Justification is provided in 8.3.1.4.4.1.1 to 8.3.1.4.4.1.8.

Category 1A: Non-Class 1E instrumentation and control cables/wires that are not supplied Class 1E power and are routed in non-Class 1E raceways but have a continuing section in Class 1E raceways or enclosures. See Figure 8.3-43a.

Category 1B: Non-Class 1E instrumentation and control cables/wires that are supplied Class 1E power and are routed in non-Class 1E raceways but have a continuing section in Class 1E raceways or enclosures. See Figure 8.3-43a.

Category 1C: Non-Class 1E instrumentation and control cables/wires that are not supplied Class 1E power but are associated by proximity inside an enclosure. See Figure 8.3-43a.

Category 2A: Non-Class 1E power cables/wires that are not supplied Class 1E power and are routed in non-Class 1E raceways, but have a continuing section in Class 1E raceways or enclosures. See Figure 8.3-43b.

Category 2B: Non-Class 1E power cables/wires that are connected to Class 1E power and are routed in non-Class 1E raceways, but have a continuing section in Class 1E raceways or enclosures. See Figure 8.3-43b.

Category 3A: Non-Class 1E instrumentation circuits that are connected to Class 1E circuits and utilize current limiting isolation devices. See Figure 8.3-43c.

Category 3B: Non-Class 1E power cables/wires that are connectd to Class 1E power through a series of two Class 1E circuit breakers or fuses.

Category 3C: Non-Class 1E power cables/wires that are supplied Class 1E power through an inverter.

8.3.1.4.4.1.1 Analysis for Category 1A Circuits

The postulated events for this category of non-Class 1E instrumentation and control cables (non-Class 1E powered but a continuing section associated by proximity with Class 1E cables/wires) are mechanical, structural, or electrical failures in the non-Class 1E raceway or equipment. These failures eventually manifest as overcurrents in the non-Class 1E cable and the continuing associated section of the cable. The design features that minimize the effects of this hazard on the Class 1E circuits are the following:

a. The cables in instrumentation and control raceways are low energy circuits.

b. The cable insulation and jacketing are fire retardant per IEEE Standard 383-1974 (see 8.3.3). Cable types are selected and routed according to their voltage level and application per Table 8.3-20.

8.3.1.4.4.1.4 Analysis for Category 2A Non-Class 1E Circuits

This category of non-Class 1E cables consists of power cables that are not supplied Class 1E power and are routed in non-Class 1E raceways but have a continuing section in Class 1E raceways or enclosures. The analysis for this category is identical to Category 1A except that these circuits are not low energy circuits. Refer to 8.3.1.4.4.1.1. The justifications for these circuits are as follows:

a. Justification b, c, d, e, f, and g as listed under Category 1A

b. The 480 V system is high resistance grounded to limit ground fault currents to 10 amperes maximum (see 8.3.1.1.10).

c. The 6.9 kV and 4.16 kV systems are high resistance grounded to limit ground fault currents to 12.5 amperes maximum.

d. The cable loading in power trays is limited to 2" fill and cable ampacities are taken from NEMAWC51-1972. Ambient temperature correction is made for temperatures above 40°C. In addition, a group derating factor is applied to further guarantee that cable overheating will not occur.

e. Non-Class 1E 480 V combination motor starters in motor control centers are provided current limiting fuses and thermal overload relays which are designed to operate at 1.25 times full load current.

8.3.1.4.4.1.5 Analysis for Category 2B Non-Class 1E Circuits

These circuits are non-Class 1E cables that are Class 1E powered and routed in non-Class 1E raceways. A continuing portion of these cables are routed in Class 1E raceways or enclosures. Justification for these circuits are as follows:

a. All the justifications listed under Category 2A.

b. Those justifications listed under Category 1B-b, c, and d.

8.3.1.4.4.1.6 Analysis for Category 3A Non-Class 1E Circuits

The cables in this category consist of data logging type instrumentation circuits such as inputs to the analog process computer. These circuits are low energy circuits and are connected to Class 1E signal circuits through Class 1E current limiting resistance units such that a fault in the non-Class 1E circuit does not affect operation of the Class 1E circuit.

8.3.1.4.4.1.7 Analysis for Category 3B Non-Class 1E Circuits

The non-Class 1E cables in this category are connected to Class 1E power and supply important to non-Class 1E loads (such as emergency lighting) and are not identified or separated as prime circuits. The justification for this category is similar to Category 2B. Additional protection is provided by isolating the circuit through two Class E overcurrent devices in series. See 8.3.1.2.1.1

8.3.1.4.4.1.8 Analysis for Category 3C Non-Class 1E Circuits

The non-Class 1E cables in this category connect to non-Class 1E loads and are powered by inverters (1N-1 and 1N-2) which are fed from Class 1E batteries. The cables of this category are not designated as prime circuits and are not separated as associated circuits. Protection of the Class 1E power supply feeding the inverter is provided by Class 1E overcurrent devices (see 8.3.1.2.1.1 and 8.3.2.2.1.1) and the current limiting characteristic of the inverter.

8.3.1.4.4.2 Categories of Associated Circuits Treated as Class 1E

The following categories of associated circuits exist and are illustrated in Figures 8.3-43D and 8.3-43E.

Category 4A: Associated instrumentation and control circuits that are connected to non-Class 1E power and routed in Class 1E raceways and/or enclosures and may have a continuing section in a non-Class 1E raceway (Category 1A).

Category 4B: Associated power circuits that are connected to non-Class 1E power and routed in Class 1E raceways and/or enclosures and may have a continuing section in a non-Class 1E raceway (Category 2A).

Category 4C: Associated instrumentation and control circuits that are supplied Class 1E power are routed in Class 1E raceways, are not isolated on accident signal, and may have a continuing section in a non-Class 1E raceway (Category 1B).

Category 4D: Associated power circuits that are connected to Class 1E power, are routed in Class 1E raceways, are not isolated on accident signal and may have a continuing section in a non-Class 1E raceway (Category 2B).

The design features of all associated circuits are in accordance with 8.3.1.4.2.1.3.2. The non-associated circuit portions of the cable routes are analyzed in 8.3.1.4.4.1.

8.3.1.4.4.3 Specific Deviations to Separation Criteria

8.3.1.4.4.3.1 RPS Power Supply

The reactor protection system power supply system consists of two non-Class 1E buses designated RPS-BUSA and RPS-BUSB which provide the failsafe power supply to the reactor trip logic circuits and to the neutron monitoring circuits (see 8.3.1.1.6). The non-Class 1E neutral of the RPS power supply bridges the various essential circuits; however, the postulated failure modes result in loss of power to various portions of the circuit. Since the systems are provided with failsafe logic circuits, power loss will not prevent them from performing their safety function. Fire barriers have been provided between redundant divisions. In areas where four-channel separation is required, the four-channel separation is maintained up to the relay. The relays in these instances do not have coil to contact separation. The assignment of RPS-bus power supply to the various RPS trip logic circuits and isolation valves circuits is consistent with the single failure criteria. The reactor protection system scram solenoid cabling at the scram solenoid units utilizes flexible conduit because of space limitations. The raceways entering these units do not meet WNP-2 cable separation criteria; however, it is in accordance with the design requirements shown on Figure 8.3-41.

TABLE 8.3-1

DIVISION 1 DIESEL GENERATOR LOADING SEQUENCE
AUTOMATIC AND MANUAL LOADING OF ENGINERED SAFETY SYSTEMS BUS

Item Description	No. On Bus	Total hp/kW Connected To Bus	SHUTDOWN WITH LOSS OF OFFSITE POWER: No. Req'd Part Of Set	Time to Start (1)	Time to Stop	kW	LOCA WITH LOSS OF OFFSITE POWER: No. Req'd Part Of Set	Time to Start (1)	Time to Stop	kW
1) Motor-Operated Valves (5)	Set	200kW	Set	0 Sec	(2)	-	Set	0 Sec	(2)	-
2) Emergency Lighting and Power (7)	Set	124kW	Set	0 Sec	(4)	124	Set	0 Sec	(4)	124
3) Diesel Auxiliaries and HVAC	Set	200kW	Set	0 Sec (3)	(3)	124	Set	0 Sec (3)	(3)	94
4) LPCS Water Leg Pump	1	15/12kW	1	0 Sec (3)	(3)	12	1	0 Sec (3)	(3)	12
5) Standby Liquid Control Pump	1	40/33kW	-	-	-	-	-	-	-	-
6) RCIC Water Leg Pump	1	15/12kW	1	0 Sec (3)	(3)	12	1	0 Sec (3)	(3)	12
7) Fuel Pool Recirculation Pump	1	50/40kW	1	10 Hrs (4)	(4)	(40)	-	-	-	-
8) Plant Service Water Pump A (7)	1	1500/1197kW	1	10 Sec	(4)	1197	-	-	-	-
9) LPCS Pump	1	1500/1197kW	-	-	-	-	1	0 Sec	(4)	1197
10) RHR Pump A	1	800/642kW	1	10 Min (4)	(4)	(642)	1	5 Sec	(4)	642
11) Standby Service Water Pump	1	1750/1377kW	1	20 Sec	(4)	1377	1	20 Sec	(4)	1377
12) Cooling Tower Makeup Water Pump (7)	* 2	1600/1270kW	1	Note 6 (4)	(4)	(635)	-	-	-	-
13) Control Rod Drive Pump (7)	** 1	250/205kW	1	(4)	(4)	(205)	-	-	-	-
14) Reactor Closed Cooling Pump (7)	1	200/160kW	1	0 Sec	(4)	160	-	-	-	-
15) Load Center Transformer Losses TR-7-71 & 7-73	2	45kW	2	0 Sec	Cont.	33	2	0 Sec	Cont.	33
16) 250 V Battery Charger	1	165kW	1	0 Sec	(4)	135	1	0 Sec	(4)	135
17) 125 V Battery Charger	1	43kW	1	0 Sec	(4)	43	1	0 Sec	(4)	43
18) Uninterruptible Power Supply (7)	1	30kW	1	0 Sec	(4)	30	1	0 Sec	(4)	30
19) Standby Gas Treatment Fans and	2	50/40kW	1	10 Min (4)	(4)	(20)	1	30 Sec	(4)	20
and Heater Coils	2	45kW	-	-	-	-	2	20 Sec	(3)	45
20) RPS MG Set (7)	1	25/20kW	1	0 Sec	(4)	20	1	(4)	(4)	(20)
21) Hydrogen Recombiner	1	25/57kW	-	-	-	-	1	60 Min (4)	(4)	(44)
22) Drywell Cooling and Fans	Set	182kW	Set	0 Sec	(4)	182	-	-	-	-
23) Control Air Compressor (7)	1	100/82kW	1	1 Hr (4)	(4)	(82)	-	-	-	-
24) Containment Instrument Air Compressor	1	15/12kW	1	0 Sec (3)	(4)	12	-	-	-	-
26) Reactor Bldg. Elec. Equip. HVAC	Set	368kW	Set	0 Sec (3)	(4)	15	Set	0 Sec (3)	(4)	15
27) Control Bldg. Elec. Equip. HVAC	Set	283kW	Set	5 Sec (3)	(4)	71	Set	5 Sec (3)	(4)	71
28) Radwaste Bldg. Elec. Equip. HVAC (7)	Set	150kW	-	-	-	-	-	-	-	-
29) Makeup Water Pumphouse Elec. Equip. HVAC (7)	*Set	90kW	Set	Note 6 (4)	(4)	(90)	-	-	-	-
30) Standby Service Water Pumphouse Elec. Equipment HVAC	Set	38kW	Set	0 Sec	(4)	10	Set	0 Sec	(4)	10
			Total Automatically Applied			3557kW	Total Automatically Applied			3860kW

For Notes see bottom of Table 8.3-2

* Only 1 required. Not added to load since other load can be dropped when they are necessary a few days later.

** Can be supplied manually after operator checks load capacity on generator.

( ) kW Figures in parenthesis are for manually applied loads not added to total automatically applied loads.

TABLE 8.3-2

DIVISION 2 DIESEL GENERATOR LOADING SEQUENCE
AUTOMATIC AND MANUAL LOADING OF ENGINERED SAFETY SYSTEMS BUS

Item Description	No. On Bus	Total hp/kW Connected To Bus	SHUTDOWN WITH LOSS OF OFFSITE POWER: No. Req'd Part Of Set	Time to Start (1)	Time to Stop	kW	LOCA WITH LOSS OF OFFSITE POWER: No. Req'd Part Of Set	Time to Start (1)	Time to Stop	kW
1) Motor-Operated Valves (5)	Set	200kW	Set	0 Sec	(2)	-	Set	0 Sec	(2)	-
2) Emergency Lighting and Power (7)	Set	122kW	Set	0 Sec	(4)	122	Set	0 Sec	(4)	122
3) Diesel Auxiliaries and HVAC	Set	185kW	Set	0 Sec (3)	(3)	127	Set	0 Sec (3)	(3)	97
4) RHR Water Leg Pump	1	15/12kW	1	0 Sec	(4)	12	1	0 Sec	(4)	12
5) Standby Liquid Control Pump	1	40/33kW	-	-	-	-	-	-	-	-
6) Standby Liquid Control Tank Heaters	2	50kW	1	0 Sec (3)	(3)	10	1	0 Sec (3)	(3)	10
7) Fuel Pool Cooling & Cleanup System	Set	50/40kW	Set	10 Hrs (4)	(4)	(40)	-	-	-	-
8) Plant Service Water Pump B (7)	1	1500/1197kW	1	10 Sec	(4)	1197	-	-	-	-
9) RHR Pumps B & C	2	1600/1284kW	1	10 Min (4)	(4)	(642)	2	5 Sec & 0 Sec	(4)	1284
10) Standby Service Water Pump	1	1750/1377kW	1	20 Sec	(4)	1377	1	20 Sec	(4)	1377
11) Cooling Tower Makeup Water Pump (7)	* 2	1600/1270kW	1	Note 6 (4)	(4)	(635)	-	-	-	-
12) Control Rod Drive Pump (7)	** 1	250/205kW	1	(4)	(4)	(205)	-	-	-	-
13) Reactor Closed Cooling Pump (7)	2	400/320kW	1	0 Sec	(4)	160	-	-	-	-
14) Load Center Transformer Losses TR-8-81 & 8-83 (7)	2	45kW	2	0 Sec	Cont.	33	2	0 Sec	Cont.	33
15) 125 V Battery Charger	1	43kW	1	0 Sec	(4)	43	1	0 Sec	(4)	43
16) Standby Gas Treatment Fans	2	50/40kW	1	10 Min (4)	(4)	(20)	1	30 Sec	(4)	20
and Heater Coils	2	45kW	-	-	-	-	2	20 Sec	(3)	45
17) RPS MG Set	1	25/20kW	1	0 Sec	(4)	20	1	(4)	(4)	(20)
18) Hydrogen Recombiner	1	25/57kW	-	-	-	-	1	60 Min (4)	(4)	(44)
19) Drywell Cooling and Fans	Set	186kW	Set	0 Sec	(4)	186	-	-	-	-
20) Control Air Compressor & Dryers (7)	1	100/126kW	1	1 Hr (4)	(4)	(126)	-	-	-	-
21) Containment Instrument Air Compressor	1	15/12kW	1	0 Sec (3)	(4)	12	-	-	-	-
22) Reactor Bldg. Elec. Equip. HVAC	Set	371kW	Set	0 Sec (3)	(4)	12	Set	0 Sec (3)	(4)	12
23) Control Bldg. Elec. Equip. HVAC	Set	331kW	Set	0 Sec	(4)	61	Set	0 Sec	(4)	61
24) Radwaste Bldg. Elec. Equip. HVAC (7)	Set	145kW	-	-	-	-	-	-	-	-
25) Makeup Water Pumphouse Elec. Equip. HVAC(7)	**Set	90kW	Set	Note 6 (4)	(4)	(90)	-	-	-	-
26) Standby Service Water Pumphouse	Set	40kW	Set	0 Sec	(4)	10	Set	0 Sec	(4)	10
				Total Automatically Applied		3382kW		Total Automatically Applied		3126kW

NOTE: (1) Time to start after bus voltage and frequency have been established. Maximum time after signal to start generator for voltage to be established is 10 seconds.

(2) Motors stop automatically when valve action is completed.

(3) Start and/or stop automatically with associated pump or diesel, pressure, temperature switch, or flow.

(4) Start and/or stop manually.

(5) Intermittent loads not included as long-term loading.

(6) Available after one day.
For additional notes see bottom of Table 8.3-1.

(7) Items are non-Class 1E

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Table 8.3-11 (Continued)

Annunciation (1)	Location (4) Local	MCR
25. DG No. 1 (DG No. 2) Room - Cooling Flow Lo	-	X
26. DG No. 1 (No. 2) Solenoid Valve Failure	X	-
27. DG No. 1 (No. 2) Lube Oil Press. Lo	X	-
28. DG No. 1 (No. 2) Oil Temp. Hi	X	-
29. DG No. 1 (No. 2) Crankcase Press Hi	X	-
30. DG No. 1 (No. 2) Engine Water Level Lo	X	-
31. DG No. 1 (No. 2) Lube Oil Level Lo	X	-
32. DG No. 1 (No. 2) Oil Temp. Lo	X	-
33. DG No. 1 (No. 2) Diff. Fuel Press. Hi	X	-
34. DG No. 1 (No. 2) Jacket Water Temp Hi	X	-
35. DG No. 1 (No. 2) Jacket Water Temp Lo	X	-
36. DG No. 1 (No. 2) Fuel Oil Press. Lo	X	-
37. DG No. 1 (No. 2) Starting Air Receivers No. 1 and No. 2 Press Lo	X	-

Notes:

1. Independent drops are provided for Division 1 and Division 2 annunciators. Drop titles for the Division 2 annunciators are indicated by parenthesis.

2. All abnormal signals detected at the local diesel generator control panels provide input to the general "engine trouble" (Item 22) alarms.

3. Diesel generating unit incomplete sequence and differential current signals trip the units via the unit lockout relays (Item 6).

4. Main Control Room - Board "C" (Panel P800).

TABLE 8.3-12

Class 1E Auxiliary AC Distribution System-Acceptable Voltage Range

	Voltages		Voltage Ranges	
System Level	System Nominal	Motor Nameplate	Normal Operation[1]	Starting[2]
4.16 kv Swgr.	4.16 kv	4.0 kv	3.6-4.4 kv	3.2-4.4 kv
480V Swgr.	480 V	460 V	414-506 V	368-506 V
480V MCC's	480 V	460 V	414-506 V	368-506 V

NOTES: 1. Minimum and maximum voltages indicated correspond to 90% and 110% (respectively) of motor nameplate voltage for the particular voltage level.

2. Minimum and maximum voltages indicated correspond to 80% and 110% (respectively) of motor nameplate voltage for the particular voltage level.

COMPARISON OF HPCS DIESEL GENERATORS USED IN LA SALLE & WNP-2

COMPONENT	DATA	
	LA SALLE	WNP-2
ENGINE:		
Model	EMD-20-645E4	EMD-20-645E4
HP	3600	3600
Speed (RPM)	900	900
GENERATOR:		
Model	Ideal Elec.-CO-SAB	GE - 264 x 730
KVA	3560	3560
Volts	2400/4160Y	2400/4160Y
Hertz	60	60
Insulation	Class B	Class B
Moment of Inertia ($\#-Ft^2$)	36,000	32,450 (Note 1)
Reactance (%)		
Subtransient (X''_d)	7.1	10.9 (Note 2)
Transient (X'_d)	14.3	16.5
Synchronous (X_d)	112.0	82.0
Time Const (Sec)		
T_d'' (S-C)	.021	.01
T'_d (O-C)	3.5	2.87
REGULATOR TYPE	Solid State	Solid State
EXCITER TYPE	Brushless Rotary	Static With Field Flashing
GOVERNOR:		
Model	Woodward UG-8	Woodward EGB-10
Speed Sensor	Mechanical	Electronic (Note 3)
Error	$\pm 1\%$	$\pm 1/4\%$
LOADS:		
HPCS Pump	3000 HP 1800 RPM 373 FLA	3000 HP 1800 RPM 373 FLA
Aux. Loads	220 KW	220 KW

NOTES:

(1) WNP-2 overall diesel gen. moment of inertia is lower than LaSalle's. Hence D-G starting time may be less for WNP-2 than for LaSalle.

(2) The higher transient & subtransient reactance for WNP-2 is compensated by the use of a static exciter which provides faster voltage recovery during voltage dips.

(3) Electronic sensing together with hydraulic actuation result in faster and more accurate response.

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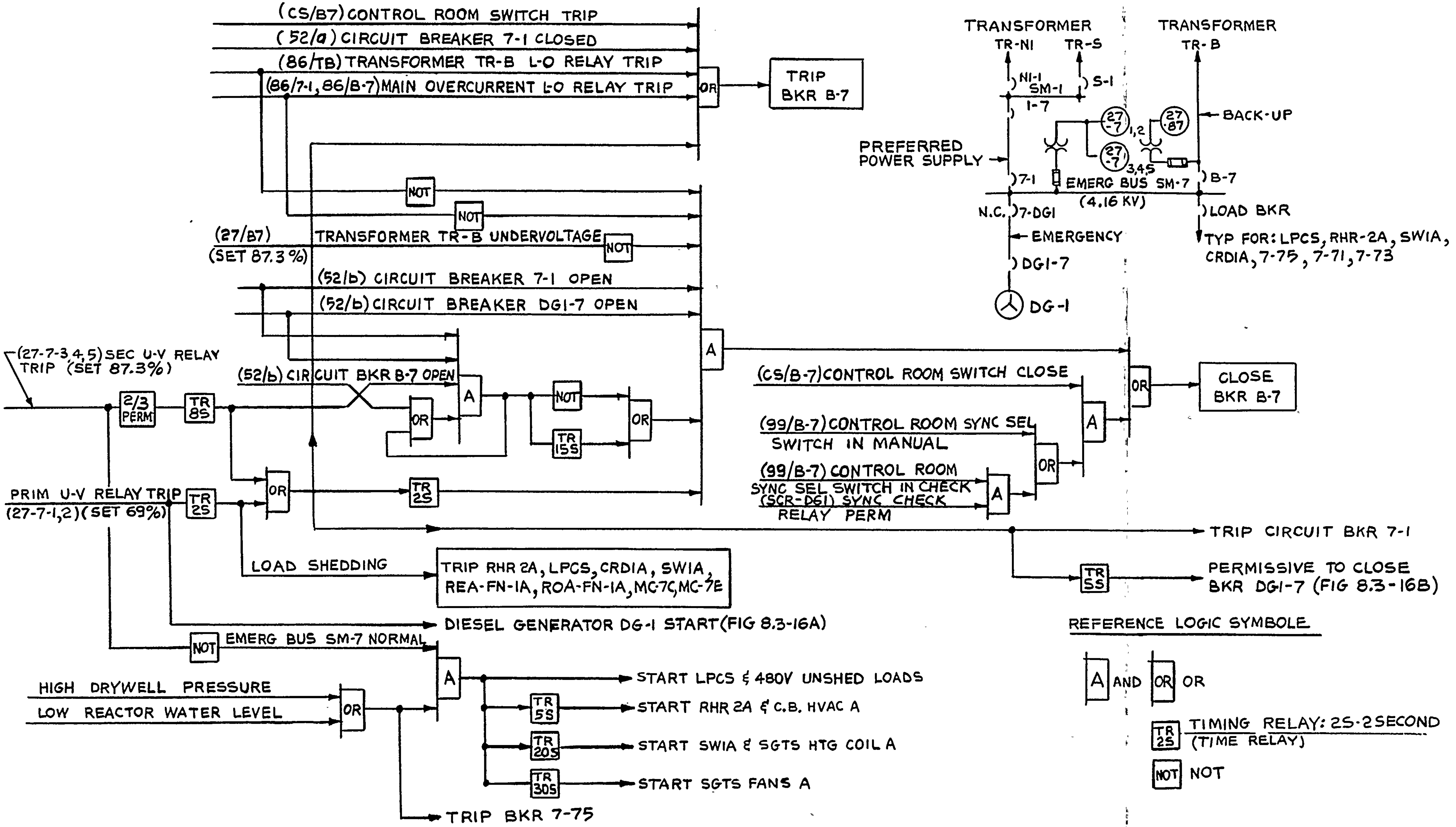
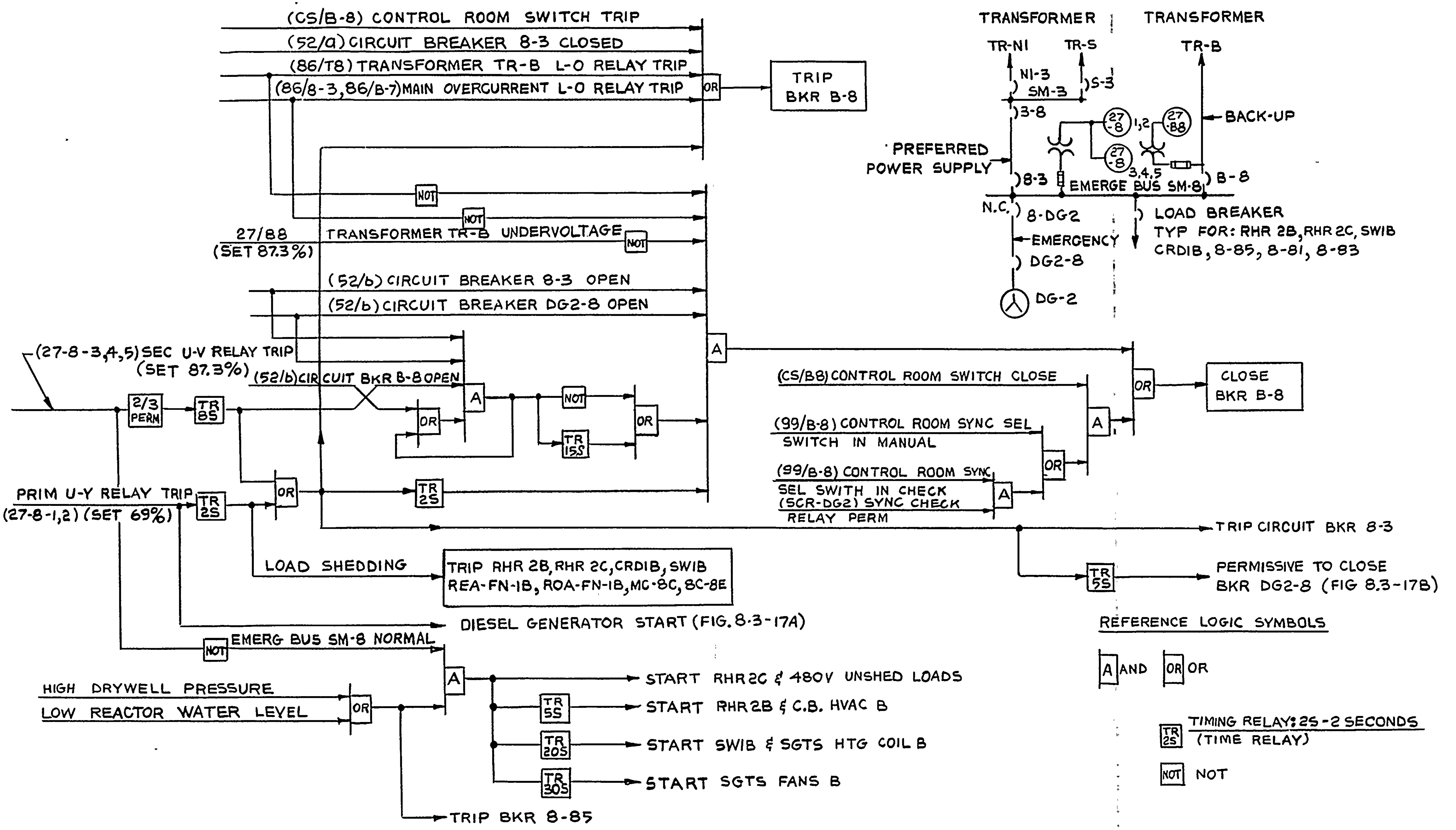


WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	EMERGENCY BUS SM-7 UNDERVOLTAGE PROTECTION, BUS TRANSFER AND LOAD SEQUENCING	FIGURE 8.3-16c

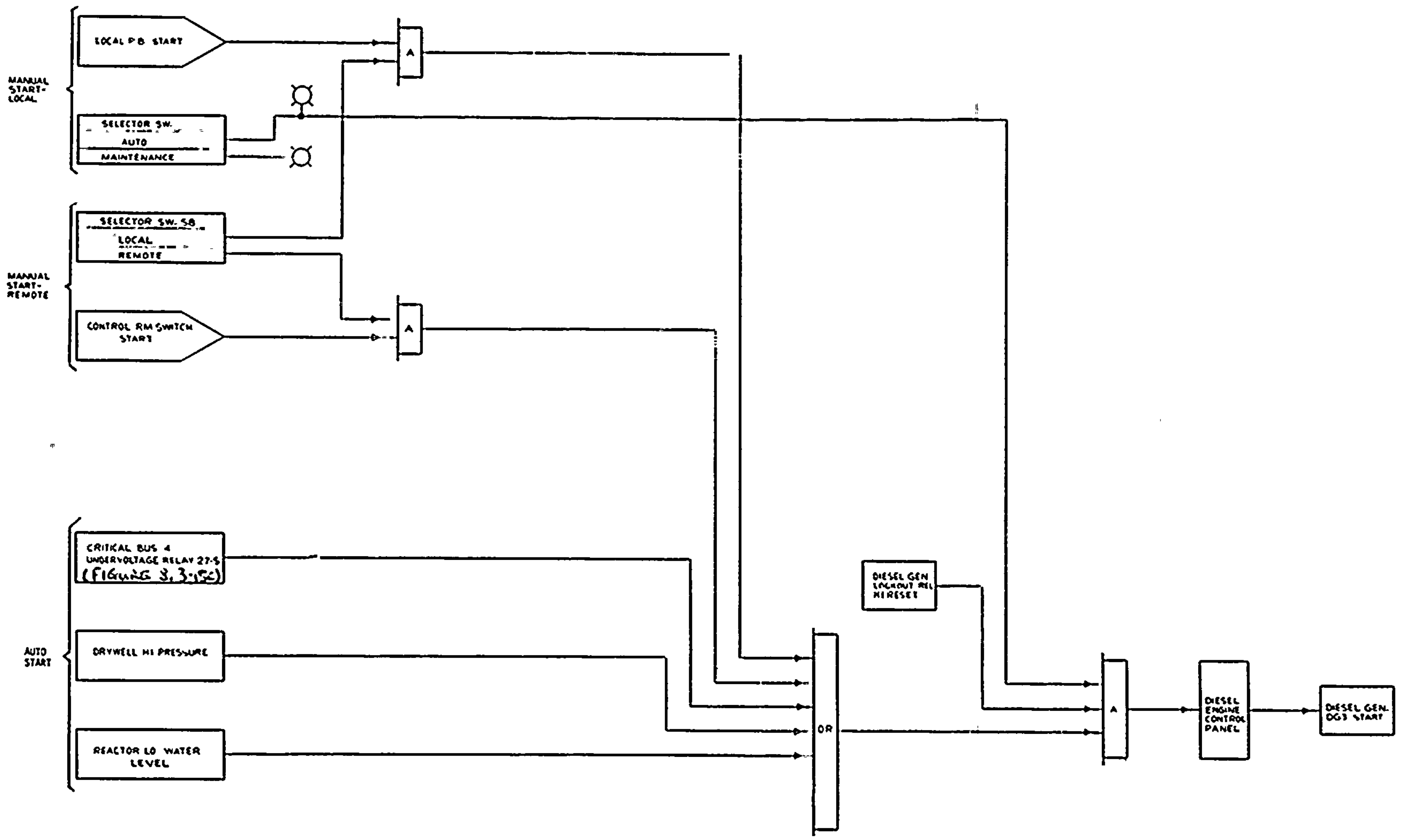


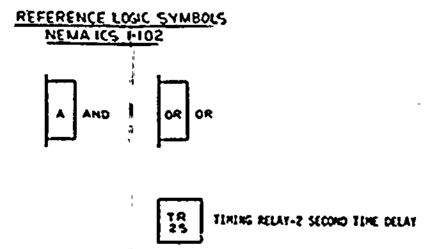
WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PROJECT NO. 2

EMERGENCY BUS SM-8 UNDERVOLTAGE PROTECTION, BUS TRANSFER, AND LOAD SEQUENCING

FIGURE 8.3-17c

SEE FIGURE 8.3-18b





WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	DIESEL GENERATOR LOGIC DIAGRAM - DIVISION 3 (HPCS), ENGINE START	FIGURE 8.3-18a

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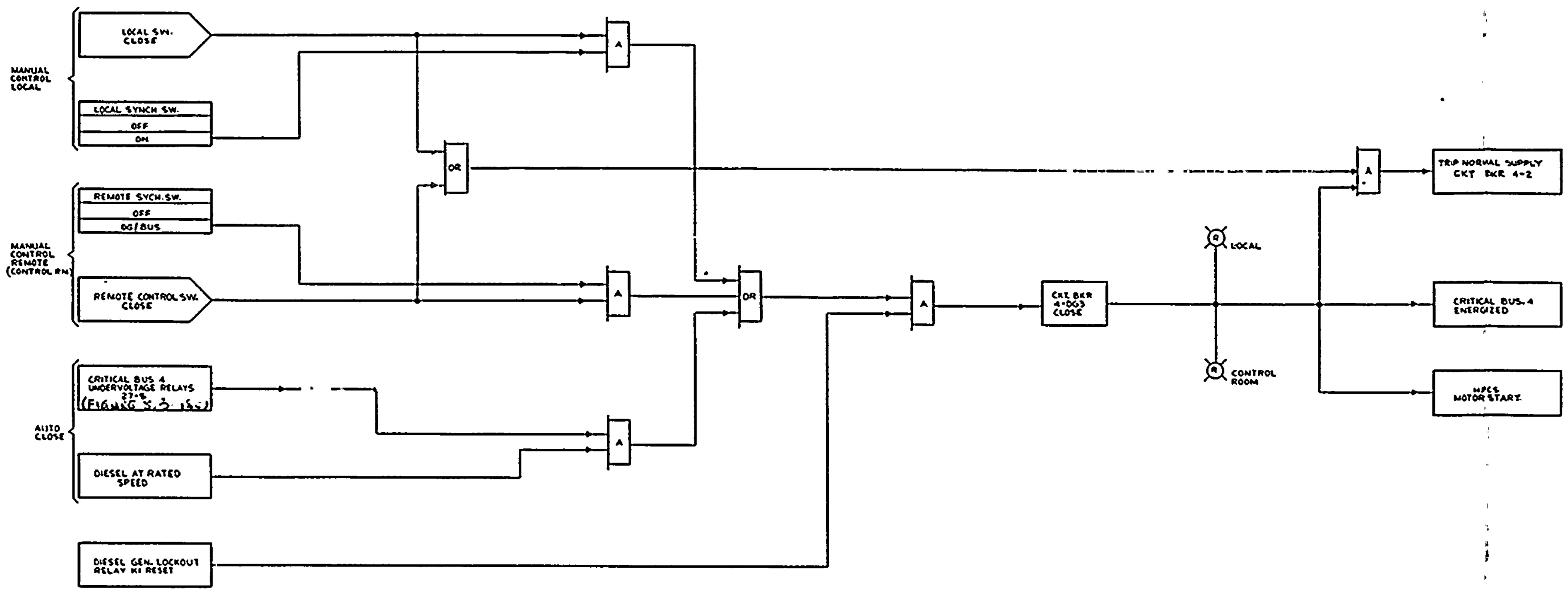
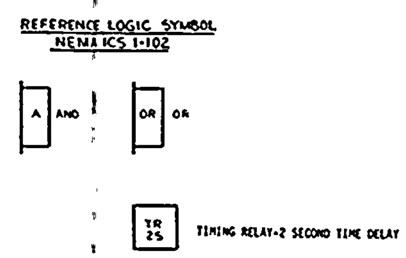
SEE FIGURE 8.3-18a





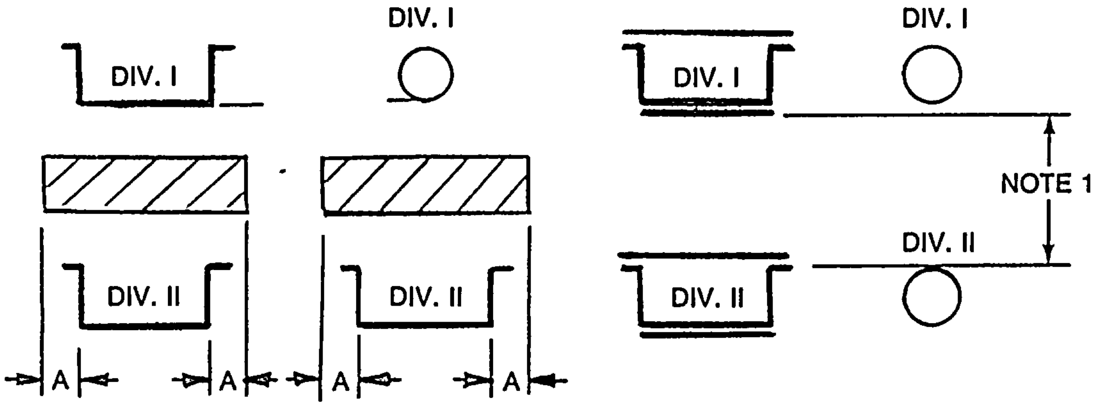
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	DIESEL GENERATOR LOGIC DIAGRAM - DIVISION 3 (HPCS), GENERATOR BREAKER CLOSE	FIGURE 8.3-18b

C. CONT'D

GENERAL AREAS

VERTICAL
(SEE NOTE ON FIGURE 8.3-29a)

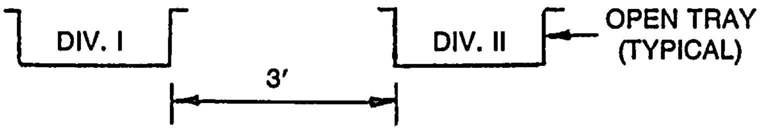
WHERE VERTICAL SEPARATION REQUIREMENTS ARE NOT MET THE USE OF BARRIERS, TRAY COVERS OR CONDUITS MAY BE USED WITH NO SPECIFIC DIMENSIONAL REQUIREMENTS EXCEPT AS INDICATED BELOW:



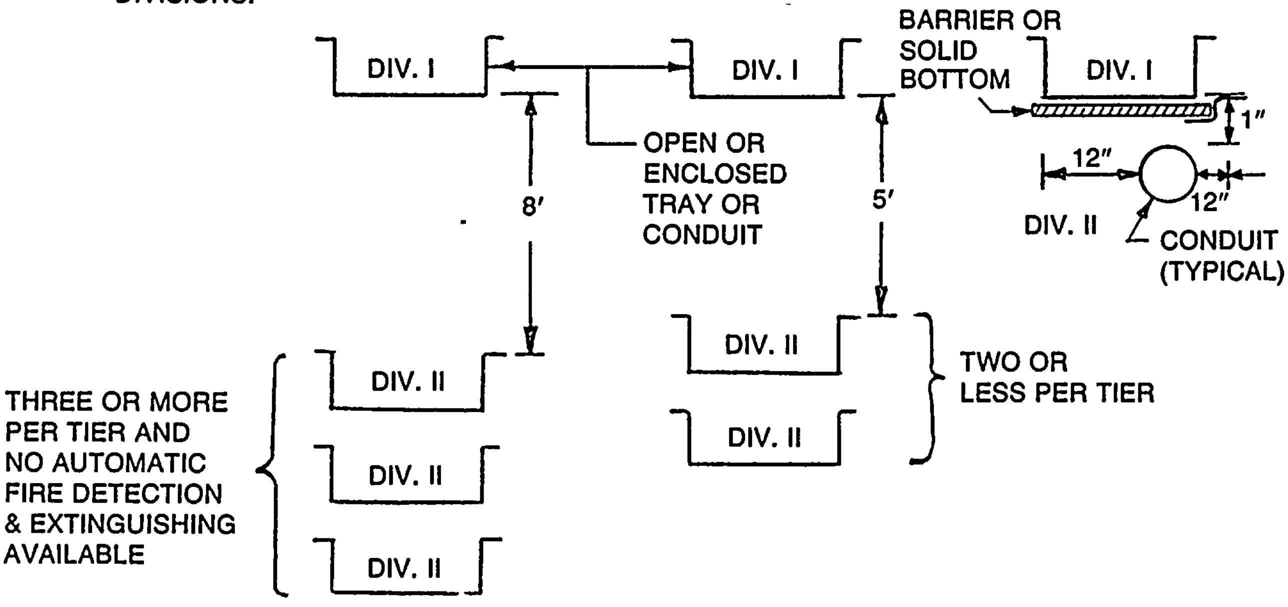
A = 12" MINIMUM OR FLUSH TO WALL.

NOTE 1: NO MINIMUM SEPARATION DISTANCE IS REQUIRED BETWEEN REDUNDANT DIVISION CONDUITS OR ENCLOSED TRAYS BUT THEY MUST NOT PHYSICALLY TOUCH.

A. MINIMUM HORIZONTAL SEPARATION REQUIREMENT BETWEEN ANY TWO REDUNDANT DIVISIONS. THIS IS ALSO APPLICABLE IF ONE RACEWAY IS ENCLOSED AND THE ENCLOSED RACEWAY IS NOT LOWER THAN THE OPEN TRAY OR RACEWAY.



B. MINIMUM VERTICAL SEPARATION REQUIREMENTS BETWEEN ANY TWO REDUNDANT DIVISIONS.



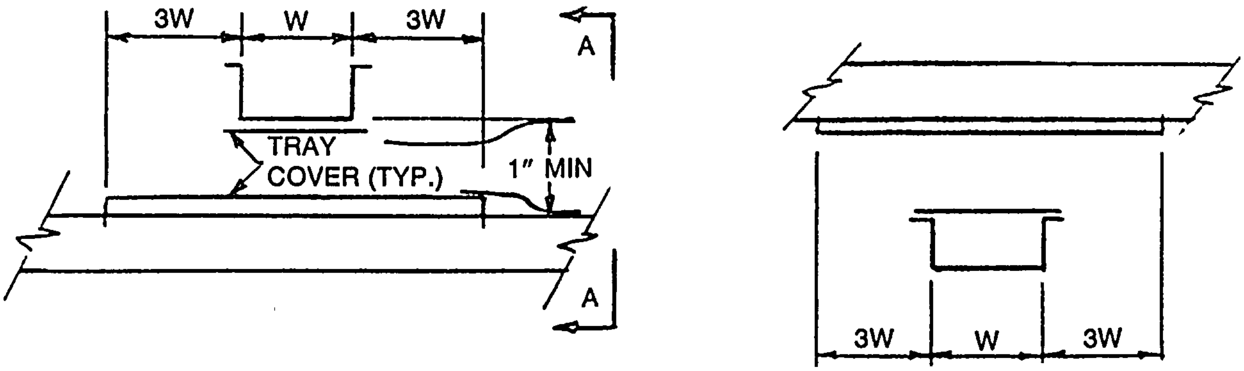
NOTE: DISTANCES SHOWN CONSIDER THE IDEAL ARRANGEMENT OF TWO (2) RACEWAYS ONLY. IF MORE THAN TWO (2) TRAYS EXIST IN ANY PARTICULAR ARRANGEMENT, PHYSICAL SEPARATION DISTANCES CHOSEN MUST BE BASED ON THE COMPLETE CONFIGURATION.

WASHINGTON PUBLIC POWER **SUPPLY SYSTEM** NUCLEAR PROJECT NO. 2	CABLE SEPARATION REQUIREMENTS GENERAL AREAS/OPEN TRAYS - PARALLEL ROUTING	FIGURE 8.3-29a

GENERAL AREAS

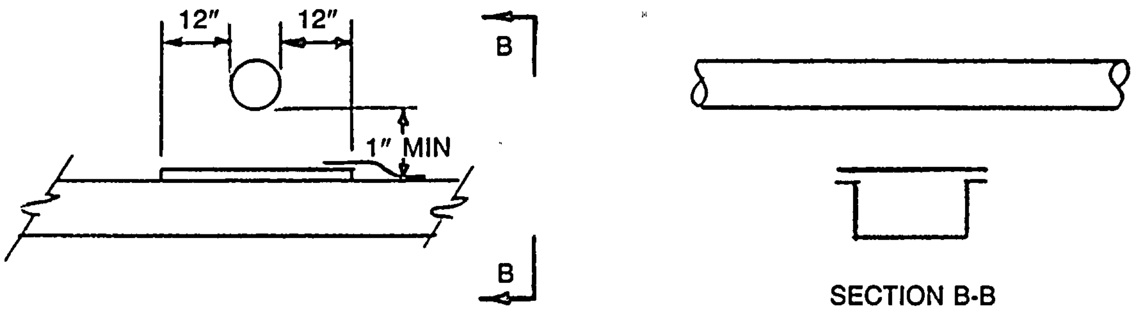
CROSSOVERS
(SEE NOTE ON FIGURE 8.3-29a)

TRAY COVERS SHALL BE USED FOR ALL CROSSOVERS OF REDUNDANT DIVISION RACEWAY SYSTEMS, EXCEPT WHEN THE BOTTOM RACEWAY IS A CONDUIT. THE SCHEMES SHOWN BELOW SHALL BE USED REGARDLESS OF THE VOLTAGE LEVEL OF THE CABLES IN A CROSSOVER RACEWAY SYSTEM.

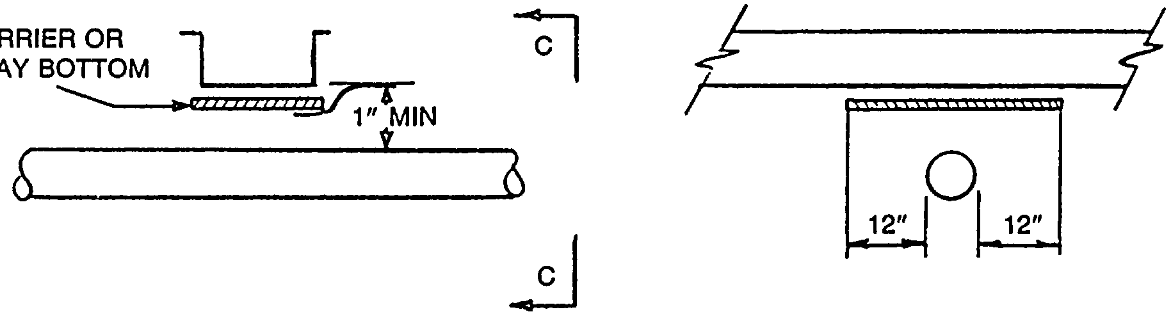


"W" IS DEFINED AS THE NOMINAL TRAY WIDTH AT THE WIDEST TRAY INVOLVED.
3W = 3 TIMES THE NOMINAL TRAY WIDTH OR FLUSH TO A WALL

SECTION A-A



SECTION B-B



SECTION C-C

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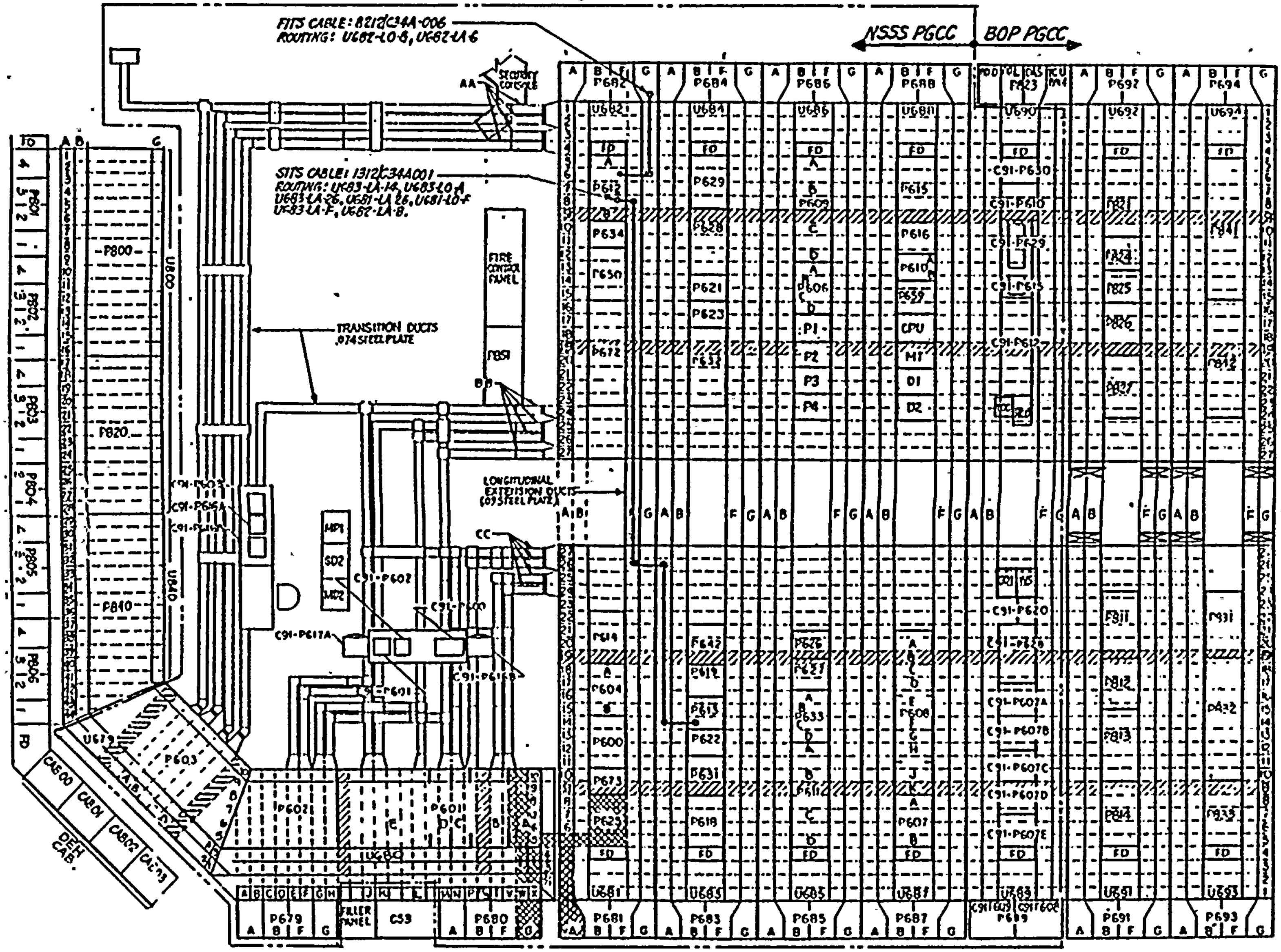
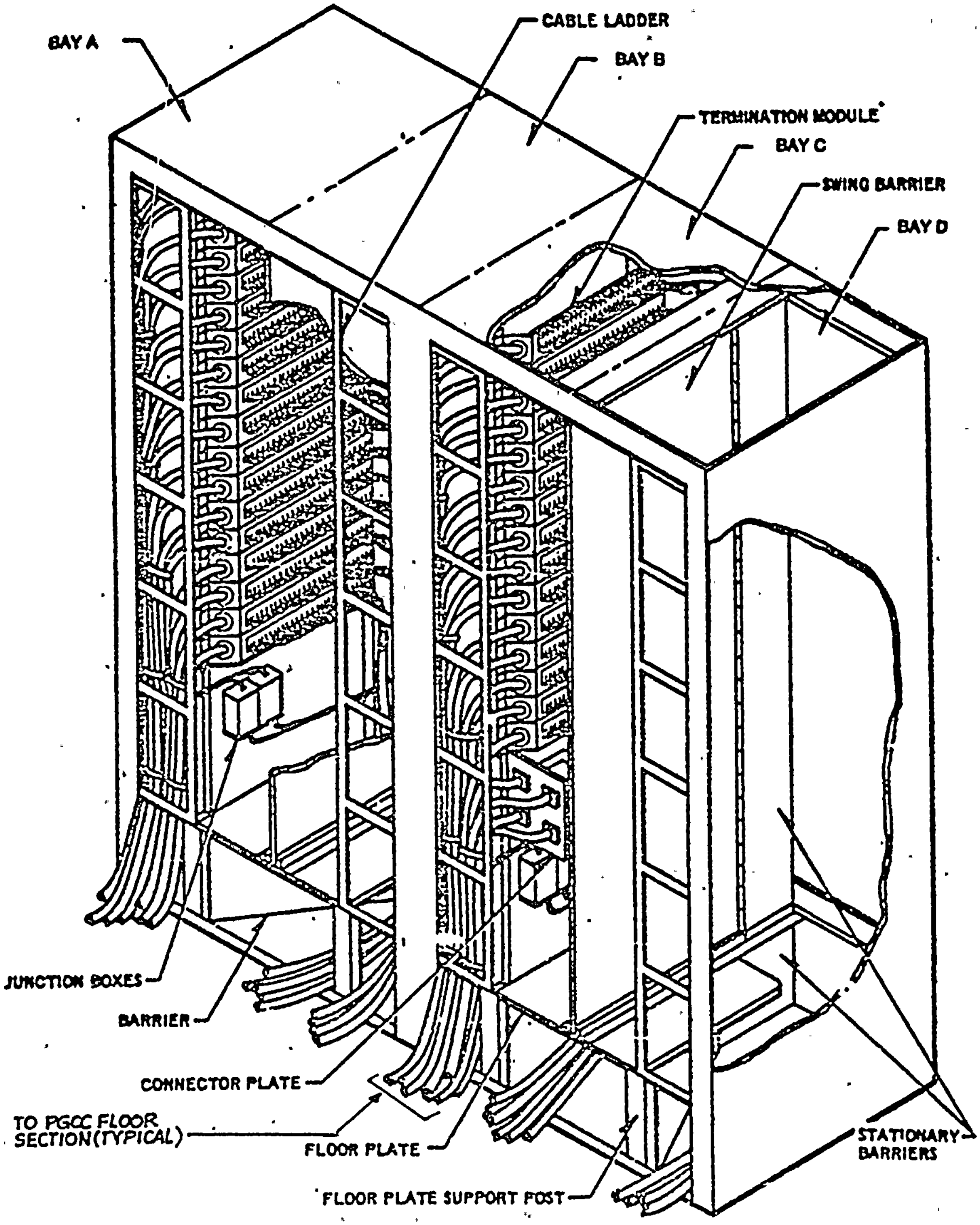
February 1982



WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PROJECT NO. 2

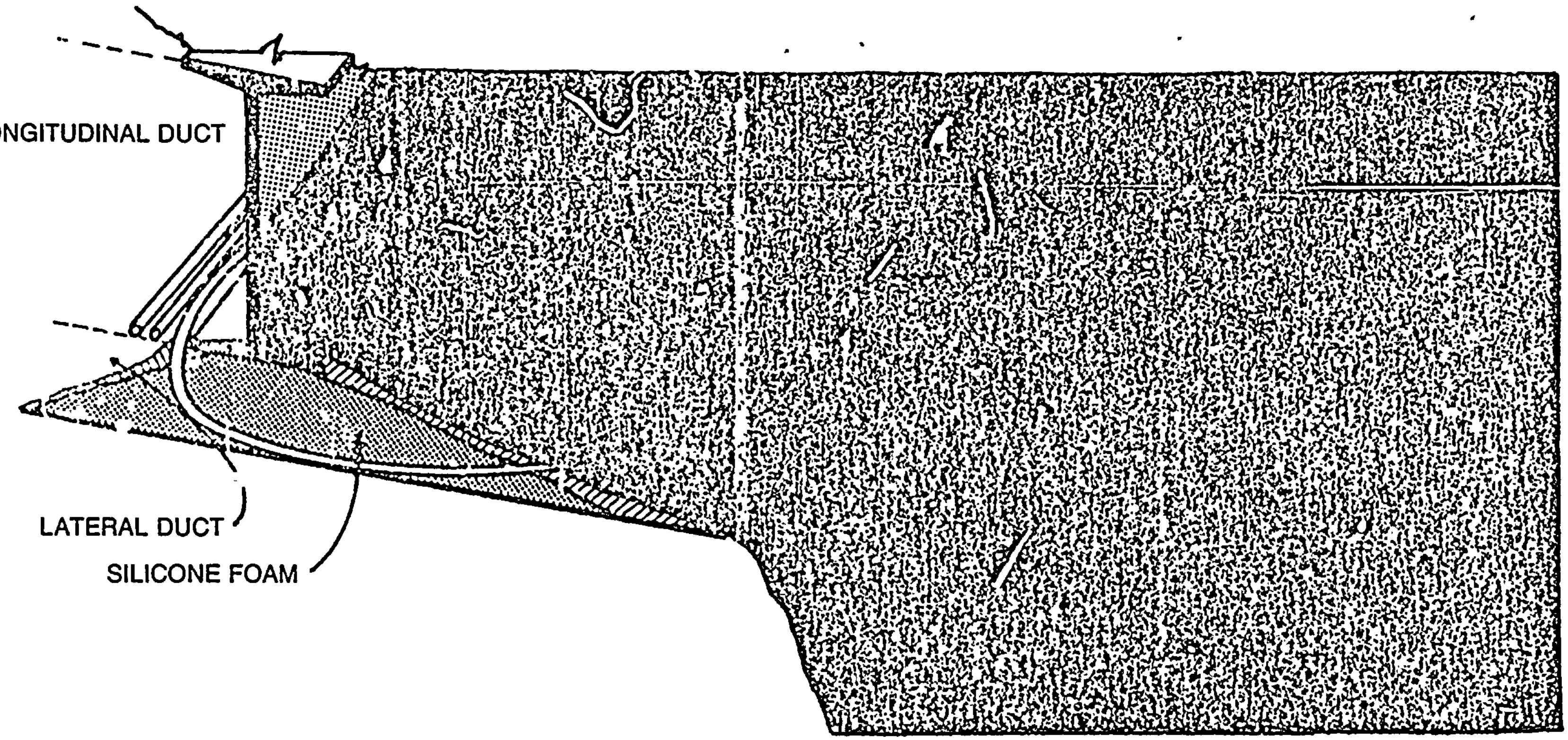
POWER GENERATION CONTROL COMPLEX
PLAN - CABLE ROUTING DETAIL

FIGURE
8.3-30



ASSEMBLED TERMINATION CABINET (DOOR REMOVED FOR CLARITY)

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	POWER GENERATION CONTROL COMPLEX TERMINATION CABINET ASSEMBLY	FIGURE 8.3-32



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WASHINGTON PUBLIC POWER
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POWER GENERATIOAN CONTROL COMPLEX FIRESTOP-PING DETAIL

FIGURE 8.3-37

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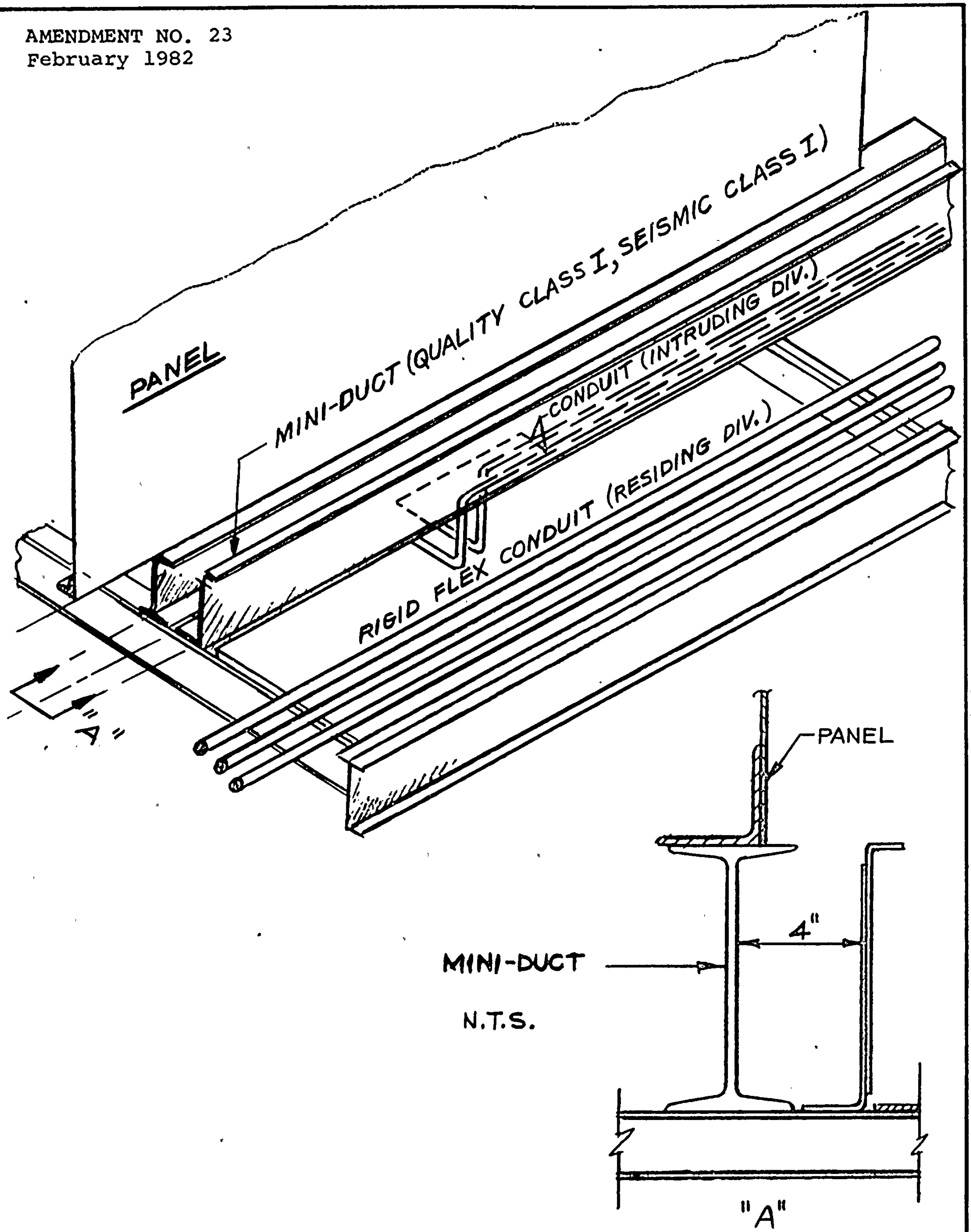
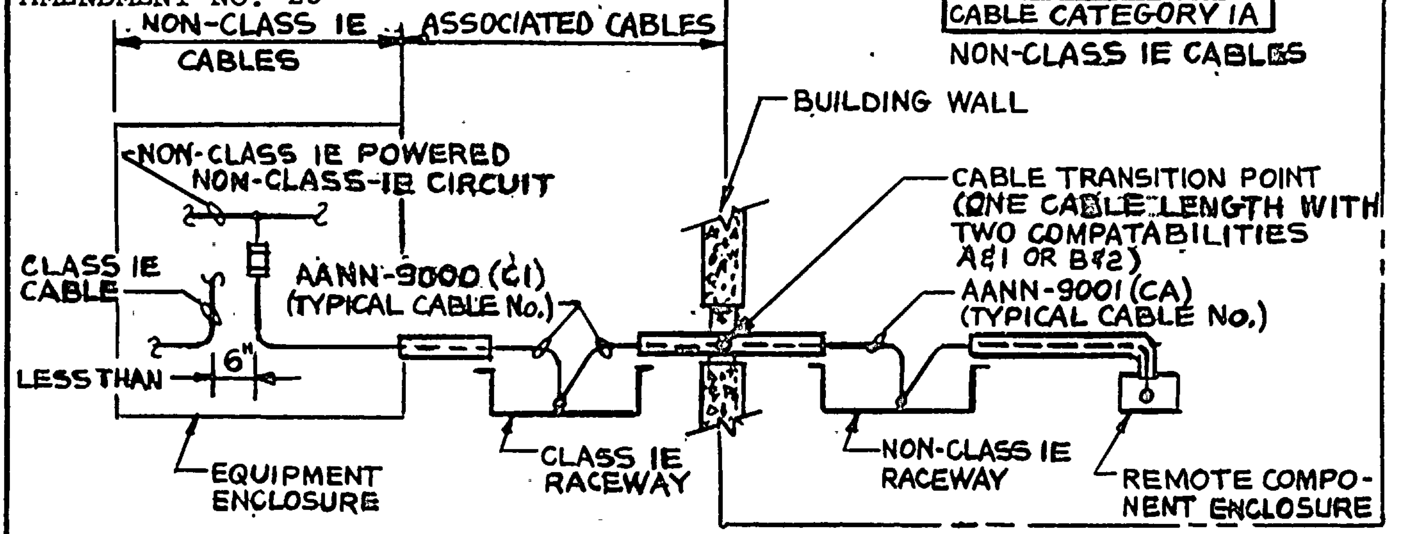
February 1982



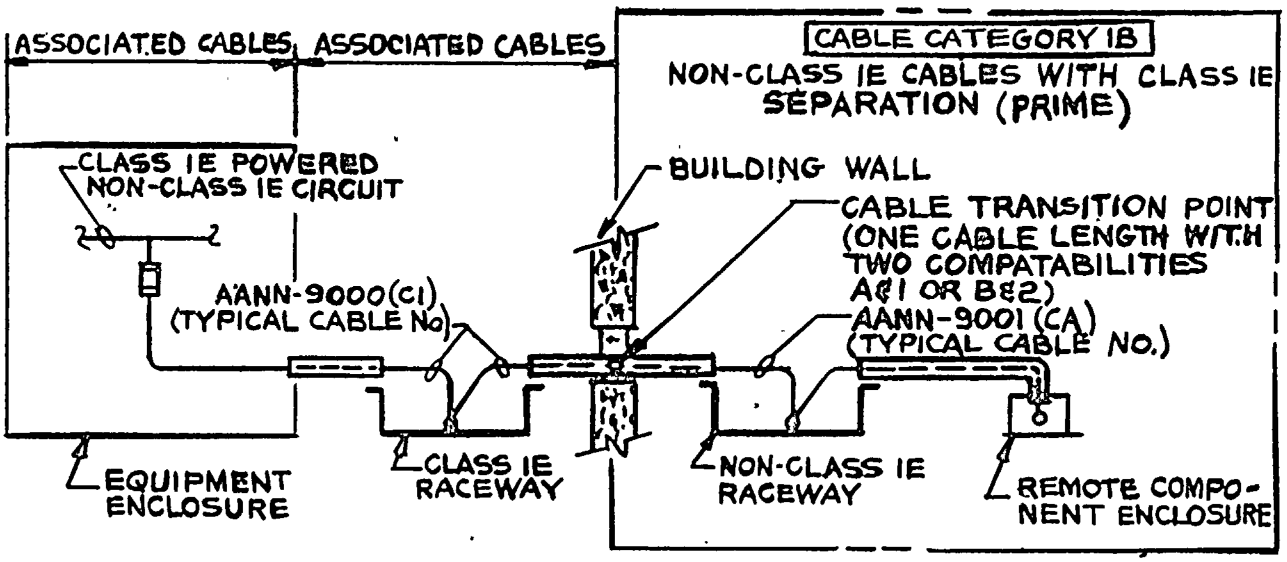
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	POWER GENERATION CONTROL COMPLEX MINI DUCT DETAIL	FIGURE 8.3-40

AMENDMENT NO. 23



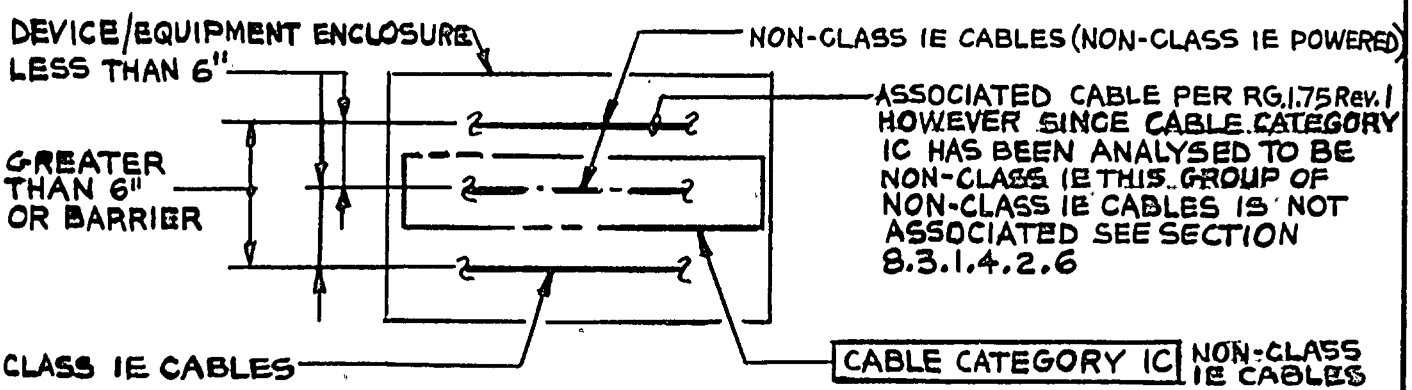
NON-CLASS IE (NON-CLASS IE POWERED) INSTRUMENTATION & CONTROL CABLES

CABLE CATEGORY IA (RACEWAYS)



NON-CLASS IE (CLASS IE POWERED) INSTRUMENTATION & CONTROL CABLES

CABLE CATEGORY IB (RACEWAYS)



NON-CLASS IE (NON-CLASS IE POWERED) INSTRUMENTATION & CONTROL CIRCUITS

CABLE CATEGORY IC (ENCLOSURES)

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	NON-CLASS IE CIRCUIT CATEGORIES REQUIRING ANALYSIS	FIGURE 8.3- 43a

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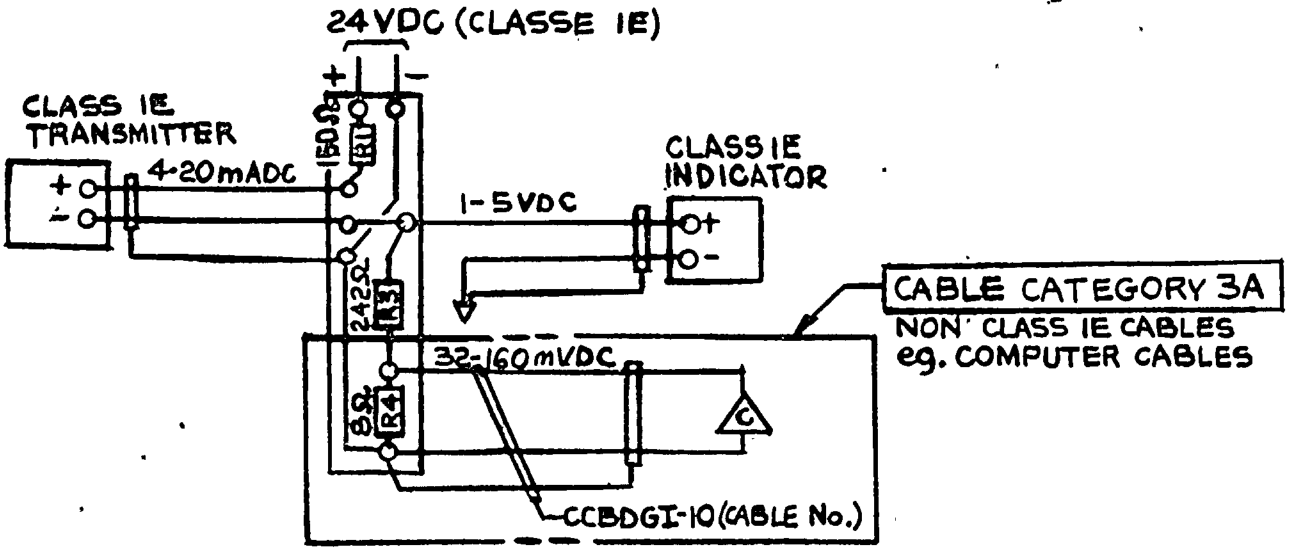
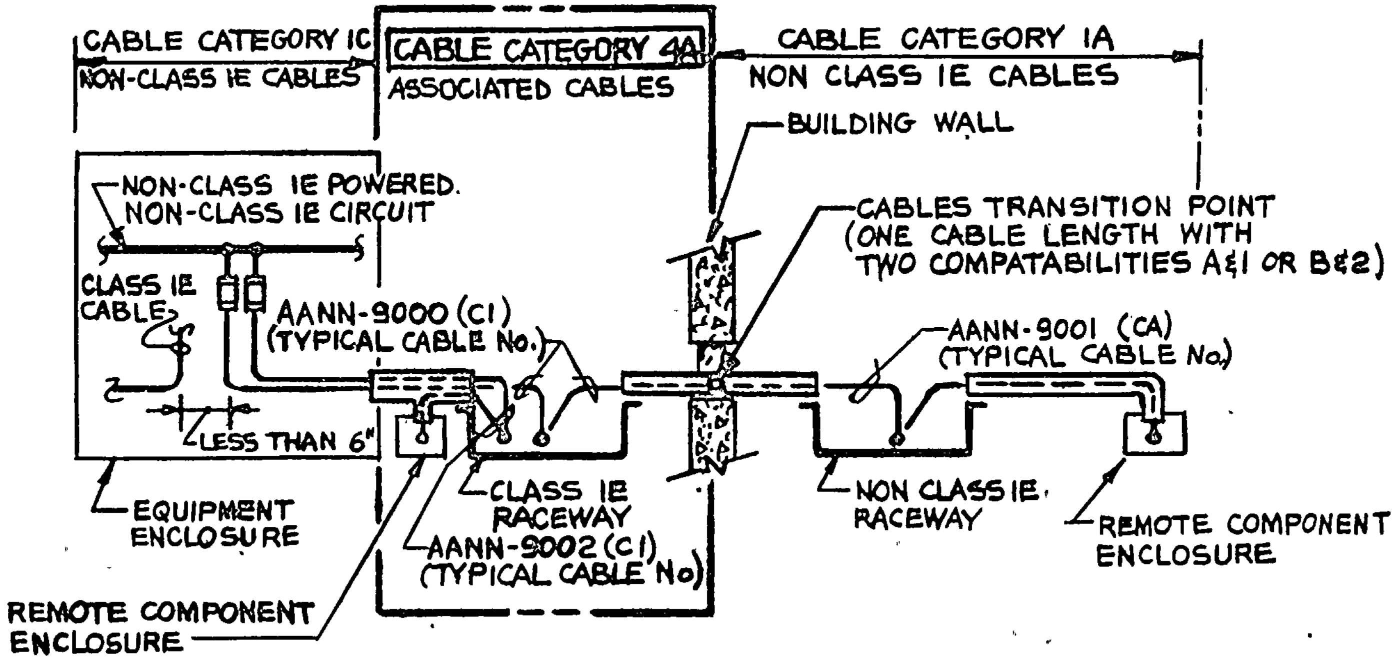
February 1982



NON CLASS IE INSTRUMENTATION CIRCUITS POWERED FROM CLASS IE THROUGH CURRENT LIMITING DEVICES-CABLE CATEGORY 3A

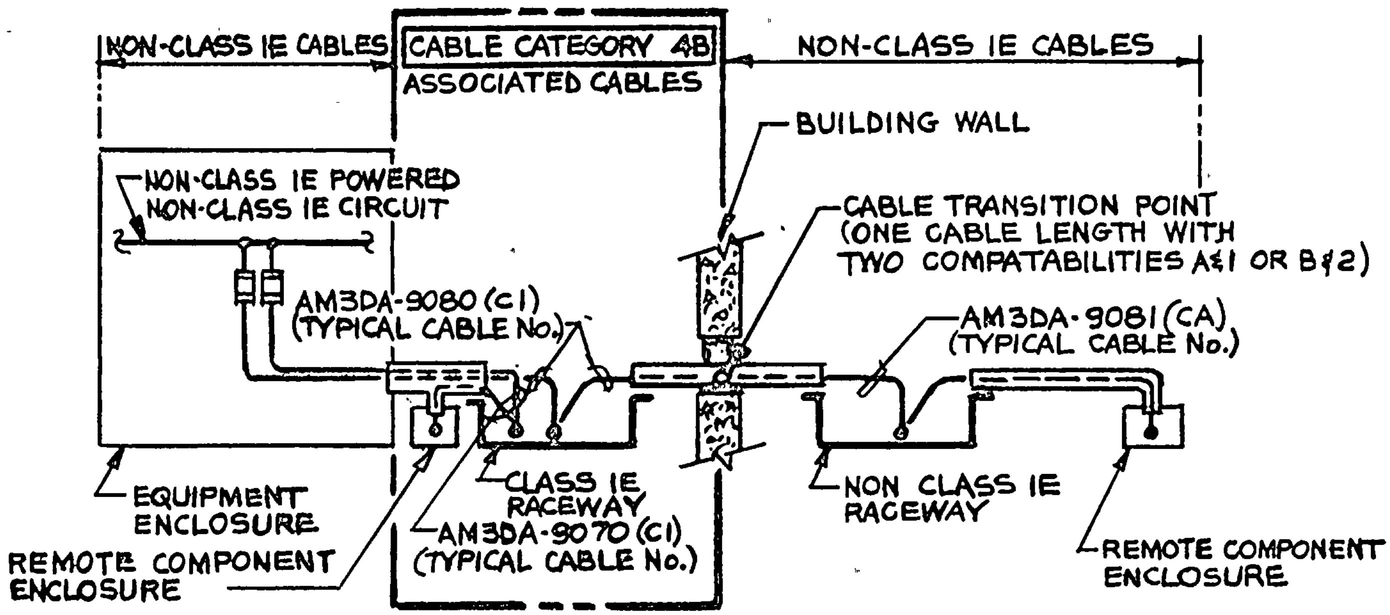
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	NON-CLASS iE CIRCUIT CATEGORIES REQUIRING ANALYSIS	FIGURE 8.3- 43c

AMENDMENT NO. 23
February 1982



ASSOCIATED (NON-CLASS 1E POWERED) INSTRUMENTATION & CONTROL CABLES

CABLE CATEGORY 4A (RACEWAY)



ASSOCIATED (NON-CLASS 1E POWERED) POWER CABLES (IN CLASS 1E RACEWAYS)

CABLE CATEGORY 4B

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	ASSOCIATED CIRCUIT CATEGORIES	FIGURE 8.3-43d

CHAPTER 9

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c) The lower casting supports the weight of the fuel assembly and restricts the lateral movement; the center and top casting restricts only lateral movement of the fuel assembly.

d) The new fuel storage racks are made from aluminum. Materials used for construction are specified in accordance with the latest issue of applicable ASTM specifications. The material choice is based on a consideration of the susceptibility of various metal combinations to electrochemical reaction. When considering the susceptibility of metals to galvanic corrosion, aluminum and stainless steel are similar insofar as their coupled potential is concerned. The use of stainless steel fasteners in aluminum to avoid detrimental galvanic corrosion is a recommended practice and has been used successfully for many years by the aluminum industry.

e) The minimum center-to-center spacing for the fuel assembly between rows is 11.875 inches. The minimum center-to-center spacing within the rows is 6.535 inches. Fuel assembly placement between rows is not possible.

f) Lead-in and lead-out of the casting provides guidance of the fuel assembly during insertion or withdrawal.

Fuel spacing (7 inches minimum center-to-center within a rack, 12 inches minimum center-to-center between adjacent racks) within the rack and from rack-to-rack will limit the effective multiplication factor of the array (k_{eff}) to not more than 0.95. The fuel assemblies are loaded into the rack through the top. Each hole for a fuel assembly has adequate clearance for inserting or withdrawing the assembly channeled or unchanneled. Sufficient guidance is provided to preclude damage to the fuel assemblies. The upper tie plate of the fuel element rests against the rack to provide lateral support. The design of the racks prevents accidental insertion of the fuel assembly into a position not intended for the fuel. This is achieved by abutting the sides of each casting to the adjacently installed casting. In this way, the only spaces in the assembly are those into which it is intended to insert fuel. The weight of the fuel assembly is supported by the lower tie plate which is seated in a chamfered hole in the base casting.

The floor of the new fuel storage vault is sloped towards a drain located at the low point. This removes any water that may be accidentally and unknowingly introduced into the vault. The drain is part of the floor drain subsystem of the liquid radwaste system.

The radiation monitoring equipment for the new fuel storage area is described in 12.3.4.

9.1.1.3 Safety Evaluation

9.1.1.3.1 Criticality Control

The calculations of k_{eff} are based upon the geometrical arrangements of the fuel array, and that subcriticality does not depend upon the presence of neutron absorbing materials. To meet the requirements of General Design Criterion 62, geometrically-safe configurations of fuel stored in the new fuel array are employed to assure that k_{eff} will not exceed 0.95 if fuel is stored in the dry condition or if the abnormal condition of flooding (with water with a density of 1 g/cc) occurs. In the dry condition, k_{eff} is maintained ≤ 0.95 due to under-moderation (water density of 0 grams per cc). In the flooded condition, the geometry of the fuel storage array assures the k_{eff} will remain ≤ 0.95 due to over-moderation.

The new fuel storage vault has concrete covers with rubber seals to provide a water tight seal. These covers are in place during long-term storage of fuel in the vault. Administrative controls are used to ensure that the shield plugs will only be removed for the minimum period of time required to complete new fuel movement evolutions. When uncovered, to preclude mist from entering the fuel area inside the fuel channels, temporary metal covers are used to cover each row of new fuel. The covers will extend below the top of the fuel channels to divert any mist to the outside of the channels preventing neutron moderation in the fueled area. The maximum fuel exposure at any one time during fuel movement evolutions is one row (ten elements). All other rows will be covered with the temporary metal covers.

The fuel storage rack is designed using noncombustible materials. Plant procedures and inspections assure that combustible materials are restricted from this area. The primary approach to fire prevention is the elimination of combustible materials. New fuel storage vault covers prevent optimum moderation in the new fuel vault (water density between 0 and 1 gram per cc).

9.1.1.3.2 New Fuel Rack Structural Design

The new fuel storage racks are designed to meet Seismic Category I requirements.

The minimum edge-to-edge distance of the assembly array from adjacent concrete walls is 16.75" between the edge of the C-14 storage rack and the shipping cask storage area wall.

The maximum stress in the fully load rack in a faulted condition is 16.5 Kip. (See Table 3.9-2(s)). This is significantly lower than the allowable stress.

The storage rack is designed to withstand horizontal combined loads up to 222,000 lbs., well in excess of expected loads.

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9.1.2 SPENT FUEL STORAGE

9.1.2.1 Design Bases

9.1.2.1.1 Safety Design Bases

9.1.2.1.1.1 Safety Design Bases - Structural

a. The spent fuel storage racks are designed to withstand the affects of the Safe Shutdown Earthquake and remain functional and maintain subcriticality. The racks are also designed to withstand the impact of a dropped fuel assembly or the upward force of a stuck assembly without loss of function.

b. The spent fuel storage facility is located so that no missiles can enter the fuel pool with the necessary energy to cause any damage to the fuel.

c. The reactor building containing the spent fuel storage facility provides the capability for limiting the potential off-site exposures in accordance with 10 CFR Part 100 in the event of significant release of radioactivity from the stored fuel.

9.1.2.1.1.2 Safety Design Bases - Nuclear

a. The center-to-center spacing between stored fuel assemblies in a fully loaded rack is sufficient to maintain a k_{eff} less than about 0.95. This design basis is met with fresh fuel of up to 3.25 weight percent enrichment, a conservative water temperature (68^{o}F) and no credit for fixed poison in the fuel assembly. Credit is taken for the fixed poison in the fuel racks.

b. The spent fuel storage rack design precludes storage of a fuel assembly other than where intended.

c. The spent fuel storage racks are designed to allow adequate cooling of the stored spent fuel assemblies.

d. Shielding for the spent fuel storage arrangement is sufficient to protect plant personnel from exposure to radiation in excess of 10 CFR Part 20 limits. Since provisions for portable shielding are not provided in the drywell, administrative control is used during refueling operations to avoid overexposure of personnel as the result of a postulated fuel drop accident such as a drop occurring on the reactor seal plate.

9.1.2.1.2 Power Generation Design Bases

a. Spent fuel storage space in the fuel storage pool is for 2658 fuel assemblies.

b. Spent fuel storage racks are designed and arranged so that fuel assemblies can be handled efficiently during refueling operations.

9.1.2.2 Facilities Description

9.1.2.2.1 Spent Fuel Storage Racks

Spent fuel storage racks provide a place in the fuel pool for storing the spent fuel discharged from the reactor vessel. They are top entry racks, designed to maintain the spent fuel in a space geometry that precludes the possibility of criticality under both normal and abnormal conditions. This is accomplished with the aid of neutron absorbing plates. The location of the spent fuel pool within the plant is shown in Figure 1.2-6.

The spent fuel storage rack design, shown in Figure 9.1-2, consists of fuel storage cells which are square stainless steel tubes with neutron absorbing B_4C plates between them. A stainless steel plate grid at the top and the bottom of the tubes, to which the tubes are welded, form the tubes into racks and maintain center-to-center spacing between the tubes at 6.5 inches. The racks are welded together into modules which are held firmly in place by seismic restraints attached between the rack modules and the pool wall. The storage racks are made of stainless steel. The square tube storage cells are 1/8 inch thick.

The neutron absorber plates have nominal dimensions of 19 inches long, 5.88 inches wide, and 0.2 inches thick. They are composed of B_4C granular material bonded together to form a plate of uniform properties. They have a nominal B^{10} loading of 0.0959 grams per square centimeter of plate and a plate density of

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If required, heat removal capacity is available from the RHR system for full core removal (core off-load) during either of these periods, in addition to the spent fuel load already stored. The system design heat loads are based on the data given in Tables 9.1-3a and 9.1-3b.

The total fission product decay heat loads generated by spent fuel in the pool, as given in Tables 9.1-3a and 9.1-3b, are in agreement with Auxiliary Systems Branch Technical Position 9-2. An evaluation of maximum spent fuel pool temperature was done using ASB TP 9-2, and it was found that the temperature remained below 175°F with one safety division of fuel pool cooling.

The system normally cools the fuel pool by transferring the spent fuel decay heat through the tube side of the two fuel pool closing heat exchangers to the reactor building closed cooling water system (RCC). Water purity and clarity in the storage pool, reactor well, and dryer-separator pool are maintained by filtering and demineralizing the pool water through the FPC cleanup system filter demineralizers. In addition to fuel pool water demineralization, the system will be used on occasion to demineralize suppression pool water.

The pool cooling and cleanup system consists of two 50 percent capacity circulating pumps, two 50 percent capacity heat exchangers, two 50 percent filter demineralizers, two skimmer surge tanks, and the required piping, valves, and instrumentation. Both pumps normally circulate the pool water in a closed loop, taking suction from the surge tanks into a single suction header, circulating the water through the two heat exchangers and one filter demineralizer, returning to the fuel pool through a single header, and discharging it through diffusers at the bottom of the fuel pool and reactor well. The water flows from the pool surface through scuppers and skimmer weirs to the surge tanks. Makeup water for the system is normally transferred from the condensate storage tank to a skimmer surge tank to make up pool water losses. The fuel pool pumps and heat exchangers are located in an enclosed room on the 548-foot level of the reactor building beneath the fuel pool.

e. Structural members/shapes not covered by the above safety factors are designed in accordance with CMAA Specification #70, and if not covered by CMAA Specification #70, in accordance with the AISC Specification for the design, fabrication and erection of structural steel for buildings except that the allowable stress shall not exceed 80% of the AISC allowable design stress.

Jib cranes MT-CRA-9A, 9B and 13 are designed to Seismic Category I requirements (with lifted load).

The cranes are designed so as to be capable of operating within the following tolerances:

a. With all brakes adjusted for normal operation, it is possible to control the vertical movement to within ¼ inch under all conditions of loading.

b. Cranes operate through full hook lift without noticeable rotation of load.

c. With hook carrying 100 percent of rated load and lowering at full speed, the motor does not exceed 125 percent of synchronous speed.

Since jib cranes MT-CRA-9A and 9B are to be used on the reactor vessel service platform and around the fuel pool for handling new and spent fuel and other components in the work area, the following safety features are provided:

To preclude the possibility of raising radioactive materials out of the water, the cable on the jib crane hoist incorporates an adjustable removable stop which will jam the hoist cable, thereby preventing drum rotation when the end of the cable is at a preset distance below water level.

The hoist is motorized with a motorized boom and jib. The unit is equipped with two full capacity brakes, as well as adjustable up-travel limit switches. On hoisting, the first two independently adjustable switches shall automatically stop the hoist approximately 8 ft. below floor level. Continued hoisting shall be possible by operating a key lock contact up-travel override push button on the control pendant together with the normal hoisting push button. Two additional independent switches shall automatically cut hoist power at the maximum safe up-travel limit.

A mechanical force gage is supplied to automatically stop the hoist on an overload signal of 1000±50 lbs. Two additional microswitches are wired in parallel and the three leads are brought out with the power leads for connection to a platform receptacle. The two additional switches are adjusted to open at 400±50 lbs.

Safety aspects (evaluation) of the fuel servicing equipment are discussed in 9.1.4.2.3 and safety aspects of the refueling equipment are discussed throughout 9.1.4.2.7. A description of fuel transfer, including appropriate safety features, is provided in 9.1.4.2.10. In addition, the following summary safety evaluation of the fuel handling system is provided below.

The fuel prep machine removes and installs channels with all parts remaining under water. Mechanical stops prevent the carriage from lifting the fuel bundle or assembly to a height where water shielding is less than 8 feet. Irradiated channels, as well as small parts such as bolts and springs, are stored underwater. The spaces in the channel storage rack have center posts which prevent the loading of fuel bundles into this rack.

There are no nuclear safety problems associated with the handling of new fuel bundles, singly or in pairs. Equipment and procedures prevent an accumulation of more than two bundles in any location.

The refueling platform is designed to prevent it from toppling into the pools during a SSE. Redundant safety interlocks are provided as well as limit switches to prevent accidentally running the grapple into the pool walls. The grapple utilized for fuel movement is on the end of a telescoping mast. At full retraction of the mast, the grapple is eight feet below water surface, so there is no chance of raising a fuel assembly to the point where it is inadequately shielded by water. The grapple is hoisted by redundant cables inside of the mast and is lowered by gravity. A digital readout is displayed to the operator, showing him the exact coordinates of the grapple over the core.

The mast is suspended and gimbaled from the trolley, near its top, so that the mast can be swung about the axis of platform travel, in order to remove the grapple from the water for servicing and for storage.

Filtered water is stored in a 10,000 gallon potable water storage tank; demineralized water is stored in a 50,000 gallon epoxy lined carbon steel demineralized water storage tank (See 9.2.4 and 9.2.3.2.2).

The effluent from the ion exchangers and the mixed bed demineralizer is continuously recorded with associated alarms. In addition, the anion exchanger effluent is monitored for pH and silica. Exhaustion of a demineralizer is indicated by high conductivity in the effluent. On high conductivity the outlet closes and a rinse commences. If the conductivity does not return within specified limits during a preset time period, the rinse stops and an alarm is given. If conductivity does return below the limit, the rinse stops, the outlet reopens and no alarm is given. The system is designed to meet the following water quality parameters:

Conductivity	1.0 umho/cm at 25°C
Chlorides (as Cl)	0.05 PPM
pH	Neutral (6.5 to 8.0 at 25°C)
Boron (as BO_3)	0.1 PPM

b. Pretreatment Filter Systems

Cooling tower make-up (river) water is pumped to both of the gravity filters which discharge into the clearwell tank. The gravity filter units filter and store their own backwash water. The backwash is completely automatic and interlocked to prevent simultaneous backwash of the two parallel filters. The gravity filters remove most of the suspended solids. From the clearwell two of the three clearwell transfer pumps are used to pump the water to the two carbon filters whose discharges supply the potable water tank and the demineralizer trains.

The carbon filter units are backwashed using their influent liquid. These filters are backwashed automatically and interlocked to prevent simultaneous backwashing. The activated carbon filters absorb organic matter and residual chlorine.

The backwash effluent from the gravity and carbon filters is directed to drains or sumps and then pumped into the storm drain system.

Chlorine used for disinfection is injected into a recirculated portion of the clearwell transfer pump discharge which then mixes with the cooling tower make-up supply.

c. Demineralizer System

The demineralizer system consists of two parallel trains each containing a cation, an anion and a mixed bed exchanger. The cation units and mixed bed units are regenerated with sulfuric acid pumped from the acid storage tank by one of two acid regeneration pumps (CF-P-1A, CF-P-1B). A third pump (CF-P-3) mounted on the acid storage tank supplies acid to the neutralization tank. The acid storage tank (CF-TK-1) has a capacity of 6000 gallons. Regeneration of the cation exchangers is automatic after manual initiation.

The anion units and mixed bed units are regenerated with sodium hydroxide (caustic) pumped from the caustic storage tank by one of two pumps (CF-P-2A, CF-P-2B). A third pump (CF-P-11) mounted on the caustic storage tank supplies caustic to the neutralization tank.

The caustic storage tank (CF-TK-2) has a capacity of 6000 gallons and is maintained at 85^{o}F by an electric heater to prevent solidification of the caustic. Regeneration of the anion exchangers is automatic after manual initiation.

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g. Offsite power is lost and Division 2 diesel fails to start, resulting in a loss of the pond A spray header. (Division 1 heat loads are slightly higher.)

h. The major heat loads considered are reactor core decay heat, sensible heat from both the coolant and the reactor, fuel pool decay heat, pump work, and the heat removed from the station auxiliaries. These heat loads are detailed in Table 9.2-8 and Figures 9.2-7c through 9.2-7e. No credit was taken for heat sinks in the primary containment other than the suppression pool volume.

The RMS average wind speed during the selected thirty-day period for the mass loss analysis was 6.91 mph. The drift loss was based on the calculated drift value at the RMS wind speed. The mass loss analysis thus demonstrates that the spray ponds contain sufficient water inventory to meet drift losses significantly higher than expected.

The analyses assume an initial temperature of 77°F. This is approximately the highest monthly average temperature expected if the sprays are not operated. To maintain the pond temperature below this limit, the spray headers will be operated and/or river water makeup to the cooling towers will be diverted through the spray ponds. Analyses have been performed which demonstrate that the above operations can maintain the spray pond below 77°F.

An analysis was conducted which verified failure of Division 1 or Division 2 power results in the most severe service water transient. If the failure was postulated in Division 3 (HPCS) instead of Division 1 or 2, the peak pond temperature is lower. The HPCS SW flow is a straight heat dump; therefore, inasmuch as the spray pond is concerned, it raises rather than lowers the temperature transient.

The resulting peak spray pond temperature, 88.6°F, predicted by the "worst case" analysis is considerably below the 95°F service water temperature assumed in the analysis performed in 6.2.1 for containment heat removal, adding further conservatism to the containment temperature and pressure transients therein presented. The service water temperature, however, exceeds the design basis temperature, 85°F, for short periods of time as shown in Figure 9.2-7a. This results in a predicted peak temperature for some of the electrical equipment rooms served by emergency HVAC equipment of, at most, 3°F higher than the continuous operating temperature limit for the equipment.

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underground. Since it is not credible to assume an earthquake coincident with a tornado, this system need not be Seismic Category I. Two 12,500 gpm plant makeup water pumps are provided, one powered from each emergency diesel generator. Should pond water be lost due to a tornado, one of these pumps will be started to provide makeup. Makeup supply to the spray ponds is controlled by level switches that automatically open a supply valve to allow gravity drain from the circulating water pump basin to replenish spray pond level when it reaches the makeup setpoint.

9.2.5.4 Testing and Inspection Requirements

After completion of the spray pond, an inspection and test program has been established to ensure that the spray system will accomplish its safety function as discussed in 14.2.

All valves and piping in the system have been hydrostatically tested in the shop per ASME Section III, Class 3. After installation the system is hydrostatically tested and visually inspected. During plant operation the system is periodically tested.

Preservice and inservice inspections for the spray system will be in accordance with 6.6.

9.2.5.5 Instrumentation Requirements

The spray pond is equipped with redundant level and temperature sensors which are alarmed and indicated in the main control room as well as locally.

In the event that the spray pond level falls below the minimum level required for 30 days of cooling, an alarm is sounded and makeup automatically is provided directly from the plant makeup water line to the spray pond.

High and low temperature alarms are provided. In the event that the pond water temperature approaches the design limit, the spray system is initiated to lower the temperature. Upon low water temperature signal, return water is dumped directly into the ponds to prevent spray trees and spray headers from icing.

TABLE 9.2-2

DESIGN PARAMETERS FOR THE SPRAY SYSTEM

Number of systems	2
Number of trees per system	32
Diameter of the ring headers	140'-0"
Circumferential spacing between trees	13'-9"
Number of horizontal arms per riser	7
Pressure at top nozzle	17 psig
Pressure at interface (flange)	24.5 psig
Flow rate per tree at design pressure	303.9 gpm
Total flow rate per system	9,725 gpm
Nozzle type	Spraying Systems Company 1-1/2-CX-27-55
Height of vertical riser	17'-9"
Spacing between arms	32"
Height of bottom nozzle elevation from system interface (flange) riser pipe diameter	6-11/16"
Riser pipe	8", Schedule 80
Horizontal branch arm pipe	1-1/2", Schedule 80

TABLE 9.2-3

TOTAL SPRAY POND WATER LOSSES AND CONTENT 30 DAYS AFTER LOCA EVENT

Drift losses	2,835,952 gal
Spray evaporation	4,986,676 gal
Surface evaporation	876,842 gal
Hydrogen recombiner	172,510 gal
Total	8,871,620 gal
Remaining inventory	3,761,661 gal

each of the primary air handling systems. The capacity of each air handling system is 22,000 cfm.

During normal operation one air handling system operates, distributing air to the main control room. The temperature and humidity are controlled by electronic controllers located in the main control room which modulate the chilled water flow to the cooling coils and start the electric heaters, as required.

Chilled water is normally supplied to the main control room and cable spreading room air handling systems by the radwaste building chilled water system. The chilled water system, which includes two 100 percent capacity chillers and two 100 percent capacity pumps is not an engineered safety feature. When the radwaste building chilled water system becomes inoperative, control room chilled water system is supplied to the air handling units for emergency cooling. Under this mode of operation the control room ambient temperature will be maintained at 78°F, which is sufficient to ensure critical equipment operation and area habitability.

The two 1,000 cfm capacity filter systems are normally in standby. They operate only in the event of an emergency (F,A,Z signal or high radiation level in the remote intake headers or high chlorine level in the common air intake header). Each of the emergency filter systems consists of an emergency filter unit, a 5 kW electric heater, bypass and recirculation control dampers, and associated ductwork. Each emergency filter unit consists of a medium efficiency prefilter, high efficiency particulate air (HEPA) filter, activated charcoal filters and direct drive centrifugal fan, all enclosed in an all-welded sheet metal housing. A deluge water spray system is provided to soak the charcoal filters in the event of high temperatures in the charcoal beds. Check valves are provided on all drain connections from the filter unit and the drain header is provided with a deep water seal trap to prevent in-leakage of air during unit operation. The electric heater located in the fresh air bypass to each emergency filter limits the relative humidity of the air entering the filter to 70 percent.

The medium efficiency prefilters are provided to protect and extend the life of the HEPA filters. The have an 85 percent dust spot efficiency by ASHRAE Standard 52-68.

The HEPA filters are designed to give essentially complete removal of fine airborne particulate matter including fission product particulates. These filters are of water repellant and fire resistant construction for operation at temperatures up to 300°F. The HEPA filters have a minimum efficiency of 99.97% on a 0.3 micron DOP (Dioctylphthalate) test. The HEPA filters are fabricated in accordance with MIL-F-51068C, MIL-STD-282, and carry a UL label certifying compliance with UL586.

The activated charcoal filters are designed to trap and remove the gaseous iodine contaminants from the airstream. The charcoal filters are laboratory tested for decontamination efficiencies greater than 99% for elemental iodine (at 70% R.H.) and 99% for methyl iodine (at 70% R.H.). The dose analysis is based on 95% charcoal efficiency.

Motor operated outside air intake (bypass) dampers WMA-AD-51A-1 and 51B-1 are spring-loaded fail-close type and are provided with limit switches to indicate full open and full closed positions on the main control room panel. Each damper is provided with a remote manual switch in the main control room. Dampers are automatically closed when deenergized by isolation signal, or by the main control room panel mounted switch. These dampers have a design leak rate of 0.5% of the rated flow. Main control room supply fan inlet pressure is higher than the emergency filter unit fan, therefore, when emergency filter unit is operating a negative pressure is developed on the inlet side of the bypass dampers preventing any contaminated air bypass of the emergency filter unit. In the event that either bypass damper does not close, an alarm will be activated in the main control room.

The three fresh air intakes for the main control room are shown in Figure 6.4.2 (see Chapter 6). Each of the three main control room fresh air intakes are fitted with two automatic, butterfly, isolation valves in series. The valves have electrohydraulic operators which are powered from the Class 1E buses. All intakes are connected, via ductwork, to a common intake header from which both main control room air handling systems and both emergency filter systems draw fresh air. The isolation valves in each fresh air intake, the emergency filter units, and the bypass dampers that direct fresh air through the emergency filter units are division oriented electrically.

bypass, between the discharge of the chiller and the suction side of the brine pump, is controlled by a pneumatic differential pressure controller set to maintain a constant differential pressure across the brine pump, thereby maintaining a constant brine flow rate through the chiller.

The charcoal adsorber vault temperature is controlled by a temperature controller, with sensors inside the vault, which modulates the pneumatic control valves in the brine supply pipes to the fan coil units.

The fan coil units of each refrigeration system are normally controlled by a rotating drum type programmer which cycles the units periodically into a defrost mode. Manual selector switches are provided for manual override of the programmers. The following are the major instrumentation devices used in conjunction with the programmer to control the fan coil units:

a. Defrost is initiated by a time clock which is field adjustable between 6 and 48 hours. On initiation of defrost, the fan coil unit fan is stopped, its motor operated inlet and outlet dampers are closed, a solenoid valve in control air line to the units brine control valve is de-energized causing the control valve to close, and the electric coil defrost heaters and drain pan heaters are energized. Electrical interlocks prevent both air handling units of a refrigeration system from going into the defrost mode at the same time so that one fan coil unit is always operating in the refrigeration mode.

b. Defrost is terminated by the temperature switch sensing brine coil temperature. On a coil temperature rise to $40^{\circ}F$, the temperature switch de-energizes the brine coil electric defrost heaters and starts a 15 minute timer. The drain pan electric defrost heater remains on for 15 minutes to completely drain all moisture. After 15 minutes, the timer de-energizes the drain pan electric defrost heater and energizes the solenoid in the control air line to the units brine control valve permitting the valve to receive a control signal and open.

c. A temperature switch sensing the brine temperature in the fan coil unit brine return pipe can energize a second solenoid valve in the control air line to the unit brine control valve. The temperature switch is set to energize the solenoid valve whenever the brine temperature is above the desired vault temperature. When energized, the solenoid valve transmits a control signal to the brine control valve from a temperature controller which senses brine temperature in the brine return pipe at the pump suction. This controller is set to limit return brine temperature to the chiller to a safe level to protect the unit from thermal shock. The controller opens the brine control valve slowly, feeding the warm brine, heated during defrost back into the refrigeration system at a safe rate.

Once the brine in the fan coil unit is reduced in temperature to that of the vault, the solenoid valve is de-energized causing the brine control valve to receive a control signal from the vault temperature controller. The fan coil unit's dampers are opened and its fan energized, thus bringing the unit back into its refrigeration mode of operation.

9.4.6 TURBINE-GENERATOR BUILDING HEATING AND VENTILATION SYSTEM

9.4.6.1 Design Bases

The turbine-generator building is provided with heating and ventilating systems designed to satisfy the following requirements:

a. To provide fresh, tempered, filtered ventilating air to the various spaces within the turbine-generator building in sufficient quantity to limit the temperature to 104°F in areas where electrical equipment is located and/or where personnel are operating, and to 120°F in other areas such as the heater bays.

b. To provide for controlled air movement from areas of potentially lower radiation contamination to areas of progressively higher radiation contamination potential. This distribution serves to limit airborne contaminants from migrating from potentially contaminated areas into clean areas. The ventilation systems normally operate on a once through basis without recirculation; however, provisions are made to operate the system in a partial recirculation mode during plant outages when potential for contamination does not exist.

c. To monitor all exhaust air from the building for radioactive contaminants, prior to discharge, to ensure that a release of contaminants which exceed the limits defined in 10CFR20 is not made to the atmosphere.

d. To automatically maintain the turbine-generator building at a negative pressure with respect to atmosphere to minimize the release of radioactive contaminants. The system is also designed to pressurize the building during periods of low contamination potential in the turbine-generator building, if required.

e. To supply air to the turbine building to maintain the space temperatures at a minimum of 50°F.

f. To automatically provide combustion air for the auxiliary boiler in the turbine-generator building.

g. To provide ventilation air to the make-up water pump transformers in the turbine building. This portion of the ventilation system is to remain operable through a design basis tornado.

h. To provide the sample room exhaust hood with a supply and exhaust filtration system and to provide tempered ventilation air to the sample room.

The components of the turbine-generator building ventilation systems are classified Seismic Category II. The system fans are constructed and rated in accordance with the applicable AMCA standards.

9.4.6.2 System Description

The heating and ventilating systems of the turbine-generator building are depicted in Figure 9.4-6. The primary system is a "push-pull" heating and ventilating system consisting of the following subsystems:

a. Main supply system

b. Main exhaust system

c. Auxiliary boiler room ventilation system

d. Transformer vault ventilation system

e. Sample room air conditioning system

Equipment details are given in Table 9.4-4.

9.4.6.2.1 Main Supply System

The turbine-generator building supply air system consists of four supply ventilation units and associated distribution ductwork. The units are operated in pairs, with one pair discharging into a common supply duct system servicing the west side of the building and the other pair discharging into a common supply duct system servicing the east side of the building.

Each of the four ventilation units consists of a pre-filter, a steam coil with face and bypass dampers, an evaporative cooling section, and a centrifugal fan enclosed in an insulated housing. The pre-filters are of the renewable roll type, automatically progressed to maintain uniform pressure drop. The steam coil is of the non-freeze type with automatic face and bypass dampers used for temperature control. The evaporative cooling section is of the capillary air washer type with two full capacity pumps which have a common suction line from the washer basin and common discharge line into the washer spray header system. Make-up water to the air washer is supplied from the plant potable water system.

The centrifugal fans of each ventilation unit have automatic inlet vanes for fan capacity control and are used to vary supply air flow to maintain the turbine building at a set pressure with respect to outdoors. The nominal rates of air flow through the ventilation units are 74,750 cfm through each of the two west units and 58,450 cfm through each of the two east units. The fan intake ducts of each pair of ventilation units are joined by means of a manual damper so that a single fan can draw air through both ventilation units in the event of failure of one fan. In this mode of operation, with fan inlet vanes fully open, the fan capacity can be increased approximately 50 percent thus minimizing the effect of a fan failure on system cooling capacity.

Automatic dampers are provided on the intake of each ventilation unit that permit the unit to draw 100 percent outdoor air or 100 percent recirculation air from the turbine building. Recirculation is performed to reduce building heat requirements only during plant outages when an airborne contamination potential does not exist.

9.4.6.2.2 Main Exhaust System

The main exhaust system consists of four, roof mounted centrifugal fans which draw air from a central exhaust plenum. Three of the exhaust fans normally operate continuously with one fan in standby. Air flow through the operating fans is maintained constant by automatic volume dampers on the fan discharges which are controlled to maintain a constant differential pressure across the fans.

Almost all exhaust air is drawn from the shielded areas of the turbine building, where the potential for airborne radioactive contamination is highest, thus inducing flow from the less contaminated areas through the shielded areas. The air in the exhaust duct is monitored for radioactive contaminants by a recorder in the main control room. Radioactive releases to the environment are discussed in 11.3.3.

In the event that supply air to the turbine-generator building is reduced, as during a plant outage, only one or two exhaust fans may be operated. Motor operated shut-off dampers are provided in the main branches of the exhaust duct system so that exhaust can be stopped on an area by area basis. Automatic volume dampers are provided in the exhaust system so that full exhaust flow can be drawn from the shielded equipment vaults on the lower level of the turbine building when the exhaust system is operating at reduced capacity. These vaults house equipment with higher contamination potential such as the air ejectors and the off-gas system hydrogen recombiners.

9.4.6.2.3 Auxiliary Boiler Room Ventilation System

The auxiliary boiler room, which is located in the lower level of the turbine-generator building, is normally ventilated with 2,000 cfm from the turbine-generator building supply air system. This ventilation rate is sufficient when the boiler is not operating. However, when the boiler is operating and drawing combustion air from the room, an additional 15,000 cfm is supplied to the boiler room by a separate air handling unit. This air handling unit starts automatically, via electrical interlocks, when the boiler is started and draws 100 percent outdoor air through a weather louver, heats it as required, and discharges it into the room. Part of this air is drawn by the boiler as combustion air, with the balance of the air leaving the boiler room via relief dampers in the exterior wall of the boiler room.

9.4.6.2.4 Transformer Vault Ventilation System

Two transformers, located in adjacent equipment vaults in the lower level of the turbine-generator building, must remain operational in the event of a design basis tornado. The power feeds of the make-up water pumps, which are the source of make-up water to the emergency spray ponds, are drawn from these transformers which can be fed from the emergency diesel generators buses. Two 9,000 cfm capacity tube-axial fans are provided for the ventilation of the vaults in the event of a tornado. The two fans exhaust air from the vaults with make-up air provided through ventilation openings in the vaults walls. Either fan has sufficient capacity to remove the heat generated by the transformers and both are powered from the emergency diesel generator buses. During normal plant operation, make-up air to the vaults is provided by the main turbine-generator building supply air system with one vault ventilation fan operating and other in standby.

9.4.6.2.5 Sample Room Air Conditioning System

The turbine building sample room, located on the lower level of the turbine-generator building, is provided with a sample hood exhaust filter system and a self-contained air conditioning system. The sample room hood is of the air curtain type with air supplied to the hood by a centrifugal fan which draws 810 cfm of air from the corridor outside the sample room and 540 cfm from the room itself. Air is exhausted from the hood by a filter unit. This unit is composed of a medium efficiency prefilter, a HEPA filter, and a 1350 cfm capacity exhaust fan in a sheet metal housing. The filter unit discharges into the main turbine building exhaust system.

The sample room air conditioning unit is a 5 ton, water cooled unit with condensing water supplied from the plant service water system (see 9.2.1). The unit delivers 2400 cfm on a partial recirculation mode of operation, recirculating 2,000 cfm of room air and drawing 400 cfm of make-up air from an adjacent corridor.

9.4.6.3 Safety Evaluation

The transformer vault ventilation system is designed to operate in the event of a design basis tornado. Two full capacity fans powered from the emergency diesel buses are provided to ensure system operation in the event of a single active component failure. The vaults, which house the ventilation fans as well as the transformers, are designed to withstand the effects of the design basis tornado.

The following features are incorporated in the design of the balance of the turbine-generator building heating and ventilation system to ensure system reliability and to minimize the release of airborne radioactivity:

a. Standby exhaust fan capacity is provided (3 of 4 fans operating) to ensure full system capacity in the event of a single fan failure.

b. The supply system ventilation units are designed with cross-ties between oversized fans to minimize the effect of a fan failure on system capacity.

c. The building is maintained at a negative pressure with respect to outdoors and air is monitored by radiation detectors located in the exhaust ductwork.

d. Exhaust air is drawn from within the shielded areas of the turbine-generator building thus inducing air flow from "clean" areas to potentially contaminated areas. A flow controller maintains a constant flow from these areas by throttling flow from other areas of the building, as required.

The radiological considerations of normal system operation are evaluated in Chapters 11 and 12.

9.4.6.4 Testing and Inspection Requirements

The performance of the heating and ventilation systems serving the turbine-generator building can be verified while the systems are operating. The operability and performance of standby equipment is determined by rotating the duty of redundant components. Pressure, temperature, and flow instrumentation is provided, as shown in Figure 9.4-6, to monitor system performance.

All system ductwork is subjected to leak tests during erection and is balanced in accordance with the procedures of the Associated Air Balance Control Council (AABC). All system components are subjected to pre-operational testing at design conditions.

9.4.6.5 Instrumentation Requirements

Control devices for the turbine-generator building heating and ventilating system are mounted on racks in unshielded areas of the building. The following major instrumentation devices are used for the turbine-generator building heating and ventilating system:

a. Main Supply System: Locally mounted, individual selector switches are provided for the fans of each of the four supply ventilation units. When a fan is started, an associated solenoid valve is energized permitting the fans pneumatic shut-off damper to receive control air and open. The fan's pneumatic inlet vane controller, which strokes open on a pressure signal reduction, receives its control signal from a differential pressure controller with probes located in the shielded condenser area and outside the turbine building. The differential pressure controller is normally set to maintain the condenser areas at a negative pressure of 0.25 inch w.g. with respect to atmosphere; however, the controller can maintain a differential pressure from minus (-) 0.25 inch w.g. to plus (+) 0.25 inch w.g. if required. The control signal is transmitted through a pressure selector which selects the lower of the two signals, one from the differential pressure controller and one from a pre-set pressure control valve.

   The control valve is preset to transmit a signal corresponding to the minimum air flow required for cooling so that the differential pressure controller does not reduce air flow below that required for cooling. The differential pressure controller has a manual/auto switch which permits an operator to override the differential pressure controller.

   The supply ventilation units' steam heating coils and evaporative cooler spray pumps are controlled in the same manner as those of the reactor building supply unit (see 9.4.2.5) except that the selector switches for the spray pumps are locally mounted. Also, the high temperature limit switch at the discharge of the supply fan stops the fan and closes the shut-off damper, as well as closes the steam supply valve.

no heat producing equipment in the wetwell; therefore, a wetwell air cooling system is not required. The drywell, which has a high internal heat load, is provided with an automatic recirculation cooling system designed to meet the following requirements:

a. To limit during normal plant operation, the average air temperature within the primary containment drywell to 135°F and to limit the maximum temperature to 150°F.

b. To provide suitable working temperatures inside the primary containment for personnel during shutdown and refueling operations.

c. To remove the additional heat released in the event of a reactor scram, and to limit temperatures in the neutron monitoring cable area beneath the reactor to a maximum of 185°F.

The drywell cooling system is sized to maintain the above conditions with an internal heat load in the drywell of 3 million Btu per hour. The additional heat released into

The primary containment cooling system is not required for safe shutdown of the reactor. Essential equipment located in primary containment that is required for safe shutdown of the reactor is designed to function without the containment cooling system in operation; however, two standby fan coil units are provided to ensure uninterruptible cooling in the event of any single unit failure.

All components of the primary containment cooling system are classified Seismic Category I. System fans are constructed and rated in accordance with applicable AMCA codes. The water cooling coils are designed and code stamped in accordance with the requirements of the ASME Code, Section III Class 3.

9.4.11.2 System Description

The primary containment cooling system is depicted in Figure 9.4-8. Cooling of the drywell is provided by five fan coil units which recirculate containment air through water cooling coils for heat removal. Seven recirculation fans and two head area return fans are also provided at various locations in the drywell to provide additional air air turbulence to prevent pockets of hot air from developing. Each of the five fan coil units consists of two vaneaxial fans, both of which operate at the same time, and a water cooling coil in a sheet metal housing. Provisions have been made to install filters in the units, for coil protection, while the units are operated during plant construction; however, no filters are required during normal plant operation. Water is supplied to the unit cooling coils from the reactor building closed cooling water system as described in 9.2.2.

Three of the fan coil units are located low in the drywell and two of the units are located at a higher level. During normal reactor operation, two of the lower level units and one of the upper level units operate continuously to remove the heat generated in the drywell. The third lower level unit and the second upper level unit are normally in standby.

Each of the three lower level fan coil units are provided with one 20,200 cfm capacity vaneaxial fan which discharges directly into the general drywell volume, and one two speed, 11,800/17,800 cfm, vaneaxial fan which discharges, via ductwork, into the neutron monitoring cable area beneath the reactor and the area between the reactor vessel insulation and the sacrificial shield wall. Volume dampers with electrohydraulic operators are provided in the branch ducts from the two speed fan to control the flow to the two areas served.

The two upper level fan coil units are each provided with one 26,200 cfm capacity fan and one 9,800 cfm capacity fan. The larger fans discharge directly into the upper volume area. The smaller fans discharge, via a shared duct header, into the containment head area above the refueling bellows. Two 5,000 cfm vaneaxial head area return fans draw air from the containment head area and discharge it below the refueling bellows. Return air to the upper fan coil units is drawn from immediately below the refueling bellows. During normal operation, one of these recirculation fans will be running and one will be in standby.

The remaining seven recirculation fans are designed for an air flow of 20,000 cfm each. Three recirculating fans are located at lower level and four fans are located at upper level in the drywell to provide air circulation. During normal operation, three lower level fans and two upper level fans are operating.

In the event of a reactor scram, both standby fan coil units and the standby recirculating fans are started upon receipt of a scram signal to remove the additional heat released.

9.4.11.3 Safety Evaluation

The primary containment cooling system does not have to operate, in the event of LOCA, to ensure the safe shutdown of the reactor. Recirculation and head area return fans will be used as the hydrogen mixing system in the event of a LOCA. However, its design incorporates the following features to ensure system operation during normal operation and the conditions noted below:

a. Two standby fan coil units are provided to ensure uninterrupted cooling in the event of any single unit failure.

b. All fan coil units, recirculation fans and head area return fans are designed to withstand the effects of a safe shutdown earthquake and are powered from the emergency diesel buses. Operator action is required to start the system on emergency power.

c. All fan coil units, recirculation fans and head area return fans are designed to operate for six hours in an environment of 340°F, 45 psig steam so that they will be functional for heat removal in the event of a small pipe break.

d. All containment fans have been qualified for use in containment in accordance with IEEE 334-1974. Qualification testing was successfully performed on a prototype fan for motor heating aging, fan resonant search, vibration endurance, and LOCA simulation (see 6.2.5).

9.4.11.4 Testing and Inspection Requirements

All components of the primary containment cooling system are subjected to shop and field tests prior to plant operation. System performance is verified during reactor operation when the equipment is operating at design conditions. The operability and performance of standby equipment is determined by rotating the duty of redundant components.

All system ductwork is subjected to leak tests during erection and is balanced in accordance with the procedures of the Associated Air Balance Control Council. All system components are subjected to preoperational testing at design conditions.

Temperature and humidity sensors are located throughout the primary containment as indicated in Figure 9.4-8. These sensors continuously monitor ambient conditions inside the containment and the performance of the cooling system.

9.4.11.5 Instrumentation Requirements

The primary containment fan coil units and recirculation fans are each controlled by individual selector switches with indication lights, mounted in the main control room.

During normal plant operation, two of the three lower level fan coil units are placed in the AUTO mode of operation with the third unit in standby. In the AUTO mode, both fans of the fan coil unit operate continuously with the two speed fan controlled by a temperature switch with its sensor located in the neutron cable area beneath the reactor. On a

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In each supply subsystem, a transfer pump powered from a UPS bus takes suction from the diesel oil storage tank and discharges to an associated diesel generator fuel oil day tank to maintain the fuel oil level within the day tank. The transfer pump is sized to provide a flow of 4.4 times the maximum engine consumption rate and is automatically controlled by level switches activated by day tank fuel level. The capacity of each fuel oil storage tank is sufficient to provide seven days of operation for the diesel generator being served.

Each transfer pump is connected to a day tank. There is a pipe interconnecting the transfer lines. By shutting off the isolation valve to day tank "A" the fuel oil can be pumped from storage tank "A" and from storage tank "B" to day tank "B". By shutting off the isolation valves at day tank "A" and at transfer pump "B" and opening of the isolation valves in the cross connection line, the fuel oil can be pumped from storage tank "A" to day tank "B". By the same logic the fuel oil can be pumped from storage tank "B" to day tank "A". If a rupture occurs in the transfer line beween one storage tank and its associated day tank, the interconnecting cross line will be isolated by manually shutting off the isolation valves in that line. This will assure adequate fuel oil supply to the other day tank. If a rupture occurs in the interconnecting cross line, this line will be isolated and thereby the fuel oil supply will not be interrupted between any storage tank and its associated day tank.

The volume of the day tanks permits eight and one-half hours of engine operation of the associated diesel generator without resupply to the day tank. This arrangement provides three hours of operation before the transfer pumps starts, two hours of operation between a start signal to the transfer pump and day tank low level alarm in the event the transfer pump does not start, and three and one-half more hours of operation after low level alarms are actuated to take required corrective action.

At normal high oil level a switch will shut off the pump. If the fuel oil level reached two inches above the normal high level, a high level condition is reached and a second level switch is activated. This switch will close the solenoid valve at the day tank inlet and send an alarm signal. Any excess oil will return to the fuel oil storage tank through the one-half-inch minimum flow line.

A single failure analysis of the fuel oil storage and transfer system for diesel generators 1A and 1B is presented in Table 9.5.7. Although a single failure may result in loss of fuel to one diesel generator, the other diesel generator can provide sufficient capacity for emergency conditions, including safe shutdown of the reactor (see 8.3) coincident with loss of offsite power.

Each diesel oil storage tank of generator 1A or 1B has a capacity of 60,000 gallons which is more than sufficient to supply oil for one diesel generator for seven days. In addition, each day tank has a capacity of 3000 gallons. The diesel generator fuel consumption at 100% generator rating of 4650 kW is 340 ga/hr. The HPCS diesel oil storage tank (50,000 gallons) and its associated day tank are also adequate to sustain operation of the HPCS diesel for at least seven days.

The minimum site storage of seven days (even assuming the loss of one storage tank serving diesel generators 1A and 1B) is considered adequate time for obtaining additional fuel oil, if required. Fuel can be available at the site within six hours from local sources (Pasco, Washington), or from more remote terminals within 12 to 24 hours.

Materials for the fuel oil supply system are as follows:

	Material	Corrosion Allowance
Piping	ASME SA-106, GR B	
Buried Storage Tank	ASME SA-515, GR 70	3/16"
Day Tank	ASME SA-283, GR C	3/16"

The corrosion protection of exterior surfaces of the buried piping and components are coated with coal tar enamel and all application of coating are in strict accordance with AWWA Specification C203.

The buried components of the fuel oil system are all at a uniform temperature and not subject to condensation phenomena. The periodic sampling of the fuel oil storage tank bottom will serve a two fold purpose - removing accumulated water and sedimentation, and monitoring any possible corrosion.

A fuel oil filter and strainer is provided on each fuel line to eliminate passage of particles, five (5) microns or larger in size, to the engine injectors.

Diesel oil pipe lines between the storage and day tanks run through culvert pipe sleeves at about six feet below the diesel generator building floor. Diesel oil pipe lines extending under the diesel gneerator building do not receive full protection from the exterior rectifier-anode system because of the electrical shielding effect of the ground grid and foundation reinforcing and structural steel. Since the earth area under the diesel generator building is sheltered and hence relatively much drier than the earth exterior to this building, no additional cathodic protection system is provided or required.

9.5.4.4 Testing and Inspection Requirements

System components are inspected and cleaned prior to installation. Instruments are calibrated during testing and automatic controls are tested for actuation at the proper set points. Alarm functions are checked for operability and limits during plant preoperational testing. Automatic actuation of system components is tested periodically in accordance with Chapter 16, Technical Specifications. The system is operated and tested initially with regard to flow paths, flow capacity, and mechanical operability in accordance with Chapter 14.

9.5.6 STARTING AIR SYSTEM

9.5.6.1 Design Bases

a. Each emergency diesel generator, including the HPCS diesel generator, is provided with separate, independent starting air systems.

b. Each starting air system on diesel generator 1A or 1B has sufficient air receivers to provide for seven diesel generator starts on the primary receivers and seven diesel generator starts on its standby receivers. For additional flexibility in the system, the redundant receivers are interconnected so that either of the two (2) air circuits is capable of starting the diesel engine in the event of a major component failure in one circuit.

c. The piping system associated with the starting air system is designed, fabricated, inspected, and erected in accordance with ANSI B31.1 with all components fabricated from carbon steel (stainless steel piping is provided on the engine). The system is designed to Seismic Category I requirements. The air receivers associated with diesel generators 1A or 1B are designed and constructed in accordance with the requirements of ASME Section VIII. The HPCS diesel generator air receivers were designed and constructed in accordance with the 1971 edition of this code.

9.5.6.2 System Description

The starting air system is shown schematically on Figure 9.5-4.

The starting air systems for diesel generators 1A and 1B consist of one electric motor driven air compressor, one dual drive (i.e., electric motor and diesel engine) air compressor, eight air receivers, and associated piping and controls. For the HPCS diesel generator, only two air receivers are provided and the redundant air compressor is diesel driven only.

The major system components are located external to the diesel generator skid in the diesel generator building. This building is designed to meet Seismic Category I requirements and contains no high or moderate energy piping.

For diesel generators 1A and 1B, two separate 250 psig air cooled compressors discharge through common piping to two banks of four 32 cubic foot air receivers which are connected in parallel. Each bank of air receivers has the capability of a minimum of seven engine starts. Each bank is connected through common piping to the air starting motors of both engines.

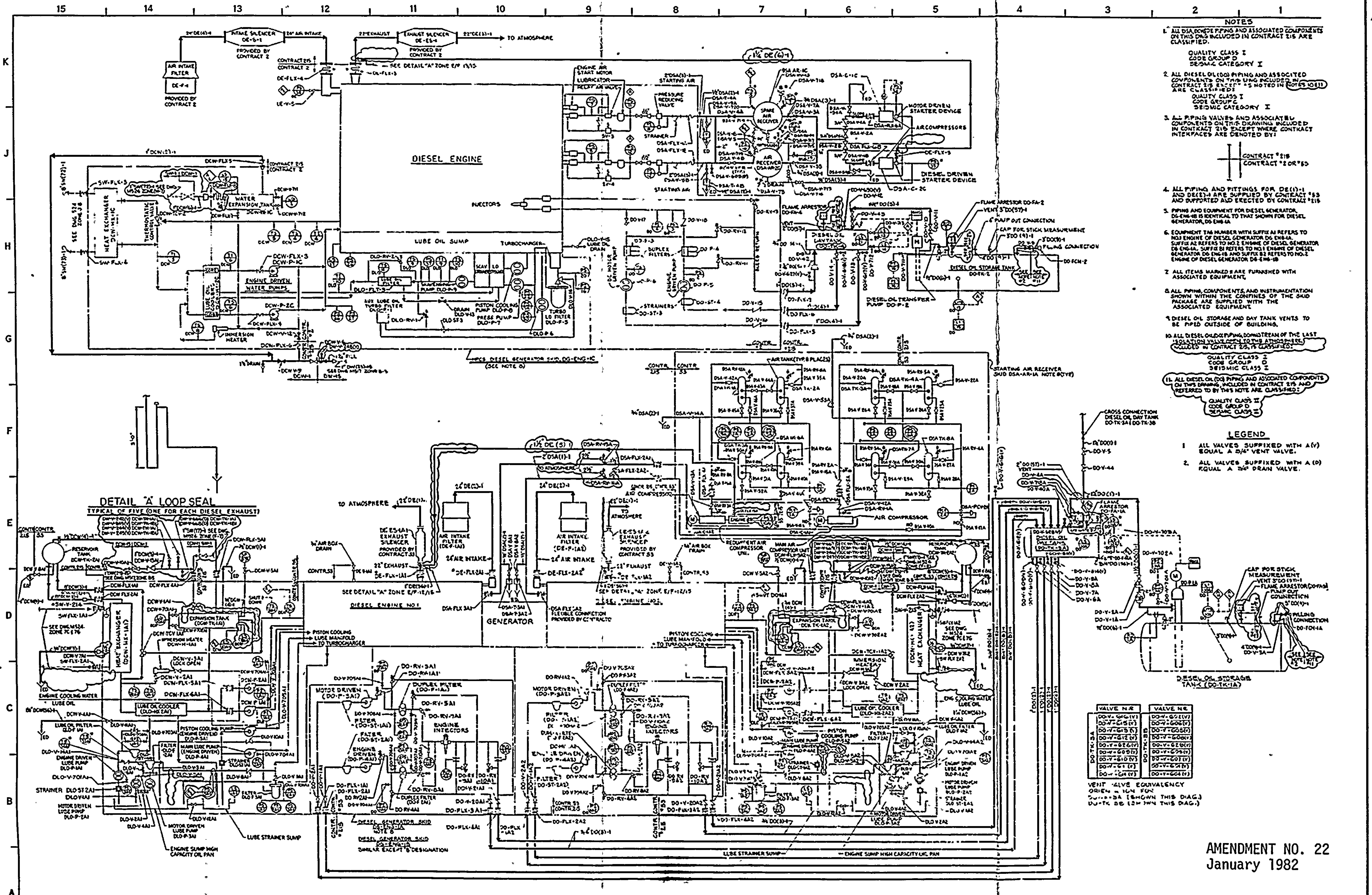
The second bank of air receivers can be valved off and kept in reserve. The flow path is from the air receiver manifold to the engine piping through a pressure control valve, an isolation valve, a strainer, a solenoid valve, an air relay valve, and a lubricator to each air starter motor.

The air start system on each engine consists of four air starter motors. Two motors are installed at each end of the engine. These air starter motors drive a flywheel ring gear which turns the engine. When a start signal is given, an air start solenoid admits air to engage a pair of air start motor pinions to the flywheel ring gear. When the pinions are engaged, air is admitted through an air control valve to a pair of air starter motors. Should the pair of air starter motors fail to engage after three seconds the other pair of starters on the opposite side of the engine automatically will be actuated.

The air starter motors are controlled by electric relays to alternate the right hand and left hand pairs. Each engine cranking time is approximately two seconds, with a free air flow to each air starter of 15 cubic feet per second at 150 psig.

Control switches for the motor driven operation of the air compressors are on the diesel engine control board. These control switches permit on-auto-off operation. A selector switch permits selection of either compressor to function as the primary pressurization compressor.

Pressure switches in either air receiver tank automatically start the selected compressor when the receiver pressure decays to 227 psig. A separate low pressure alarm switch is provided for each bank of air receivers and is set to alarm at 215 psig on a local panel and in the main control room. If the selected compressor fails to operate or cannot hold system pressure (215 psig) the compressor, which is on standby, will start automatically.



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January 1982

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PROJECT NO. 2

DIESEL OIL AND MISC. SYSTEMS

FIGURE 9.5-4

11.3 GASEOUS WASTE MANAGEMENT SYSTEMS

11.3.1 DESIGN BASES

11.3.1.1 Design Objective

The objective of the gaseous waste management system is to process and control the release of gaseous radioactive effluents to the site environs so as to maintain as low as reasonably achievable the exposure of persons in unrestricted areas to radioactive gaseous effluents (Appendix I to 10 CFR 50, May 5, 1975). This is to be accomplished while maintaining occupational exposure as low as reasonably achievable and without limiting plant operation or availability.

11.3.1.2 Design Criteria

The gaseous waste management systems are designed to limit the dose to off-site persons from routine station releases to significantly less than the limits specified in 10 CFR 20 and to operate within the emission rate limits established in the technical specifications.

As a design basis for this system, an annual average noble radiogas source term (based on 30-minute decay) of 100,000 μCi/sec of the "1971 Mixture" as discussed in 11.1 is used. Table 11.3-1 indicates the design basis noble radiogas source terms referenced to 30-minute decay.

The annual average exposure at the site boundary during normal operation and anticipated operational occurrences from gaseous effluents does not exceed the dose objectives of Appendix I to 10 CFR 50. The radiation dose design basis for the treated off-gas is to delay the gas until the required fraction of the radionuclides has decayed and the daughter products are retained by the charcoal and the HEPA filters.

The gaseous radwaste equipment is selected, arranged and shielded to maintain occupational exposure as low as reasonably achievable. The design of the system was accomplished prior to the issuance of Regulatory Guide 8.8. However, the system incorporates substantially the guidance provided in this regulatory guide. The gaseous effluent treatment system is designed to the requirements of General Design Criteria as follows:

General Design Criteria 60

The system has sufficient capacity to reduce the off-gas activity to permissible levels for release during normal operation, including anticipated operational occurrences, and to alleviate any termination of releases or limitation of plant operation due to unfavorable site environmental conditions.

General Design Criteria 64

Continuous monitoring of activity levels in the system upstream of the delay line provides advance notice of any potentially significant increase in releases. Continuous monitoring of the system effluent, with automatic isolation at activity levels corresponding to administrative release limits and annunciation at lower levels, along with continuous monitoring of the reactor building elevated release duct, radwaste building ventilation exhausts and turbine-generator building ventilation exhausts, provide assurance that activity releases to the environment will in all events be maintained within established limits.

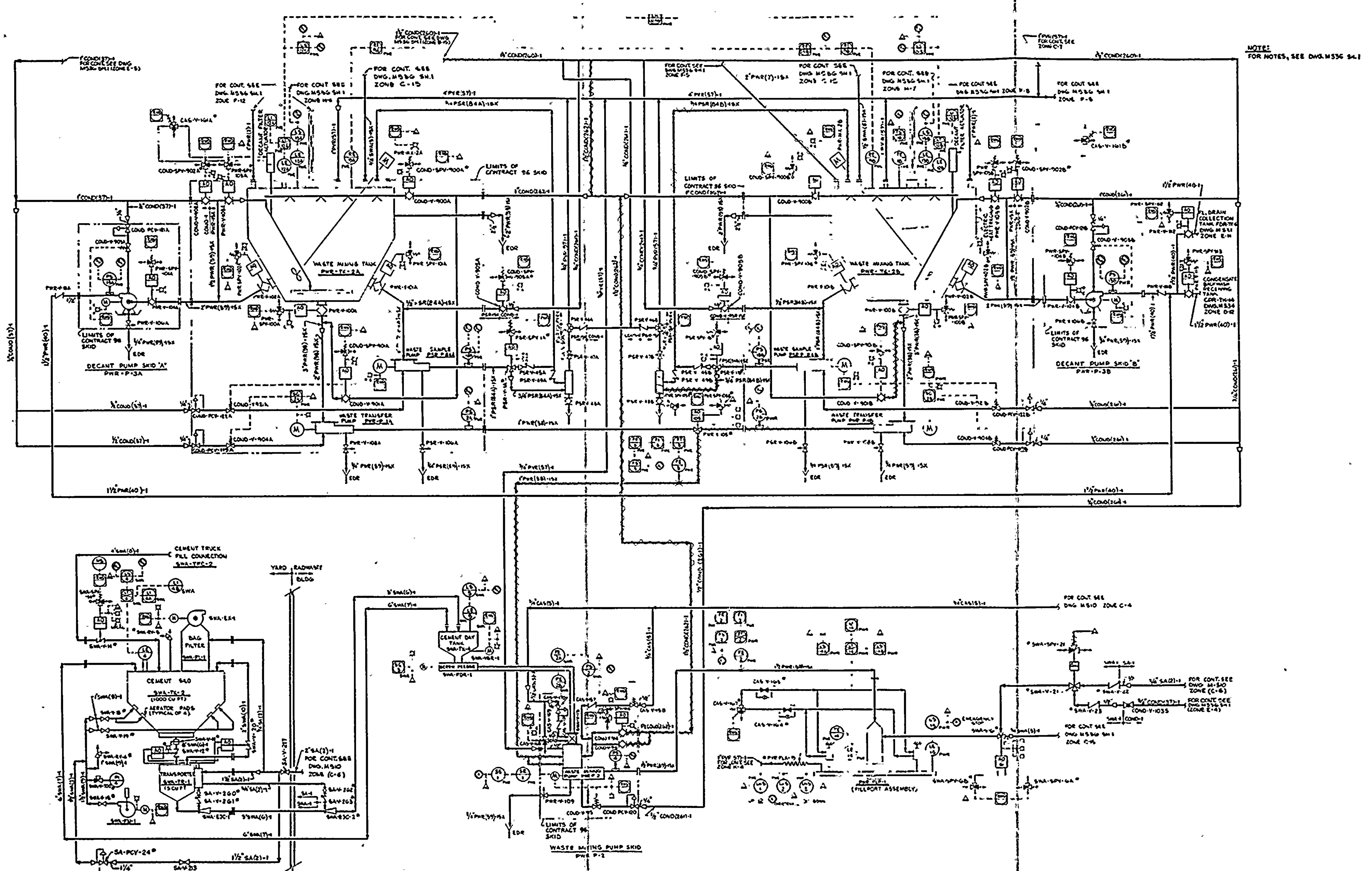
11.3.1.3 Equipment Design Criteria

A list of the off-gas system major equipment items which includes materials, process conditions, and number of units supplied, is provided in Table 11.3-2. Equipment and piping is designed and constructed in accordance with the requirements of the applicable codes as given in Tables 3.2-1 and 3.2-2.

The quality group classifications of the various systems are shown in Table 3.2-1. Seismic category, safety class, quality assurance requirements, and principal construction codes information is contained in 3.2. The system is designed to Quality Group Classification C.

The reactor building, turbine-generator building, and radwaste building contain radioactive gas sources. The design bases and characteristics for the ventilation systems for these three buildings are described in 9.4.

Equipment and components used to collect, process, or store gaseous radioactive waste are not designed as Seismic Category I, with exception of the charcoal adsorber vessel supports. Conservative analyses similar to those presented in Reference 11.3-5 demonstrate that equipment failure will not result in off-site doses exceeding 0.5 Rem. The failure of the off-gas system, the related failure of the steam-jet air ejector lines and the gland sealing system are analyzed in 15.7.1.



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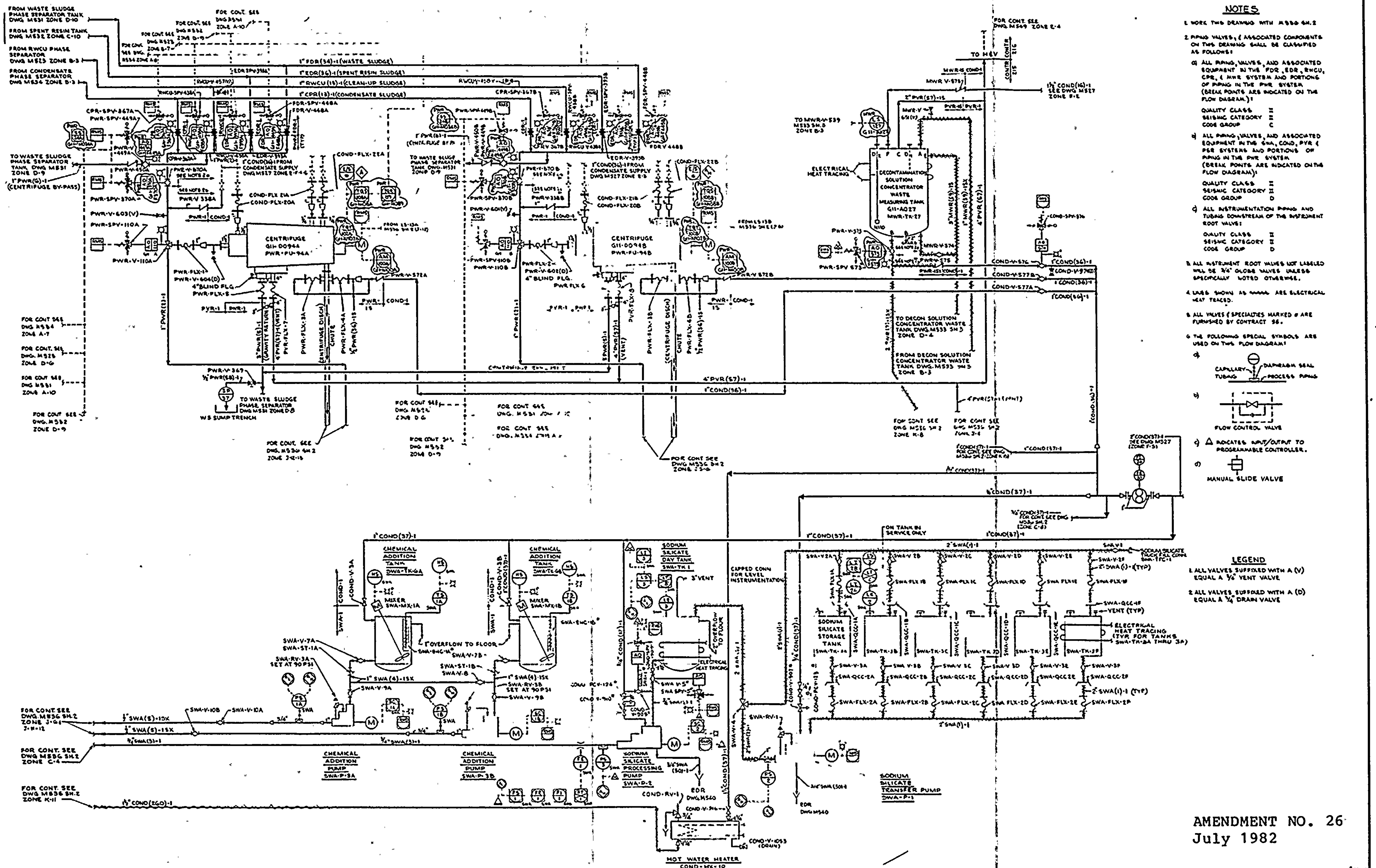
WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PROJECT NO. 2

FLOW DIAGRAM RADIOACTIVE WASTE DISPOSAL SOLIDS HANDLING SYSTEM

FIGURE 11.4-b



AMENDMENT NO. 26
July 1982

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	FLOW DIAGRAM RADIOACTIVE WASTE DISPOSAL SOLIDS HANDLING SYSTEM	FIGURE 11.4-2a

An additional trip signal for high radiation alarm is provided by the recorder and actuates a reactor building vent high radiation control room annunciator. Each radiation monitor visually displays the measured radiation level.

Arrangement details are shown in Figure 11.5-2.

11.5.2.1.3 Control Room Fresh Air Intake Radiation Monitoring System

This monitor system measures the radioactivity in the two remote fresh air intake lines to the main control room. In the event of a release of abnormal gaseous radioactivity from the plant and the transporting of this radioactivity by wind currents to the remote air intakes, this monitoring system provides channel trip signals to initiate protective action by closing valves in the effected fresh air intake line(s). The system consists of two divisionally separated channels. Each channel consists of redundant local detectors (beta scintillation type) and redundant control room indicator-trip units, alarms and a two-pen radiation recorder.

Required 120 VAC supply for Division I and II equipment in both the main control room and remote locations is provided on a divisional basis by the 120/240 VAC critical (Class 1E) instrumentation power system.

Gas samples are withdrawn from sample probes in a continuously flowing section of the fresh air intake pipelines. These samples run in stainless steel tubing to local cabinets located on the 525 foot level of the control building. The divisionally separated local cabinets each have two detectors and preamplifiers, blowers and sample flow control equipment. The beta scintillation detectors are housed in lead shields to minimize the effects of background radiation and enhance response to low level radioactivity. Associated radiation monitors and recorders are mounted in the main control room.

Each radiation monitor has three trip circuits: one upscale for high radiation, one upscale for high-high radiation and air intake (channel) valve closure, and one downscale for instrument inoperative. All alarms annunciate in the main control room.

Arrangement details are shown on Figure 11.5-3.

11.5.2.2 Systems Required for Plant Operation

All systems associated with the plant process cycle provide for indication and recording of radiation levels in the main control room in conjunction with alarm annunciation features.

Information on these systems is presented in Table 11.5-1 and the arrangements are shown in Figures 11.5-2 and 11.5-4 through 11.5-10.

11.5.2.2.1 Gaseous Process and Effluent Radiation Monitoring System

11.5.2.2.1.1 Off-Gas Pretreatment Radiation Monitoring System

This system can monitor radioactivity in the condenser off-gas at the inlet to the secondary air ejector on the steam jet air ejector (SJAE) but normally it monitors at the outlet of the water separator downstream of the catalytic recombiners. The two sampling points are manually switched to assess process operation. The monitor detects the radiation level which is attributable to the fission gases produced in the reactor and transported with steam through the turbine to the condenser.

A continuous sample is extracted from the off-gas pipe via a stainless steel sample line. It is then passed through a sample chamber and a sample panel before being returned to the suction side of the SJAE. The sample chamber is a steel pipe which is internally polished to minimize plateout. It can be purged with room air to check detector response to background radiation by using a three-way solenoid operated valve. The valve is controlled by a switch located in the main control room. The sample panel measures and indicates sample line flow.

The sample chamber is monitored by a gamma-sensitive ionization chamber mounted external to the sample chamber. The channel has a logarithmic radiation monitor which provides a system alarm output and is provided with a recorder.

Power is supplied from the 125 VDC nondivisional bus for the logarithmic radiation monitor, from the 120 VAC instrument bus for the recorder and from a local 120 VAC bus for the sample and vial sampler panels.

The radiation monitor has four trip circuits: two upscale (high-high and high), one downscale (low), and one inoperative.

The trip outputs are used for alarm function only. Each trip is visually displayed on the radiation monitor and actuates a control room annunciator: off-gas high-high, off-gas high, and off-gas downscale/inoperative. High or low sample line flow measured at the sample panel actuates a control room off-gas sample high-low flow annunciator.

The radiation level output by the monitor can be directly correlated to the concentration of the noble gases by using the semiautomatic vial sampler panel to obtain a grab sample. To draw a sample, a serum bottle is inserted into a sample chamber, the sample lines are evacuated and a solenoid-operated sample valve is opened to allow off-gas to enter the bottle.

An additional trip signal for high radiation alarm is provided by the recorder and actuates a reactor building vent high radiation control room annunciator. Each radiation monitor visually displays the measured radiation level.

Arrangement details are shown in Figure 11.5-2.

11.5.2.1.3 Control Room Fresh Air Intake Radiation Monitoring System

This monitor system measures the radioactivity in the two remote fresh air intake lines to the main control room. In the event of a release of abnormal gaseous radioactivity from the plant and the transporting of this radioactivity by wind currents to the remote air intakes, this monitoring system provides channel trip signals to initiate protective action by closing valves in the effected fresh air intake line(s). The system consists of two divisionally separated channels. Each channel consists of redundant local detectors (beta scintillation type) and redundant control room indicator-trip units, alarms and a two-pen radiation recorder.

Required 120 V AC supply for Division 1 and 2 equipment in both the main control room and remote locations is provided on a divisional basis by 120/240 V AC critical (Class 1E instrumentation power system.

Gas samples are withdrawn from sample probes in a continuously flowing section of the fresh air intake pipelines. These samples run in stainless steel tubing to local cabinets located on the 437-foot level of the radwaste building. The divisionally separated local cabinets each have two detectors and pre-amplifiers, blowers and sample flow control equipment. The beta scintillation detectors are housed in lead shields to minimize the effects of background radiation and enhance response to low level radioactivity. Associated radiation monitors and recorders are mounted in the main control room.

Each radiation monitor has three trip circuits: one upscale for high radiation, one upscale for high-high radiation and air intake (channel) valve closure, and one downscale for instrument inoperative. All alarms annunciate in the main control room.

Arrangement details are shown on Figure 11.5-3.

11.5.2.2 Systems Required for Plant Operation

All systems associated with the plant process cycle provide for indication and recording of radiation levels in the main control room in conjunction with alarm annunciation features.

Information on these systems is presented in Table 11.5-1 and the arrangements are shown in Figures 11.5-2 and 11.5-4 through 11.5-10.

The bottle is then removed and the sample is analyzed in the counting room with a multichannel gamma pulse height analyzer to determine the concentration of the various noble gas radionuclides. A correlation between the observed activity and the monitor reading permits calibration of the monitor.

For arrangement details see Figure 11.5-4.

11.5.2.2.1.2 Off-Gas Post-treatment Radiation Monitoring System

This system monitors radioactivity in the off-gas piping downstream of the off-gas system charcoal vessels and upstream of the off-gas system discharge valve. A continuous sample is extracted from the off-gas system piping, passed through the off-gas post-treatment sample panel for monitoring and sampling, and returned to the off-gas system piping. The sample panel has a pair of filters (one for particulate collection and one for halogen collection) in parallel (with respect to flow) with two identical continuous gross radiation detection assemblies. Each gross radiation detection assembly consists of a shielded chamber, a scintillation detector, and a check source. Two radiation monitors in the main control room analyze and visually display the measured gross radiation level.

The sample panel shielded chambers can be purged with room air to check detector response to background radiation by using a three-way solenoid valve operated from the control room. The sample panel measures and indicates sample line flow. A solenoid operated check source for each detection assembly operated from the control room can be used to check operability of the gross radiation channel.

Power is supplied from ±24 VDC buses for the radiation monitors, from a 120 VAC instrument bus for a common two-pen recorder, and from a 120 VAC local bus for the sample panel.

Each radiation monitor has four trip circuits: two upscale (high-high-high, and high), one downscale (low) and one inoperative. Each trip is visually displayed on the radiation monitor. The first three trips actuate corresponding control room annunciators: off-gas post-treatment high-high-high radiation, off-gas post-treatment high radiation, and off-gas post-treatment downscale. The high-high trip circuit on the recorder actuates an off-gas post-treatment high radiation annunciator in the main control room. High or low sample flow measured at the sample panel actuates a control room off-gas vent pipe sample high-low flow annunciator.

A trip auxiliary unit in the control room takes the high-high-high (HHH) and downscale trip outputs and, if its logic is satisfied, initiates closure of the off-gas system discharge and drain valves. The logic is satisfied if two HHH, one HHH and one downscale, or two downscale trips occur. The HHH trip setpoints are determined such that valve closure is initiated prior to exceeding technical specification limits. Any one high upscale trip initiates closure of off-gas system bypass line valve and initiates opening of the treatment line valve.

A visual sampler panel similar to the pretreatment sampler panel is provided for grab sample collection to allow isotopic analysis and gross monitor calibration.

For arrangement details see Figure 11.5-4.

11.5.2.2.1.3 Charcoal Bed Leak Detection Vault Radiation Monitoring System

The charcoal bed vault air handling room is monitored for an increase in the gross gamma radiation level from leakage of radioactive noble gases out of the treatment system. The channel includes a sensor and converter, indicator, trip unit, and a locally-mounted auxiliary unit. The detector is mounted on the outside of the air handling room door to avoid the low temperature inside the room. The insulated door only attenuates 80 keV gamma (Xe-133) by 40 percent. The indicator and trip unit is located in the main control room. The channel provides for sensing and readout, both local and remote, of gamma radiation over a range of six logarithmic decades (1 to 10^6 mR/hr).

The indicator and trip unit has one adjustable upscale trip circuit for alarm and one downcale trip circuit for instrument inoperative which annunciate in the main control room. The trip circuits are capable of convenient operational verification by means of test signals or through the use of portable gamma sources. Power is supplied from the channel A power supply of the reactor building ventilation exhaust plenum RMS.

For arrangement details see Figure 11.5-2.

11.5.2.2.1.4 Mechanical Vacuum Pump Exhaust Radiation Monitoring System

The radiation monitor on the mechanical vaccum pump exhaust is designed to alarm and stop the mechanical vacuum pumps and turbine gland seal condenser exhaust fans in the case of high level of radioactive gases in air being exhausted to the reactor building elevated release duct. The mechanical vacuum pump is operated during plant startups to remove bulk air from the condenser and is secured at the point where the steam jet air ejection suction is available and condenser off-gases are routed through the recombiner charcoal process treatment system. In addition to monitoring discharges via the mechanical vacuum pumps, the turbine gland seal air exhauster system is continuously monitored via this process radiation monitoring system. Clean sealing steam is used on the turbine gland seals to maintain the releases of radionuclides to as low as reasonably achievable limits. The monitor complies with General Design Criterion 64 is Quality Class II and Seismic Category II.

The channel includes a local sensor and auxiliary unit in the main control room, an indicator and trip unit and a recorder. The channel provides for sensing and readout, both local and remote, of gamma radiation over a range of four logarithmic decades (0.01 to 100 mR/hr).

The indicator and trip unit has one adjustable upscale trip circuit for high radiation alarm and to stop the mechanical vacuum pumps, and one adjustable downscale trip circuit for instrument inoperative that annunciate in the main control room.

For arrangement details see Figure 11.5-5.

11.5.2.2.1.5 Reactor Building Elevated Release Duct Radiation Monitoring System

This monitor subsystem measures the radioactivity in the reactor building exhaust prior to its discharge to the environment, and in doing so complies with Regulatory Guide 1.21, Rev. 1 and General Design Criterion 64. This monitor detects radioactivity in the exhaust from gland seal and mechanical vacuum pumps, the treated off-gas system effluent, standby gas treatment and exhaust air from the entire reactor building ventilation. Samples of particulate and iodine activity are accumulated on filters which will be changed and analyzed at least weekly.

A continuous representative sample is extracted from the elevated release duct through an isokinetic probe, passed through a filtered paper to collect particulates and through an impregnated charcoal filter to collect iodine. These filters are analyzed to determine the quantities of the specific radionuclides released. These results, together with the strip chart recording of gaseous activity, provide a permanent record of the activity released to the environment. The sample travels through the gas monitor, a flow indicator and then a sample pump prior to being returned to the exhaust vent.

The gas monitor is mounted in a heavily shielded chamber. Table 11.5-1 lists the sensitivity and range of this detector. In the event that the chamber becomes contaminated, increasing background, it can be disassembled for cleaning or replacement.

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The gas channel consists of the local detector and preamplifier, a radiation analyzer and a recorder in the main control room.

This monitor has no control functions. There are two adjustable trip circuits, one high for high radiation alarm and one low for instrument inoperative that annunciate in the main control room.

Arrangement details are shown in Figure 11.5-5.

11.5.2.2.1.6 Turbine-Generator Building Ventilation Release Duct Radiation Monitoring System

This monitor system measures the radioactivity in the turbine building exhaust prior to its discharge to the environment and in doing so complies with Regulatory Guide 1.21, Rev. 1 and General Design Criterion 64. This monitor detects the fission and activation products from the steam which may leak from the turbine or the other primary components in the building. The gaseous activity in the exhaust is expected to normally be below detectable levels. The particulate and iodine activity is accumulated on filters for a week to obtain sufficient activity to be detectable. These filters are analyzed to determine the quantities of specific radionuclides present and these results together with the gaseous activity strip chart recorder, provide a permanent record of radioactivity released to the environment.

A continuous representative sample is extracted from the exhaust vent through an isokinetic probe, passed through a filter paper to collect particulates and through an impregnated charcoal filter to collect iodine. The sample travels through the gas monitor, a local flow indicator and then a sample pump prior to being returned to the exhaust vent.

The gas monitor is mounted in a heavily shielded chamber. The gas channel consists of the local detector and preamplifier count rate meter and a recorder in the main control room. Arrangement details are shown on Figure 11.5-6.

This monitor has no control functions. There are two adjustable trip circuits, one high for high radiation alarm and one low for instrument inoperative that annunciate in the main control room.

TABLE 11.5-1

PROCESS AND EFFLUENT RADIATION MONITORING SYSTEM (GASEOUS AND AIRBORNE MONITORS)

A. SAFETY RELATED SYSTEMS

Monitor	Detector Location (No. of Channels)	Type	Sensitivity	Range (Scale)	Principle Radio-nuclides Measured	Expected Activity	Upscale Set Points Alarms	Upscale Set Points Trips
Main Steam Line Radiation Monitor	Adjacent to steam lines (4)	γ-Ion Chamber	3×10^{-10} Amp/R/h	$10^{0}-10^{6}$ mR/h (6 dec. log)	Coolant activation gases	Steam line activity defined in Table 11.1-4	Above full power background, below trip	Tech. Spec.
Reactor Building Exhaust Plenum Radiation Monitor	In-line (4)	GM[b]		$10^{-2}-10^{2}$ mR/hr (4 dec. log)		Reactor Bldg. activity defined in Table 11.3-7	Above background, below trip	Tech. Spec.
Control Room Fresh Air Intake	Off-line (4)	β-Scint Part. Filter	10^{-6} μCi/cc	$10^{1}-10^{6}$ cpm (5 dec. log)	Xe-133[a]	Within Monitor Range	Above Background, below trip	Tech. Spec.

B. SYSTEMS REQUIRED FOR PLANT OPERATION

Monitor	Detector Location (No. of Channels)	Type	Sensitivity	Range (Scale)	Principle Radio-nuclides Measured	Expected Activity	Upscale Set Points Alarms	Upscale Set Points Trips
Off-Gas Pretreatment Radiation Monitor	Off-line, adjacent to sample chamber (1)	γ-Ion Chamber	3×10^{-10} Amp/R/h	$10^{0} - 10^{6}$ mR/h (6 dec. log)	Noble gas Fission Products	Off-Gas activity defined in Table 11.3-1	Above back-ground	Not Applic-able
Off-Gas Post Treatment Radia-tion Monitor	Off-line (2)	GM Part. Filter Iodine Filter	250cpm/ pCi/cm^3	$10^{1} - 10^{6}$ cpm (5 dec. log)	Kr-85[(a)]	Off-Gas activity defined in Table 11.3-7	Above back-ground	Tech. Spec.
Charcoal Bed Vault Radiation Monitor	Charcoal bed vault (1)	GM		$10^{0} - 10^{6}$ mR/h (6 dec. log)	Noble gas	Charcoal Bed Inven-tory de-fined in 11.3	Above back-ground	Not Applic-able
Mechanical Vacuum Pump Discharge	In-line (1)	GM		$10^{-2} - 10^{2}$ mR/hr (4 dec. log)	XE-133	Within Monitor Range	Above back-ground	Tech. Spec.
Reactor Bldg. Elevated Dis-charge Radi-ation Monitor	Off-Line (1)	GM Part. Filter Iodine Filter	250cmp/ pCi/cm^3	$10^{1} - 10^{6}$ cpm (5 dec. log)	Kr-85[(a)]	Reactor Bldg. activity defined in Table 11.3-7	Above back-ground	Tech. Spec.

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CHAPTER 12

RADIATION PROTECTION

12.1 ASSURING THAT OCCUPATIONAL RADIATION EXPOSURES ARE AS LOW AS REASONABLY ACHIEVABLE (ALARA)

12.1.1 POLICY CONSIDERATIONS

The Washington Public Power Supply System (WPPSS) Organization is committed to maintaining occupational radiation exposures at the lowest practicable level while performing all activities related to operation of their nuclear power plants. This commitment is reflected by providing for effective control of radiation exposure in the following major areas:

a. Management direction and support

b. Consideration during design of facilities and equipment

c. Development of good radiation practices, including preplanning and the proper use of appropriate equipment by qualified, well trained personnel.

The radiation protection practices are based, when practicable and feasible, on Regulatory Guide(s) 8.8, Revision 3 and 8.10, Revision 1. The Operational Health Physics Program provides for the majority of the recommended actions in both regulatory guides, including:

a. Organization and position descriptions to ensure an adequate ALARA program;

b. Exposure reduction program;

c. Cost benefit analysis program;

d. Exposure tracking program employing the "Radiation Work Permit".

12.1.1.1 Organization

The WPPSS Organization is structured to provide assurance that the ALARA policy is effective in the areas described above. Following is a description of the applicable activities conducted by individuals or groups having responsibility for radiation protection:

a. The Assistant Director of Generation and Technology is the upper management person responsible for ensuring that an effective ALARA policy and program is maintained.

b. The Manager of Health, Safety and Security, through the Manager of Radiological Programs, develops and directs an ALARA Program that reflects management philosophy, meets regulatory requirements and remains effective. Radiological Programs staff support the plant Health Physics Section on ALARA considerations and provide an annual appraisal of plant ALARA performance and practices.

b. Equipment Location

1. Several radiation sources on the 437'-0" level of the Radwaste Building are located with two sources in each cubicle. This arrangement maintains occupational exposures "as low as reasonably achievable" (ALARA) by use of the following alternate ALARA methods:

   The waste collector tank and floor drain collector tank are in the same cubicle. These tanks share redundant pumps and cross tie piping. If abnormal conditions occur and one or both of these tanks becomes a major source of radiation, either one of the pumps can be used to empty the tanks prior to any maintenance.

   The chemical waste tank and distillate tank share the same cubicle. These tanks are not expected to be major sources of radiation. Based on the source terms described in Table 11.2-8, the dose rate at three feet from the surface of these tanks normally does not exceed 0.1 mrem/hr. In addition, redundant pumps and cross tie piping permit the transfer of tank contents should abnormally high radioactivity levels occur.

   Gas coolers and charcoal absorbers share the same cubicle. These items have no moving parts, and are highly reliable with no routine maintenance requirements. In addition, system redundancy and remote isolation capabilities eliminate the need for prompt entry into the cubicle. This permits the noble gases and radioiodines to significantly decay prior to entry.

   Placing the above sources in shared cubicles does not result in increased occupational exposures.

   Area radiation monitors 28 and 29 are located in corridor C-125 to detect abnormal radiological conditions. During reactor and radwaste operations and under the direction of a Radiation Work Permit entry to this area is expected only for non-routine observation and maintenance.

(2) Radioactive pipes are routed so that radiation exposure to plant personnel is minimized. The extent to which radioactive pipes are routed through normally accessible areas is minimized. Shielded pipe chases are utilized in normally accessible areas. Whenever possible, radioactive and non-radioactive pipes are kept separate for maintenance purposes.

(3) Shielded valve stations are used where practical. To further minimize personnel exposure, remotely operated valves are used, where practical. Normally operated manual valves in high radiation areas are provided with extension stems through a shield wall to a low radiation area.

(4) Where practical, pumps are located in shielded areas outside cubicles containing radioactive components.

(5) Where practical, local instrumentation readouts are brought to points outside shielding walls.

(6) To minimize maintenance time and hence exposure, sufficient space is available in shield cubicles housing radioactive equipment (e.g. heat exchangers, demineralizers, etc.) to perform required tasks. Access platforms at intermediate levels are provided to enhance access to portions of equipment inaccessible from the floor.

(7) Where possible, equipment and components which require frequent servicing are designed so that they can be removed, with minimum exposure, to appropriate low radiation areas.

12.3 RADIATION PROTECTION DESIGN FEATURES

12.3.1 FACILITY DESIGN FEATURES

The WNP-2 plant incorporates the design objectives and the design feature guidance given in Regulatory Guide 8.8 to the extent discussed in 12.1.2.1. Examples of these features are discussed in 12.3.1.2.

Figures 12.3-1 to 12.3-15 show the general arrangement for each of the plant buildings. In addition, these figures show the shielding arrangement, radiation zone designations for both normal operation and shutdown conditions, controlled access areas, personnel and equipment decontamination areas, location of the health physics facilities, location of radiation monitors, location of radwaste control panels, location of the counting room and location of the onsite laboratory for analysis of chemical and radiochemical samples. The counting room is located on El.487'-0" of the Radwaste and Control Building. (Refer to Figure 12.3-5, identification number 485.) The design basis radiation level within the counting room is 0.1 mrem/hr during normal operation.

12.3.1.1 Radiation Zone Designations

Five main radiation zones have been defined as a means of classifying the occupancy restriction on various areas within the plant as follows:

a. Zone I - applies to areas that have a maximum design dose rate of 1 mrem/hr. Habitation of such an area, on a 40-hour-per-week, 50-week-per-year basis, results in a whole-body dose of less than 1.25 rem per calendar quarter, the limit specified in 10 CFR 20.101. Plant personnel and authorized visitors are allowed uncontrolled access to these areas.

b. Zone II - is used to indicate the lowest level radiation areas within the plant to which access is controlled. This zone applies to areas that have a design dose rate of between 1.0 and 2.5 mrem/hr. Occupancy on a 40-hour-per-week, 50-week-per-year basis results in a whole-body dose which does not exceed the 1.25 rem per calendar quarter limit for individuals in a restricted area specified in 10 CFR 20.101.

c. Zone III - areas which are designed as Zone III are "radiation areas", as defined in 10 CFR 20.202, in that occupancy for 1 hour could result in a dose in excess of 5 mrem. The design dose rate in Zone III areas does not exceed 15 mrem/hr. All such areas are posted with signs bearing the radiation caution symbol and the words "CAUTION - RADIATION AREA," as prescribed by 10 CFR 20.203.

d. Zone IV - is used to designate radiation areas where the maximum design dose rate does not exceed 100 mrem/hr. These areas are "radiation areas," as defined in 10 CFR 20.202, and are posted with "CAUTION - RADIATION AREA" signs required by 10 CFR 20.203. An area radiation survey of radiation levels is conducted prior to occupancy of Zone IV areas in order to determine the allowed occupancy time.

e. Zone V - areas which are designated as Zone V are "high radiation areas," as defined in 10 CFR 20.202. The design dose rate in Zone V areas exceeds 100 mrem/hr. All such areas are posted with signs bearing the radiation caution symbol and the words "CAUTION - HIGH RADIATION AREA," as described in 10 CFR 20.203.

   Each access point to every Zone V area is secured by locked door or other positive control method. Occupancy of such areas is limited in frequency and duration and entrance must be authorized in advance by the Health Physics Supervisor or his representative.

   An area survey of radiation levels will be conducted prior to first entry of Zone V areas in order to determine the maximum habitation time.

12.3.1.2 Traffic Patterns

Access to the various plant areas is shown on Figures 12.3-16 to 12.3-19. The basic traffic flow for entry into the plant is as follows:

a. After passing through the guard house, all plant personnel enter the service building lobby (see Figure 12.3-16).

b. Clerical personnel, engineers and management personnel use uncontrolled stairs to go to the second floor of the service building.

c. All other personnel go directly from the lobby

f. Access to the turbine generator building, reactor building, radwaste building, diesel generator building is then from the main plant corridor by stairs and/or elevators through positive access controlled doors. Only authorized personnel can gain access to a particular building.

12.3.1.3 Radiation Protection Design Features

Section 12.1.2 discusses the design objectives for the WNP-2 plant. Examples showing the incorporation of these objectives are provided below. The layout of the plant, including major equipment locations and radiation zone designations are shown on Figure 12.3-26 through 12.3-39.

12.3.1.3.1 Facility Design Features

Filters and Demineralizers - Liquid radioactive waste and other process streams containing radioactive contaminants are processed through filters and demineralizers. The pressure-precoat type of filter is used in the major fluid processing systems. Cartridge type filters are used in a few select instances such as in the CRD system. In the case of demineralizers, either the pressure-precoat or deep bed type of demineralizer is employed. The location and the arrangement of the filters and demineralizers are shown on Figures 12.3-32, 12.3-33, 12.3-34 and 12.3-35.

Each filter and demineralizer is located in a shielded cubicle on El. 487'-0" of the radwaste and control building. These filters and demineralizers are accessible through the ceiling of the cubicle by removing the shielding plug at El. 507'-0". This minimizes the radiation exposure to plant personnel from adjacent sources. After removal of the shielding plug, the filter or demineralizer can be serviced remotely by use of special tools designed for this purpose. If it is necessary, the filter or demineralizer can be removed from the cubicle to a work area for servicing. There are overhead cranes provided for the purpose of shielding plug and filter or demineralizer vessel removal.

Each pressure precoat type filter or demineralizer has its own support equipment such as a holding pump, process control valves and precoating equipment. The holding pump and process control valves associated with each filter or demineralizer is located in the valve gallery. This valve gallery is located on the east side of the radwaste-control building, El. 467'-0", and is a Zone IV radiation area (Figure 12.3-2). The holding pump and motor operated valves can be operated from control panels located in Zone II or III radiation areas. Manually operated process control valves are operated by use of reach rods that pass through the shielding walls into the corridor. This corridor is a Zone III radiation area. With the exception of instrument root valves, all pumps and valves can be remotely operated. Instrument root valves are normally opened and are not used during normal plant operation. The filter or demineralizer precoat equipment and associated controls, which includes metering equipment, are located in a Zone II radiation area to provide for maintenance access. Each filter or demineralizer may be backwashed with condensate water, chemically cleaned or purged with air from a remote control panel. Each deep bed demineralizer has its own support equipment. A gravity feed subsystem transfers the fresh resins from the resin addition tank to the demineralizers. The spent resins are transferred hydro-pneumatically to the spent resin tank.

All piping routed to and from filter or demineralizer cubicles are located in the valve gallery area or in shielded pipe tunnels. The pipes are routed to avoid unnecessary bends, thus minimizing possible crud buildup.

Specific examples of filters or demineralizers that incorporate the aforementioned design features are the waste collector filter and waste collector demineralizer. A typical layout is shown in Figure 12.3-21.

Tanks - All tanks which contain radioactive liquids and solids are categorized into different groups depending on their level of radioactivity. Tanks that contain significant level of radioactivity are located on El. 437'-0" of the radwaste and control building.

The tanks that contain radioactive backwash and resins are located in shielded cubicles. These include the condensate phase separator tanks, condensate backwash receiving tank, spent resin tank, waste sludge phase separator tank and the RWCU phase separator tanks. These tanks are

e. Leak tests - sources are checked for leakage or loss of material at least semi-annually.

f. Disposal - all licensed material disposals are in accordance with 10 CFR Part 20 requirements, or by transfer to an authorized recipient as provided in 10 CFR Parts 30, 40 or 70.

12.3.1.4.2 Facilities and Equipment

Facilities are provided for handling unsealed sources, such as the liquid standard solutions used for calibration of plant instrumentation. The radiochemical laboratory is equipped with a negative pressure fume hood with filtered exhaust. The hood work surface is designed to withstand heavy weights, so that shielding can be provided in the form of lead brick. Drains from the fume hood are routed to the liquid radwaste system.

Remote handling tools are used as needed for movement of the high level sealed sources from their normal storage containers. Shielding to reduce personnel exposure is provided for these sources when they are not in use and to the extent practicable while they are in use.

Portable radiation and contamination monitoring instrumentation is provided, as described in 12.5.2, for surveillance to maintain control of the sources.

12.3.1.4.3 Personnel and Procedures

The WNP-2 Health Physics/Chemistry Supervisor, Health Physics Supervisor, and the Plant Chemistry Supervisor are responsible for control and monitoring of sealed and unselaed source and byproduct materials. The WNP-2 Nuclear Engineer is accountable for special nuclear materials (SNM). Monitoring during handling of these materials is provided by the health physics group. Experience and qualifications of health physics personnel are described in Chapter 13.

Radiation safety procedures and instructions to personnel involved in handling byproduct materials are included in the WPPSS Health Physics Programs and Procedures Manual.

The generic Emergency Plan and the plant Emergency Plan Implementing Procedures provide instructions for:

a. designated evacuation routes;

b. assembly area(s);

c. procedures;

d. drills;

in accordance with ANS 8.3-1979.

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12.3.1.4.4 Required Materials

Any byproduct, source or special nuclear materials in the form of reactor fuel, sealed neutrol sources for reactor startup, sealed sources for reactor instrument and radiation monitoring equipment calibration, or as fission detectors, will be limited to the amounts required for reactor operation or specific calibration purposes.

12.3.2 SHIELDING

12.3.2.1 General

The radiation shielding design is in compliance with all NRC regulations concerning permissible radiation doses to individuals in restricted and non-restricted areas. The guidance provided in Regulatory Guide 1.69 on concrete radiation shields is followed to the extent discussed in Appendix C. The guidance provided in Regulatory Guide 8.8 on radiation protection is followed to the extent discussed in 12.1.2.1. The plant design and layout optimizes personnel and/or equipment protection. Shielding is supplemented with whatever administrative control procedures are necessary to ensure regulatory compliance. These control procedures include area access restrictions, occupancy limitations, personnel monitoring requirements, and radiation survey practices. Other criteria and considerations are listed in 12.1.2.

The shielding design is evaluated under the following conditions of plant operation:

a. Operation at design power, including anticipated operational occurrences.

b. Shutdown conditions, with radiation from the subcritical reactor core, spent fuel assemblies and other sources discussed in 12.2.

c. Post-accident conditions, including those accident occurrences analyzed in Chapter 15. Emphasis is placed on control room habitability.

The majority of the shielding calculations performed are of the "bulk shielding" type. Ordinary concrete, having a density of about 150 lbs/ft^3, is used for shielding except for special applications. In special applications, water, steel, high density concrete, lead and permali JN P/3% boron are used.

The effects of mechanical or electrical penetrations in shield walls on radiation exposure to personnel is minimized by locating penetrations to preclude direct view of radiation sources through the penetration. The effect of penetrations in shield walls is also minimized by keeping penetration openigs to the smallest practicable size. Penetrations are locatd away from immediate areas with personnel access. When these criteria cannot be implemented, penetrations are off-set.

Access into shielded areas is, in general, by labyrinths. Labyrinths are located to preclude direct personnel radiation exposure. Where labyrinths are not practicable, shield doors are used. Knock-out walls for equipment removal are constructed of brick arranged in staggered rows to preclude direct streaming.

Portable and removable shielding devices are used when practical and feasible. Portable shielding devices are easily moved from one location to another. Removable shielding devices are normally used at specific locations and can be removed when necessary. The reactor vessel to fuel pool transfer passage is a location where removable shielding is employed primarily for the protection of personnel working in the drywell.

12.3.2.2 Methods of Shielding Calculations

Standard methods are used in computing the required shielding thickness for a given source. These methods are described in References 12.3-1 through 12.3-4. Specific methods of calculation and the computer codes used in the shielding design are discussed below.

The NRN computer code (Reference 12.3-5) is used to determine the shielding requirements for the core generated neutrons and to calculate the thermal neutron flux used to determine captured gamma sources outside the core. This code is based on a multi-group slowing down and diffusion system corrected by a multi-group first flight or removal neutron source. The neutron cross sections used with this code are from Oak Ridge National Laboratories with modifications which have resulted from comparisons with data in BNL-325 (Reference 12.3-6) and the ENDF/B data libraries.

The QAD-BR computer code, which is based on the QAD-P5 code (Reference 12.3-8) is the basic code used to determine shielding requirements for gamma ray sources. This code provides gamma flux, dose rate, energy deposition and other quantities which result from a point by point representation of a volume distributed source of radiation. Attenuation coefficients for water, iron and lead, used in this program are taken from the Engineering Compendium for Radiation Shielding (Reference 12.3-1). Concrete attenuation coefficients are taken from ANL-6443 (Reference 12.3-9).

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Any shielding requirements which are not determined with the QAD code were determined by using the methods discussed in the Reactor Shielding Design Manual[2]. The various sources are reduced to their basic geometric configuration (line, disc, cylinder, sphere, etc.) and the corresponding equations are solved to find the dose. The Taylor exponential form of the buildup factor is used in these equations. All required data is taken from Reference 1.

The criteria for penetration acceptability is based on the radiation zone levels in the areas separated by the wall where the penetration is located. The penetration is analyzed if the radiation zone changes by greater than one level (i.e., from Zone V to Zone III) in passing from one area to another. This analysis considers both the scattered as well as the direct radiation. The direct component is calculated using the point source attenuation equation, as described in the Reactor Shielding Design Manual [2]. The scattered component is calculated using the Chilton-Huddleston equations [10]. Compensatory shielding (e.g., labyrinths, steel plate, lead wool) is used as needed, to reduce radiation streaming through penetrations and to protect against localized "hot spots".

The general dose rate in each plant area, including contributions from radiation streaming, satisfies the design dose rate specified for that area.

Entrances to shielding cubicles are designed to prevent source radiation from passing directly through the opening. Whenever possible, a labyrinthine entrance is designed to reduce the emerging radiation to a level compatible with the access requirements outside the cubicle. The scattered and direct components of the emerging radiation are calculated by the above methods.

12.3.2.3 Shielding Description

12.3.2.3.1 General

The description of the shielding throughout the entire plant is summarized on the shielding drawings shown in Figures 12.3-7 to 12.3-10. These drawings show the shield wall and floor thicknesses and are to be used in conjunction with the radiation zone maps, Figures 12.3-1 to 12.3-6, to locate the process equipment which is shielded and to determine the design dose rate.

12.3.2.3.2 Reactor Building

The sacrificial shield is an ordinary concrete structure two feet thick, lined on the inside and outside by steel plates of a minimum thickness of 0.5 inches each. The sacrificial wall extends between elevations 519'-2 1/4" and 567'-4 1/2".

The biological shield wall protects station personnel in the reactor building from primary and secondary radiation emanating from the reactor vessel. The dose rate at the outer face of the biological shield as well as above the shield plug (above the reactor vessel) is, in general, less than 2.5 mrem/hr during normal operation. The reactor core is the primary source of radiation, and it is used in computing the above dose rate. The wall is in the shape of a shell of the frustrum of a cone, and its composition is ordinary concrete at least 5 feet thick. Inside the biological wall exists the primary containment vessel which has the same shape as the wall. The primary containment vessel is made of 3/4" minimum steel plate. The core, N-16 contained in the recirculation system, the main steamlines and the water in the vessel below the core constitute the major sources of radiation used to determine the radial dose rate. The shielding arrangement for the other major sources in the reactor building is shown on Figures 12.3-1 to 12.3-10.

12.3.2.3.3 Turbine Building

The turbines (201), moisture separator reheaters (270) and the feedwater heater system (252, 253) are located in the turbine access areas at El. 501'-0", and El. 471'-0". These areas are surrounded by ordinary concrete walls at least 3-1/2 feet thick. The dose rate to the areas outside these walls is less than 2.5 mrem/hr.

The walls which surround the turbine-generator access area at El. 501'-0", extend up to El. 524'-0". This minimizes the effects of direct radiation streaming at the site boundary.

The shielding arrangement for the major sources of radiation in the turbine building, including those discussed above, are shown in Figures 12.3-1 to 12.3-10.

12.3.2.3.4 Radwaste Building

The shielding arrangement for the major sources in the radwaste building are shown in Figures 12.3-1 to 12.3-10.

12.3.3 VENTILATION

The plant ventilation systems for the different areas of the plant are designed to meet the requirements of 10 CFR Parts 20 and 50. Gaseous wastes will be released in a controlled manner to environs such that during plant operation, on-site and off-site radioactivity levels are as low as reasonably achievable. The design features which limit and reduce the airborne radioactivity are as follows:

a. In the reactor, radwaste and turbine generator buildings, the air flow is from areas of low radioactivity potential to areas of higher radioactivity potential. This serves to isolate and segregate airborne radioactivity which may be released due to equipment failure or malfunction, and leakage from fluid systems.

b. To prevent radioactivity buildup, all ventilation air is supplied to the reactor, turbine and radwaste building on a once through basis.

c. All cubicles housing equipment which handles radioactively contaminated material are ventilated at a minimum rate of three volume air changes per hour.

d. All sinks and chemical laboratory work areas where radioactive samples or materials are handled are provided with exhaust hoods to protect operating personnel from airborne contaminants.

e. All liquid equipment leaks which are potential sources of airborne radioactivity in the reactor building are collected in the reactor building equipment drain system. The drain system is maintained at a negative pressure with respect to the balance of the building to protect operating personnel from airborne leakage generated in the system sumps. All exhaust air drawn from the reactor building equipment drain system is filtered by absolute particulate and charcoal filters. The particulate and charcoal filters minimize the release of contaminated particulates and iodine.

Figure 12.3-25 (el. 572'-0") shows the layout of the standby gas treatment system filter units. The concrete wall between the units serves as both a fire wall and missile barrier between the two filter trains. Access doors, 20" x 50", are provided into each plenum section between unit elements. Ample aisle space is provided outside the units for ease of access for personnel to perform tests and maintenance. Charcoal test cannisters are provided as shown in Figure 12.3-25. There are 12 test cannisters per four inch deep filter bed. DOP and freon injection and detection ports are provided as shown.

12.3.4 IN-PLANT AREA RADIATION AND AIRBORNE RADIOACTIVITY MONITORING INSTRUMENTATION

12.3.4.1 Criteria for Necessity and Location

The objective of the in-plant area radiation and airborne radioactivity monitoring systems are:

a. To warn of excessive gamma radiation levels in areas where nuclear fuel is stored or handled.

b. To provide operating personnel with a record and indication in the main control room of gamma radiation levels at selected locations within the various plant buildings.

c. To provide information to the main control room so that decision may be made with respect to deployment of personnel in the event of a radiation accident or equipment failure.

d. To assist in the detection of unauthorized or inadvertent movement of radioactive material within the various plant buildings.

e. To provide local alarms at selected locations where a substantial change in radiation levels might be of immediate importance to personnel frequenting the area.

f. To monitor the atmosphere in areas having a high potential for increase gamma radiation levels where personnel may be required to work.

g. To supplement other systems including process radiation leak detection or building release detection in detecting abnormal migrations of radioactive materials from process streams.

h. To monitor the general conditions in the reactor building following an accident.

i. To furnish information for making radiation surveys.

Except for the three high range (10-107 mR/hr) monitors in the reactor building, no credit is taken for the operability of the in-plant area radiation and airborne radioactivity monitors in the event of an accident. However, the probability is high that many or all of the thirteen (13) area monitors in the reactor building will be operable. These monitors have ten local sensors in separate physical locations within the reactor building. The wiring from the local sensors is run to the main control room in cable runs that have Seismically I qualified supports. The electrical supply for the area monitor indicatoralarms in the main control room are powered from a critical 120 V AC supply. Only the local audible alarms are powered from a local AC supply and its loss would not impact control room readings. In the event of a LOCA creating high humidity conditions, the sensors would not be impacted for they are designed to maintain operability and accuracy to 100 percent RH. The Geiger-Mueller sensor will maintain overall accuracy to 70°C.

12.3.4.2 Description and Location

a. Area Radiation Monitors

Area radiation monitors consist of local detector alarm units and main control room mounted indicator trip units, alarms and recorders. Redundant criticality monitors are located in the reactor building new fuel storage pit as recommended by Regulatory Guide 8.12. Other detector locations have been selected in accordance with good operating practice and from past operating experience with similar plants. Detector locations are shown in Figures 12.3-26 to 12.3-39. Annunciations are given in the main control room and locally at the sensors when radiation levels exceed a predetermined level. Point indication and recording are provided for in the main control room. Local detectors are wall-mounted approximately seven feet off the floor. The detectors have sufficient cable length to be taken from their normal positions to floor level for insertion into calibrating chambers to verify instrument accuracy. Portable monitors are normally carried by personnel working in areas where area radiation monitors have not been installed. These are areas that are accessed very little.

The location and ranges of the 34 area radiation monitors are given in Table 12.3-1.

b. Airborne Radiation Monitors

Airborne radioactivity monitoring for plant personnel protection and surveillance utilizes: fixed location, continuous particulate monitors which include continuous iodine samplers; portable continuous particulate monitors with continuous iodine samplers positioned at specific work sites; and particulate and iodine grab samples taken before and during specific jobs.

Movable local alarming continuous air monitors are placed at predetermined plant locations for personnel protection and to substantiate the quality of the plant breathing atmosphere. The monitors have local readouts (charts) and have radioiodine sampling capabilities.

The installed continuous particulate monitoring system was designed for responsive personnel protection and plant surveillance. The four installed particulate monitors measure the airborne particulate activity levels in the radwaste, reactor, and turbine building ventilation exhaust, and furnish alarm and recording signals to the main control room. These units draw above five (5) cfm air sample through the particulate filter which is monitored by a shielded beta detector with an efficiency of approximately 30%. The resultant response of the system is an increase of about 600 cpm for one hour of sampling at a 1×10^{-10} μCi/cc concentration. External gamma radiation will increase the background by 70 cpm/mR/hr.

The actual ability of a ventilation exhaust monitoring system to detect the airborne particulate concentration in a specific space is dependent upon the following factors:

1. Flow rate ratio (flow of air from a specific confined space/flow rate of bulk ventilation system exhaust);

2. Particulate activity and its half-life of the bulk ventilation system exhaust air;

3. Radionuclide composition in the specific confined space;

4. The energy of the beta radiation from the radionuclide composition.

Normal plant conditions are expected to yield a bulk ventilation exhaust air concentration (primarily short-lived fission product daughters and natural activity half-life about 20 min.) of 1 - 3 x 10^{-10} μCi/cc. This will reach an equilibrium on the sample filter of about 1000 cpm. The MPC_a for normal plant airborne contamination is expected to be greater than 6 x 10^{-8} μCi/cc. At this MCP_a concentration a one-hour accumulation (one MPC_a - hour) will equal 3.3 x 10^5 cpm. Consider a dilution factor of 250:1, the one-hour accumulation will equal 1300 cpm. This is a worst case dilution that considers the reactor building CRD room at 400 cfm in the 97,000 cfm building bulk exhaust flow. Therefore, the ventilation monitoring system will easily detect 10 MPC_a - hours on all locations.

12.3.4.3 Specification for Area Radiation Monitors

The areas radiation-monitoring system is shown as a function block diagram in Figure 12.3-20. Each channel consists of a combined sensor and a converter unit, a combined indicator and trip unit, a shared power supply, and a shared multipoint recorder. All channels also have a local audible alarm auxiliary unit mounted near the sensor.

Each monitor has an upscale trip that indicates high radiation and a downscale trip that indicates instrument trouble. These trips sound alarms but cause no control action. The trip circuits are set so that a loss of power initiates an alarm.

The type of detector used is a Geiger-Mueller tube responsive to gross gamma radiation over an energy range of 80 KeV to 7 MeV. Detector ranges are given in Table 12.-1.

The overall accuracy within the manufacturer's design range of temperature, humidity, line voltage, and line frequency variation is such that the actual reading relative to the true reading, including susceptability and energy dependence (100 KeV to 3 MeV) is within 9.5% of equivalent linear full scale recorder output for any decade.

The calibrating frequency is once every 18 months and assures that drift does not exceed $\pm$ 0.2% of equivalent linear full scale recorder output for a 24-hour period of a $\pm$ 2% for a 30-day period.

Facilities for calibrating area radiation monitor units are provided for by means of a test fixture designed for use in the adjustment procedure for the area radiation monitor sensor and converter unit. It provides several gamma radiation levels between 10 and 250 mR/hr. The calibration unit source is cobalt-60. A cavity in the test fixture receives the monitoring sensor. A window is located on the back wall of the cylindrical lower half of the cavity through which radiation emanates from the source to the sensor. A chart on each test fixture indicates the radiation levels available from the unit for the various control settings. For checking at higher radiation levels, a source of sufficient strength and energy levels is provided in a shielded test fixture.

An internal trip test circuit, which is adjustable over the full range of the trip circuit, is provided. The test signal is fed into the indicator and trip-unit input so that a meter reading is provided in addition to a real trip. All trip circuits for high level and criticality monitors are of the latching type and must be manually reset at the front of the control room panel. The trip circuits for all other ARMs are of the non-latching type. Testing of the system circuits will be possible from the control room.

12.3.4.4 Specification for Airborne Radiation Monitors

The airborne particulate monitors contains a β scintillation detector, a count ratemeter and a local radiation recorder. Means for remote recording and alarm annunciation is provided for in the main control room. Sample collectors consist of shielded, stationary filter-type air collector. The calibration frequency will occur at least annually and after major maintenance. Instrument response checks will be made at least monthly. Monitors will be calibrated using standard radioactive sources in the samme geometry as the location of the particulate filter or by collection and analysis of mixtures present at known air flow rates. Particulate monitors are provided in the reactor, turbine and radwaste buildings. The monitors are located so as to monitor the exhaust air from that building prior to any filtration. In addition, charcoal sampling cartridges will be installed in each monitor for laboratory analysis of iodine.

TABLE 12.3-1 (Continued) Page 2 of 3

Station Number	Location And Title	Range
12	Reactor Building RCIC Pump Room	$1-10^4$mR/hr
13	Reactor Building HPCS Pump Room	$1-10^4$mR/hr
14	Reactor Building 471 Level	$10^{-2}-10^4$R/hr
15	Reactor Building 501 Level	$10^{-2}-10^4$R/hr
16	Reactor Building 606 Level	$10^{-2}-10^4$R/hr
17	Turbine Building Turbine Front Standard	$1-10^4$mR/hr
18	Turbine Building Entrance	$1-10^4$mR/hr
19	Turbine Building Reactor Feed Pump Area 1A	$1-10^4$mR/hr
20	Turbine Building Reactor Feed Pump Area 1B	$1-10^4$mR/hr
21	Turbine Building Condensate Pump Area	$1-10^4$mR/hr
22	Main Control Room	$1-10^4$mR/hr
23	Radwaste Building Valve Room E	$1-10^4$mR/hr

TABLE 12.3-1(Continued) Page 3 of 3

Station Number	Location And Title	Range
24	Radwaste Building Valve Room W	1-10^4mR/hr
25	Radwaste Building Sample Area	1-10^4mR/hr
26	Radwaste Building North CRD Pump Area	1-10^4mR/hr
27	Reactor Building North 478' Level	1-10^4mR/hr
28	Radwaste Building Hot Machine Shop	1-10^4mR/hr
29	Radwaste Building Contaminated Tool Room	1-10^4mR/hr
30	Radwaste Building Waste Surge Tank Area	1-10^4mR/hr
31	Radwaste Building Tank Corridor Area North	1-10^4mR/hr
32	Radwaste Building Tank Corridor Area South	1-10^4mR/hr
33	Radwaste Building Radwaste Control Room	1-10^4mR/hr

Note: Alarm settings for all of the above monitors will be selected to provide indication of any abnormal increase in radiation levels while minimizing false alarms.

REACTOR BLDG.

1. REACTOR
2. REACTOR PRESSURE VESSEL PEDESTAL
3. VENT PIPE
4. LPCS PUMP LPCS-P-1
5. HPCS PUMP HPCS-P-1
6. LPCS WATER LEG PUMP LPCS-P-2
7. HPCS WATER LEG PUMP HPCS-P-3
8. RHR PUMP
9. RHR WATER LEG PUMP RHR-P-3
10. RCIC PUMP RCIC-P-1
11. RCIC WATER LEG PUMP RCIC-P-3
12. VACUUM TANK RCIC-TK-1
13. CONDENSER PUMP RCIC-P-4
14. VACUUM PUMP RCIC-P-2
15. RCIC BAROMETRIC CONDENSER RCIC-HX-1
16. REACTOR BLDG AUX COND SPLY PUMP COND-P-3
17. RADWASTE BLDG AUX COND SPLY PUMP COND-P-4
18. CONDENSATE F/D BACKWASH PUMP COND-P-5
19. REACTOR BLDG EQUIP DRAIN HEAT EXCH EDR-HX-2
20. PUMP SUCTION FILTER CRD-FU-10
21. CONTROL ROD DRIVE PUMP CRD-P-1A & 1B
22. AIR TIGHT/WATERTIGHT HATCH'1
23. SUPPRESSION POOL CLEAN UP PUMP FPC-P-3
24. VACUUM BREAKER VALVE
25. EQUIP DRAIN SUMP
26. FLOOR DRAIN SUMP
27. CONTROL INSTRUMENT AIR TANK CIA-TK-1
28. MOTOR CONTROL CENTER
29. INSTR.RACK & STANDBY LIQUID CONTROL PANEL
30. VAPORIZER CN-VZ-1
31. WALL HUNG TRAVELING JIB CRANE MTCRAIS
32. INDEX MECHANISM
33. RECIRCULATING PUMP P-1A & -B
34. PERSONNEL LOCK
35. CRD REMOVAL HATCH
36. CRD REPAIR ROOM
37. PORTABLE BENCH & STORAGE RACK
38. DECONTAMINATION AREA
39. AIR COMPRESSOR
40. MAIN STEAM TUNNEL
41. VALVE PURGE ASSEMBLY
42. DRIVE MECHANISM
43. PRE AMP CABINET
44. CRD TEMP RECORDER PANEL
45. MOTOR CONTROL CENTER ROOM DIV'2
46. CRD MODULE CR-DOO1
47. RWCU PUMP ROOM
48. MASTER CONTROL AREA - PIPING
49. SACRIFICIAL SHIELD WALL
50. RBCC WATER PUMP P-1A,-1B & -1C
51. RBCC WATER HEAT EXCHANGERS HX 1A,1B & 1C
52. RBCC WATER CHEM METERING PUMP
53. RBCC WATER CHEM ADDITION TANK
54. RHR HEAT EXCHANGER HX 1A & 1B
55. FUEL POOL CIRC PUMP P-1A & -1B
56. FUEL POOL HEAT EXCHANGER HX-1A & -1B
57. RWCU SAMPLING & ANALYZER ROOM 1A & 1B
58. STAND-BY LIQUID CONTROL STORAGE TANK
59. STAND-BY LIQUID CONTROL TEST TANK
60. STAND-BY LIQUID CONTROL PUMPS
61. REGENERATIVE HEAT EXCHANGER
62. NON REGENERATIVE HEAT EXCHANGER
63. REACTOR WELL
64. SKIMMER SURGE TANK
65. AIR LOCK
66. STEAM DRYER
67. SHROUD HEAT & STM SEPARATOR
68. CASK
69. FUEL PREP MACHINE
70. FUEL POOL STORAGE VALVE BOX
71. NEW FUEL INSPECTION STAND BASEPLATE
72. CHANNEL HANDLING CRANE BOOM
73. JIB CRANE MOUNTING BASE
74. UPPER & LOWER SHIELD PLUG LAYDOWN
75. RPV HEAD INSULATION
76. FLUX MONITOR SHIPPING CRATE
77. NEW FUEL STORAGE VAULT
78. NEW FUEL INSPECTION STAND
79. DRYWELL HEAD LAYDOWN
80. HEAD STUD RACK
81. HEAD NUT WASHER RACK
82. UPPER POOL PLUG LAYDOWN
83. LOWER POOL PLUG LAYDOWN
84. RPV HEAD LAYDOWN
85. CASK WASHDOWN AREA
86. REFUELING PLATF. ELECT BOX
87. SKIMMER SURGE TANK VALVE BOX
88. SLOT PLUG
89. STUD TENSIONER SPREADER
90. FUEL STORAGE POOL
91. RBCC WATER SURGE TANK RBCC-TK-1
92. STANDBY GAS FILTER UNIT
93. DAMPER(AIR OPERATORS)
94. HYDROGEN RECOMBINER CAC-HR-1A & -1B
95. RETURN AIR PLENUM
96. FILTER UNIT FU-2A & B
97. FLOOR DRAIN RADIOACTIVE
98. EQUIP DRAIN RADIOACTIVE
99. RAILROAD LOCK FAN COIL RRA-AH-7
100. FAN COIL UNIT
101. SUPPRESSION POOL ACCESS
102. T.I.P. ROOM
103. CRD TRANSFER CART
104. LOWER LEVEL RECIRC FAN
105. UPPER LEVEL RECIRC FAN
106. RETURN AIR FAN
107. H&V UNIT
108. AC UNIT
109. RELEASE STACK OPENING
110. GAMMA SCAN COLLIMATOR PORT
111. BRIDGE CRANE
112. DRYER & SEPARATOR STORAGE POOL
113. POTABLE WATER COLD PUMPS PWC-P-4A & B
114. SAMPLE RACK SR-6
115. FUME HOOD SR-7
116. PARTICULATES, I_2 NOBLE GAS ANALYZERS
117. H_2-O_2 ANALYZERS SR-16 & SR 15
118. ELECTRONICS ROOM
119. GAS MONITOR RACK
120. AIR WASH CIRC PUMPS RCA P1A & -1B
121. FAN REA-FN-2B & REA-FN-15
122. EXHAUST AIR FAN REA-FN-1A & -1B
123. FAN MSLC-FN-1 & -2
124. AIR DRYER
125. EXHAUST AIR FILTERS HF-15 & FU-15
126. RETURN AIR FANS FN-15 & FN-17
127. RETURN AIR FAN COILS FC-15 & FC-17
128. RETURN AIR COOLING COILS CC-15 & CC-17

TURBINE GEN. BLDG.

200. MAIN CONDENSER
201. TURBINE GENERATOR UNIT
202. MAIN STEAM & FEEDWATER PIPE CHASE
203. OIL DRAIN SUMP
204. GAS DRYER
205. GENERATOR H_2 CONTROL STATION
206. H_2 CONTROL PANEL
207. H_2 SEAL OIL UNIT
208. CARDOX UNIT FP-TK-1
209. GENERATOR STATOR WATER COOLING UNIT
210. BUS DUCT
211. CHLORINE ANALYZER PANEL
212. CONDENSATE PUMP P-1A,-1B & -1C
213. CONDENSATE BOOSTER PUMP P-2A,-2B & -2C
214. REACTOR FEED PUMP P-1A & -1B
215. MECH VACUUM PUMP P-1A & -1B
216. STEAM JET AIR EJECTOR COND HX 6A & 6B
217. GLAND SEAL STEAM COND COND-HX-7
218. CATALYTIC RECOMBINER RC-5A & -5B
219. OFF GAS SAMPLE ROOM
220. OFF GAS LOCAL PANEL
221. MOTOR CONTROL CENTER
222. INSTRUMENT RACK
223. JUNCTION BOX
224. OFF GAS CONDENSER OG-HX-2
225. WATER SEPARATOR OG-MS-6
226. SEAL WATER LIQUID TANK TK2
227. PUMPED DRAIN TANK TK-1
228. CONDENSATE STORAGE TANK TK-1A & -1B
229. REACTOR FEEDWATER TURBINE PANEL
230. EXHAUST FAN FN-5A & -5B
231. TRANSFORMER
232. SERVICE & INSTRUMENT AIR COMP. C-1A,B & C
233. SERVICE & INSTRUMENT AIR RECEIVER AR-1A,B & C
234. AIR DRYER DY-1A & B
235. BOILER ROOM
236. AUX BOILER AS-BLR-1
237. AUX BOILER CONTROL PANEL
238. AUX BOILER COND RETURN TANK CO-TK-1
239. DEAERATOR FEED PUMP P-1A & B
240. BOILER FEED PUMP P-2A & B
241. DEAERATOR CO-HX-1
242. FUEL OIL SERV PUMP & STRAINER UNIT
243. BOILER CHEM FEED TANK BFC-TK-1
244. BLOWDOWN TANK BD-TK-1
245. AIR HANDLING UNIT
246. TURBINE LUBE OIL STORAGE TANK TO-TK-1
247. MAIN LUBE OIL TRANSFER PUMP TO-P-1
248. TURBINE LUBE OIL CONDITIONER TO-LOC-1
249. TURBINE OIL PUMP TO-P-2
250. ELECTRICAL PULL BOX
251. STEAM UNIT HEATER TRA-SUH-1
252. H.P. FEEDWATER HEATER
253. L.P. FEEDWATER HEATER
254. STEAM EVAPORATOR
255. DRAIN TANK
256. RH DRAIN TANK
257. TURBINE BY-PASS VALVE ACCUMULATOR ASSY
258. TURBINE BY-PASS VALVE ASSEMBLY
259. TURBINE OIL COOLER TO-HX-1A & -1B
260. TURBINE OIL RESERVOIR TO-TK-2
261. ELECTRO-HYDRAULIC FLUID SUPPLY PUMPS
262. AUX BOILER STACK
263. MOISTURE SEPARATOR DRAIN TANK
264. GEN BUS DUCT HEAT COOLING UNIT & HEAT EXCH
265. GEN LOOP SEAL TANK TO-TK-4
266. GEN LOOP SEAL VAPOR EXTRACTOR TO-EX-4
267. NEUT GROUNDING XFMR & RESISTOR CUBICLE
268. EXCITATION CUBICLES
269. SWITCHGEAR
270. MOISTURE SEPARATOR REHEATER
271. EXHAUST PLENUM
272. LOUVER PENTHOUSE
273. EQUIPMENT DRAIN RADIOACTIVE T-6 & -7
274. FLOOR DRAIN RADIOACTIVE T-4 & -5
275. FLOOR DRAIN NON RADIOACTIVE T-1,-2 & 3
276. H&V UNIT
277. P/T CUBICLE
278. BRIDGE CRANE
279. CIRC WATER INTAKE TUNNEL
280. TUR & EXHAUST FANS TEA-FN-51 & -53
281. AIR CONDITIONING UNIT TRA AC-52
282. CORROSION PRODUCTS MONITOR 822-7001
283. FILTER UNIT TEA-FU-52
284. SAMPLE RACKS SR-18 DIT J005
285. VIAL SAMPLER DIT J004
286. SAMPLE CHAMBER DIT J002
287. CONSTANT TEMPERATURE BATH
288. HYDROGEN ANALYSER ROOM
289. HYDROGEN ANALYSERS H60-H2A & -H2B
290. ELECTRICAL RACK SR 4
291. FUME HOOD SR-3

RADWASTE & CONTROL BLDG.

300. FLOOR DRAIN COLLECTOR TANK FDR-TK-6
301. WASTE COLLECTOR TANK EDR-TK-2
302. CONDENSATE SEPARATOR TANK CPR-TK-92A
303. PHASE TANK CPR-TK-92B
304. CONDENSATE BACKWASH RECEIVING TANK CPR-TK-14
305. SPENT RESIN TANK EDR-TK-1
306. WASTE SLUDGE PHASE SEP TANK FDR-TK-22
307. CLEAN-UP PHASE SEPARATOR TANK TK104A & -104B
308. CHEMICAL WASTE TANK TK-23A & -23B
309. DISTILLATE TANK TK-25A & -25B
310. DETERGENT DRAIN TANK TK-5A & -5B
311. DECONTAMINATION SOL CONC WASTE TANK TK-31A & -31B
312. WASTE SURGE TANK EDR-TK-5
313. WASTE SAMPLE TANK TK-4A & -4B
314. FLOOR DRAIN SAMPLE TANK FDR-TK-9
315. POLYMER DAY TANK CF-TK-7A
316. CATALYST MIXING TANK TK 6A & B
317. POLYMER TANKS
318. FLOOR DRAIN COLLECTOR PUMP FDR-P-16
319. WASTE COLLECTOR PUMP EDR-P-11
320. COND SLUDGE DISCHARGE MIXING PUMP CPR-P-25
321. COND DECONT PUMP CPR-P-24
322. COND BACKWASH XFER PUMP CPR-P-22
323. WASTE SURGE PUMP EDR-P-15
324. WASTE SAMPLE PUMP
325. COND PUMP SET WHCO-CU-1
326. FLOOR DRAIN SAMPLE PUMP FDR-P-21
327. SPENT RESIN PUMP EDR-P-10
328. DECONT PUMP FDR-P-36
329. CLEAN-UP DECANT PUMP RWCU-P-27
330. WASTE SLUDGE DISCHARGE PUMP FDR-P-23
331. CONCENTRATOR FEED PUMP P-34A & B
332. CHEMICAL WASTE PUMP
333. DISTILLATE TANK PUMP P-37A & E
334. DETERGENT DRAIN PUMP P-20A & B
335. DECON WASTE PUMP MWR-P-39
336. POLYMER TRANSFER PUMP CF-P-6
337. CLEAN-UP SLUDGE DISCH MIXING PUMP RWCU-P-28
338. POLYMER DAY TANK PUMP CF-P-7
339. OFF GAS CHILLER PUMP P-7A & B
340. FLOOR DRAIN SUMP RADIOACTIVE W-1 & 2
341. EQUIPMENT DRAIN SUMP RADIOACTIVE W-3
342. CHEMICAL DRAIN SUMP RADIOACTIVE W-4
343. MOTOR CONTROL CENTER
344. INSTRUMENT RACK
345. LOCAL CONTROL PANEL
346. POLYMER TANK LEVEL INDICATION PANEL
347. AIR BLOWER BA-C-1
348. COOLER CONDENSER HX-10A & B
349. MOISTURE SEPARATOR MS-10A & B
350. GLYCOL DRUM DRAIN
351. DESICANT DRYER DY-20A THRU-20D
352. REGENERATOR RG-2A & 2B
353. GAS COOLER HX 11C & 11D
354. CHARCOAL ADSORBERS
355. OFF GAS CHILLER UNITS CR 7A & -7B
356. HVAC PANEL
357. STORAGE AREA CRANE PENDANT CONTROL STATION
358. STORAGE AREA CRANE PWR CRA 1 & 2
359. TRUCK LOADING CRANE
360. SOLID HANDLING/DRUM CASK STORAGE AREA
361. TRUCK
362. SWIPE TOOL
363. BLOWER
364. CONTAINER WASHDOWN SPEAR & TESTING STATION
365. NITROGEN BOTTLES
366. CONTAINER CAPPING STATION
367. CONTAINER FILLING STATION
368. VIEWER PWR-VD-1
369. SOLID RADWASTE CONTROL PANEL
370. DECON STA CONTROL PANEL
371. HYDRAULIC BALER MWR-BL-1
372. FLUSH DOWN FUNNEL
373. DOLLY HOIST
374. DECONTAMINATION AREA
375. EMBEDDED CONDUIT
376. DETERGENT DRAIN FILTER
377. EXPANSION TANK
378. AIR HANDLING UNIT WOA-AH-3
379. HOPPER
380. WASTE PROCESSING PUMP CF-P-9
381. GLYCOL TANK OG-TK-2
382. GLYCOL PUMP
383. OFF GAS REFRIGERATION MACHINE
384. PRE-FILTER
385. AFTER FILTER
386. DECON SOLUTION CONCENTRATOR VAPOR BODY
387. DECON SOLUTION CONCENTRATOR HEATING ELEMENT
388. DECON SOLUTION CONCENTRATOR COND RETURN TANK
389. POWDEX & PRECOAT STORAGE AREA
390. RPS ROOM"1&"2
391. VALVE ROOM
392. RADWASTE CONTROL ROOM
393. CONTAMINATED TOOL ROOM
394. REMOTE SHUTDOWN ROOM
395. SWITCHGEAR ROOM"2
396. M/G SET
397. STATIC SWITCH & INVERTER PANEL IN-1
398. INVERTER BY PASS TRANSFORMER IN-3
399. INVERTER FEEDER TRANSFORMER
400. CRITICAL DISTRIBUTION PANEL
401. TRANSFORMERS
402. BATTERY RACK
403. REACTOR PROTECTION SYS PANEL
404. MAIN DISTRIBUTION PANEL
405. TRANSFORMER NEUTRAL RESISTOR COMPARTMENT
406. SWITCHGEAR
407. EQUIPMENT REMOVAL PLUG
408. CONCENTRATOR WASTE MEASURING TK.CMW-TK-27
409. CENTRIFUGE FU-94A & B
410. COND DEMIN CONTROL PANEL
411. RADWASTE CONTROL PANEL
412. CHEMICAL SOLUTION TANK MWR-TK-1
413. CONDENSATE PRECOAT TANK CF-TK-4
414. PRECOAT PUMP CF-P-4
415. CHEMICAL SOLUTION PUMP MWR-P-1
416. WASTE PRECOAT PUMP CF-P-15
417. WASTE PRECOAT TANK CF-TK-3
418. CHEMICAL ADDITION PUMPS
419. CHEMICAL ADDITION TANK
420. WASTE FILTER AID TANK CF-TK-7
421. WASTE FILTER AID PUMP CF-P-18
422. FLOOR DRAIN FILTER AID PUMP FDR-P-19
423. FUEL POOL PRECOAT PUMP CF-P-5
424. FUEL POOL PRECOAT TANK CF-TK-5
425. RESIN TANK CF-TK-17
426. CLEAN-UP PRECOAT TANK RWCU-TK-2
427. CLEAN-UP PRECOAT PUMP RWCU-P-4
428. DUST EVACUATOR RWCU-EX-80
429. HOLDING PUMP P-10A THRU 10F
430. FLOOR DRAIN FILTER HOLD PUMP FDR-P-17
431. WASTE FILTER HOLD PUMP EDR-P-12
432. FUEL POOL HOLD PUMP P-2A & -2B
433. CLEAN-UP HOLD PUMP P-3A & -3B
434. DECON SOL CONC DEAER FEED PUMP P-3A & -B
435. DECON CONC BOTTOM RECYCLE PUMP P-117A & B
436. HEALTH PHYSICS OFFICE
437. AIR LOCK
438. CONDENSATE FILTER DEMINERALIZER
439. FLOOR DRAIN FILTER FDR-FU-19
440. WASTE COLLECTOR FILTER EDR-DM-9
441. FUEL POOL FILTER DEMIN
442. CLEAN-UP FILTER DEMINERALIZER
443. WASTE DEMINERALIZER EDR-DM-29
444. FLOOR DRAIN DEMINERALIZER FDR-DM-
445. POLISHING DEMINERALIZER MWR-DM-40
446. RADIO CHEMISTRY LABORATORY
447. DECON SOL CONC EVAP AS-EV-1A & 1B
448. DECON SOL CONC EVAP DRAIN TANK
449. SUMP
450. MECHANICAL EQUIPMENT ROOM
451. AIR HANDLING UNITS WOA AH 5 & WMA AH 6
452. HOT WATER HEATER WMH-HX-1
453. FILTER UNITS FU 1A,-1B,-1C & -5 & 2
454. FWMV CONTROL PANEL
455. HEATING & VENT UNIT
456. SAMPLING AREA
457. DECON CONC CONDENSER
458. HOT INSTRUMENT SHOP
459. HOT MACHINE ROOM
460. EXHAUST FILTER
461. EXHAUST FAN
462. CONTROL ROOM
463. TERMINAL CABINETS
464. BENCHBOARD
465. RELAY CABINETS
466. COMPUTER
467. FILTER DEMINERALIZER REMOVAL ROOM
468. DECONTAMINATION STATION
469. RESIN ADDITION TANK CF-TK-34
470. CHILLERS CR-51A & -51B
471. WATER PUMP P-51A & -51B
472. SUPERVISOR CONTROL PANEL
473. BRIDGE CRANE
474. A C UNITS WRA-AC-1
475. DELUGE STATION
476. RWCU SYSTEM CONTROL PANEL P026
477. FUEL POOL DEMINERALIZER FPC-CP-1
478. DC BATTERY CHARGER
479. SAMPLING ELECTRONIC PANEL SR 12
480. EXHAUST PLENUM
481. VACUUM PUMP & TANK
482. DECON SOLN CONC EVAP BLWDN COOLER
483. FUME HOODS SR 10 & SR-12
484. TEMPERATURE BATH SR 11
485. COUNTING ROOM
486. JANITORS CLOSET & MISC STORAGE ROOM
487. GAS SAMPLER RACKS
488. GAS MONITOR RACK
489. RADIANT HEATER
490. AIR WASHER PUMPS
491. H&V UNIT WASHERS
492. AIR COMPRESSORS AC 51 & AC 52
493. HVAC PANEL
494. EXHAUST FANS (FOR TURB GEN BLDG)
495. FIRE DISPLAY PANEL
496. UNIT HEATER WRA SUH-1,-2,-3,-4 & 5
497. SAMPLE RACKS

DIESEL GEN. BLDG.

500. DIESEL GENERATOR ENG-1A & B
501. HPCS DIESEL GENERATOR ENGINE
502. DIESEL OIL DAY TANK TK-5A,B & TK-6
503. SWITCHGEAR
504. MOTOR CONTROL CENTER
505. DIESEL GENERATOR PANEL
506. AIR INTAKE PANEL
507. EXHAUST FAN
508. H&V CONTROL PANEL
509. DC BATTERY CHARGER & RACK
510. TRANSFORMER
511. AIR COMPRESSOR
512. AIR RECEIVER AR-11A & B
513. ELECTRIC UNIT HEATERS
514. DIESEL OIL TANK
515. FUEL OIL TANK
516. CN TANK CN-TK-1
517.
518. AIR INTAKE FILTERS
519. AIR HANDLING UNIT
520. EXHAUST SILENCER
521. DIESEL GEN.AIR STARTING SKID
522. PREFILTERS DOA-FL-11
523. AIR INTAKE SILENCER

SERVICE BLDG.

600. DEMIN WATER STORAGE TANK DW-TK 1
601. ACID STORAGE TANK CF-TK-1
602. CAUSTIC STORAGE TANK CF-TK-2
603. POTABLE WATER STORAGE TANK PWG-TK 1
604. NEUTRALIZATION TANK CF-TK-3
605. HOT WATER TANK DW TK 2
606. CLEARWELL FW-TK-1
607. CLEARWELL TRANSFER PUMPS
608. POTABLE WATER PUMPS
609. DEMIN WATER TRANSFER PUMPS
610. CHILLED WATER PUMPS
611. WASTE TRANSFER PUMPS
612. CONDENSATE PUMP SET SHCO-CU-1
613. POTABLE WATER HEATER SPWH HX 1
614. HEAT EXCHANGER PACKAGE SHW HTP-S2
615. DUPLEX CARBON FILTERS
616. GRAVITY FILTERS
617. FLOW SPLITTER BOX
618. DEMINERALIZERS
619. GRAPHIC CONTROL PANEL
620. WATER CHILLER SCH-CR-S1
621. MOTOR CONTROL CENTER
622. NEUTRALIZATION SUMP
623. DUST COLLECTOR WITH SKIMMER SEA-DC1
624. CHLORINE ROOM
625. STORAGE AREA
626. WATER TREATMENT LABORATORY
627. MACHINE SHOP
628. BRIDGE CRANE
629. ROOF VENTILATORS RV1 & -2
630. STEAM UNIT HEATER SRA-SUH-1
631. GRAVITY ROOF VENT SEA-GVT-1
632. INSTRUMENT RACK
633. HVAC ROOM
634. HEATING & VENTILATING ROOM
635. MULTIZONE HVAC UNIT SMA-MZ-S1
636. EXHAUST FAN
637. SUPPLY FAN
638. ELECT UNIT HEATER SRA-EUH-S1
639. FLOOR DRAIN SUMP
640. RECEPTION AREA
641. LOBBY
642. MEN'S LOCKER ROOM
643. HEALTH PHYSICS ROOM
644. LOUVER HOUSE
645. SUMP PUMPS FD-P-19A & -19B
646. SKIMMER SEA-FU 1
647. DUST COLLECTOR SEA-DC1
648. PLANT SERVICE WATER CHLORINATOR
649. SURFACE GRINDER
650. SHAPER
651. RADIAL ARM DRILL

MISC. EQUIPMENT

700. ELEVATOR
701. COVERED HATCH
702. OPEN HATCH
703. RAILROAD
704. CRANE RAIL
705. MONORAIL
706. ROOF
707. MANHOLE

MAKE-UP WATER PUMP HOUSE

800. TOWER MAKE UP PUMP TMU P-1A,-1B & -1C
801. FAN COIL UNIT PRA-FN 91A & -91B
802. INSTRUMENT RACK IR 29 & IR-30
803. JET PUMP PWG-PS
804. HVAC RACK MWHV 1 & MWRV-2
805. AIR HANDLING UNIT PRA-FC-91A & 91B
806. AIR COMPRESSOR TMU C-1A & -1B
807. AIR TANK TMU TK-1A & -1B
808. DRYER TMU-DY-1
809. AIR HANDLING UNIT FMA-AH 81A & 81B
810. ELECT UNIT HEATER PEA EUH 92A & -92B
811. BACKWASH VALVE TMU V 19A & -19B
812. DISCH VALVE TMU V 1A,-1B & -1C
813. SLUICE GATE VALVE TMU-V-7A & -7B
814. BATTERY RACK EXHAUST HOOD E 81S1-4
815. POTABLE WATER PRESS TANK PWH HX-81
816. ELECT DUCT HEATER PMA EHC 81A & -81B
817. EXH.PLV DUCT FAN PEA FN 81A & -81B
818. EXHAUST FAN PEA-FN-82
819. PRESSURING TANK PWG TK-81
820. XFMR TR 72 TR 82, TR 72-1 & TR 82-B
821. 4.16KV SWITCHGEAR SM 72 & SM-82
822. NEUTRAL GROUND RESISTOR NR TT72 & TB 82
823. ISOLATION VALVE TMU V 20 & -21
824. HYPO CHLORINATOR
825. SUPERVISORY PANEL
826. DISCH VALVE TMU V 16A,-16B & -16C

SPRAY PONDS IA & IB

850.
851.
852.
853.
854.
855.
856.
857.
858.
859.

STANDBY SERVICE WATER PUMP HOUSES IA&IB

900. STANDBY SERVICE WTR PUMPS SW P 1A & -1B
901. PUMP CHAMBER ACCESS 1A,1B
902. DIESEL SERVICE WTR PUMP(7.1L 1A ONLY)
903. ELECT UNIT HTRS PRA-EUH-1A,2A,2B,2B & -3B
904. FAN COIL UNITS PRA-FC-1A AND -1B
905. FANS POA FN-2A AND -2B
906. INSTRUMENT PANELS 1R-21,-24,-26 & 22 & 25
907. SUPERVISORY CONTR.PANELS S-1,S-3 & -S2
908. DISTRIBUTION PANELS PP-7A-7B & -8A & -8B
909. SUMPS
910. VALVE PITS 1A & 1B
911. TRANSFORMERS TR 7A-F & TR-8A-F
912. LIGHTING PANELS LP-7A F & LP-8A-F
913. ELECTRIC VAULT
914. STOP LOGS
915. SCREENS

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	RADIATION ZONE DRAWING - EQUIPMENT LIST	FIGURE 12.3-11

b. Regulatory Guide 8.4 is implemented except for C.2.b, which states, "The calibration/response test result should not exceed ±10% of an exposure from a source traceable to the National Bureau of Standards." This is accepted on the minus side, but is considered excessively stringent on the positive side. Since the error on the positve side results in exposure conservatism to the worker, +20% is a more reasonable limit for rejection of a pencil dosimeter.

c. Regulatory Guide 8.6, "Standard Test Procedure for Geiger Muller Counters," will be used as applicable. This guide references ANSI N42.3-1969 (ANSI/IEEE Standard 309-1970) for twelve different tests to Geiger Muller counters. The Supply System will develop tests and procedures to assure that Geiger Muller tube characteristics are appropriate for planned (or intended) applications. These tests may incorporate plateau characteristics, lead time, efficiency, and operating environment.

d. Regulatory Guide 8.28 is implemented with the following exceptions:

The 1.2-meter drop test is considered abusive and omitted with preevaluation, preoperational, and premaintenance checks completed prior to their use. These are:

1. Source and battery checks completed prior to use;

2. Use restricted to personnel completely familiar with the dosimeter;

3. Suspected, or actually defective dosimeters are repaired, checked, and certified completely operational prior to reissue;

4. Inoperable dosimeters taken out of service.

12.5.2.1 Criteria for Selection

a. Radiation and Contamination Survey Instrumentation - This equipment was selected to cover the wide range requirements extending from picocurie quantity measurements in the laboratory to the thousand R/hour ranges necessary for emergency dose rate determinations. The laboratory instrumentation was chosen to provide capability for the quantitative and qualitative analyses required to identify and measure the radionuclides encountered in a power reactor. The portable instrumentation includes low level detection capabilities for alpha, beta, and gamma contamination and wide ranges of dose rate measuring instruments for beta, gamma, and neutron radiation. The criteria for quantity selection were to provide adequate available counting time for anticipated demand in the laboratory and sufficient portable instruments to cover normal operational and emergency requirements in all areas of the WNP-2 facility.

b. Airborne Radioactivity Monitoring - Basic criteria for selection of this equipment was to provide a means for determining radioactive airborne effluents released from the plant, and to effectively monitor airborne radioactivity levels within the plant environs. Provisions have been made for continuing response monitoring of noble gases discharged from gaseous release points from the reactor, radwaste, and turbine building, and for continuous sampling of radioiodines and particulates at these same locations. Internal plant air monitoring instrumentation is used within these buildings with readout locally and in the

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control room. Selected devices, capable of airborne particulate monitoring, are included in all the instruments and for radiohalogens and gases where appropriate.

c. Area Radiation Monitoring - This system was designed to provide continuous surveillance of radiation levels throughout the plant with local alarm at predetermined levels, local indication and control room annunciation and recording. Functions of the system include warning of excessive gamma radiation levels in fuel storage and handling areas, detection of unauthorized or inadvertent movement of radioactive materials in the plant, local alarms to warn personnel in an area of a substantial increase in radiation levels, provision for supervisory information in the control room so that correct decisions may be made in the event of a radiation incident, backup to other systems for detection of abnormal migrations of radioactive materials in or from the process streams, and providing a permanent record of gamma radiation levels at selected locations within the various plant buildings.

d. Personnel Monitoring - Personnel dosimetery devices were chosen to provide a record of exposure received by all workers and visitors entering the controlled areas of the plant under normal or accidental conditions.

Personnel dosimeter badges containing thermoluminescent dosimeters, film, or other acceptable dosimeter provide the primary legal record of exposure incurred by personnel. Each person entering plant controlled areas is assigned a badge, which is recorded with the wearer's identification. Results of the badge and the period of exposure are recorded on a document kept as a legal WPPSS record. Badges used will be capable of recording exposure over a range of at least 10 mrem to greater than 1,000 rem.

Neutron exposures are assigned by determining the dose rate versus the time spent in any areas

Procedures for conducting radiation surveys are given in the WPPSS Health Physics Program and Procedures manual.

12.5.3.4 Procedures for Radioactive Contamination Control

This section describes the bases and methods used for monitoring and control of radioactive contamination on personnel, equipment and plant surfaces. The following limits are used for release of materials and equipment from the plant controlled areas:

a. "Loose", "Smearable", or "Transferable" Contamination - Is kept at a minimum and maintained below 1,000 dpm/100cm^2 β, γ and 100 dpm/100cm^2 α to be considered clean. α surveys are not routinely made unless plant conditions indicate α may be present.

b. "Fixed" Contamination - Is measured by direct survey, and a surface is considered radioactively contaminated if it exceeds 100 CPM above background per GM probe area, with the background less than 500 CPM. Measurements are made at an average distance of 1 cm, through a maximum absorber thickness of 7 mg/cm^2. Fixed contamination is further defined as that radioactive material remaining after successive attempts at removal by approved procedures which are no longer effective.

Procedures for personnel entering and leaving contaminated areas and the associated survey requirements are given in the WPPSS Health Physics Manual.

12.5.3.5 Procedures for Control of Airborne Radioactivity

Evaluation of airborne radioactivity concentrations is done procedurally by several methods. Routine airborne surveys consist of observing the continuous air monitors located in various areas of the plant and also the effluent monitors. These observations are supplemented by grab samples taken on a routine basis and by laboratory analysis of selected particulate and charcoal filters used on the continuous monitors. Special airborne surveys are made with portable samplers when a constant air monitor indicates increases in airborne radioactivity, or to evaluate conditions in a specific area or on a specific job.

The portable air sampling equipment consists of both high and low volume collectors with appropriate media for collecting particulates and radioiodines. These samplers are used for both spot evaluations by collection of grab samples and longer term evaluations by use of low volume samplers to collect over the period of a specific job or activity. Laboratory analysis is made of air samples for gross radioactivity and, where warranted, for specific isotope identification and quantification to determine and record airborne concentrations.

Selected numbers of the routine air samples collected are analyzed for specific isotope content to ensure that MPC levels are not being approached. Special samples are taken for this purpose whenever unexplained increases occur on constant air monitors or when gross activity levels indicate there is a potential for having 25% of the value specified in 10CFR20, Appendix B, Table 1, Column 1 of any isotope present in the mixture.

Airborne radioactive iodine monitoring includes integrated sample collection and laboratory analysis plus portable sampling and analysis. Portable sampling encompasses iodine collection on charcoal cartridges of nominal dimension of 2" disc diameter by 1" thickness at calibrated flow rates up to 2.5 scfm. Duration of sampling is determined by the anticipated ambient concentration levels whereas a nominal sampling period in excess of five minutes is selected to minimize sampling errors. Where gross noble gas concentrations exist, the sample cartridge may be purged in the laboratory with clean filtered air to minimize noble gas interferences. The cartridge will be sealed in a clean plastic bag and taken to the analytical laboratory counting room for analysis.

d. The Health Physics Supervisor and his staff work on an individual and group basis with other plant organizations to determine what their principal sources of exposure are and to look for methods of reducing these exposures.

e. Plant administrative practices provide for regular review and updating of all procedures.

f. Procedures provide for routine maintenance, calibration, and testing of all radiation instrumentation and equipment. New equipment will be added as necessary for replacement and to supplement that existing. Written procedures are provided for use of equipment where required.

g. Plant facilities are routinely reviewed for possible improvements from a radiation protection standpoint. 12.1.3 describes several changes that have been incorporated into plant design for this purpose. Other considerations are additional shielding where practicable, improved ventilation control, additional equipment, and increased physical restriction.

h. The routine and special surveys previously described point out levels of radioactive contamination in plant areas. The WNP-2 staff is committed to maintaining a clean plant and considers it routine procedure to reduce levels of contamination whenever such action will not result in an increase of occupational radiation exposure to personnel.

i. One aspect that is considered important and used in implementing the radiation protection program is the incorporation of previous reactor and power reactor experience in this area. Previously successful methods, procedures, and equipment are used whenever possible.

j. Training of all personnel who work in the plant in radiation safety practices is mandatory and given a high priority by Supply System and WNP-2 Management. The System Training Manager is supplemented by a full time Training Coordinator in each plant and is responsible for development of all training programs, including radiation safety indoctrination.

Radiological Programs personnel and Plant Radiation Safety Staff personnel assist in this training by providing instructors for some phases. The degree of training provided each plant worker is dependent on his function and degree of responsibility, however, all radiation workers in the plant are provided training considered necessary or required for their position. The training programs provided are designed to meet the requirements of 10CFR19.12 and the guidance of Regulatory Guides 8.8, 8.10, and 1.8.

TABLE 12.5-1

WNP-2 PLANT HEALTH PHYSICS INSTRUMENTATION

Number	Type	Minimum Accuracy	Minimum Radiation
1	Multichannel γ Energy Analytical System with GE-Li Detector	Not Applicable	Not Applicable
1	Multichannel γ Energy Analytical System with NaI Detector	Not Applicable	Not Applicable
3	β - γ Proportional Counters	Not Applicable	Not Applicable
1	Single Channel Analyzer - Well Detection Systems	Not Applicable	Not Applicable
1	Liquid Scintillation Counter	Not Applicable	Not Applicable
4	Scaler - GM Detector - Shield Units	Not Applicable	Not Applicable
14	Ion Chamber Dose Rate Instruments	±10% of Full Scale	0-5R/hr
4	Telescoping Dose Rate Instruments	Full Scale ±10%	0.01 R/hr- 999.9 R/hr
2	Neutron Dose Rate Instruments*	Not Specified	0 mrem/hr - 5 rem/hr
14	β - γ Survey Meters with Standard, End Window, or Pancake Type Probe	±10% of Full Scale	0-70,000 CPM
2	Alpha Counters - Gas Proportional Portable Survey Instruments	±10% of Full Scale	0-500,000 CPM
10	Frisker Type Personnel Contamination Monitors	±10% of Full Scale	0-500,000 CPM
5	Hand and Foot Counters	±10% of Full Scale	0-50,000 CPM
1	Portal Monitor	Not Specified	Not Specified
1	Condenser R-Meter	±3% of Full Scale	0-250R
3	Portable Area Monitors with Adjustable Alarm	±15% of Actual Intensity	1-1000 mr/hr
6	Constant Air Monitors - Moving Filter β Detector	±10% of Actual Intensity	50-50,000 CPM
1	Portable Constant Air Monitors	±10% of Full Scale	0-50,000 CPM
900	Personnel Dosimeters - Direct Reading	+20% to -10%	0-500 mR
100	Personnel Dosimeters - Direct Reading High Ranges	+20% to -10%	Various Ranges to 100 R
6	Personnel Alarming Dose Integrators	Not Specified	Not Specified

* Provides dose rate in mrem/hr for neutrons with energies between 0.025 eV and 10MeV, directional response ±10%

14.2.12.1.36 Standby Gas Treatment System Preoperational Test

a. Purpose

To verify the reliable operation of the Standby Gas Treatment (SGT) System, including fans, filter trains and related controls.

b. Prerequisites

The System Lineup Tests have been completed and the TWG has reviewed and approved the procedure and the Startup Superintendent has approved the initiation of testing. The following systems must have readiness verification:

(1) Essential 480 Vac power

(2) Instrument power

(3) Control air

(4) Reactor Building Heating and Ventilation

c. General Test Methods and Acceptance Criteria

Verification of the Standby Gas Treatment System is demonstrated by the proper integrated operation of the following:

(1) SGT fans and control logic

(2) Filter trains and related instruments

(3) Automatic valves and control logic

(4) System interconnections to Reactor Building Heating and Ventilation, and Primary Containment Atmospheric Control Systems

(5) Annunciators

14.2.12.1.37 Loss of Power and Safety Testing Preoperational Test

a. Purpose

To verify the operaton of the 230/115kV, 6.9kV, 4.16kV, and 480V distribution systems.

To verify the integrated ability of the plant electrical distribution and safety systems to operate on normal and standby power sources during accident conditions.

To verify that loss of a single AC or DC distribution system division (exclusive of the HPCS diesel generator and batteries) will not prevent the remaining systems from actuating during an accident condition.

b. Prerequisites

The System Lineup Tests and the 69/N consecutive starts for the emergency D/Gs have been completed and the TWG has reviewed and approved the procedure and the Startup Superintendent has approved the initiation of testing. The 125V DC system and the ECCS are available to support testing.

c. General Test Methods and Acceptance Criteria

Verification of the 230/115kV, 6.9kV, 4.16kV and 480V distribution system operability shall be demonstrated by the following:

(1) Demonstration of circuit integrity and integrated operation of circuit breakers, controls and interlocks, instrumentation, automatic transfer features and protective devices and alarms.

(2) Demonstration of proper system response to a loss of the 230kV and 115kV distribution systems independently and simultaneously both with and without LOCA/containment isolation signals.

(3) Demonstration of proper system response to a loss of the 230/115kV distribution systems and one individual standby diesel generator during an ECCS/containment isolation actuation.

c. The steam lines are modeled by eight pressure nodes incorporating mass and momentum balances which will predict any wave phenomena present in the steam line during pressurization transient.

d. The core average axial water density and pressure distribution is calculated using a single channel to represent the heated active flow and a single channel to represent the bypass flow. A model, representing liquid and vapor mass and energy conservation and mixture momentum conservation, is used to describe the thermal-hydraulic behavior. Changes in the flow split between the bypass and active channel flow are accounted for during transient events.

e. Principal controller functions such as feedwater flow, recirculation flow, reactor water level, pressure and load demand, are represented together with their dominant nonlinear characteristics.

f. The ability to simulate necessary reactor protection system functions is provided.

g. The control systems and reactor protection system models are, for the most part, identical to those employed in the point reactor model, which is described in detail in Reference 15.1-1 and used in analysis for other transients.

15.1.2.3.2 Input Parameters and Initial Conditions

These analyses have been performed, unless otherwise noted, with the plant conditions tabulated in Table 15.0-2.

End of cycle (all rods out) scram characteristics are assumed. The safety/relief valve action is conservatively assumed to occur with higher than nominal setpoints. The transient is simulated by programming an upper limit failure in the feedwater system such that 135% feedwater flow occurs at the design pressure of 1060 psig.

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CHAPTER 17

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17.1 QUALITY ASSURANCE DURING DESIGN AND CONSTRUCTION

There are four principal participants in WNP-2 design and construction quality programs. They are the Owner, Washington Public Power Supply System; the Architect/Engineer (AE), Burns and Roe, Inc.; the Nuclear Steam Supply System (NSSS) Supplier, General Electric Company; and the Construction Manager (CM), Bechtel Power Corporation.

a. The Supply System, as the Owner and licensee, has overall responsibility for assuring that the plant is designed and constructed in accord with approved QA programs. The Supply System WNP-2 Project QA organization provides management overview of the other elements of the site QA programs. Section 17.1.1 describes the Supply System WNP-2 Quality Assurance Program.

b. Burns and Roe, Inc. provides Architect/Engineer and related services for WNP-2. Section 17.1.2 describes the Burns and Roe Quality Assurance Program.

c. The General Electric Company provides NSSS design, fabrication, and erection/construction services for WNP-2. Section 17.1.3 describes the GE Quality Assurance Program.

d. The Bechtel Power Corporation provides construction management services for WNP-2. This service consists primarily of direction and coordination of site contractor activities and includes related QA/QC services. Section 17.1.4 describes the Bechtel Quality Assurance Program.

17.1.1 WASHINGTON PUBLIC POWER SUPPLY SYSTEM QUALITY ASSURANCE PROGRAM

The Washington Public Power Supply System (Supply System or WPPSS) has implemented a Quality Assurance Program (QA Program) for the design, procurement, and construction of WPPSS Nuclear Project No. 2 (WNP-2). This QA Program has been implemented in accordance with requirements of Appendix B to 10CFR50. The applicable requirements of Appendix B, 10CFR50 are applied to those items classified as WPPSS Quality Class I due to their relationship to a nuclear safety function.

As the license applicant, the Supply System is responsible for the plant. Therefore, the Supply System WNP-2 QA Program and its implementation has been structured to assure that design, procurement, and construction activities are accomplished in accordance with sound engineering principles and practices. Systems, components, and structures that are safety-related, in the context of 10CFR20, 10CFR50, and 10CFR100, are required to be designed, specified, fabricated, installed, and tested in accordance with applicable regulatory requirements, codes, standards, specifications, and procedures.

The description of the Supply System WNP-2 Design and Constructon QA Program which follows is of the program as it currently exists. This program evolved from the original quality program which first appeared in Appendix D.O of the PSAR. The changes involved in this evolution process include: NRC requested changes; updates in organization responsibilities and authorities; and the incorporation of new requirements.

17.1.1.1 Organization

The Supply System Managing Director is responsible to the Board of Directors for the overall management of Supply System activities, including the establishment and implementation of policies. The Managing Director resolves issues involving quality brought to his attention because of failure to reach resolution at lower levels of management. Overall Supply System organization is shown on Figure 17.1-1.

The Deputy Managing Director is responsible and accountable to the Managing Director for:

a. coordinating and integrating the activities of Supply System organizations;

b. supporting and advising the Managing Director in his functions of leadership and evaluation; and

c. acting for the Managing Director as and when requied.

The Quality Assurance Director is responsible and accountable to the Managing Director to develop, administer, and assess the implementation of the Supply System Corporate Quality Assurance Program. Included in this responsibility are auditing functions performed on the Supply System WNP-2 quality affecting activities; audits, surveillance or surveys of suppliers of material, equipment, or services for the WNP-2 Project. The Quality Assurance Director has stop work authority. He provides for the review of the status and adequacy of the WNP-2 QA Program on an annual basis.

The Director of Nuclear Safety is responsible and accountable to the Managing Director to develop and administer Licensing, Operational Nuclear Safety, and Design and Nuclear Safety Assessment activities in support of the Project.

The Technology Director is responsible and accountable to the Managing Director for technical support of Supply System activities from a centralized organization. Functions which are encompassed by this organization include corporate engineering, nuclear fuel management, environmental programs, corporate performance, and project support.

The Director, Contracts and Materials Management is responsible and accountable to the Managing Director for the procuremment and control of materials, equipment, and services of the Supply System. This includes the Headquarters and Project Business organizations which provide support to the Program Directors for procurement, contract management, contract administration, including commercial claims analysis and negotiation, business management systems and contract reporting/measurement systems, and the Fuel Contracts organization which provides support to the Fuel Supply Department for nuclear fuel procurement and administration. Support is also provided to the Program Director for control of materials, equipment, and services through the Materials Management organization.

The WNP-2 Program Director, as shown on the WNP-2 Project Organizational Chart, Figure 17.1-2, has overall responsibility and authority for all WNP-2 Project activities. He resolves WNP-2 issues involving quality brought to his attention because of failure to reach resolution at lower levels of WNP-2 management. He is assisted by the Project Manager, the Plant Manager, and the Project Quality Assurance Manager.

The Supply System Project Manager is responsible for WNP-2 design and construction and provides direction for Construction Manager (Bechtel) and the Architect/Engineer (Burns & Roe) activities, as shown on the Organizational Chart, Figure 17.1-3. The Architect/Engineer and Construction Manager Organizations are shown on Figures 17.1-4 and 17.1-5, respectively.

The manager of each WNP-2 department or organization, as well as the manager of each Supply System home office support organization, is responsible for:

a. Identifying those activities within his organization which are quality-related.

b. Establishing and clearly defining the duties and responsibilities of personnel within his organization who execute those quality-related activities.

c. Assuring that quality-related activities are accomplished by qualified personnel in accordance with approved procedures, as required.

The principal WNP-2 project organizations are shown on Figures 17.1-2 and 17.1-3. A listing of the primary quality-related functions follows:

<u>Engineering</u> - The Deputy Project Manager for Engineering is accountable to the Project Manager and is responsible for:

a. Identifying all engineering requirements required to accomplish project requirements and goals.

b. Establishing organizations to acquire and allocate resources for implementation of engineering functions in accordance with an integrated project schedule.

c. Coordinating and controlling engineering performance to the project schedule.

d. Providing technical support/evaluation services to QA.

e. Assuring adequacy and engineering document compliance to technical commitments.

f. Supporting project licensing activities.

g. Coordinating with Deputy Project Managers for construction and startup and Project Department Managers as required to meet project goals.

Construction - The Deputy Project Manager-Construction is accountable to the Project Manager and is responsible for the Supply System Construction Management activities. The Supply System Construction Management group will monitor or conduct management surveillance of the Construction Management Contractor and Site Contractors to:

a. Evaluate the Construction Management Contractor and Site Contractor performance, and Construction Management Contractor performance reporting systems.

b. Ensure that the Construction Management Contractor Quality Program is effectively implemented.

c. Ensure that an adequate construction safety program is maintained.

d. Expedite delivery of Supply System furnished equipment and material.

e. Concur with and monitor the Construction Contractor integrated schedule for compliance to milestones and overall project schedule.

f. Direct the activities of the Construction Management Contractor, when required.

Startup - The Deputy Project Manager for Startup is accountable to the Project Manager and is responsible for:

a. Managing the activities of test groups during the testing phase of the project.

b. The development, monitoring, analysis, and approval of plans, schedules, and procedures for testing plant systems and components.

c. Coordinating with Deputy Project Managers, Construction, and Engineering on the iden-

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of nondestructive examination and inspection activities; and has the lead role for acquiring and maintaining ASME Certificates of Authorization. Included in his responsibilities are:

a. Ensuring that ASME Code requirements are properly interpreted and included in the Quality Assurance program requirements.

b. Interfacing with the Authorized Nuclear Inspector (ANI), Authorized Inspection Agency, and the Enforcement Authority.

c. Ensuring that a written agreement with an Authorized Inspection Agency is obtained to provide for ANI Services; and that the ANI is provided free access.

d. Ensuring that all nondestructive examination personnel involved in examination activities are certified in accordance with ASNT and/or the ASME Code.

e. Acquisition and maintenance of ASME Certificates of Authorization and/or Owners Certificates.

f. Ensuring the appropriate certification of Supply System personnel who perform quality-affecting activities.

g. Developing and maintaining the Supply System Design and Construction, and ASME Quality Assurance Program Manuals.

h. Reviewing and approving Project Quality Assurance Instructions.

i. Reviewing and concurring with offsite design documents (such as drawings and specifications) to assure conformance to the QA Program requirements.

j. Reviewing proposed changes to the Quality Assurance Program, defined in SAR documents, for Director of Licensing and Assurance approval.

k. Providing technical services to other Licensing and Assurance departments, as requested.

l. Providing Initial Quality Assurance Indoctrination and Training for Supply System personnel.

m. Quality Assurance functions associated with plant modifications that are comparable to activities occurring during the initial construction phase.

n. Vendor qualification, review, and concurrence with vendor furnished programs and procedures, source verification (e.g., surveillances, inspections, and audits at Vendor's facilities), and receiving inspection of vendor-furnished items received at the Corporate warehouse.

NOTE: Supply System personnel assigned to remote locations may be indoctrinated by the appropriate Quality Assurance Manager.

The Manager of Construction Quality Assurance is supported by the following.

The Manager of Procurement Quality Assurance reports to the Manager of Construction Quality Assurance and is primarily responsible for the definition and implementation of the source surveillance/audit program for verification of activities performed by Supply System vendors (including the Nuclear Steam Supply System vendors). The Manager of Procurement Quality Assurance is specifically responsible for:

a. Review of and concurrence with procurement documents for items and services (other than nuclear fuel) initiated by Corporate personnel.

b. Performance of pre-award surveys/evaluations of vendors/suppliers, and maintaining and distributing an updated listing of those approved.

c. Planning, coordination, and performance of source surveillances, source inspections, and source audits to verify implementation of Supply System direct-purchase Supplier QA/QC Programs.

d. Review and/or approval of offsite Supply System-administrated vendor/supplier quality assurance/quality control procedures and programs.

e. Perform receipt-inspection of items received at the Corporate Warehouse and Corporate extensions.

f. Verify that received items are handled and stored correctly.

g. Ensure training of receiving inspectors.

h. Provide program overview of AE vendor surveillance activities.

i. Quality assurance vendor surveillance of offsite Supplier activities.

j. Audits, surveillances, and/or surveys of Suppliers of items, materials, or services who do not have ASME Certification.

k. Provide overview of NSSS vendors.

The Project Quality Assurance managers report directly to the Manager, Construction Quality Assurance and are matrixed to the Program Directors. Project Quality Assurance managers are responsible for:

a. Verification of the implementation of the Quality Assurance Requirements Manual.

b. Verifying adequate implementation of an approved stop work authority program and directing a stop work order should conditions so dictate.

c. Assurance of a program for identification and reporting of nonconformances.

d. Verification, by audits and surveillances, that the AE, CM, selected Contractors and other Project organizations are implementing applicable quality requirements.

e. Ensuring that adequate staffing is obtained to implement the Quality Assurance programs at the Project.

f. The assignment of adequately trained and qualified/certified personnel to perform quality verification activities.

g. Overview of AE/CM approval of Contractor procedures and instructions.

h. Reporting significant conditions adverse to quality to the Program Directors and the Director, Licensing and Assurance.

tification and solution of startup problems requiring Enginering and/or Construction resolution.

d. Serving as a member of the Plant Operations Committee (POC) for all matters related to the Plant Test Program.

e. Implementing a safe, efficient, and adequate test program in accordance with the requirements of the Test and Startup Program Manual.

f. Preparing and approving Test and Startup instructions.

Startup activities are conducted in accordance with the Operational Quality Assurance Program, topical report WPPSS-QA-004, as referenced in Chapter 17.2.

Systems Turnover - The Deputy Project Manager for Systems Turnover is accountable to the Project Manager and is responsible for:

a. Managing special activities to expedite completion of the WNP-2 Project.

b. Providing support to expedite resolution of outstanding concerns/problems.

c. Performing reverification/review of prior work, as required.

d. Performing evaluations to assure the adequacy of management systems used to control continuing work.

Quality Assurance - The WNP-2 Project Quality Assurance Manager is accountable to the Program Director and is responsible for:

a. Administration of the Quality Assurance Department to develop and verify site implementation of the Quality Assurance Program.

b. Interfacing with Engineering to determine whether a nonconforming condition, existing on any safety-related activity, is reportable under the requirements of 10CFR50.55(e) or 10CFR21.

c. Representing Quality Assurance during NRC audits, inspections, meetings, and presentations.

d. Reviewing Project audit reports, nonconformances, and corrective actions to determine trends that may be detrimental to quality.

e. Requiring stop work on those activities that do not conform to the requirements of the Quality Assurance Program.

f. Auditing, surveilling, and evaluating the adequacy of the Architect/Engineer's, the NSSS Contractor's, and Construction Management Contractor's Quality Assurance Programs, and the adequacy of the implementation of these programs.

g. Providing for evaluation of the adequacy of Supply System home office quality-related activities which support the WNP-2 Project.

h. Performing audits and surveillance of Construction Management Contractor and Burns & Roe Engineering to assure that activities affecting quality are performed in accordance with the requirements specified in the contract documents.

i. Assuring identification of nonconformances and that steps are taken to stop the nonconforming activity, to assure the nonconformance is documented, and that resolution is implemented in a timely and effective manner.

j. Administration and implemention of the Operational Quality Assurance Program during the test and startup phase, prior to issuance of operation license.

17.1.1.2 Quality Assurance Program

Washington Public Power Supply System has established and implemented a Quality Assurance Program for the design, procurement, and construction phase of the WNP-2 facility. The QA Program is based on the assignment of quality classifications which impose applicable quality requirements to structures, systems and components.

The WPPSS Quality Assurance Program and the supporting procedures and instructions comply with the requirements of

e. Instructions, Procedures and Drawings, QAR-5

Establishes system defining the requirements and responsibilities controlling the preparation, review, approval, and release of instructions, procedures, and drawings which implement quality requirements.

f. Document Control, QAR-6

Establishes a system to control the issuance of documents, including changes thereto, which prescribe activities affecting quality.

g. Control of Purchased Material, Equipment, and Services, QAR-7

Establishes a system to assure material, equipment and services are procured in accordance with the requirements specified in the procurement documents.

h. Identification and Control of Materials, Parts and Components, QAR-8

Establishes a system for the identification and control of material, parts, components, equipment and partially-completed assemblies to assure that items incorporated into the plant are of proper configuration and, when necessary, traceable to all supporting quality assurance documentation.

i. Control of Special Processes, QAR-9

Establishes a system for the control of special processes.

j. Inspection, QAR-10

Establishes a system which assures the program requirements for inspection are delineated in the specifications and contracts and assures that inspection and surveillance activities are performed in accordance with predetermined requirements delineated in written instructions in a planned and systematic manner.

k. Test Control - QAR-11

Establishes a system to assure that plant testing activities are performed in accordance with pre-determined requirements, approved, and delineated in written instructions.

l. Control of Measuring and Test Equipment, QAR-12

Establishes a system for the control, calibration, and adjustment of tools, gauges, instruments and other inspection, measuring, testing, and maintenance devices at specified periods to assure the useage of proper type, range, and accuracy necessary to verify conformance to established requirements.

m. Handling, Storage and Shipping, QAR-13

Establishes system to control the handling, storage, shipping, cleaning, and preservation of material, parts, components and equipment in accordance with written and approved procedures, instructions and recommendations, to assure that the designed integrity and functionality of the item are maintained.

n. Inspection, Test, and Operating Status, QAR-14

Establishes a system to indicate the inspection, test, and operating status for all structures, systems or components to preclude the inadvertent bypassing of their inspection and test requirements and to prevent their inadvertent operation.

o. Nonconforming Material, Parts or Components, QAR-15

Establishes a system to assure that nonconformances are identified, documented, segregated or otherwise controlled, prevented from inadvertent use or installation and that notification of actions taken is transmitted to the affected parties.

p. Correctie Action, QAR-16

Establishes a system to assure that significant conditions adverse to quality are identified, the cause determined, documented, brought to the

Assurance Program or plan describing their policies, procedures, and systems to be utilized in the control of quality throughout the applicable phases of production, from design to final shipment, erection, or installation.

Procurement documents provide requirements for suppliers to submit or make available for review applicable documents such as drawings, specifications, procedures, instructions, inspection and test records, and quality assurance records to the Project for review and/or approval.

Procurement documents require suppliers to provide measures for retention, control, and maintenance of their Quality Assurance records. Procurement documents specify the appropriate records to be delivered to the Project prior to or with delivery.

Procurement documents require suppliers to provide right of access to their facilities, procedures, and records for inspection and audit by Project personnel. Procurement documents issued after January 1978 require the supplier to establish measures for reporting 10CFR Part 21 reportable deficiencies and disposition of nonconformances from procurement document requirements. Procurement documents require that the supplier retain the responsibility for monitoring and evaluating their sub-tier suppliers' performance to specified requirements.

Procurement documents for spare or replacements contain original or improved technical requirements including codes and standards and current applicable QA program requirements.

Changes and revisions to procurement documents are subject to the same or equivalent review/approval requirements as the original document.

17.1.1.5 Instructions, Procedures and Drawings

Activities affecting quality are described in procedures, instructions, and drawings and the activities are conducted in accordance with these documents.

Procedures, instructions, and drawings include adequate quantitative and qualitative acceptance criteria to ascertain that the prescribed activities have been satisfactorily accomplished.

Procedures, instructions, and drawings are subject to review to assure that applicable codes, standards, and acceptance/rejection criteria are included.

17.1.1.6 Document Control

A document control system is implemented by the Project. The requirements assure that documents, including changes, are reviewed, approved and released in a timely manner to the locations where the activity is being performed. The Project prepares procedures, instructions, and drawings as necessary to assure that activities such as design, procurement, manufacturing, construction and installation, testing, inspection, auditing, calibration, and special processes are adequately prescribed and the necessary quality requirements are stated. Changes to these documents require review and/or approval commensurate to that performed on the original document.

Contractors/subcontractors involved in activities affecting quality are required to establish measures for document control which satisfy project requirements.

Changes to specifications and drawings require approval of the cognizant Engineering personnel. As required by Procurement Documents, changes to supplier and contractor drawings and procedures are reviewed and approved by the Project Organization. Changes to documents such as specifications and drawings are indicated by a revision, change order, or equivalent documented methods.

Project drawings and specifications, supplier and contractor drawings, current revisions, addenda, changes in design and engineering change notices are released in a controlled manner.

To preclude the inadvertent use of obsolete or superseded documents, a Project drawing/specification status report is periodically issued. These reports indicate the current revision to Architect/Engineer drawings and specifications and related changes, addenda, and design and engineering change notices. Site contractors are required to establish measures to assure that obsolete or superseded documents are controlled to prevent their inadvertent use.

17.1.1.7 Control of Purchased Material, Equipment and Services

Prior to award of contract, Quality Assurance, Engineering, and other personnel, as required, perform an evaluation of accepted bids to determine the supplier's capability to meet procurement requirements. The evaluation may consist of a direct survey of the prospective supplier's facility and personnel or, a review and evaluation of the implementation of his quality assurance program, or evaluation of the supplier's history of providing satisfactory products to the project, or evaluation of the supplier's current records supported by objective evidence.

Surveillance of suppliers, as required, during fabrication, inspection, testing, and shipment of materials, equipment, and components is performed to provide assurance that material, equipment, and services conform to procurement document requirements. Surveillances are conducted by qualified personnel in accordance with established plans and to procedures that identify the attributes or processes to be witnessed and/or verified and the acceptance criteria. Those items which are simple and standard in design, manufacture, and test, or where quality characteristics can be verified by standard inspections or tests after delivery, are accepted during receiving inspection with no source surveillance. Receiving inspection is performed in accordance with written procedures or instructions.

Measures are established to provide for delivery of documentation from the supplier to the site, prior to or with delivery. These documents provide objective evidence:

a. That the items conform to the procurement quality requirements such as specifications, codes, and standards.

b. That the required tests, examinations, and inspections have been performed.

c. That nonconformances have been dispositioned as required.

17.1.1.8 Identification and Control of Materials, Parts and Components

Measures are established to identify and control materials, parts and components including partially completed subassemblies. Requirements for identification and traceability are determined during initiation of design documents and are specified in procurement specifications and on drawings.

These measures require that items important to the safety of the Project are identified in a manner (i.e., heat/lot number, part number, serial number, etc.) that can be traced to the appropriate documentation, or group of documents, such as drawings, specifications, purchase orders, material certifications, etc. The identification is maintained and verified, as required, throughout fabrication, installation and use of the item.

Implementation of these measures is accomplished by the responsible contractors in accordance with approved procedures.

Verification that items are properly identified is performed during vendor surveillance and receiving inspection activities.

During receipt inspection, materials, parts, and components are identified as acceptable or unacceptable. Where practicable, unacceptable items are physically segregated from acceptable items. Items identified as unacceptable may be released for installation provided the following conditions are met:

a. Traceability and identification is maintained.

b. The item can be brought to an acceptable condition without damage to associated equipment or structures.

c. Controls are established to assure retrievability and, when applicable, limit the use of the item.

17.1.1.9 Control of Special Processes

Measures are established for the procedural control of special processes that require interim in-process controls in addition to final inspection and/or examination to assure achievement of required quality. Examples of these processes are coating/plating, heat treating, welding material cleaning, and nondestructive testing (NDT).

Special processes specified in fabrication/construction documents are controlled and are performed by qualified personnel using approved procedures and equipment evaluated to assure compliance in accordance with applicable codes, standards, and specifications. Special processes delineated in the procurement documents may require that the applicable contractors submit procedures for review and approval.

Procurement documents require that qualification of procedures, personnel, and equipment involved with special processes be established, kept current, and maintained on file.

17.1.1.10 Inspection

Measures are established to assure that an inspection program is planned and scheduled.

Equipment manufacturers, installers, and constructors are required by procurement documents to perform the inspection necessary to verify that items conform to established cri-

d. That rework or repair of nonconforming items be subject to the same, or an equal test or inspection as was originally imposed, or an approved alternate, and the inspection, testing, rework and/or repair activities are documented.

e. That nonconformance reports are reviewed for potential 10CFR50.55(e) and Part 21 reportability.

f. For identification and control of conditional released items.

g. That measures are established in procurement documents to require off-site vendors and suppliers to include their nonconformance reports, which deviate from procurement documents, as a part of their Quality Assurance records.

h. That site contractors and subcontractors document deviations from contract requirements, and nonconformances dispositioned "use-as-is" or "repair" are submitted to the project for review and/or concurrence.

Nonconformance documentation identifies the nonconforming item, describes the nonconformance and the disposition of the nonconformance, identifies any special inspection requirements and the completion of inspection, and contains required signatures/approvals.

Construction Management Contractor Quality Assurance is responsible for the review of these nonconformance reports to ascertain that they have been dispositioned, approved, and closed out.

Reviews include trend studies, corrective action adequacy, and reporting to appropriate levels of management.

The Architect/Engineer is responsible to provide acceptance of disposition for those conditions for which they have assigned technical responsibility. When technical responsibility has not been assigned to the Architect/Engineer, or another design contractor, or when technical requirements are not affected or technical responsibility has been assumed by the Supply System, the Supply System will provide acceptance of disposition.

17.1.1.16 Corrective Action

Measures are established to provide for the prompt identification, evaluation and correction of conditions adverse to quality such as nonconformances, failures, malfunctions, deficiencies, deviations, defective material, and equipment.

The Quality Assurance programs for the project organization, off-site vendors and suppliers, on-site contractors and subcontractors are required to establish provisions:

a. That corrective action is implemented in accordance with procedures.

17.1.2.3 Exceptions to the B&R Quality Assurance Topical Report

17.1.2.3.1 Chapter I - Organization

Paragraph 4.1.2

The B&R WNP-2 Project Organization chart is shown as Figure 17.1-4.

Paragraph 4.3

Construction Management is not within B&R scope of services.

17.1.2.3.2 Chapter II - Quality Assurance Program

Paragraph 2.1

The USNRC Regulatory Guides applicable to WNP-2 are identified in Appendix C.3 of the WNP-2 FSAR.

Paragraph 4.6

Under the B&R WNP-2 Quality Assurance Program, satisfactory accomplishment of the following quality affecting functions shall be verified:

a. The design process is accomplished in accordance with established procedures.

b. Specifications contain appropriate quality requirements.

c. For those prepurchased equipment contracts for which Burns and Roe performs the vendor surveillance function:

   1. Contractors' quality assurance programs and procedures are adequate.

   2. Nonconformances are identified and dispositions provided.

   3. Material receiving, inspection and storage functions are performed in accordance with established procedures.

d. Surveillance of the activities performed by Contractors whose sole function is to provide engineering and design services.

e. Audits of the quality affecting activities described above are performed on a scheduled basis.

Superseded

17.1.2.3.3 Chapter III - Design Control

Paragraph 2.1

Regulatory Guide 1.64, Revision 0 is the basis for the B&R design control program.

Paragraph 4.1

The detailed design effort is based only on an approved project criteria document.

Paragraph 5

Additional design reviews/verifications have been performed on a sampling of previously issued system designs by the performance of special design reviews in accordance with project procedure WNP-2-ED-013.

B&R procedures for design control have been upgraded to verify that future issued designs and modifications comply with applicable codes, standards, and design requirements.

17.1.2.3.4 Chapter IV - Procurement Document Control

Paragraph 3.4

Records to be retained, controlled and maintained by a supplier are not identified in the specification.

any work initiated after March 1978, applies the criteria represented by "Green Book" (NEDO-11209-04A). Note that those portions dealing with the Standard Reactor Island (STRIDE) are not applicable to WNP-2 in that WNP-2 is not provided a STRIDE by GE.

In so far as the NSSS is concerned, GE positions and commitments to Regulatory Guides and ANSI Standards as made in the applicable revisions of NEDO-11209 take precedence over the positions and commitments described in the FSAR Chapter 3.

17.1.4 BECHTEL POWER CORPORATION QUALITY ASSURANCE PROGRAM

17.1.4.1 Quality Assurance Topical Report

The Bechtel Quality Assurance Program Plan for use by the Bechtel Power Corporation during Construction Management and System Completion of Washington Public Power Supply System (Supply System) Project WNP-2 is described in the NRC-approved Bechtel Topical Report BQ-TOP-1, Revision 3A, <u>Bechtel Quality Assurance Program for Nuclear Power Plants.</u>

17.1.4.2 Scope of Responsibility

This section describes Bechtel responsibilities for providing quality-related services in Constructon Management and Systems Completion to the Supply System on the WNP-2 Project. The scope of responsibility differs from that indicated in BQ-TOP-1 in that Bechtel does not provide procurement services, and does not function as the responsible design engineering organization. Therefore, those provisions in BQ-TOP-1 associated with design engineering and procurement services do not apply.

Bechtel will have an Engineering Management group under the direction of the Project Engineering Manager. This group will provide engineering management staff support capability to the Supply System. Engineering personnel will assist in developing the scope and relative priority of remaining engineering activities and will interface with Supply System licensing personnel. Bechtel may perform engineering design assignments on a task basis. Such design tasks will meet design requirements established by the Architect/Engineer (Burns & Roe) and will be performed to the applicable requirements of BQ-TOP-1.

Bechtel will perform construction in the completion of systems, structures, components as assigned by the Supply System, utilizing materials provided by the Supply System.

Construction Management provisions for quality-related services include:

a. Receiving including receipt inspection of Supply System purchased items,

b. Storage and maintenance of Supply System purchased items,

c. Contractor/vendor QA documentation review, retention and turnover to the Supply System,

d. Review and approval of onsite contractor quality-related procedures and manuals,

e. QA/QC audit and surveillance inspection over onsite contractor activities,

f. Administration of the project program for controlling nonconforming items,

g. Administration of the project program for control of design documents.

17.1.4.3 Project Unique Modification to BQ-TOP-1, Revision 3A

a. Introduction Page 2 - Replace Regulatory Guide 1.58 (August 1973) with Regulatory Guide 1.58, Revision 1 (September 1980).

b. Introduction Page 2 - Add Regulatory Guide 1.146 "Qualification of Quality Assurance Program Audit Personnel for Nuclear Power Plants (Revision 0, 1978)."

c. Section 1 ORGANIZATION Subsection 1.5.1, Page 10 - Add Subsection 1.5.1 with Attachment 1.

d. Section 1 ORGANIZATION Subsection 1.5.2, Page 10 -Replace Subsection 1.5.2 with Attachment 2.

e. Section 1 ORGANIZATION Subsection 1.5.4, Page 11 -Replace Subsection 1.5.4 with Attachment 3.

f. Section 2 QUALITY ASSURANCE PROGRAM (Subparagraphs 2 and 4), Page 23 - change Regulatory Guide 1.58 (August 1973) to Regulatory Guide 1.58 Revision 1 (September 1980).

g. Section 2 QUALITY ASSURANCE PROGRAM (Subparagraph 3) Page 23 - change ANSI N45.2.12 to ANSI N45.2.23.

h. Change "Project Engineer" to "Project Engineering Manager" throughout.

Table 1	"Bechtel Quality Program Documents" Page 57 and 58 - Add to Table 1 the Project Documents shown on Attachment 4.
Add Fig. 15	Bechtel Projects Management Organization Attachment 5.
Add Fig. 16	Quality Assurance/Quality Control Organization Attachment 6.
Appendix A	Bechtel Position on QA NRC Regulatory Guides and ANSI standards - delete 5th paragraph (A-7) on page A-1; delete pages A-7 thru A-13 entirely.
Appendix B	Division Quality Policies, scope, and relationship to 10CFR50, Appendix B - Add Project Nuclear Quality Assurance Manual as shown by Attachment 7.

ATTACHMENT 1

The Manager of Projects (Attachment 5) is the senior Bechtel representative assigned to the WNP-2 Project. The Manager of Projects reports to the Division Manager of Project Operations and Services, and is responsible for providing overall project direction to assure the consistent and coordinated application of Bechtel policies and skills for the benefit of the WNP-2 Project. The Manager of Project's staff includes a Deputy Manager of Projects and other managers to coordinate activities in labor relations, the quality program and administrative services.

ATTACHMENT 2

QUALITY ASSURANCE

The SFPD QA Manager (SFHO) is independent of the other managers within the division and has the authority to carry out the responsibilities listed below in directing the Division Quality Assurance Program. He is assisted by a staff of Quality Assurance Managers (SFHO) assigned to functional areas of Program, Training, Project QA, and Audit. The SFPD QA Manager's (SFHO) functions for the WNP-2 Project include:

a. Provide technical guidance and concurrence for the WNP-2 Project Quality Assurance Program for conformance with the requirements of 10CFR50 Appendix B.

b. Formulate and approve Division Quality Assurance Department Procedures which define responsibilities, authority and functions of SFPD home office staff Quality Assurance Department personnel. Review and concur with the WNP-2 PQAM and revisions.

c. Maintain an awareness of WNP-2 project status, through management audit and day-to-day contact with the Manager of Quality, and provide assistance to the Manager of Quality to assure timely and effective implementation of the WNP-2 quality assurance program.

d. Formulate and conduct management QA audits to assure compliance with the WNP-2 Nuclear Quality Assurance Manual (NQAM) and implementing procedures and to identify quality problems; identify the need for corrective action and initiate, recommend, coordinate or provide solutions; and verify implementation of solutions and corrective actions.

e. Provide and maintain a qualified and suitably trained staff of Quality Assurance Engineers to carry out required project and staff functions. Assign Quality Assurance Engineer(s) to the WNP-2 project and provide them with administrative direction through the QA Manager - Projects (SFHO).

f. Formulate and implement programs to provide indoctrination and training of Quality Assurance Department Personnel to assure that suitable proficiency is maintained.

g. From information supplied by the Manager of Quality, provide quarterly reports to the Division Manager and Manager of Quality Assurance, evaluating the status and adequacy of the WNP-BPC quality assurance program, and advising of any problems requiring program revision or special attention including recommendations for corrective actions. At least annually, a meeting is held with the Division Manager (SFHO) and his staff on the subject of status and adequacy of the Division QA Program. The Manager of Quality participates in this meeting to cover the status and adequacy of the WNP-2 QA program.

MANAGER OF QUALITY

The Manager of Quality receives administrative, technical, and project direction from the Manager of Projects, and is responsible for the project and technical direction of the WNP-2 quality assurance program. The Manager of Quality receives technical guidance for QA and QC from the SFPD QA Manager (SFHO) and Chief Construction Quality Control Engineer (SFHO) respectively. He is assisted by, and provides project and technical direction to the Project Quality Assurance Engineer and Project Construction Quality Control Engineer (Attachment 6). The Manager of Quality is independent of the other line managers within the Project Management organization and has the authority to carry out the responsibilities listed below in directing the Quality Assurance Program including authority to stop work or control further processing. The Manager of Quality's functions include:

a. Provide technical and project direction to Quality Assurance Engineers assigned to the Supply System projects.

b. Formulate and approve, after review and concurrence by the SFPD QA Manager (SFHO) the Supply System Projects SAR and Quality Assurance Programs as defined in the Supply System Projects Nuclear Quality Assurance Manuals (NQAMs). The NQAMs shall be in conformance with the requirements of 10CFR50, Appendix B, the TPO Quality Program Policy Manual, and the appropriate Project SAR.

ATTACHMENT 3

DIVISION CONSTRUCTION

The Manager of Division Construction provides technical and administrative direction of the Construction Department personnel. The Manager of Division Construction (SFHO) is assisted by Construction Managers (SFHO), Chief Construction Engineers (SFHO), where assigned, and the Chief Construction Quality Control Engineer (SFHO), Construction Managers (SFHO), are responsible for the management and technical direction of assigned projects, and for assuring that construction projects are provided with appropriate personnel and are following prescribed division practices and procedures for conduct of construction activities. Chief Construction Engineers (SFHO) are responsible for providing division standard work procedures to the projects.

Formal quality verification inspection and onsite contractor surveillance inspection activities performed by Bechtel are the responsibility of Construction Quality Control. The Chief Construction Quality Control Engineer (SFHO) is responsible for providing administrative direction to the Construction Quality Control Engineers assigned to the WNP-2 Project. The Chief Construction Quality Control Engineer's functions include:

a. Provide administrative direction to the Project Construction Quality Control Engineer.

b. Assign quality control engineers to the project.

c. Assist with the training and qualification of construction quality control engineers.

d. Provide technical guidance to the Manager of Quality for the preparation of quality control procedures and instructions.

ATTACHMENT 4

WNP-2 PROJECT QUALITY PROGRAM DOCUMENTS

DOCUMENTS	ORIGINATING AUTHORITY	REVIEW FOR QA POLICY AND PROGRAM REQUIREMENTS	AUTHORIZING APPROVAL	CONTENTS
WNP-2 Nuclear Quality Assurance Manual (NQAM)	Project QA Engineer	SFPD QA Manager (SFHO)	Manager of Quality	Quality program policy. Based on Division policy as contained in SFPD Standard NQAM
WNP-2 Project QA Manual (PQAM)	Project QA Engineer	SFPD QA Manager (SFHO)	Manager of Quality	Procedures for conducting Project QA activities
WNP-2 Construction Quality Control Manual (CQCM)	Project Construction	Project QA Engineer	Manager of Quality	Responsibilities and procedures for construction QC activities
WNP-2 Construction Procedures	Project Field Engineer	Project QA Engineer	Chief Construction Engineer (SFHO)	Responsibilities and requirements for construction site activities
WNP-2 Bechtel Quality Assurance Manual ASME Nuclear Components	Manager of Codes and Standards	Manager of Quality, and SFPD - QA Manager (SFHO)	President - BPC & appropriate authorized code inspection agency	Policies and procedures for overall Bechtel Program applicable to ASME work
Engineering Dept. Project Instructions	Project Engineering Manager	Project QA Engineer	SFPD Engineering Manager	Responsibilities and requirements for engineering departments activities

ATTACHMENT 7
APPENDIX B
DIVISION QUALITY POLICIES, SCOPE AND RELATIONSHIP
TO 10 CFR 50, APPENDIX B
WNP-2 NUCLEAR QUALITY
ASSURANCE MANUAL

SAN FRANCISCO
POWER DIVISION

10CFR50 APP. B NO.	SUBJECT	0-1 TABLE OF CONTENTS	0-2 QA PROGRAM APPLICABILITY	0-3 QA PROGRAM DEFINITION	0-4 DEFINITIONS	0-5 FIRE PROTECTION QA PROGRAM	0-6 RADWASTE MANAGEMENT SYSTEM QA PROGRAM	0-7 SEISMIC II/I QA PROGRAM	0-8 MATRIX	I-1 ORGANIZATION CHARTS	I-2 SFPD ORGANIZATION	I-3 PROJECT QA TEAM	I-4 PROJECT MANAGEMENT TEAM	I-5 PROJECT ENGINEERING TEAM	I-6 PROJECT CONSTRUCTION TEAM	I-7 PROJECT ORGANIZATION CHARTS	I-8 PROCUREMENT SUPPLIER QUALITY DEPARTMENT	I-9 MATERIALS & QUALITY SERVICES DEPARTMENT	I-10 BECHTEL POWER CORPORATION
I	ORGANIZATION		●	●	●					●	●	●	●	●	●	●	●	●	●
II	QUALITY ASSURANCE PROGRAM		●	●						●									
III	DESIGN CONTROL																		
IV	PROCUREMENT DOCUMENT CONTROL																		
V	INSTRUCTIONS, PROCEDURES, AND DRAWINGS			●															
VI	DOCUMENT CONTROL			●															
VII	CONTROL OF PURCHASED MATERIAL, EQUIPMENT AND SERVICES																		
VIII	IDENTIFICATION AND CONTROL OF MATERIALS, PARTS AND COMPONENTS																		
IX	CONTROL OF SPECIAL PROCESSES																		
X	INSPECTION																		
XI	TEST CONTROL																		
XII	CONTROL OF MEASURING AND TEST EQUIPMENT																		
XIII	HANDLING, STORAGE AND SHIPPING																		
XIV	INSPECTION, TEST, OPERATING STATUS																		
XV	NONCONFORMING MATERIAL, PARTS OR COMPONENTS																		
XVI	CORRECTIVE ACTION																		
XVII	QUALITY ASSURANCE RECORDS																		
XVIII	AUDITS																		

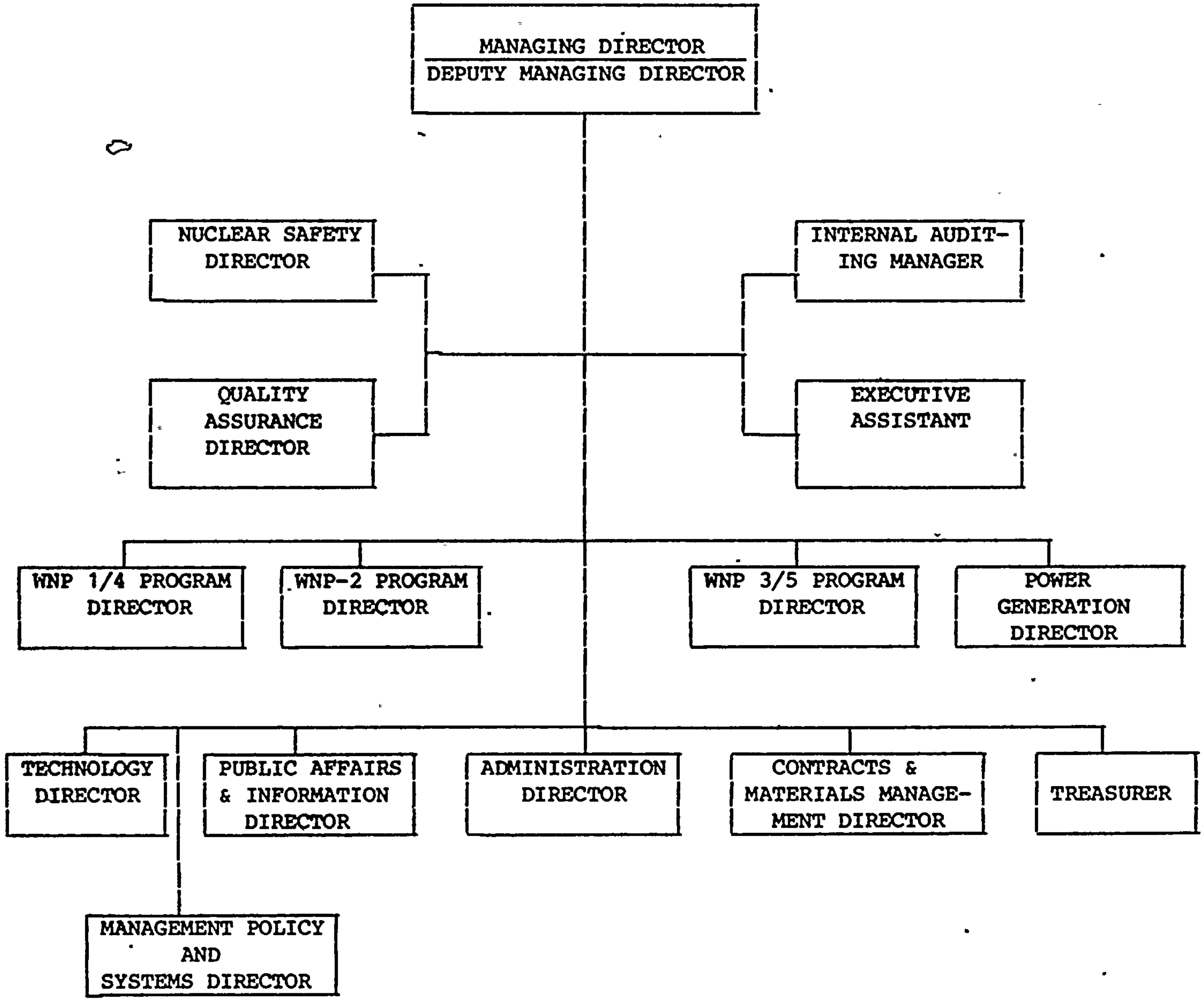
10CFR50 APP. B NO.	SUBJECT	II-1 DESIGN CONTROL PROCEDURES	II-2 DESIGN PROCESS AND CHANGE CONTROL	II-3 DESIGN VERIFICATION	II-4 DESIGN INTERFACE	II-5 SPECIALTY GROUP DESIGN CONTROL	III-1 SUPPLIER EVALUATION ASME III	III-2 FIELD MATERIAL REQUISITIONS	IV-1 CONSTRUCTION SITE QUALITY PROGRAM	IV-2 MR, STORAGE, HANDLING, MAINTENANCE & CONTROL	IV-3 FIELD INSPECTION AND TEST	IV-4 NONCONFORMING MATERIALS	IV-5 CONTROL OF MEASURING AND TEST EQUIPMENT	IV-6 SYSTEM T/O FOR PREOPERATIONAL TESTING	IV-7 FIELD CONTRACTOR CONTROL	IV-8 CONTROL OF SPECIAL PROCESSES
I	ORGANIZATION															
II	QUALITY ASSURANCE PROGRAM	●							●	●	●		●			●
III	DESIGN CONTROL	●	●	●	●	●										
IV	PROCUREMENT DOCUMENT CONTROL						●	●								
V	INSTRUCTIONS, PROCEDURES, AND DRAWINGS	●							●							
VI	DOCUMENT CONTROL	●							●							
VII	CONTROL OF PURCHASED MATERIAL, EQUIPMENT AND SERVICES						●	●		●	●	●			●	
VIII	IDENTIFICATION AND CONTROL OF MATERIALS, PARTS AND COMPONENTS									●		●				
IX	CONTROL OF SPECIAL PROCESSES															●
X	INSPECTION							●			●				●	●
XI	TEST CONTROL			●							●			●		
XII	CONTROL OF MEASURING AND TEST EQUIPMENT												●			
XIII	HANDLING, STORAGE AND SHIPPING							●	●						●	
XIV	INSPECTION, TEST, OPERATING STATUS										●			●		
XV	NONCONFORMING MATERIAL, PARTS OR COMPONENTS							●				●				
XVI	CORRECTIVE ACTION	●						●				●				
XVII	QUALITY ASSURANCE RECORDS															
XVIII	AUDITS															

10CFR50 APP. B NO.	SUBJECT	V-1 NQAM POLICIES AND REVISIONS	V-2 QUALITY ASSURANCE PROCEDURES	V-3 INDOCTRINATION, TRAINING & QUALIFICATION	V-4 MANAGEMENT CORRECTIVE ACTION	V-5 STOP WORK	V-6 PROCEDURE CONTROL	V-7 QUALITY ASSURANCE RECORDS	V-8 QUALITY ACTION REQUESTS	V-9 STATUS AND ADEQUACY REVIEW	VI-1 QUALITY AUDIT SYSTEM
I	ORGANIZATION										
II	QUALITY ASSURANCE PROGRAM		●	●						●	
III	DESIGN CONTROL										
IV	PROCUREMENT DOCUMENT CONTROL										
V	INSTRUCTIONS, PROCEDURES, AND DRAWINGS		●				●				
VI	DOCUMENT CONTROL						●				
VII	CONTROL OF PURCHASED MATERIAL, EQUIPMENT AND SERVICES										
VIII	IDENTIFICATION AND CONTROL OF MATERIALS, PARTS AND COMPONENTS										
IX	CONTROL OF SPECIAL PROCESSES										
X	INSPECTION										
XI	TEST CONTROL										
XII	CONTROL OF MEASURING AND TEST EQUIPMENT										
XIII	HANDLING, STORAGE AND SHIPPING										
XIV	INSPECTION, TEST, OPERATING STATUS										
XV	NONCONFORMING MATERIAL, PARTS OR COMPONENTS					●					
XVI	CORRECTIVE ACTION				●						
XVII	QUALITY ASSURANCE RECORDS							●			
XVIII	AUDITS			●							●

TABLE 17.1-1

GENERAL ELECTRIC QUALITY ASSURANCE EVOLUTIONARY PROCESS

Date of Effective-ness	NED Quality Objectives - Safe & Reliable Systems & Components	Intent of Proposed AEC QA Criteria	Intent of 10CFR50 Appendix B (proposed)	10CFR50 Appendix B	ANSI N45.2	AEC Reg. Guide 1.28	ASME B&P Code	QA Related Reg. Guide & ANSI Stds.
8/20/68	Blue Book							
10/1/69	Green Book Rev. 0	x						
5/1/70	Green Book Rev. 1	x						
9/15/71	Green Book Rev. 2		x					
6/1/72	Green Book Rev. 3			x	x			
3/1/73	Green Book Rev. 4 (NEDO-11209)			x	x			
5/7/74	Green Book Rev. 5 (NEDO-11209-01)			x	x	x	x	x
12/12/75	Green Book (NEDO-11209-02)			x	x	x	x	x
11/76	Green Book (NEDO-11209-03A)			x	x	x	x	x
3/31/78	Green Book (NEDO-11209-04A)			x	x	x	x	x
10/80	Green Book (NEDO-11209-04A)			x	x	x	x	x



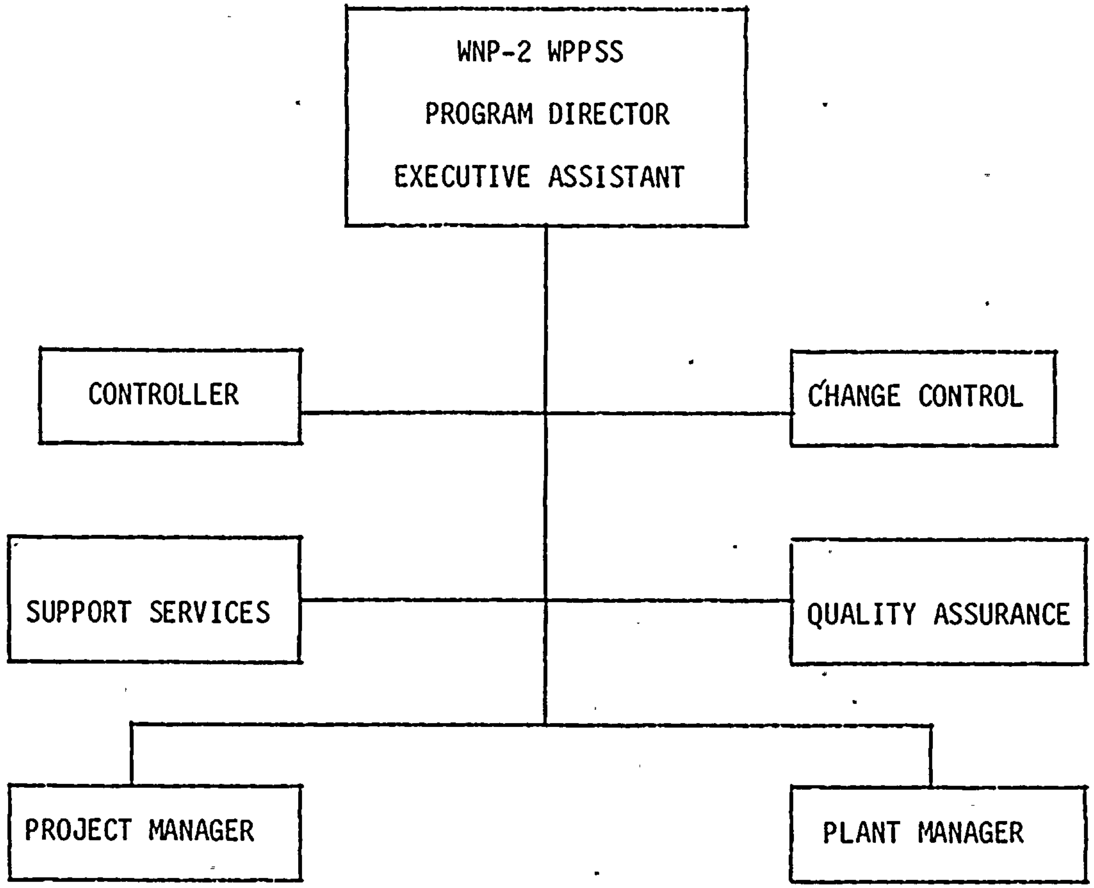
AMENDMENT NO. 20
November 1981

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PROJECT NO. 2

SUPPLY SYSTEM ORGANIZATION CHART

FIGURE 17.1-1

0

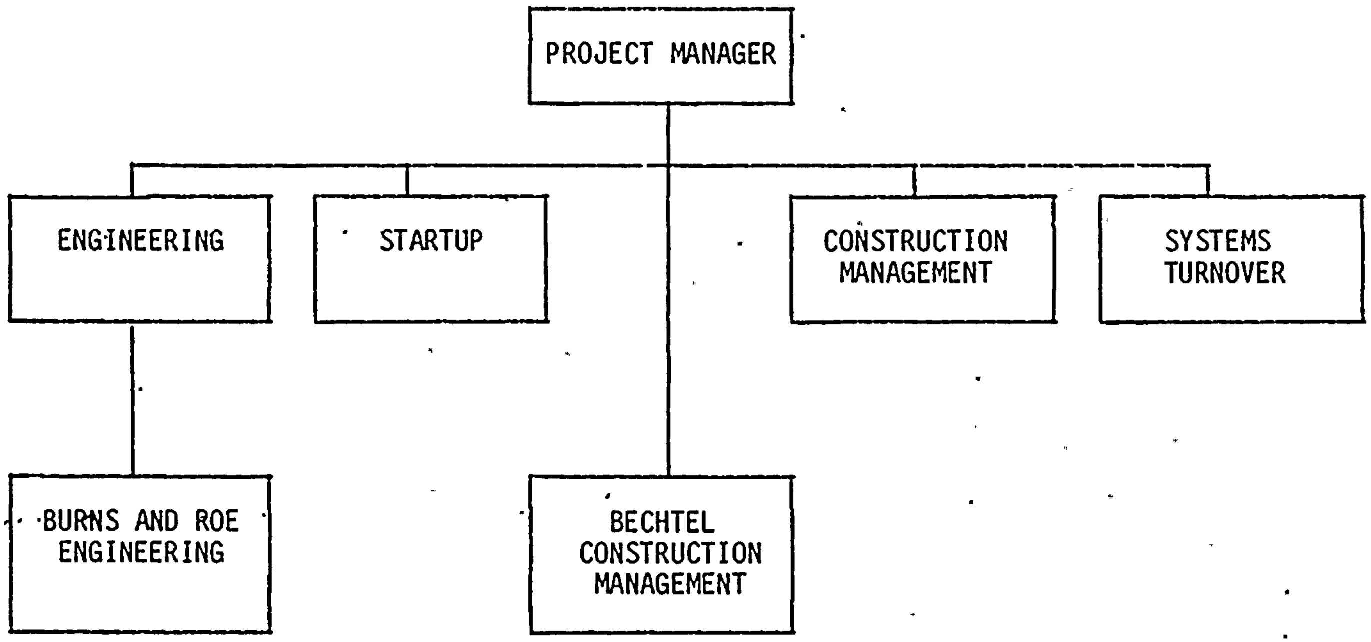


AMENDMENT NO. 17
July 1981

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PROJECT NO. 2

SUPPLY SYSTEM WNP-2 ORGANIZATION CHART

FIGURE 17.1-2



AMENDMENT NO. 17
July 1981

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PROJECT NO. 2

SUPPLY SYSTEM WNP-2 PROJECT MANAGEMENT ORGANIZATION CHART

FIGURE 17.1-3

17.2 QUALITY ASSURANCE DURING THE OPERATIONS PHASE

The WNP-2 program for quality assurance during the operations phase is described in report number WPPSS-QA-004, Revision 3, WPPSS Operational Quality Assurance Program Topical Report, whichh was transmitted to the NRC under separate cover.

Staffing Plan:

Shift coverage is provided by utilizing a rotating shift schedule based on a 40-hour work week and 24-hour/day, 7-day/week coverage.

To ensure that sufficient SRO and RO licensed individuals are available for filling the shift manager, control room supervisor, and reactor operator positions on five rotating shifts, the Supply System is hiring and training 17 candidates for SRO licensing and 18 for RO licensing. If it is assumed that two SRO and two RO license candidates are lost due to attrition and one SRO and two RO license candidates fail the exam, 14 SRO and 14 RO licenses would be available for staffing the five rotating shifts and for providing relief.

Overtime:

WNP-2 will prepare administrative procedures to provide a policy for maintaining adequate personnel in the shift manager, control room supervisor, shift technical advisor, control room operator, and equipment operator positions to prevent routine use of overtime as compensation for insufficient staffing.

WNP-2 policy will also require that work schedules be prepared in advance to ensure that the potential for exceeding the following guidelines is minimized when filling the minimum shift crew requirements previously defined. The overtime guidelines are:

a. No individual should work more than 12 consecutive hours excluding shift turnover.

b. No individual should work more than 24 hours in any 48-hour period.

c. No individual should work more than 72 hours in any 7-day period.

d. No individual should work more than 14 consecutive days without having two consecutive days off.

Unexpected illness or other uncontrollable factors may create situations requiring overtime in excess of these guidelines. These deviations will be corrected as soon as possible, documented, and reviewed by the plant manager or his designee as soon as practical.

(DELETED)

I.G.1 PREOPERATIONAL AND LOW-POWER TESTING

Position (NUREG-0660)

The objective is to increase the capability of the shift crews to operate facilities in a safe and competent manner by assuring that training for plant changes and off-normal events is conducted. Near-term operating license facilities will be required to develop and implement intensified training exercises during the low-power testing programs. This may involve the repetition of startup tests on different shifts for training purposes. Based on experiences from the near-term operating license facilities, requirements may be applied to other new facilities or incorporated into the plant drill requirement (Item I.A.2.5). Review comprehensiveness of test programs.

NRR will require new operating licensees to conduct a set of low-power tests to accomplish the requirement. The set of tests will be determined on a case-by-case basis for the first few plants. Then NRR will develop acceptance criteria for low-power test programs to provide "hands on" training for plant evaluation and off-normal events for each operating shift. It is not expected that all tests will be required to be conducted by each operating shift. Observation by one shift of training of another shift may be acceptable.

NRR will develop criteria in conjunction with initial near-term operating license reviews.

Licensees will (1) define training plan prior to loading fuel, and (2) conduct training prior to full-power operation.

Clarification

None

WNP-2 Position

The Supply System is committed to meet the intent of NUREG-0660 by performance of a special low power test subprogram which provides supplemental operator training in the areas of response to abnormal plant conditions and familiarity with critical systems. The special subprogram will amplify the well-established training value of the present Startup Test Program (STP) through (1) instruction on the content, goals, and requirements of the existing program, (2) addition of selected special tests to the STP to demonstrate abnormal scenarios and use of critical systems and/or emergency operating procedures to control them, and (3) utilization of the knowledge and experience gained during the STP in the training programs for future operators.

The overall Startup Test Program is outlined in Chapter 14 while the conduct of operations is discussed in Chapter 13. During the preoperational and power ascension test phases, the operations personnel will be intimately involved in the performance of the various test procedures. With the impetus provided by the responsible test phase organization, the operations staff is charged with establishing the required plant/system conditions, initiating and controlling the desired test transient and returning the plant/system to its normal condition. The operations staff provides the physical ability to accomplish the Startup Test Program. In this fashion, the completion of the Startup Test Program provides an unparalleled training opportunity for the operators.

The following outlines those additional actions the Supply System will implement to augment the extensive training benefits inherent in the existing STP program:

I. Development and Implementation of a Training Course on the STP

A. General Classroom Instruction (Prior to testing)

1) STP Overview

a) Organization, Delineation of Responsibilities, Goals

b) Administrative and Emergency Procedures

c) Preop and Power Ascension Test Schedule

2) Review Selected STP Specifics, for example;

a) Pertinent Preop Test Purposes, Procedures, Anticipated Results

b) Integrated System Cold Functional Tests

c) Fuel Loading, Heatup, Power Ascension Test Purposes, Procedures, Anticipated Results

d) Special Test Subprogram Test Purposes, Procedures, Anticipated Results

3) Review Expected Utilization of STP Data

sufficiently low backgrounds for such analyses following an accident. In the low background area, the sample should first be purged of any entrapped noble gases using nitrogen gas or clean air free of noble gases. The licensee shall have the capability to measure accurately the iodine concentrations present on these samples under accident conditions. There should be sufficient samplers to sample all vital areas.

For applicants with fuel loading dates prior to January 1, 1981, provide by fuel loading (until January 1, 1981) the capability to accurately detect the presence of iodine in the region of interest following an accident. This can be accomplished by using a portable or cart-mounted iodine sampler with attached single-channel analyzer (SCA). The SCA window should be calibrated to the 365 KeV of iodine-131 using the SCA. This will give an initial conservative estimate of presence of iodine and can be used to determine if respiratory protection is required. Care must be taken to assure that the counting system is not saturated as a result of too much activity collected on the sampling cartridge.

WNP-2 Position

WNP-2 is responding to this position as follows: Six (four fixed and two mobile) continuous air monitoring systems are provided for air sampling in plant areas where personnel may be present during accident conditions. In addition, ten (10) low volume air sampling systems will be strategically located throughout the plant in frequently occupied areas to continuously draw air samples for subsequent analysis.

Grab samples will be obtained using varying volume air samplers that are both AC and DC powered.

Movable local alarming continuous air monitors are placed at predetermined plant locations for personnel protection and to substantiate the quality of the plant breathing atmosphere. These monitors have local readouts (charts) and radioiodine sampling capabilities.

The Supply System is currently using activated charcoal cartridges for radioiodine analysis and is evaluating the attributes of silver zeolite. Upon completion of a satisfactory evaluation the Supply System will, where applicable, incorporate silver zeolite into its air sampling program. The charcoal cartridges are used in conjunction with a Ge (Li) gamma spectroscopy system located in a low background, low contamination area such as the radiochemistry lab in the near site facility. Prior to analysis, cartridges are purged in a fume hood using plant air, instrument air, bottled air, or bottled nitrogen which is stored onsite.

Two D.S. Davidson Company model 1056B type multichannel analyzers are available for air quality analysis. This analyzer is portable, uses a NaI detector, and is adaptable for radioiodine analysis.

Station procedures are provided for obtaining and evaluating both routine and non-routine air samples. In addition to initial training provided for Health Physics/Chemistry personnel, periodic drills are conducted in accordance with the WNP-2 Emergency Plan Section 17.

Superseded per AMDT 31

sufficiently low backgrounds for such analyses following an accident. In the low background area, the sample should first be purged of any entrapped noble gases using nitrogen gas or clean air free of noble gases. The licensee shall have the capability to measure accurately the iodine concentrations present on these samples under accident conditions. There should be sufficient samplers to sample all vital areas.

For applicants with fuel loading dates prior to January 1, 1981, provide by fuel loading (until January 1, 1981) the capability to accurately detect the presence of iodine in the region of interest following an accident. This can be accomplished by using a portable or cart-mounted iodine sampler with attached single-channel analyzer (SCA). The SCA window should be calibrated to the 365 KeV of iodine-131 using the SCA. This will give an initial conservative estimate of presence of iodine and can be used to determine if respiratory protection is required. Care must be taken to asure that the counting system is not saturated as a result of too much activity collected on the sampling cartridge.

WNP-2 Position

WNP-2 is responding to this position as follows: Six (four fixed and two mobile) continuous air monitoring systems are provided for air sampling in plant areas where personnel may be present during accident conditions. In addition, ten (10) low volume air sampling systems will be strategically located throughout the plant in frequently occupied areas to continuously draw air samples for subsequent analysis.

Grab samples will be obtained using High Volume Air Samplers that are both AC and DC powered operation.

During accident conditions, activated charcoal cartridges will be used for radioiodine analysis in conjunction with a Ge(Li) Gamma Spectroscopy System located in a low background, low contamination area such as the Radiochemistry Lab in the Near-Site Facility. Prior to analysis, cartridges will be purged in a fume hood using plant service air or bottled nitrogen which is stored on site.

Station procedures are provided for obtaining and evaluating both routine and non-routine air samples. In addition to initial training provided for Health Physics/Chemistry personnel, periodic drills are conducted in accordance with the WNP-2 Emergncy Plan Section 17.

III.D.3.4 Control Room Habitability Requirements

Position

In accordance with Task Action Plan Item III.D.3.4 and control room habitability, licensees shall assure that control room operators will be adequately protected against the effects of accidental release of toxic and radioactive gases and that the nuclear power plant can be safely operated or shut down under design basis accident conditions (Criterion 19, "Control Room," of Appendix A, "General Design Criteria for Nuclear Power Plant," to 10 CFR Part 50).

Clarification

a. All licensees must make a submittal to the NRC regardless of whether or not they met the criteria of the referenced Standard Review Plans (SRP) sections. The new clarification specifies that licensees that meet the criteria of the SRPs should provide the basis for their conclusion that SRP 6.4 requirements are met. Licensees may establish this basis by referencing past submittals to the NRC and/or providing new or additional information to supplement past submittals.

b. All licensees with control rooms that meet the criteria of the following sections of the Standard Review Plan:

2.2.1-2.2.2	Identification of Potential Hazards in Site Vicinity
2.2.3	Evaluation of Potential Accidents
6.4	Habitability Systems

shall report their findings regarding the specific SRP sections as explained below. The following documents should be used for guidance:

1. Regulatory Guide 1.78, "Assumptions for Evaluating the Habitability of Regulatory Power Plant Control Room During a Postulated Hazardous Chemical Release";

2. Regulatory Guide 1.95, "Protection of Nuclear Power Plant Control Room Operators Against an Accident Chlorine Release"; and,

Regulatory Guide 1.45, Rev. 0, May 1973

Reactor Coolant Pressure Boundary Leak Detection System.

Regulatory Guide Intent:

The guidelines are prescribed to assure that leakage detection and collection systems provide maximum practical identification of leaks within the reactor coolant pressure boundary (RCPB).

Application Assessment:

Assessed capability in design.

Compliance or Alternate Approach Statement:

Identified NSSS scope of supply analysis, design and/or equipment utilized in this facility is in compliance with the intent of the subject regulatory guide through the incorporation of the alternate approach cited.

General Compliance or Alternate Approach Assessment:

The leak detection system consists of temperature, pressure, fission product monitoring and flow sensors with associated instrumentation and alarms. This system detects, annunciates, and isolates (in certain cases) leakages in the following systems:

1. Main steam lines
2. Coolant systems within the drywell
3. Reactor water cleanup (RWCU) system
4. Residual heat removal (RHR) system
5. Reactor core isolation cooling (RCIC) system
6. Feedwater system
7. High pressure core spray (HPCS) system

General Compliance or Alternate Approach Assessment: (Cont'd.)

8. Low pressure core spray (LPCS) system

Leakage is separated into identified and unidentified categories thus meeting Position C.1. of Regulatory Guide 1.45.

Small unidentified leaks (5 gpm and less) inside the drywell are detected by temperature changes, pressure changes, drain pump activities, fission product monitoring, and drywell cooler condensate flow monitoring.

Large leaks are also detected by changes in reactor water level and changes in flow rates in process lines.

The 5 gpm leakage rate is a proposed limit on unidentified leakage inside the drywell. The leak detection system is fully capable of monitoring the flow rates of 1 gpm and is thus in compliance with Paragraph C.2 of Regulatory Guide 1.45.

By monitoring drywell equipment and floor drain sump flow rates, drywell coolers' condensate flow rates and fission products, Position C.3 is satisified.

Isolation and/or alarm of affected systems and the detection methods used are summarized in Table 5.2-9.

Monitoring of coolant for radiation in the RHR and Reactor Water Cleanup Heat Exchangers satisfies Position C.4 of the regulatory guide. (For system details see 7.6.1.2 and 11.5).

The three methods described are designed to detect 1 gpm in less than one hour, thus Position C.5 is satisfied. The drywell floor drain sump and drywell cooler

General Compliance or Alternate Approach Assessment (Cont'd.)

condensate monitors systems are not qualified for seismic events because the regulatory guide was issued well after the design was developed. However, administrative procedures could be utilized to verify operability following an event if required. This satisfies position C.6.

Leakage detection indicators and alarms are provided in the main control room. This satisfies C.7 for the NSSS scope of supply. The operator has developed procedures for converting the various indications to a common leakage equivalent for the operators to satisfy remainder of C.7.

The leakage detection systems are equipped with provisions to permit testing for operability and calibration during operation by the following methods:

1. Continuous monitoring of sump level compared to flow rates into sump.

2. Operability checked by comparing one method to another.

3. Simulation of signals into trip monitors.

4. Channel "A" against Channel "B" of the same method.

Thus position C.8 is satisfied.

Limiting conditions for identified and unidentified leakage are established as 25 gpm and 5 gpm respectively, thus satisfying position C.9.

Specific Evaluation Reference:

Refer to 5.2.5.

Similar Application Reference:

Similar application was utilized on Zimmer and La Salle.

Regulatory Guide 1.46, Rev. 0, May 1973

Protection Against Pipe Whip Inside Containment

Regulatory Guide Intent:

Regulatory Guide 1.46 describes an acceptable basis for selecting the design locations and orientations of postulated breaks in fluid system piping within the reactor containment and for determining the measures that should be taken for restraint against pipe whipping that may result from such breaks.

Application Assessment:

Assessed capability in design.

Compliance or Alternate Approach Statement:

Identified NSSS scope of supply analysis, design and/or equipment utilized in this facility is in compliance with the intent of the subject regulatory guide through the incorporation of the alternate approach cited.

General Compliance or Alternate Approach Assessment:

This regulatory guide is applicable to the recirculation pipe lines.

The design of the containment structure, component arrangement, Class 1 pipe runs, pipe whip restraints and compartmentalization was done in consonance with the acknowledgement of protection against dynamic effects associated with postulated rupture of piping. Analytically sized and positioned pipe whip restraints were engineered to preclude damage based on the pipe break evaluation.

Pipe whip requirements for fluid system piping within the primary containment that, under normal operation, has service temperatures greater than 200°F or pressures greater than 275 psig, complied with ANS N176, "Design Basis for Protection Against Pipe Whip", and Regulatory Guide 1.46 except as delineated in the following criteria for no breaks in Class 1 piping:

Regulatory Guide 1.28, Rev. 0, June 1972

Quality Assurance Program Requirements (Design and Construction)

I Design and Construction Phase

Compliance or Alternate Approach Statement:

WNP-2 complies with the guidance set forth in this regulatory guide as described below.

General Compliance or Alternate Approach Assessment:

Procurement documents issued after November 1973 required compliance with ANSI N45.2. Prior to that time, an "explanative version" of 10CFR50 Appendix B was employed. The design and construction activities initially complied with 10CFR50 Appendix B. In November 1974, reference to ANSI N45.2 was added to the construction specifications.

Specific Evaluation Reference:

None

II Operational Phase

Compliance is discussed in the Topical Report referenced in 17.2.

Regulatory Guide 1.29, Rev. 3, September 1978

Seismic Design Classification

Compliance or Alternate Approach Statement:

WNP-2 complies with the intent of the guidance set forth in this regulatory guide by an alternate approach.

General Compliance or Alternate Approach Assessment:

Supply System Nuclear Project No. 2 classifications are consistent with Regulatory Guide 1.29 with the following clarification:

Cooling of the spent fuel storage pool is accomplished by the spent fuel cooling and cleanup system. The spent fuel pool cooling portion which is used normally to cool the spent fuel pool water is Seismic Category I. The cleanup portion of the system is not Seismic Category I. However, all structures, systems, and components required for maintaining water cover for the spent fuel are Seismic Category I. The spent fuel cooling system utilizes some common pump suction and discharge piping which is embedded in concrete.

Specific Evaluation Reference:

Refer to 3.2.1, 3.7, 3.8, 3.9, 3.10, and 9.1.3.

Regulatory Guide 1.30, Rev. 0, August 1972

Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electrical Equipment.

I Design and Construction Phase

Compliance or Alternate Approach Statement:

WNP-2 generally complies with the guidance set forth in this regulatory guide. In a few cases, WNP-2 complied with the intent of this guidance by an alternate approach.

General Compliance or Alternate Approach Assessment:

Procurement documents require compliance with ANSI N45.2.4 for the installation, inspection, and testing activities performed, except in those isolated instances where requirements were entered directly in the specification with limited or no reference to ANSI N45.2.4 or IEEE Std. 336.

Specific Evaluation Reference:

None

II Operational Phase

Compliance is discussed in the Topical Report referenced in 17.2.

Regulatory Guide, 1.31, Rev. 2, May 1977

Control of Ferrite Content in Stainless Steel Weld Metal

Compliance or Alternate Approach Statement:

WNP-2 complies with the intent of the guidance set forth in this regulatory guide by an alternate approach.

General Compliance or Alternate Approach Assessment:

WNP-2 complies fully with Revision 1 of this guide on all contracts initiated after the date of its publication, and no advantage has been taken of the relaxations allowed by Revision 2. Prior to issue of Revision 1, WNP-2 conformed to the original issue of this regulatory guide.

Specific Evaluation Reference:

Refer to 4.5.2.4, 5.3.1.4.1.1, and 5.2.3.4.2.1.

Regulatory Guide 1.45, Rev. 0, May 1973

Reactor Coolant Pressure Boundary Leak Detection Systems

Compliance or Alternate Approach Statement:

WNP-2 complies with intent of the guidance set forth in this regulatory guide by an alternate approach.

General Compliance or Alternate Approach Assessment:

WNP-2 leak detection system provides monitoring in the following areas in compliance with Regulatory Guide 1.45:

a. Primary containment air particulate radiation monitoring

b. Primary containment gas radiation monitoring

c. Primary containment moisture monitoring

d. Primary containment temperature monitoring

e. Primary containment pressure monitoring

f. Intersystem leakage monitoring by means of process radiation monitors

g. Primary containment air cooler flow rate monitoring

h. Sump level and flow monitoring

i. Ambient temperature monitoring in the vicinity of piping containing main steam outside primary containment

The WNP-2 leak detection system indicators, recorders, and annunciators are not seismically qualified.

Specific Evaluation Reference:

Refer to 7.6.2.4.

Regulatory Guide 1.46, Rev. 0, May 1973

Protection Against Pipe Whip Inside Containment

Compliance or Alternate Approach Statement:

WNP-2 complies with the intent of the guidance set forth in this regulatory guide by an alternate approach.

General Compliance or Alternate Approach Assessment:

Pipe break location criteria is based on guidelines provided in the subject regulatory guide, as well as the NRC Branch Technical Positions APCSB 3-1, Appendix B, and MEB 3-1. The subject criteria is applicable to all piping systems inside as well as outside containment. Pipe whip protection for the recirculation system is provided by the NSSS supplier. Pipe whip protection for all other piping systems, including the NSSS-furnished main steam piping, is provided by the AE.

Specific Evaluation Reference:

Refer to 3.6.2.1.

Regulatory Guide 1.62, Rev. 0, October 1973

Manual Initiation of Protective Actions

Compliance or Alternate Approach Statement:

WNP-2 complies with the guidance set forth in this regulatory guide.

General Compliance or Alternate Approach Assessment:

Means are provided in the main control room for the manual initiation of BOP engineered safety feature systems or supporting systems at the division level by the operation of a minimum of equipment.

Specific Evaluation Reference:

Refer to 7.3.2.1.3.

Regulatory Guide 1.63, Rev. 1, May 1977

Electric Penetration Assemblies in Containment Structures for Light-Water-Cooled Nuclear Power Plants

Compliance or Alternate Approach Statement:

Revision 1 is not applicable to WNP-2 since it applies to the evaluation of construction permit applications docketed after December 30, 1977. WNP-2 complies with the guidance set forth in IEEE 317-1972 as modified by Revision 0 of Regulatory Guide 1.63.

General Compliance or Alternate Approach Assessment:

The compliance assessment given below correspond numerically to the Regulatory Positions as indicated in Section C of Regulatory Guide 1.63, Rev. 0, October 1973.

1. Capability of withstanding maximum fault I^2T heating in the case that overload protective devices fail:

   WNP-2 is in compliance with this requirement. In all cases, the overcurrent protective devices in circuits subject to short circuit are backed up by other overcurrent protective devices which are also designed to limit the fault current I^2T heating experienced by the penetration conductors to levels below the conductor ratings.

2. The maximum containment pressure specified for WNP-2 complies with the safety margins required by the ASME Boiler and Pressure Vessel Code, Article N3000, Footnote 1.

3. The position refers to specific applicability or acceptability of other codes, standards and guides covered separately in other regulatory guides.

4. WNP-2 complies with the requirement of IEEE 336 and ANSI N45.2 concerning the quality assurance.

Specific Evaluation Reference:

Refer to 3.8.6.

Refer to the response to Question 040.034 for detailed analysis of primary and backup overcurrent protective device fault clearing capability.

Regulatory Guide 1.70, Rev. 2, September 1975

Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants - LWR Edition

Compliance or Alternate Approach Statement:

This FSAR complies with the guidance set forth in this regulatory guide.

General Compliance or Alternate Approach Assessment:

The FSAR has generally been prepared to satisfy the requirements of Regulatory Guide 1.70, Rev. 2. This includes both format and content.

Specific Evaluation Reference:

The balance of plant portions of this FSAR.

Regulatory Guide 1.71, Rev. 0, December 1973

Welder Qualifications for Areas of Limited Accessibility

Compliance or Alternate Approach Statement:

WNP-2 complies with the intent of the guidance set forth in this regulatory guide by an alternate approach.

General Compliance or Alternate Approach Assessment:

There are few incidents where welding accessibility is limited during field fabrication. Any areas where welding accessibility was limited during shop fabrication were qualified on a "mock-up", and additional microsectioning and X-Ray inspection was done.

Specific Evaluation Reference:

Refer to 4.5.2.4, 5.3.1.4.1.6 and 5.2.3.3.2.4.

Regulatory Guide 1.84, Rev. 9, March 1977

Code Case Acceptability - ASME Section III Design and Fabrication

Compliance or Alternate Approach Statement:

(To be provided at a later date)

General Compliance or Alternate Approach Assessment:

(To be provided at a later date)

Specific Evaluation Reference:

Refer to 3.8.2.2.4.8

Regulatory Guide 1.85, Rev. 11, March 1977

Materials Code Case Acceptability - ASME Section III Division 1.

Compliance or Alternate Approach Statement:

WNP-2 is in full compliance with the guidance set forth in this regulatory guide.

General Compliance or Alternate Approach Assessment:

WNP-2 used the following code cases which are acceptable to the NRC:

1332	Rev. 6	1644	Rev. 6
1557	Rev. 2	1728	
1567			

Specific Evaluation Reference:

Refer to 3.8.2.2.4.9.

Regulatory Guide 1.97, Rev. 0, December 1975

Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant Conditions During and Following an Accident

Compliance or Alternate Approach Statement:

This regulatory guide is not applicable to WNP-2 since it applies to the evaluation of construction permit applications docketed on or after August 1, 1976.

General Compliance or Alternate Approach Assessment:

WNP-2 provides sufficient instruments in the main control room to monitor plant variables and systems during and following an accident. The instrumentation is qualified to remain functional during the worse case environmental conditions that it must monitor. The indicators and recorders are not seismically qualified. Means are provided to monitor the primary containment atmosphere, the spaces containing components for recirculation of loss of coolant accident fluids, effluent discharge paths, and the plant environs for radioactivity that may be released from postulated accidents.

Specific Evaluation Reference:

Refer to 7.5.

Regulatory Guide 1.100, Rev. 0, March 1976

Seismic Qualification of Electric Equipment for Nuclear Power Plants

Regulatory Guide Intent:

Regulatory Guide 1.100 endorses both the requirements and recommendations of IEEE Standard 344-1975, "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations", when such qualification is performed in conjunction with Regulatory Guide 1.89, and subject to the Regulatory position stipulations.

Compliance or Alternate Approach Statement:

This regulatory guide is not applicable to WNP-2 since it applies to the evaluation of construction permit applications docketed after November 15, 1976.

General Compliance or Alternate Approach Assessment:

All Class 1E equipment qualifications will be evaluated against the requirements set forth within IEEE 344-1975. The evaluations will be documented and will demonstrate adequacy of the methods and results of the qualifications as equal or conservative to the requirements of IEEE 344-1975. These will include evaluations of seismic and hydrodynamic load combinations.

Specific Evaluation Reference:

Refer to 3.10.

Regulatory Guide 1.128, Rev. 0, April 1977

Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants.

Compliance or Alternate Approach Statement:

This regulatory guide is not applicable to WNP-2 since it applies to the evaluation of construction permit applications docketed after December 1, 1977. However, WNP-2 complies with the intent of the guidance set forth in this regulatory guide by an alternate approach.

General Compliance or Alternate Approach Assessment:

Safety-related battery installation design criteria conforms to IEEE Standard 484-1975. In addition, HYDROCAPS (catalyst battery caps) are provided to preclude discharge of combustible gases into the battery room area. A Class 1E ventilation system is also provided which is capable of limiting hydrogen concentrations (Neglecting HYDROCAPS) to 1%.

Storage prior to installation was not in strict compliance with subsection 5.1.3 "Storage" of the subject regulatory guide. However, preoperational tests will establish whether or not any damage or loss of capacity resulted from storage.

Specific Evaluation Reference:

8.3.2.1.5
8.3.2.1.6
8.3.2.2.1.1
8.3.2.2.1.2

Regulatory Guide 1.129, Rev. 0, April 1977

Maintenance, Testing and Replacement of Large Lead Storage Batteries for Nuclear Power Plants

Compliance or Alternate Approach Statement:

Although Regulatory Guide 1.129 is not directly applicable to WNP-2, the Supply System's startup testing and future maintenance procedures are written to conform to IEEE Standard 450-1975, "IEEE Recommended Practice for Maintenance, Testing and Replacement of Large Lead Storage Batteries for Generating Stations and Substations". The frequency for "service" testing is in accordance with Regulatory Guide 1.129 - that is, service tests are performed every 18 months.

General Compliance or Alternate Approach Assessment:

None

Specific Evaluation Reference:

None

Regulatory Guide 1.144, Rev. 1, September 1980

Auditing of Quality Assurance Programs for Nuclear Power Plants

I Design and Construction Phase

Compliance or Alternate Approach Statement:

WNP-2 complies with the guidance set forth in this regulatory guide as described below.

General Compliance or Alternate Approach Assessment:

Contractors and Suppliers comply with the requirements imposed by procurement documents.

The Supply System, the Architect/Engineer (Burns and Roe), and the Construction Manager (Bechtel) comply with the guidance set forth in this regulatory guide except for the following:

The requirements of ANSI N45.2.12-1977 as modified and interpreted below:

a. Reference: Standard Section 3.5.2 (Scheduling)

Suppliers that are satisfactorily implementing a Quality Assurance Program based on NRC IE Inspection (VIB), as evidenced by an NRC letter so stating, need not be audited by Bechtel.

b. Reference: Regulatory Section C.3.b (External Audits)

The requirement for external audits shall not apply to procurement actions, such as for standard off-the-shelf items and bulk commodities. Where required, quality can adequately be determined by receipt inspection, source surveillance, or post-installation check-out or test.

c. Reference: Regulatory Section C.4.a (Supplemental Audits)

As an equivalent option to regulatory guide position that would require the mandatory performance of a supplemental audit when any of the conditions of Sections 3.5.3.3 through 3.5.3.5 occur, Bechtel may employ means such as surveillance by inspection personnel, spot checks or investigation by management, quality assurance or engineering personnel in lieu of a supplemental audit for assessing a Quality Assurance program. Sections 3.5.3.3 through 3.5.3.5 will still be considered as guidance in determining if a supplemental audit is necessary.

d. Reference: Regulatory Section C.4.a and Standard Section 3.5.3.6 (Verification)

Delete Standard Section 3.5.3.6. Bechtel's implemenation of Standard Section 4.5.2 will provide adequate coverage of the verification process without resorting to a supplemental audit, audit reports, etc. Verification will be accomplished during the performance of follow-up action by the auditing organization.

e. Reference: Standard Section 4.3.2.4 and 4.5.1 (Investigation)

As an equivalent alternative to the requirement for the audited organization to investigate any adverse audit finding to determine and schedule appropriate corrective action, Bechtel's auditing organization may determine the investigatory action and corrective action including action to prevent recurrence pertinent to adverse audit finding.

f. Reference: Regulatory Section C.7 and Standard Section 5.2 (Audit Records)

Audit records shall include documents as defined in the Standard and other documents if necessary to support audit findings.

Early project procurements specified audit program requirements in terms of Appendix B to 10CFR50 and ANSI N45.2. As appropriate, future procurements will require that audit programs comply with ANSI Standard N45.2.12.

II Operational Phase

Compliance is discussed in the topical report referenced in 17.2.

APPENDIX D

NRC QUESTIONS SUBMITTED AS

SEPARATE VOLUMES

(VOLUMES 21, 22 and 23)

ISSUE: RSB-22 ATWS (15.2.1)

Question:

We require that the applicant agrees to implement plant modifications on a scheduled basis in conformance with the Commission's final resolution of ATWS. In the event that La Salle starts operation before necessary plant modifications are implemented, we require some interim actions be taken by La Salle in order to further reduce the risk from ATWS events. The applicant will be required to:

a. Develop emergency procedures to train operators to recognize an ATWS event, including consideration of scram indicators, rod position indicators, flux monitors, vessel level and pressure indicators, relief valve and isolation valve indicators, and containment temperature, pressure, and radiation indicators.

b. Train operators to take action in the event of an ATWS including consideration of immediately manual scramming the reactor by using the manual scram buttoms followed by changing rod scram switches to the scram position, stripping the feeder breakers on the reactor protection system power distribution buses, opening the scram discharge volume drain valve, prompt actuation of the standby liquid control system, and prompt placement of the RHR in the pool cooling mode to reduce the severity of the containment conditions.

Response:

The Supply System has committed to implement the modifications outlined in a petition for rulemaking and supplement filed by the Utility Group on ATWS on September 16, 1980 and January 5, 1981, respectively. The petition and supplement were noticed in the Federal Register on November 4, 1980 (45 Federal Register 73080) and February 3, 1981 (46 Federal Register 10501), respectively.

The modifications will include the following:

a. Recirculation pump trip (RPT) of the approved Zimmer design.

b. Alternate rod insertion (ARI), which is diverse and independent from the RPS. This system will comply with IEEE-279 and will act as a backup to the electrical portion of the current scram system.

c. Modification to the scram discharge volume to provide redundant and diverse scram instrumentation.

Although we believe the modifications addressed above will improve system reliability so as to essentially preclude ATWS events, we will implement emergency procedures to train operators to recognize ATWS events and take action to mitigate them.

WNP-2 currently plans to implement the above modifications and procedures by fuel load.

Q. 005.1

In order that we might evaluate your compliance with the Codes and Standards Rule, Section 50.55a of 10CFR Part 50, identify the edition Section III of the ASME Boiler and Pressure Vessel Code and the applicable code addenda for the following Quality Group A components within the reactor coolant pressure boundary identified in Table 3.2-1 of the FSAR. These components are: (1) the reactor pressure vessel; (2) the main steam and feedwater piping inboard of the outermost isolation valves; (3) the piping of other interconnecting systems inboard of the outermost isolation valves; (4) the main steam isolation valves; (5) the explosive valves of the standby liquid control systems; and (6) the system or isolation valves of other interconnecting systems.

Response:

Please see the attached Table 5.5-1.

TABLE 5.1-1

Requested Item Per Question	WNP-2 Installation	Applicable Code Per 10CFR 50.55(a)*	Purchase Order Date	Actual Code Used
1) Reactor Pressure Vessel	N/A	1971 code, no addenda	11/71	1971 code, summer '71 addenda (para. NB 3338.2 is Winter '71 addenda)
2) Main Steam & Feed-water Piping	Shop Fabricated	1971 code, Winter '73 addenda	10/74	1971 code, Winter '73 addenda
	Field Fabricated	1971 code, Summer '73 addenda	5/74	1971 code, Winter '73 addenda
	Main Steam	1971 code, Winter '71 addenda	9/72	1971 code, Summer '72 addenda
3) Piping of Inter-connecting Systems	Shop Fabricated	Same as (2)		
	Field Fabricated	Same as (2)		
	Recirc System Piping**			
4) MSIV's	N/A	1971 code, Summer '71 addenda	4/71	1971 code, Winter '71 addenda
5) SLCS Explosive Valves	N/A	1971 code, Winter '72 addenda	12/73	1971 code, Winter '72 addenda
6) Other Valves of Interconnecting Systems	Velan Valves I	1971 code, Summer '73 addenda	1/74	1971 code, Winter '73 addenda
	Anchor Darling Valves	1971 code, Winter '72 addenda	7/73	1971 code, Winter '73 addenda
	Velan Valves II	1971 code, Summer '72 addenda	1/73	1971 code, Winter '72 addenda
	Borg-Warner Valves	1971 code, Summer '73 addenda	5/74	1971 code, Winter '73 addenda
	Recirc and Crosby Valves**			

* CP issued 3/73

** See Table 5.2-5 of the FSAR

005.001-2

Q. 010.035
(3.4.1)

The FSAR states that the "Seismic Category I piping and electrical conduit penetrations that are below grade ... are ... not sealed against groundwater pressure." Demonstrate that the safety functions would not be compromised by water flowing into the building through these piping and conduit penetrations as the result of the following events:

a. Another compartment is flooded and water is flowing out of the building through the piping and conduit penetrations, resulting in saturated ground conditions.

b. A non-Seismic Category I tank ruptures, emptying all of its contents.

Response:

Please refer to revised 3.4.1.4.2, page 3.4-4 for the information requested.

The design and installation of the boots at pipe penetrations and of the silicon foam at conduit penetrations, described in 3.4.1.4.2, provide waterproof penetrations that are capable of preventing the compromise of safety functions by events such as those stated in the question.

The response to Question 010.010 has been similarly revised.

Q. 010.036
(3.5.1)
RSP

It is the Staff's position that all safety-related equipment shall be appropriately protected against the effects of internally generated missiles in accordance with Title 10, Code of Federal Regulations Part 50, Appendix A, General Design Criteria 4. The effects of internally generated missiles such as valves stems, bonnets, control rod drive mechanisms, and high pressure accumulators impacting onto safety-related equipment must be evaluated. Appropriate protection must be provided to assure that a missile will not prevent a safe shutdown of the plant or result in uncontrolled release of radioactivity during normal operation or during the most severe design basis accident with the most limiting single active failure. Describe the means provided for assuring protection of safety-related equipment from all internally generated missiles.

Response:

The means for assuring protection of safety-related equipment from all internally generated missiles will be discussed in updated 3.5, as outlined below:

Evaluation of Postulated Missiles

A. Assessment of Postulated Missile Credibility

Postulated missiles are analyzed to determine if a credible failure mode resulting in a missile exists. Failure modes determined to be credible are then assessed for impact on plant safe shutdown.

B. Assessment of Potential Credible Missile Damage

The ability of the plant to achieve safe shutdown is assumed by physical separation and redundancy of safety-related systems. The adequacy of the physical separation and redundancy of safety-related systems was evaluated using the following procedure:

(1) Target Determination

Based on the missile location and orientation, the target areas are predicted. Trajectories are selected to encompass the most adverse conditions. The essential systems within that region are assumed damaged and not available for a safe shutdown.

Q. 010.037
(3.5.1.2)

Regulatory Guide 1.70, Revision 3, Section 3.5.1.2, requires that the structures, systems, and components protected by physical barriers shold be identified. The discussion and the figures in the FSAR do not indicate where, if it all, physical missile barriers are used.

Identify all structures, systems, and components that are protected by physical barriers. Provide a description of the types of physical barriers that are employed at your plant.

Response:

The updated FSAR 3.5, submitted in June 1982, will identify all structures, systems, and components in the plant which are protected by missile barriers. Safety-related systems and equipment outside the primary containment are located in isolating compartments by division. The walls of these compartments are designed to contain all postulated missiles intrenal to the compartment and to protect against missiles originating outside the compartment.

External walls providing protection from missiles external to the plant are described in FSAR 3.8.4. FSAR Figure 3.5-36 illustrates these walls. Spray ponds and piping are protected by earth cover barriers. Exterior openings for HVAC systems are protected from transmitting missiles by labyrinths of missile shield walls. These openings are listed in FSAR Table 3.6-6. Barrier design procedures will be discussed in FSAR 3.5 as follows:

I. BARRIER DESIGN PROCEDURES

The design objectives emphasize missile containment and structural integrity without secondary missile generation.

a. Concrete Barriers

Concrete missile barriers are designed in accordance with the modified Petry equation (Reference 3.5-2). In all cases, except for barriers exposed to turbine missiles, a concrete thickness of twice the penetration thickness determined for an infinitely thick slab is provided to prevent perforation, spalling or scabbing. For discussion of turbine generator missiles see 3.5.1.3.

b. Steel Barriers

The Ballistic Research Laboratories Formula (Reference 3.5-1) is used to determine penetration depths of missiles into steel barriers.

The overall response of bariers subject to impact are investigated by the use of general energy equations given in "Introduction to Structural Dynamics", J. M. Bigs (Reference 3.5-9). Upon determination of penetration depth and duration of impact, an effective dynamic force is computed. The additional calculation of the natural period of the target structure and the selection of a ductility ratio facilitates the determination of the required structural resistance. In this manner, missile impact is translated to an equivalent static load in an effort to quantify bending moments and shear. The detailed method used for predicting the overall response of missile barriers, including the forcing function method of determining ductility in structural elements and the basis for the ductility ratios used in the calculations, is provided in Appendix C of the report "Protection Against Pipe Breaks Outside Containment" (Reference 3.5-13) that was presented to and approved by the NRC.

c. Earth Barriers

When the protective barrier is of earthen origin, the soil penetration studies are based on alternate techniques. Buried safety-related piping and electrical systems required for a safe shutdown are ensured adequate protection from tornado generated missiles. Analysis of potnetial damage is performed using the "Tornado Design Considerations for Nuclear Power Plants" by Bates and Swanson, 1976 (Reference 3.5-8). The analysis procedure neglects soil interlocking under a suddenly applied load and ignores lateral soil resistance. A 5-foot embedment depth is calculated to be acceptable to ensure pipe integrity.

d. Applications

Examples of barrier design are as follows:

Steel covers for manholes containing cabling for safety-related equipment required for safe shutdown are designed to withstand tornado generated missile impact and associated wind-pressure. These 2'-9" circular steel plates are designed using conventional elastic analysis and design methods for determining stress and strain. The design adopted uses two 1-1/8-inch plates of ASTM A 514 steel plate to prevent penetration and blowout.

The reactor building railroad airlock exterior doors and the standby service water pumphouse exterior equipment doors are designed and certified by the manufacturer to withstand the effects of tornado generated exterior missiles as described in 3.5.1.4.

All other doors in Seismic Category I and safety-related structures are not designed to withstand the effects of the missiles described in 3.5.1. These doors are backed up, wherever missile protection is required, with reinforced concrete walls forming a labyrinth behind the door. Similarly, louvers in exterior walls, which are vulnerable to missile penetration are backed up by reinforced concrete plenums or walls.

Based upon the selection and description of missiles cited in 3.5.1, the interaction of missiles with structural elements is determined and the results are given in Table 3.5-5. The tabulations assume the missiles to impact at the most vulnerable point of a structure or component (e.g., at the center of a slab).

The reactor protection system motor-generator sets flywheels located in the critical DC switchgear rooms at elevation 467'-0" in the Radwaste Building were analyzed and determined to be credible missile sources, with the potential consequences affecting the safe shutdown of the plant. Barriers were constructed around these flywheels of steel and aluminum honeycomb material, which were designed to contain the credible missiles.

Q. 010.038
(3.5.1.2)

Section 3.5.1.1.2 of the FSAR states that missile trajectories are selected to encompass the most adverse conditions. It is not clear from the information provided in the FSAR what the trajectories of the credible primary missiles would be and what systems might be disabled by the missiles.

Provide the bases for selection of the probable missile trajectories and show the trajectories on the appropriate FSAR figure. Include a discussion on the system, component, or structure that could be damaged or disabled by a missile. The extent of damage from each missile should be discussed.

Response:

The basis of selection of the probable missile trajectories utilizes SRP 3.6.1 and 3.6.2 which outlines the procedures for trajectories of jets. For rotating missiles, a 10° divergence angle is assumed in addition to their possible path.

A discussion of the analytical approach is provided in the response to Question 010.036 and a tabulation of credible missiles will be provided in the June 1982 submittal of an updated FSAR 3.5.

Q. 010.065
(10.4.5)

Your responses to Question 010.034 regarding the potential flooding of safety-related equipment due to a circulating water failure are inadequate. An analysis shall be conducted in accordance with Standard Review Plan 10.4.5, "Circulating Water System," which assumes:

a. An expansion joint break (note: an incident of this type occurred at an operating BWR).

b. No credit shall be taken for isolation valve closure unless these valves are designed to safety grade requirements.

Response:

Please see revised 10.4.5.3.

Q. 010.066
(4.6)

NUREG-0803 states that pipe breaks in the control rod drive hydraulic system and the resulting environmental effects should be verified on a plant specific basis. In order to conform to the guidelines of NUREG-0803, provide information to address the following concerns:

I. Taking no credit for seals and assuming no operator actions inside of the control room for 20 minutes (30 minutes for the first operator action outside of the control room plus five minutes for each additional action), provide the following information for a non-isolable break in the CRD piping between the containment penetration and the first isolation valve.

Reactor Coolant	- Mass flow rate out of the break as a function of time (= f (t))
	- Temperature = f (t)
Compartment	- Temperature = f (t)
	- Pressure = f (t)
	- Humidity = f (t)
	- Airborne Radioactivity Level = F (t)

Provide the assumptions used in determining the above information. If a computer was used, provide the computer printout and the following information:

1. With respect to the pipe to be broken:

   a. Type of fluid (water or steam);

   b. Temperature;

   c. Pressure;

   d. Source of the fluid;

   e. Flow rate (or assumed flow rate);

   f. Pipe internal diameter;

   g. Wetted perimeter of the break (feet);

   h. Total pipe internal volume;

   i. Exit flow area, if the break was not in the pipe, just described above;

j. Area of flow restriction, if any;

k. Differential elevation from the source to the pipe break;

l. Total flow resistance (only if the fluid is water);

m. Means to stop fluid flow (none, gate valve, globe valve, etc.); and

n. If 1.m is a valve, then the valve's open throat area, full open flow coefficient, valve closure time, and delay time until initiation of valve closure.

2. With respect to the compartments being analyzed:

a. Number of compartment analyzed; and

b. For each compartment:

i. initial temperature;
ii. initial pressure;
iii. initial humidity;
iv. free air volume (cubic feet);
v. number of vents and vent areas (square feet) for each vent; and
vi. minimum pressure to initiate flow to the next compartment (psia).

3. All assumptions used, including but not limited to the:

a. Orifice coefficient for the "end effects" for the discharge fluid; and

b. Fluid expansion factor.

II. Verify that all electrical and mechanical equipment needed to mitigate the event is qualified to the environmental conditions determined in Part I. Verify that no pump cavitation will occur when pumping 212°F water.

III. Provide a discussion of the procedural steps to be taken to isolate the break in the CRD pipe at the outside surface penetration of containment to terminate the small pipe LOCA accident. Identify all equipment and materials required to isolate the break. Provide a commitment to maintain onsite these items as dedicated equipment and materials. Discuss your procedure to verify periodically the existence and condition of these dedicated items.

IV. Assuming that the sumps are inoperative for the event in Part I (since they are not Seismic Category I, Class 1E), provide maximum water level in the compartment. Verify that no equipment required to bring the plant to a safe condition will fail as the result of internal flooding. Verify that no personnel radiation hazard will exist due to wading through reactor coolant.

V. Verify that all analysis performed in Parts I and IV includes time for the items listed below. The first action outside of the control room should be assumed to be at least 30 minutes after annunciation in the control room plus five minutes for each personnel action in accordance with ANS 58.8. Installing scaffolding requires multiple actions just like donning protective garb.

1. HP survey of the area and documentation;

2. Establishment of protective garb requirements;

3. Establishment of change areas, clean areas, check-in and check-out lists, waste disposal and facilities and transportation of necessary garb to the area for the workers;

4. Following all HP procedures;

5. Review of repair procedures;

Assume that the event occurs with the minimum plant personnel available on any shift.

Response:

Following the Supply System submittal responding to NUREG-0803 concerns (Reference 1 and 2), the NRC is requesting, via NRC Question 010.066 (4.6), that the Supply System evaluate a single CRD withdrawal line break at a specified location. However, according to the NRC's own NUREG-0803:

> From page 2-2 . . . This assessment is based on the fact that the CRD withdraw lines penetrating the containment and routed to the HCUs are small in diameter (3/4 in.) and are conservatively designed and of high quality. Nevertheless, even if the staff postulated a break in one of these lines during reactor operation (including scram):

(1) The leakage through this break is within the reactor coolant makeup capabilities (feedwater and reactor core isolation cooling) since, as required by GDC 14, "Reactor Coolant Pressure Boundary," the CRD system contains redundant CRD seals and a restricted flow area that limits the reactor coolant leakage to a very small value;

(2) The reactor can be shut down and cooled down in an orderly manner; and

(3) No leakage from the SDV, where flow from all other CRD withdraw lines is accumulated following scram, will occur through the break because of the existence of a check valve between the SDV and the withdraw line manual isolation valves.

and from page 4-27 . . . Breaks upstream from the isolation valves in the 3/4-inch piping were judged to be minor in size and with no potential short-term effects on the core cooling capability.

The Supply System agrees that a single CRD withdrawal line rupture event is minor and fully enveloped by existing analyses. For example, an instrument line rupture, 15.6.2 and 6.3.3, presents a similar type break, but with larger leak flow and more severe consequences. However, as requested in NRC Question 010.066 (4.6), evaluation of the single CRD withdrawal line rupture is presented in the following paragraphs to provide the NRC reviewers with quantification of the event to support the already recognized conclusions stated above.

Question 010.066 contains five parts (I through V) and each section or part is addressed separately below:

I. A simplified diagram of the postulated line rupture is shown in Figure 010.066-1. It is assumed that a complete severence of a withdrawal line occurs, following a reactor scram, at a location between the reactor containment and the first isolation valve (in HCU). There is no back-flow through the break due to a check valve between the break location and the scram discharge volume (SDV). Therefore, the only leak out of the break is the reactor coolant that can leak around the CRD piston seals. This leakage is normally about 2 gpm and can be as high as 6 gpm with badly worn seals. The stipulation in the Question 010.066 above that no credit for seals be taken is an unrealistic conservatism. However, GE tests show that with seals completely missing, at operating pressure, the leakage is a maximum of 10 gpm. This value is used as the initial leak rate.

The scenario can be defined as follows:

Time	Event Description
0	Reactor scrams. Complete severence of a single CRD withdrawal line occurs.
20 mins.	Operator initiates cooldown at 100°F/hr due to leakage exceeding tech spec values.
240 mins. (3.8 hr.)	Reactor on RHR with RC temp ≤ 200°F

The analysis assumptions and results are presented below in the same order and numbering system used in the question.

1. a. Type of fluid: Water

   b. Temperature: } See Figure 010.066-2

   c. Pressure: }

   d. Source of fluid: Reactor vessel

   e. Flow rate: See Figure 010.066-3

   f. Pipe internal diameter: }

   g. Wetted perimeter: }

   h. Total pipe internal volume: } Not applicable, see Item 1.j below.

   i. Exit flow area: }

   j. Area of flow restriction: 1.19×10^{-4} ft^2 - equivalent area for 10 gpm leak at 1000 psia.

   k. Differential elevation: See Figure 010.066-1

   l. Total flow resistance: Total pipe resistance was neglected for the low flow rates encountered. The hydrostatic analysis accounted for orifice pressure drop at the CRD, see Item 3.a below.

m. Means to stop fluid flow: Mechanical plugging at operator's discretion, see Part III below.

n. Not applicable.

2. With respect to the compartments being analyzed:

a.} b.} Compartment pressure and temperature were not analyzed for two reasons. First, as stated in our original response to NUREG-0803, no equipment necessary to achieve cold shutdown following a scram is located at the 522' level; therefore, compartment conditions for equipment qualification is not a concern. Secondly, the integrated leak mass at 3.8 hours is only 9370 lbm which, even if held to the 522' compartment, would not significantly affect pressure or temperature. After 3.8 hours, any leakage (< 2 gpm) is at a temperature of less than 200°F and has negligible effect.

3. All assumptions used, including but not limited to the:

a. Orifice coefficient: Moody critical flow was assumed out to 3.8 hours for an area equivalent to no seals and 10 gpm initial flow. For the hydrostatic pressure difference analysis, an orifice equation was used with a discharge coefficient of 0.7.

b. Fluid expansion factor: Not applicable.

II. As stated in Part I.2 above, no equipment necessary for safe shutdown following scram is located in this area, therefore, environmental qualification is not an issue. The Supply System interprets ". . . no pump cavitation . . ." to refer to the sump pump to which the reactor leakage drains (see Figure 010.066-1). If the total leakage (assuming no flashing) drains to the sump, its water level would be 0.2". Therefore, pump cavitation is not an issue as the sump pumps are not required to prevent flooding.

III. After 3.8 hours the leak is reduced to ≤ 1.7 gpm and 200°F water from the severed withdrawal line. It should be noted that a leak of 1.7 gpm is possible only by neglecting all withdrawal line losses and assuming no CRD piston seals exist. The realistic flow rate would be much less. A temporary fix could be effected easily by plugging or freeze sealing the tube. Since a permanent fix becomes a question of availability and the total scenario given in Part I indicates no safety questions pertain to the incident, the Supply System does not feel a commitment to maintain and verify the existence of the equipment necessary to fix a leak of less than 1.7 gpm is prudent nor necessary.

IV. See response to Part II of this question regarding water level and equipment necessary to achieve a cold shutdown. With the leak at < 2 gpm and floor drains available, no personnel will be required to 'wade' through reactor coolant. As was true for Part III of this question, it is a matter of plant availability, not public health and safety, as to when personnel would enter. Access to the area can be controlled since no time constraints are imposed for stopping a leak of this magnitude.

V. Parts III, IV, and V of this question carry the connotation that this scenario should be reacted to on the old event-based procedure basis. WNP-2 has formulated its secondary containment response activities in accordance with the BWR Owner Group symptom based procedures which adequately cover coolant leakage events including small leaks such as postulated here. As mentioned in Parts III and IV of this question, it would not be meaningful to assign times to each action as the mitigation function can be done according to availability determination and is not a question of necessity for public health and safety.

Response:

The WNP-2 design requirement as described in this response has been replaced by the equation in Question 022.078 and described in revised 6.2.5. This letter formulation is more conservative than the one previously used by the WNP-2 project.

A review of tests conducted to date on aluminum, zinc, and zinc coatings, indicates that several factors which would tend to mitigate the evolution of hydrogen following a postulated loss-of-coolant accident have not been reported or have not been investigated. A brief explanation, therefore, is required to substantiate the rationale for the conclusions drawn in this response.

Question 022.048 asks a question with respect to the corrosion of aluminum and the subsequent evolution of hydrogen. The water chemistry of WNP-2 is such that the water is free from additives and is neutral, i.e., a pH of 6.5-7.5.

With reference to aluminum, Uhlig[1] states: "Aluminum base alloys are not appreciably affected by distilled water even at elevated temperatures (up to 180°C (350°F) at least). Furthermore, distilled water is not contaminated by contact with most aluminum base alloys."

Uhlig[2] states: "Condensate from steam boilers, if free from carryover of water from the boiler, is similarly inert to aluminum base alloys. Thus, either wrought or cast aluminum alloys are used successfully for steam radiators as unit heaters. Where aluminum alloys are used it is desirable to install suitable traps in the seam lines, since entrapped boiler water, especially if alkaline water treating compounds are employed, may be corrosive."

Uhlig[3] states: "Steam causes a definite protective white film to form on aluminum alloys. This film is highly protective at temperatures up to 180° to 350°C (350° to 500°F). At temperatures above this range, under some conditions at least, the steam reacts with aluminum with the formation of aluminum oxide and hydrogen."

Experimental data from the aforementioned references indicate that aluminum and aluminum alloys are nonreactive with pure water and/or steam at temperatures up to and including 500°F. Aluminum rapidly forms a protective oxide film, in oxygen containing atmospheres, which is insoluble in neutral water or steam. Since the containment is noninerted, there is free access to oxygen during operation and has been throughout construction. The oxygen has reacted with the aluminum to form the protective tight adherent water insoluble and nonreacting film, which eliminates the case of hydrogen evolution at the temperature and/or environment present during or following a postulated loss-of-coolant accident.

Question 022.048 also addresses the corrosion of zinc and zinc base paints and the evolution of hydrogen following a loss-of-coolant accident.

Hubbell and Finkeldy[4] stated: "Like several other metals which exhibit marked resistance to corrosion in the atmospher bright zinc rapidly tranishes when first exposed, forming a smooth, tightly adherent protective film. The film is apparently a combination of zinc oxide, zinc carbonate and zinc hydroxide. It is not readily soluble in ordinary atmospheric waters nor easily destroyed by other atmospheric agencies.

The film varies in thickness depending upon the exposure conditions, probably reaching a maximum thickness of .003 in. If removed or worn thin by abrasion, it is renewed in a few days to its original thickness."

McKay and Worthington[5] state in their chapter on Defining Non-Corrosive Neutral Range of Aqueous Solutions: "Zinc has useful resistance only in a relatively narrow, neutral range of solution; this resistance being due in the simplest case to a protective film of hydrate, abetted in the case of impure solutions by other precipitatd corrosion products and compounds deposited from solution. The hydrate is soluble on both the acid and alkaline sides of this neutral zone.

Work by Roetheli, Cox and Litteral has very effectively drawn the limits of the neutral, hydrateforming zone in tests in distilled water with hydrochloric used to throw the solution acid and/sodium hydroxide alkaline. The solutions were kept rather strongly agitated." Figure 6.2-21 depicts the results.

McKay and Worthington[6] explain that: "The hydrate is seen to have been most protective between the neutral point of pH=7 and pH-12.5. The fact is brought out that the exact shape and location of this curve is typical probably only of the particular set of conditions under which the tests were made. Factors such as agitation, aeration, salts in the solution, and temperature, in conjunction with hydrogen-ion concentration, affect the characteristics of film formation. The investigators conclude in a universal sense the condition of low or negligible corrosion probably lies between pH values of 6 and 8 as a minimum and 11 as a maximum."

Cox[7] in a paper titled "Effect of Temperature on the Corrosion of Zinc", established the effect of temperature on the behavior of zinc in distilled water. The specimens were constantly in motion in the solution, and the solution was aerated with a stream of unwashed air bubbles. The duration of the test was 15 days.

Q. 031.013 (RSP)
(6.3.1.3)
(7.3.1.1)

Provide justification for not testing the emergency core cooling system flow rate and the associated sensing networks during normal operation. Define the term "sensing network" as used in 6.3.1.3 of the FSAR. Identify each network which cannot be tested during normal operations. It is the staff's position that the WNP-2 design should provide engineered safety feature circuits which satisfy the guidance contained in Regulatory Guide 1.22. Accordingly, we require you to provide a revised design which conforms with the staff's position on this matter and to provide a description of these sensors and networks which provides the information requested in 7.3 of the Standard Format. Clarify the discrepancy between 6.3.1.3 and 7.3.1.1.1.2.1.2 with regard to the testability of the emergency core cooling system.

Response:

Section 6.3.1.3 was in error. The text of 6.3.1.1.2(m) and 7.3.2.1.2.3.1.10 have been revised to reflect that all active components of the ECCS are testable during normal operation.

Amendment 10, revising Chapter 7, replaced 7.3.2.1.2.3.1.10 with 7.3.2.1.2.a.10 which references 7.3.2.1.3.a for the discussion of ECCS testability.

Q. 031.014
(6.3.2.2)
(6.3.2.8)
(F6.3-1a)

The location of sensors LS N001 A, B, C, and D, as shown in Figure 6.3-1a, does not appear to meet Seismic Category I requirements. Revise the design of WNP-2 to assure that the sensors controlling the transfer of suction to the suppression pool will be seismically and environmentally qualified for their location and environment.

Response:

Condensate storage tank pressure sensors used for level switches are designed and qualified to Seismic Category I requirements and are environmentally qualified. For further details see responses to Questions 031.128, 211.146, and 211.197.

Q. 040.25
(9.5.7)

Describe the measures incorporated in the WNP-2 facility to prevent entry of deleterious materials into the engine lubrication oil system due to operator error either during recharging of the lubricating oil or during normal operation.

RESPONSE:

The text of 9.5.7.2 has been revised to incorporate the response to this question.

Q. 040.026

Provide the results of an analysis demonstrating that the function of the diesel engine air intake system will not be degraded to an extent which prevents the diesel from developing its full rated power or cause shutdown of the diesel as a consequence of any meteorological or accident condition. Include in this discussion, the potential for the following materials being drawn into the diesel air intake: (a) gaseous (e.g., carbon dioxide) fire extinguishing materials; (b) recirculation of diesel combustion products; (c) accidental release of gases transported or stored in the vicinity of the diesel intakes, and (d) airborne dust. Discuss any potential restriction of the airflow to the diesel intakes. Discuss the effects of these phenomena.

Response:

a. Each diesel generator is located in a separate fire area and is protected by a fixed water fire suppression system*. Heat and smoke generated from a fire would be controlled by discharging them to the atmosphere from a penthouse above the diesel generator building roof. Damper and fan controls on the diesel generator room HVAC system insures that smoke would be discharged via this path. There are no fire dampers in the discharge path which could potentially block the exhaust. The inlet dampers are interlocked with the applicable supply fan to close the outside air inlet if the supply fan is not operating. The centerline of the discharge opening is approximately 30 feet above the intake opening and there is a 65-foot horizontal separation.

Chapter 2.3 indicates a bimodel wind occurance following south and northwest flow patterns. A southerly wind direction would push smoke gases away from the air intake opening. As the wind direction changes to the northwest pattern, the presence of the reactor and radwaste buildings considerably alter the flow pattern over the downwind diesel generator building. The 195-foot

* The consequences of fires in the diesel generator rooms have been evaluated in accordance with Appendix R of 10CFR50. See the WNP-2 Fire Protection Evaluation submitted with Amendment No. 19 to the FSAR (October, 1981).

11. Cathodic protection surveillance

    a) 12 month check to insure protection is adequate.

    b) Test leads maintained to allow periodic testing.

    c) 2 month inspection of cathodic protection rectifiers.

    d) Maintain records of these tests.

WNP-2 intends to meet the requirements previously outlined with the exception of the following:

WNP-2 has taken exception to cleaning the storage tanks at 10-year intervals. (B.9) Periodic sampling for sediment content in the fuel should indicate if sediment at the bottom is becoming excessive. WNP-2 commits to filtering or replacing the fuel if it does not meet the specifications. Cleaning of the tank will be accomplished if it is found necessary to replace the fuel.

WNP-2 takes exception to item 11, which outlines cathodic protection surveillance. The standby diesel fuel oil storage tanks are protected with cathodic protection by anodes which are located in the near vicinity, but there are no pigtails connected to the fuel oil system piping, thus no leads to maintain. Cathodic protection is an independent system at WNP-2 and surveillance should not be scoped into the diesel fuel oil system surveillance.

WNP-2 Operations concur with the intent of Regulatory Guide 1.137, concerning the method of adding fuel to the storage tanks. WNP-2 must, however, take exception to this recommendation as it now stands. Situations may ocur where both standby diesel generators are in long term operation. Although this situation is not expected to occur frequently it is a possibility. Thus we feel an unqualified commitment to this issue is too restrictive. WNP-2 will, however, when refueling during normal plant status, comply with this requirement.

Pigtails attached to the system piping are used to identify the amount of corrosion which has taken place. No pigtails are attached to D-G system piping. Cathodic protection rectifiers are maintained as an independent system.

Q. 40.48
RSP
(9.5.4)

In Figure 9.5-4 of the FSAR, you identify the 1/2 inch minimum flow line, DO(6)-1, as non-safety class G piping. This is unacceptable. Accordingly, we require this line to be designed to Seismic Category I criteria and satisfy the requirements for safety Class 3. Revise you design accordingly.

Response:

The 1/2 inch minimum flow line DO(6)-1 is designed to Seismic Category I, ASME Section III, Class 3 and Quality Class I. This is as indicated by note 2 on Figure 9.5-4. The color coding shall be used for general information only. Any discrepancy between color coding and "Note" on drawing, the "Note" shall rule.

ASME Section III, 3	ANSI B31.1
1) Requires ASME material and mill test reports for piping.	1) Requires only material certifications.
2) Requires seismic design in addition to the B31.1 requirements.	2) Requires design for pressure, temperature, and normal operating loads.
3) Requires liquid penetrant examination for welds over 4" IPS.	3) Requires only visual inspection of welds for design pressure and temperatures of the auxiliaries.
4) Requires hydrostatic test to 1.25 x design pressure.	4) Requires initial service leak test

The diesel generator auxiliaries are separated into three different segments for design and manufacture, as shown on Figure 9.5-4:

a) The auxiliaries that were supplied as part of the diesel engine skid and diesel starting air skid.

b) The fuel oil storage tanks and day tanks (provided by a tank fabricator).

c) The piping that connects the DSA skid with the engine skid, the cooling water reservoir tank to the cooling water heat exchanger and the diesel engine air intake and exhaust (designed by the Architect/Engineer and supplied and installed by the mechanical contractor).

A discussion of each segment follows:

Diesel Engine and Diesel Starting Air (DSA) Skid

The diesel generator units and their skid-mounted auxiliary systems are designed, fabricated, shop installed, inspected, examined, and tested in accordance with the commitments in Table 3.2-1, "Equipment Classification."

The engine-mounted piping and components of the fuel oil, engine cooling water (except heat exchangers - ASME Section III, Class 3), starting air and lubricating oil systems are seismically qualified to Category I requirements as part of the diesel engine skid. These systems, furnished with the engine, are the standard systems developed by the engine manufacturer in accordance with DEMA standards, and have a long history of service and reliability. These systems, piping, and components, are designed, fabricated, inspected, installed, examined, and tested in accordance with the guidelines and requirements of ANSI B31.1 and are specified as Quality Class I.

It should be also noted that it is not possible to obtain all auxiliary components to ASME Section III, Class 3 requirements. For example, the diesel oil pump, lubricating oil pump, filters and flex hoses could not be purchased to ASME Section III, Class 3, since they are unique to engine component manufacturers, which do not manufacture to ASME Section III, Class 3 requirements.

For the engine skid and DSA skid, the technical differences between ANSI B31.1 and ASME Section III, Class 3 are largely closed by the specification of Quality Class I and Seismic Category I. The technical differences are delineated in the following, formatted consistent with the above table. (Technical differences are distinguished from the Section III, Class 3 administrative requirements in that a technical difference will result in a difference in construction, whereas an administrative requirement provides additional paper evidence the work was done in accordance with the Code.)

1) By specifying Quality Class I, the Supply System obtained mill test reports for the piping and material certifications for the components. The piping materials meet the material requirements of ASME Section III, Class 2 materials and the components are to standards recognized by ASME Section III, Class 3.

2) By specifying the skids to be Seismic Category I, the skids and auxiliaries on them will withstand a seismic event.

3) The only piping on the diesel engine skids that is over 4 inches is the 6-inch lines between the cooling water heat exchanger, expansion tank, and engine block. These have not been liquid penetrant examined.

4) The engine auxiliary systems will be at operating pressure for a considerable period of time throughout plant startup testing and thus, will provide a good test of their leak tightness before the systems are put into operation. Because of the overspecified design pressure of the components and piping, the chance for leakage at other than mechanical joints is low. The expansion tank was

Q. 110.003
(3.6.1)

Describe in 3.6.1.11.2 of the FSAR, how you evaluate the environmental effects of leakage cracks in high energy fluid systems postulated in accordance with the criteria contained in 3.6.2.1.3 and 3.6.2.1.4.2.

Response:

Leakage cracks in high energy piping are not postulated since the environmental and flooding effects of high energy pipe breaks are considered as described in 3.6.1.11, and are bounding. The FSAR will be revised to reflect the results after the current pipe break and missile evaluation has been completed.

Q. 110.004
(3.6.1)

Expand Section 3.6.1.11.3.1 of the FSAR to: (1) provide justification for not assuming the simultaneous malfunction of equipment in one or more contiguous grids; (2) describe your procedures to evaluate the effects of flooding which are discussed in Section 3.6.2.1.4.2.c of the FSAR.

Response:

Environmental and flooding effects resulting from moderate energy piping failures are not assumed to be confined by grid boundaries. Refer to revised 3.6.1.11 and 3.6.1.15 for the methods of analysis to evaluate the effects of flooding. The "grid" concept is not used in the current pipe break evaluation.

In addition, provide a description of the augmented inservice inspection (ISI) program to be implemented including scheduled surface examination, ultrasonic testing and verification of the leak tight integrity of the joint between the thermal sleeve and the safe end on all nozzles. The essential elements of an acceptable program are given in the Appendix attached to this set of questions.

Response:

A description of the WNP-2 feedwater nozzle and sparger is presented on Figures 121.8-1 and 121.8-2.

The mechanisms which have caused a cracking in operating BWRs are understood. A summary discussion of problems and the solutions incorporated in the WNP-2 design is presented in the following.

A detailed evaluation of the problems of the feedwater nozzle and sparger is presented in NEDE-21821 "BWR Feedwater Nozzle/ Sparter Final Report" March 1978. The solution of the feedwater nozzle and sparger cracking problems involves several elements, including material selection and processing, nozzle clad elimination, and thermal sleeve and sparger redesign. The following summarizes the problems and solutions that have been implemented in the WNP-2 design.

PROBLEM	CAUSE	FIX
Sparger Arm Cracks	Vibration	Eliminate clearance between thermal sleeve and safe end.
RPV Feedwater Nozzle	Thermal Fatigue	Eliminate clad, eliminate leakage with a welded joint between the sparger and safe end.

The sparger vibration has been attributed to a self-excitation caused by instability of leakage flow through the annular clearance between the thermal sleeve and safe end. Tests have shown that the vibration is eliminated if the clearance is reduced sufficiently or sealed. The solution which has been selected for WNP-2 uses a welded joint to assure no leakage. This feature is also an essential part of the solution of the nozzle cracking problem. Freedom from vibration over a range of conditions has been demonstrated by the tests reported in NEDE-23604.

The cracking of the feedwater nozzles is a two-part process. The crack initiation mechanism as discussed above is the result of self-initiated thermal cycling. If this were the only mechanism present, the cracks would initiate, grow to a depth of approximately 0.25 inch, and arrest. This degree of cracking could be tolerated, but unfortunately there is another mechanism which supports crack growth. This mechanism is the system induced transients, primarily the startup/shutdown transients. The welded thermal sleeve arrangement also assists in this area because without leakage, the heat transfer coefficient between the feedwater and the nozzle are reduced to the point where the thermal stresses in the nozzle are not high enough to cause a significant crack growth. Analyses presented in NEDE-21821, Section 4.7, demonstrates the benefits of the welded thermal sleeve and of using unclad nozzles. With these demonstrated benefits, WNP-2 does not believe it necessary to install instrumentation for design verification.

WNP-2 has installed an automatic feedwater low flow control valve, RFW-FCV-10. This valve has the capabilitiy to control flow down to 362 gpm, or about 1.25% of total flow. This valve will substantially reduce the temperature differential between the feedwater and the water in the RPV during low power operation.

The following paragraphs address RPV feedwater nozzle examination questions other than Appendix A to Section 121.

<u>Feasibility of Installing Mechanized Ultrasonic Scanners</u>

All feedwater nozzle inner radii, safe-end, and bore regions are capable of automated ultrasonic examination. Both preservice and inservice inspections of the inner radii and safe end welds will be performed using such equipment. Tooling has been contracted from the baseline examination agency that will allow nozzle inner radius scanning by contacting an angle beam transducer to the vessel plate surface adjacent to the nozzle to vessel weld. The scanner mechanism is removable and would be compatible with any of the six (6) feedwater nozzles. The Supply System is currently evaluating the benefit of performing an automated examination of the bore region versus a manual examination, in terms of radiation exposure (examination/setup time) and examination coverage. The technique providing the best balance of those two factors will be chosen. Adequate access exists for either technique.

nozzle mock-up. The mock-up will be unclad if negotiations can be reached with a utility owning such a mock-up. As an alternative, the examiners will qualify on a clad mock-up owned by the General Electric Company. Following the qualification process, the examinations will be conducted under the direct supervision of the experienced NDE specialists responsible for ultrasonic technique and procedure development for the Supply System.

III. RECORDING AND REPORTING STANDARDS

The Supply System will record crack indications and report inspection results in compliance with the requirements stated in NUREG-0312.

121.8 JUSTIFICATION OF DEVIATION FROM APPENDIX A

I.B.1 Ultrasonic Examinations Frequency

The Supply System will examine only one RFW nozzle per refueling outage rather than all nozzles using an ultrasonic technique from the outside of the vessel. This is justified for the following reasons, which reflects a significant advance in the WNP-2 design and operating procedures towards the long term solution of the BWR nozzle cracking problems per NUREG-0312, Section 8.0, Part. 1.

a. Improved Design: The WNP-2 RFW welded thermal-sleeve-to-safe-end joint provides a "zero leakage" design. This design essentially eliminates the primary historical initiating source of nozzle cracking in BWRs.

b. No Nozzle Cladding: The WNP-2 RFW nozzle surfaces are not clad. The likelihood of crack initiation in unclad nozzles is more than a factor of a 5 less than for clad nozzles. All cracks in BWR feedwater nozzles have initiated in the clad metal.

c. Proven Examination Technique: The ultrasonic examination equipment and personnel to be used in performing both baseline and inservice ultrasonic examinations will be qualified on a full scale mock-up of the nozzle, simulating the nozzle geometry and anticipated fatigue crack defects. Since the WNP-2 reactor feedwater nozzles are unclad as stated in b) above, a more sensitive examination is possible due to lack of clad/basemetal interface.

d. Augmented Examination Frequency: The above stated program provides RFW nozzle examination coverage at nearly twice the frequency of the ASME Section XI requirements, i.e., all RFW nozzles will be examined within 6 years (approximately) rather than within 10 years.

e. Feedwater Temperature Controls: As previously stated, WNP-2 has incorporated a feedwater, low flow control valve. The advantages gained from low flow control are identified in Section 4.7 of NEDE-21821.

f. Projected Crack Growth Rates: As presented in Section 4.7 of NEDE-21821, the WNP-2 design should have greater than 35 years of operation, considering our low flow control, prior to an initiated crack reaching 1 inch in depth. This provides for a minimum of 4 examinations per nozzle before reaching a point requiring repair. Even if the extremely conservative (factor of 5) upper bound crack growth curve is applied, each RFW nozzle would be examined by the Supply System program prior to a crack becoming 1 inch in depth. It is clear that ample conservatism exists in the Supply System examination frequency of the RFW nozzles.

The above factors, when combined, provide a great deal of assurance that the factors which have led historically to BWR RFW nozzle cracking have been virtually eliminated. Furthermore, any cracking which might occur from unanticipated sources will be discovered before propogating to a significant depth due to low flow controls and an augmented examination schedule with state-of-the-art qualified ultrasonic examination techniques.

I.B.2&3 Surface Examinations

The Supply System will perform surface (penetrant) examinations of the accessible internal surfaces of RFW nozzles during the preservice inspection program. Inservice surface examinations will be performed only when indications of service induced cracking are found using the ultrasonic examination technique. This is justified as follows:

a. Reduced probability of crack initiation and growth as stated in the justification under I.B.1a) through f) above.

b. Access: In order to obtain access to perform a penetrant surface examination of the RFW nozzle surfaces during a refueling outage, the vessel water level would have to be lowered below the level of the spargers and hydrolaser decontamination performed. A special shielded work platform would have to be devised to minimize radiation exposure. This technique was performed at Vermont Yankee resulting in about 15 man rem.

I.C Leak Test

Thermal-Sleeve-to-Safe-End Joint: The Supply System will perform inservice inspection to determine the integrity of the thermal-sleeve-to-safe-end joint only when indications of service induced cracking are detected using the ultrasonic examination technique. The justification for this exception is similar to the justification for not performing inservice surface examinations cited above, with the following additional justification:

a. Test Effectiveness: The maximum pressure which could practically be placed on the subject weld joint would be that available from the static head of a filled sparger, or approximately 6" of water. The effectiveness of this test to reveal throughwall cracks in the weld joint is questionable, since the weld experiences significantly higher differential pressure and temperature during operation. Furthermore, this test would not provide evidence of other than gross throughwall cracks which, if and when detected via such a test, will in all likelihood have been resulting in some degree of leaking for a significant period of time. As was previously demonstrated, any cracks developing as a result of such leakage will be detected prior to the crack propagating to a depth which would jeopardize the nozzle integrity. There is, therefore, no appreciable benefit from performing the leakage test of the spargers other than to determine the status of their integrity in the event service induced cracks are confirmed. Since there is no appreciable benefit, and the cost in dollars and man rem exposure for such a test is quite high, the performance of this test on a routine basis is not justified.

BLANK

Q. 211.023
(3.5)
(4.6.1)

Provide assurance that the essential portions of the CRD system (i.e., the 1-inch supply and return piping located inside the containment) shown in Figures 3.5-20, 3.5-22, and 3.5-27 of the FSAR, are protected from the effects of high or moderate energy line breaks. In responding to this item, consider postulated breaks such as ones in the high pressure core spray (HPCS) system, the feedwater injection system and the reactor coolant pressure boundary. Our concern is whether pipe whip and/or jet impingement forces resulting from these postulated breaks can impair the capability of the CRD system to scram. Additionally, provide an assessment of the damage which could occur to the cluster of CRD return and supply lines, including the effect on the scram capability, due to a postulated rupture of a single CRD supply or return line.

Response:

Rupture of CRD supply and return piping inside containment would not prevent safe shutdown since the control rods would then be inserted by reactor pressure. The only accident affecting CRD piping inside containment which could prevent safe shutdown would involve crimping of more than one 3/4 inch return line in any 3 x 3 array of control rods such that reactor pressure could not insert the control rods. A testing program has been initiated to evaluate the susceptibility of the 3/4 inch CRD piping to crimping caused by pipe break accidents inside containment. The complete response to this question will be provided later after the testing program has been completed.

Q. 211.024
(5.4.7)

It is our position for all light-water-reactors that the RHR system shall be capable of bringing the reactor to a cold shutdown condition using only safety-grade systems. Confirm that this requirement is satisfied for the WNP-2 facility. In responding to this request, include a consideration of the capability of the air supply system which is used to operate the RCIC steam and condensate control valves located at the RHR heat exchanger, when the RHR system is in the steam condensing mode.

Response:

All portions of the RHR system required to function in bringing the reactor to a cold shutdown condition are safety grade and redundant except for the shutdown cooling suction line. If this line were unavailable due to a single failure of a suction valve, a safety grade alternate shutdown cooling path can be established through the ADS valves as described in the notes to Figure 15.2-11, Activity C1 or C2.

The steam condensing mode is used only to maintain hot standby condition should the vessel be isolated from the main condenser. Specifically, it allows for maintenance on the turbine generator set without first requiring a cold shutdown of the RPV or continued opening of the main steam relief valves to the suppression pool.

No analysis has been performed which demonstrates that the steam condensing can be used to bring the reactor to a safe, cold shutdown. No credit has been taken for the steam condensing mode in any safety analysis, accordingly, it is permissible to use non-safety air for E12-F051 (RHR-PCV-51) and E12-F065 (RHR-LCV-65). On a loss of air these valves fail-shut, the desired position during accident conditions.

Acceptance Criteria for RHR Preoperational Test

1. RHR-V-42A, B, C — LPCI injection valve maximum opening time: 27 seconds

2. RHR-V-8, RHR-V-9 — Shutdown cooling suction valve maximum closing time: 40 seconds

3. RHR-V-53A, B — Shutdown cooling return valve maximum closing time: 40 seconds

4. RHR-FCV-64A, B, C — Minimum flow valve maximum opening/closing time: 15 seconds.

5. Motor operated valves open with initial differential pressure of:

RHR-V-42A, B, C	Loop A injection	750 psi
RHR-V-16A, B	Containment Spray	SOH (shutoff head)
RHR-V-17A, B	Containment Spray	SOH
RHR-V-27A, B	Suppression Pool Spray	SOH
RHR-V-24A, B	Suppression Pool Test Return	SOH
RHR-V-21	Suppression Pool Test Return	SOH
RHR-V-53A, B	Shutdown Cooling Return	SOH
RHR-V-8	Shutdown Cooling Suction	150 psi
RHR-V-9	Shutdown Cooling Suction	150 psi
RHR-V-23	Reactor Vessel Head Spray	30H
RHR-V-4A, B, C	LPCI Suppression Pool Suction	70 psi
RHR-V-64A, B, C	Minimum Flow	500 psi
RHR-V-123A, B	Shutdown Cooling Check Bypass	1050 psi

6. RHR pump flow at 26 psi pressure differential between the RPV > suppression pool: 7450 gpm minimum.

7. RHR System flow with three (3) pumps at 26 psi pressure differential between RPV > suppression pool: 22,350 gpm minimum.

8. Low pressure coolant injection initiation to rated flow with normal auxiliary power available: 27 seconds maximum.

9. Low pressure coolant injection to rated flow from time diesel generator initiation from loss of auxiliary power: 37 seconds maximum.

10. NPSHA in mode B, post-accident containment spray, 7900 gpm and 220°F suppression pool suction with 50% strainer flow: (Later) ft.

11. NPSHA in mode D, shutdown cooling, flow 7450 gpm and 335°F suction temperature: (Later) ft.

Temperature	340°F	320°F	250°F	200°F
Pressure	-2 to 45 psig	-2 to 45 psig	-2 to 25 psig	-2 to 20 psig
Relative Humidity	100%	100%	100%	100%
Duration	3 hrs.	6 hrs.	1 day	100 days

In addition, they have been designed to be operable during and after an SSE.

The gate valves listed above are maintenance valves and are normally locked open. Althrough they are designed to be operable, they are not required to operate following an accident. The only electrical components on these valves are the limit switches, which are utilized to provide verification that these valves are open during normal plant operation. Therefore there is no effect on the operation of the ECCS if these valves are subject to jet impingement following a postulated LOCA.

The testable check valves are equipped with an air operator to allow valve stroking during normal plant shutdown and thus verify operability. This air operator is designed so that it will not prevent the check valve from opening for forward flow or closing to prevent reverse flow. The only electrical components on these valves are the stem actuated limit switches which provide position indication of the air operator rod, and magnetic sensors which provide position indication of the valve disc. The solenoid valve for the air operators and control element for the magnetic sensors are located outside primary containment. Therefore there is no effect on the operation of the ECCS if these valves are subject to jet impingement following a postulated LOCA.

The ADS valves are not designed for operability after steam jet impingement. However, WNP-2 is currently evaluating the consequences of jet impingement on the ADS valves. If the analysis shows the the results are unsatisfactory, then the ADS valves will be protected from jet impingement. The results of this analysis will be reported by amendment to Chapter 3.6.

Q. 211.093
(15.1.2)

For the transient resulting from a postulated failure of the water controller during maximum flow demand, you indicate a feedwater flow of 146 percent in Table 15.1-3 of the FSAR. However, you indicate in Section 15.1.2.3.2 that the feedwater flow is 135 percent for the maximum flow setting in simulating this transient. Clarify this apparent discrepancy.

Response:

Section 15.1.2.3.2 states that 135% feedwater runout flow will result if the operating pressure is at the design pressure of 1060 psig. In the analysis, the operating dome pressure is 1020 psig, hence higher runout flow will result.

Q. 211.094
(15.1.2)

When a sudden increase in feedwater flow occurs, there will be a corresponding drop in the feedwater temperature which contributes to the reactivity increase during the first part of this transient. For example, the combination of a drop in the feedwater temperature and a smaller maximum flow rate could cause a Level 8 trip with the surface heat flux close to the flux scram setpoint. If you have assumed that the feedwater temperature into the reactor vessel has remained constant, reanalyze this transient to include the effect of the variation in the feedwater temperature on the MCPR. Provide your basis for determining the time variation in the feedwater temperature in the reactor vessel. Demonstrate that a smaller increase in the feedwater flow rate than the one you analyzed, in conjunction with the change in feedwater temperature, does not result in a lower MCPR.

Response:

It is true that there will be a drop in the feedwater temperature with an increase in feedwater flow. However, the feedwater heater usually has a large time constant (in minutes, not in seconds) so the feedwater temperature change is very slow. In addition, there is a long transport delay time before the cold feedwater reaches the vessel. Therefore, it is expected that the feedwater temperature change during the first part of the feedwater controller failure (maximum demand) transient is insignificant, and its effect on the transient severity is minimal.

Q. 211.167
(15.1.3.3.3)

The depressurization rate has a proportional effect on the voiding action of the core. For the "pressure regulator failure-open" transient, the assumed depressurization rate results in a L8 trip. The results are not consistent with GESSAR 238-732 where a lower depressurization rate results in a trip from low turbine inlet pressure. Explain this discrepancy and provide justification that the assumed trip provides the most restrictive margins on MCPR and peak vessel pressure.

Response:

If the depressurization rate is not sufficient to cause level swell to reach L8, then turbine inlet pressure will drop below the isolation setpoint and cause isolation and scram. Since power is being depressed as the pressure decreases (due to additional voiding in the core), this transient is less severe when you assume a slower depressurization rate. Therefore, the assumed L8 trip provides the most restrictive margins on MCPR and peak vessel pressure. The results of this transient in the GESSAR II 238 document (22A7000) assume that water level swell will reach Level 8 and cause reactor scram which is consistent with the Supply System analysis.

Q. 211.168
(15.1.4.2.1.1)

For the "inadvertent opening of a safety/relief valve" transient, include the time at which suppression pool temperature alarms and Technical Specification limit are attained in event Table 15.1-5.

Response:

WNP-2 is currently in the process of analyzing the suppression pool (SP) temperature response for various transients, including a stuck open relief valve. The specific transients to be analyzed along with the methodology, assumptions, and initial conditions are outlined in NUREG-0783. Among the initial conditions assumed in these analyses is that the suppression pool temperature is at the technical specification limit. For WNP-2, this limit is 90° Fahrenheit, which is also the SP high temperature alarm point. Table 15.1-5 has been revised to indicate that at time zero the plant is operating at the maximum technical specification, suppression pool temperature, and the high suppression pool temperature alarm is received in the control room. Upon completion of the SP temperature response analysis, the FSAR will be revised to incorporate the final results.

Q. 212.003
(6.3)

Your discussion of single failure does not adequately address ECCS passive failures during long-term cooling. Accordingly, provide a response to the attached Reactor Systems Branch Technical Position regarding the leak detection requirements for passive failures in the ECCS piping.

REACTOR SYSTEMS BRANCH TECHNICAL POSITION
Leak Detection Requirements for ECCS Passive Failures

The passive failures to be considerd are limited to leaks from valve stem packing and pump seals. The sum of these leak rates may range from essentially no leakage up to the equivalent of the sudden failure of the seal of the largest ECCS pump (e.g., about 50 gpm). It is the staff's position that detection and alarms be provided to alert the operator of passive ECCS failures during long-term cooling. The timing of these alarms should be such that the reactor operator has sufficient time to identify and isolate the faulted ECCS line. Provide the following information regarding the ECCS leak detection system:

a. An identification and justification of the maximum leak rate.

b. The maximum allowable time for operator action, including a justification of the time interval.

c. A demonstration that the leak detection system will be sensitive enough to provide an alarm to the operator, subsequent identification by the operator of the faulted line, and, finally, permit the operator to isolate the faulted line prior to the leak creating any undesirable consequences such as flooding of redundant equipment. The minimum time to be considered for this sequence of events is 30 minutes.

d. A demonstration that the leak detection system can identify the faulted ECCS train and that the leak is isolable.

Additionally, the ECCS lead detection system must meet the following standards: (1) control room alarm, and (2) IEEE-279, except single failure requirements.

Response:

a. The ECCS are capable of withstanding passive failure of valve stem packings and pump seals following a major pipe break. The maximum leakage due to a failure of this nature could be as high as 23 gpm from an HPCS, LPCS, or RHR pump seal failure. Valve stem leakage would be significantly less than this.

b. The maximum allowable time for operator action is determined as the shorter of the time required to flood to the level of an ECCS pump motor in the secondary containment, or the time required to drain the suppression pool to a level below that required for ECCS pump NPSH. The minimum established NPSH required for any ECCS pump for worst case (HPCS) is 31.6 feet. This is considered a conservative number. During HPCS pump performance testing (see Question 211.061) a constant suction head of 31.6 feet was available over the full flow range of the pump with no evidence of cavitation. With a minimum NPSH available of 36 feet, calculated in accordance with Regulatory Guide 1.1, and a leak rate of 23 gpm, there is about 5 days of operator time available before the NPSH becomes a problem. A Class 1E level instrument will be installed in each ECCS pump room and it will be mounted just above floor level. After the operator receives an alarm in the control room, there is at least 44 hours of operator time available before the water level reaches the bottom of an ECCS pump, assuming a 23 gpm leak rate into the smallest ECCS pump room (RHR C).

c. The sensitivity of the leak detection system is not vital to the identification and subsequent isolation of the faulted line prior to any undesirable consequences with at least 44 hours available.

d. Any ECCS valve stem packing leak can be isolated, including any packing failure on any ECCS pump suction valve. The packing is isolated by closing the valves which are double-seat, wedge knife gates. With a Class 1E level instrument in each ECCS pump room, the faulted ECCS train can be determined. The leak detection system will have Class 1E indication in the control room which meets IEEE 279-1971, except single failure requirements. In addition, a high level annunciator will also be provided.

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Q. 361.016

Estimate the ground motion (including high frequencies) assuming a magnitude $M_L = 4.0$ (largest swarm event in the Columbia Plateau) occurred at a distance of 3 to 5 kilometers from the site. Compare the response spectra from this event to the SSE response spectra. Also, state your position on how large and close a potential swarm earthquake could come to the site.

Response:

Until recently there has been a lack of recorded strong ground motions from small magnitude earthquakes at very close distances (3 to 5 km). Consequently, estimation of near field motions for small magnitude events by scaling recorded ground motions at greater distances has not been well documented. The large number of small magnitude strong motion recordings obtained during the recent aftershock sequences of the Imperial Valley, 1979, and Mammoth Lakes, 1980, earthquakes should aid in documenting estimation methods for near field motions. The Supply System is currently gathering and analyzing the newly available data in order to develop an estimate for the ground motions from a magnitude M_L 4.0 earthquake occurring at a distance of 3 to 5 km.

A preliminary estimate can be made for a distance of 10 km using recordings obtained during the Oroville, 1975 aftershock sequence.

Table 361.016-1 lists the 12 available accelerograms for magnitude M_L 4.0 to 4.1 Oroville aftershocks in the distance range 8 to 13 km on soil sites. Two of the recordings were obtained at the Johnson's Ranch station, which has been shown to exhibit a significant "ringing" at a frequency of 6 Hz due to a 10-meter thick layer of aluvium overlying bedrock. Figure 361.016-1 shows the median, mean and 84th percentile response spectra computed using the twelve recorded motions. Also shown is the 0.25 g SSE design spectra (Regulatory Guide 1.60 spectra anchored to 0.25 g). (The WNP-2 plant has been analyzed and found to be adequate for the Regulatory Guide 1.60 spectra anchored to 0.25 g.) The statistical spectra are generally well below the design spectra, approaching the SSE only at high frequencies.

As can be seen in Figure 361.016-1, there is a large peak in the statistical spectra at a period of 0.17 seconds (frequency 6 Hz). The source of the peak is the recordings obtained at Johnson's Ranch. Figure 361.016-2 shows the effect of removing the four accelerograms obtained at Johnson's Ranch from the data set. The large peak at 6 Hz is removed and the overall level of spectral acceleration is reduced.

The median and 84th percentile peak accelerations for the two data sets are tabulated below.

Data Set	Peak Accelerations (g) median	84th percentile
12 records (with Johnson's Ranch)	0.10	0.18
8 records (without Johnson's Ranch)	0.07	0.12

The severity of the ground motions from small magnitude earthquakes can be evaluated by comparing their frequency and energy content and significant duration with the frequency and energy content and significant duration of motions recorded during the 1971 M_L 6.4 San Fernando earthquake.

Figure 361.016-3 shows a plot of peak acceleration vs. total energy content (measured by the square of the acceleration integrated over the duration of shaking) for the M_L 4.0 - 4.1 Oroville recordings at 8-13 km and soil site recordings from the M_L 6.4 San Fernando earthquake at distances of 24-27 km. For comparable levels of peak acceleration, the energy content of the Oroville recordings is an order of magnitude lower than the San Fernando recordings. This is due in large part to the short duration of shaking. The significant duration (defined as the time required to transmit 90% of the energy content of the accelerogram) ranges from 1 to 3 seconds for the Oroville recordings as compared to from 15 to 25 seconds for the San Fernando recordings.

The frequency content of the recordings can be examined by passing the accelerograms through a band pass filter having corners at 1 Hz and 9 Hz. The effect of filtering on peak acceleration and energy content is tabulated below.

	Average Percent Reduction In:	
Recordings	Peak Acceleration	Total Energy Content
M_L 4.0 - 4.1 Oroville	35%	45%
M_L 6.4 San Fernando	5%	30%

These results indicate that nearly half of the energy content of the small magnitude recordings is at frequencies greater than 9 Hz.

The maximum magnitude associated with shallow seismicity that can be expected to occur within the Columbia River Basalts in close proximity to the site is approximately M_C 3.0 (Appendix 2.5J).

TABLE 361.16-1

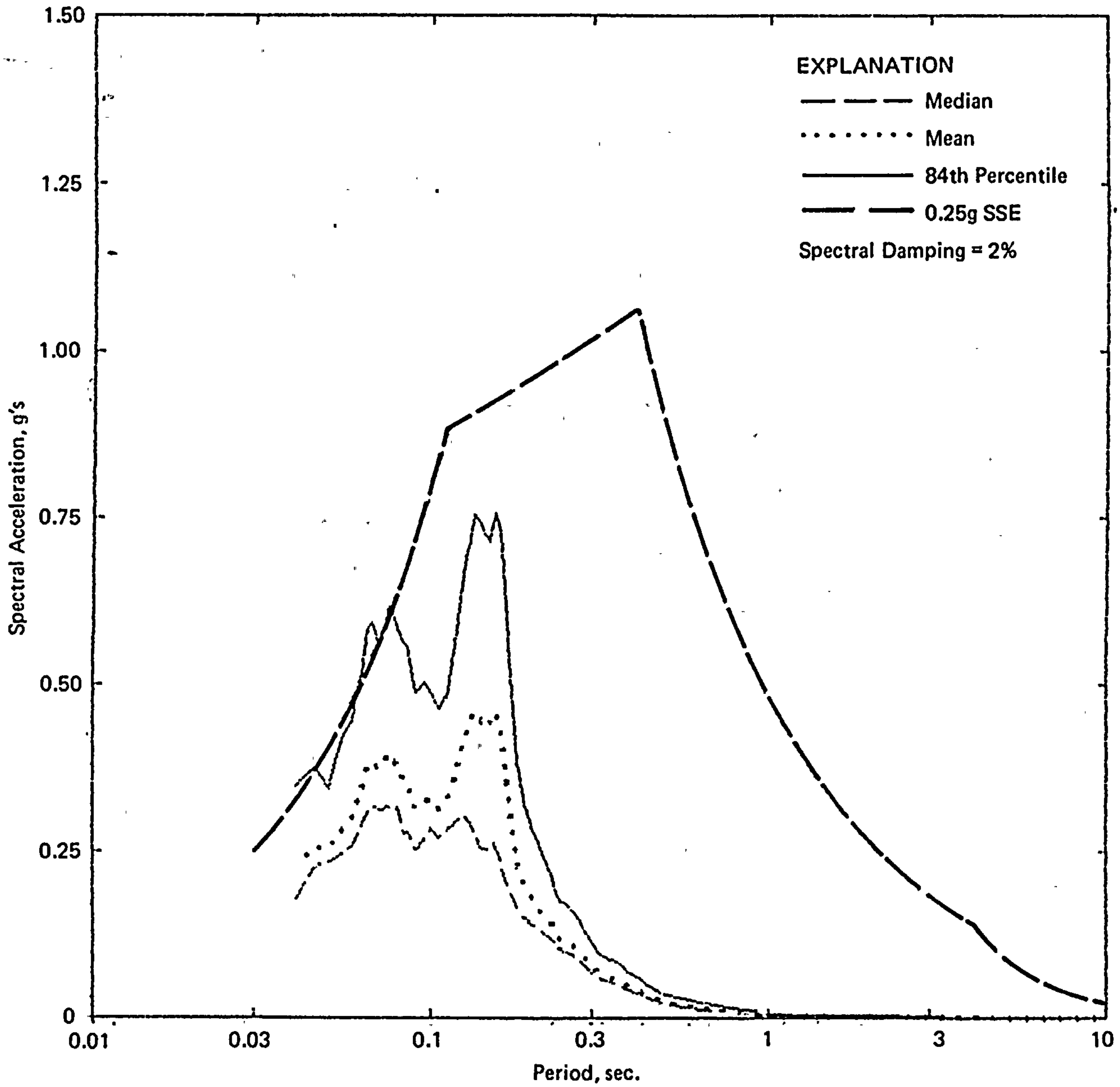
Oroville Accelerograms M_L 4.0 to 4.1, R = 8 to 13 kilometers

Stiff Soil Sites

EARTHQUAKE	DATE Y M D	TIME H M S	MAGNITUDE MB	ML	MS	DEPTH (KM)	RECORDING STATION	USGS STAT NO	SITE CLASS	DISTANCE TO: HYPOC (KM)	EPIC (KM)	RUPTURE (KM)	RECORD	COMP	PEAK ACELL (G)
OROVILLE AFTERS HOCK B	75 8 3	247 9		4.1		6.8	OMC OROVILLE MEDICAL CENTER TEMP STAT	10	ABB	8.3	4.7		B10	N24W	.086
													B10	S66W	.148
OROVILLE AFTERS HOCK P	75 816	548 9		4.0		8.8	CDMG7 CDMG TEMP STAT 7 AT OROVILLE CA	7	ABB	9.0	1.7		P07	N90W	.070
													P07	S00W	.060
							DWR D. JOHNSON RANCH TEMP STAT OROVILLE	9	AAB	10.2	5.2		P09	N90E	.159
													P09	N00E	.222
							OMC OROVILLE MEDICAL CENTER TEMP STAT	10	ABB	9.8	4.4		P10	N24W	.100
													P10	-S66W	.030
OROVILLE AFTERS HOCK T	75 926	231 7		4.0		9.4	DWR D. JOHNSON RANCH TEMP STAT OROVILLE	9	AAB	12.0	7.5		T09	N90E	.242
													T09	N00E	.163
							OMC OROVILLE MEDICAL CENTER TEMP STAT	10	ABB	9.8	2.8		T10	N24W	.081
													T10	S66W	.086

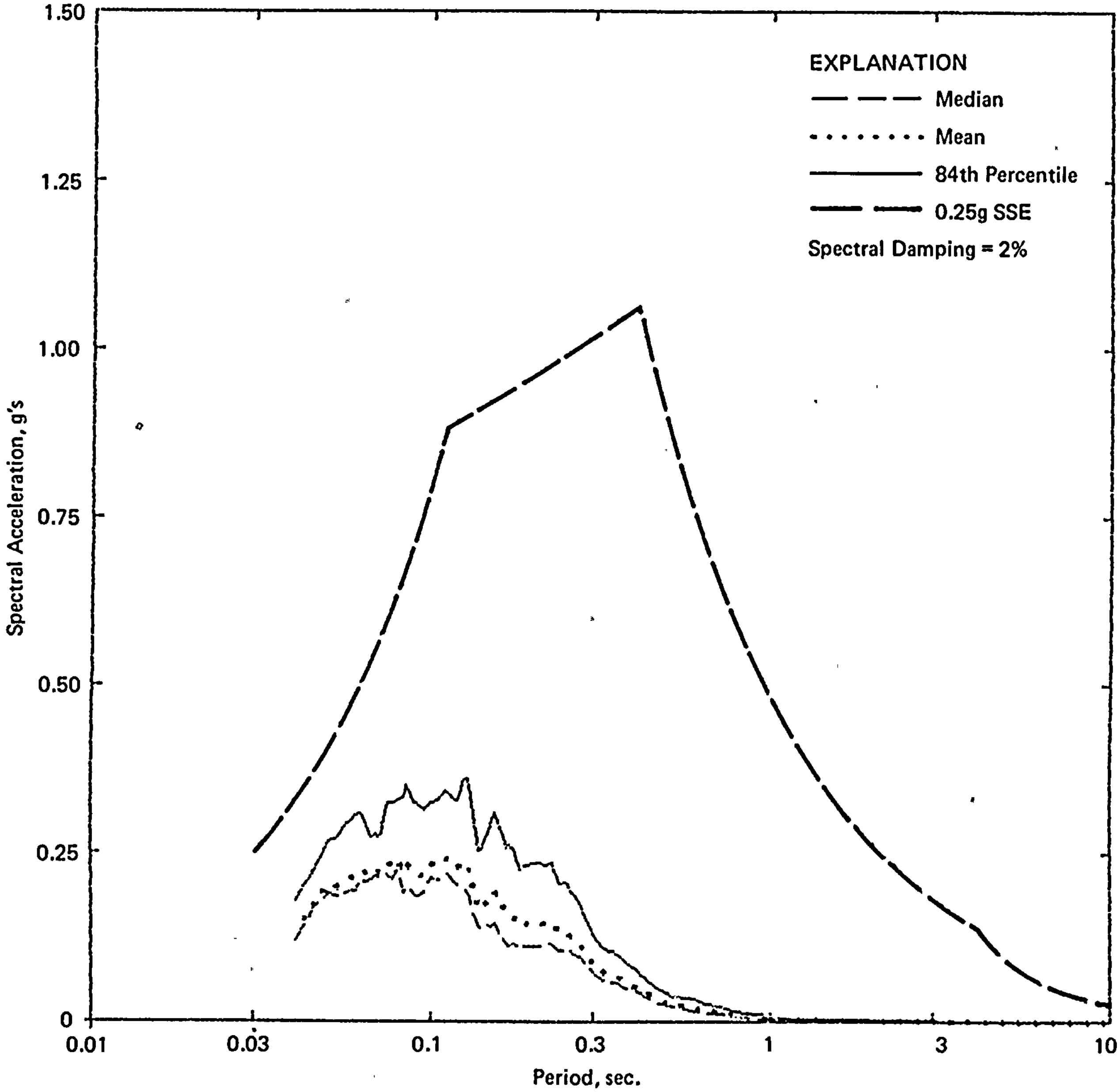
NUMBER OF DATA POINTS = 12

AMENDMENT NO. 23
February 1982

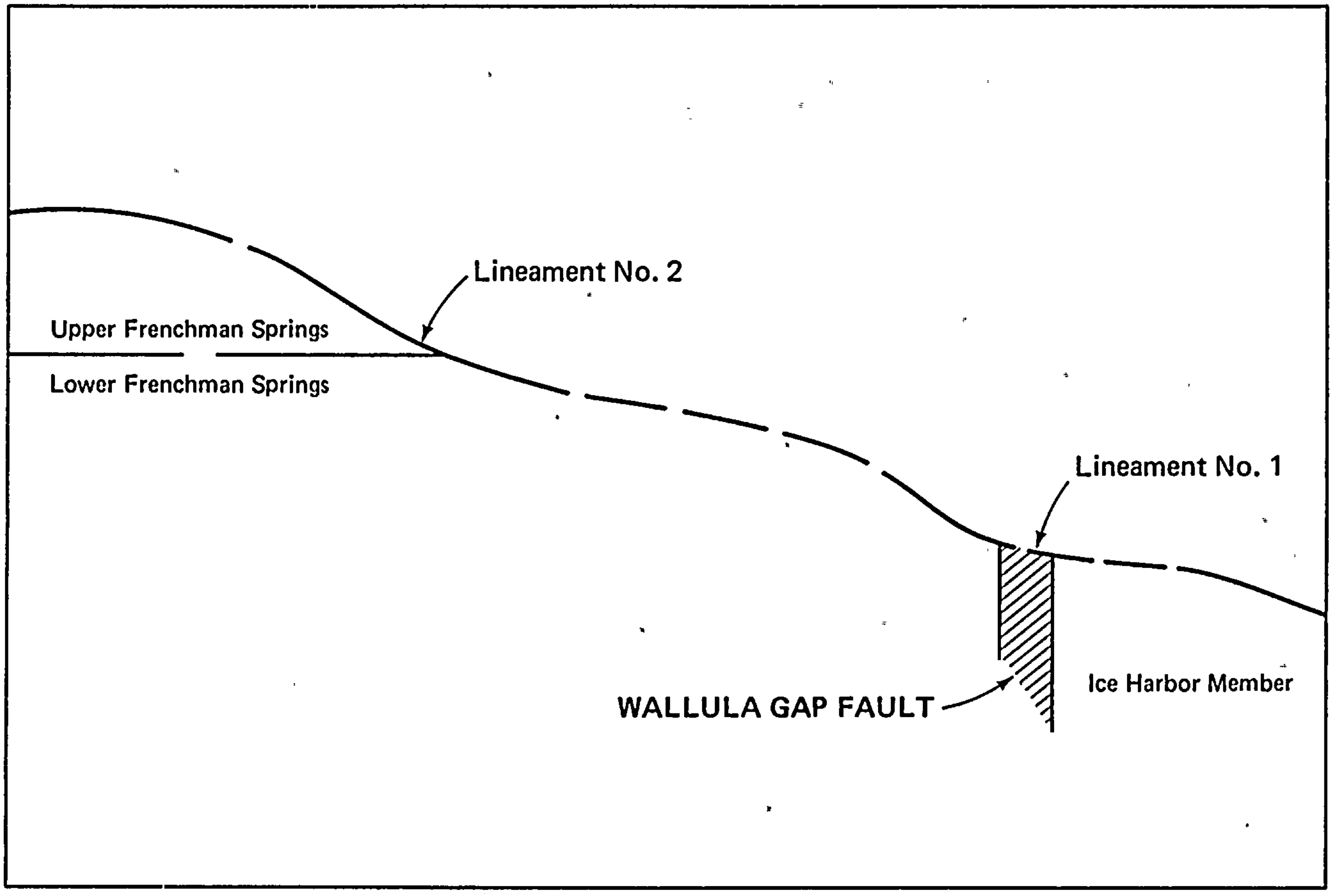


WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	STATISTICAL SPECTRA FOR 12 OROVILLE M_L 4.0-4.1, R=8-13 km ACCELEROGRAMS	FIGURE 361. 016-1

AMENDMENT NO. 23
February 1982



WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	STATISTICAL SPECTRA FOR 8 OROVILLE M_L 4.0-4.1, R=8-13 km ACCELEROGRAMS	FIGURE 361. 016-2



WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	DIAGRAMATIC CROSS-SECTION THROUGH THE VICINITY OF THE WARM SPRINGS TRENCHES	FIGURE 361.016-3

Q. 361.017

Estimate the ground motion (both peaks and response spectra) from an M_L 6.1 (July 16, 1936) earthquake occurring close to the WNP-2 site. Compute the median, mean and mean plus one standard deviation from this data set and compare them with the SSE response spectra. Also provide the staff with a comparison of the site conditions of the chosen strong motion recordings and the WNP-2 site.

Response:

The July 16, 1936 Milton-Freewater earthquake (M_S 5-3/4, M_L 6.1) is considered to be associated with a northeast trending fault that is parallel to, and likely an element of, the Hite fault system of eastern Washington. The area of maximum intensity for the event was in the vicinity of Miton-Freewater, while the instrumental epicenter was located on the basis of 25 regional and teleseismic readings, about 30 km to the northeast near Waitsburg (Reference 27). The aftershocks were first felt near Waitsburg and Walla Walla, but after several days reports were primarily from the Milton-Freewater area (WPPSS, 1974). The pattern of aftershocks suggests a northeast-southwest aftershock zone that initiated near Waitsburg and extended to the southwest. The available focal mechanism data are consistent with the faulting on a northeast-southwest striking plane, but the sense of movement is not well constrained. The focal depth appears to have been shallow (about 5 km), which indicates that although surface fault rupture was not observed in this particular event, the causative fault should be evident at the surface. These features of the 1936 earthquake are compatible with the data on the Hite fault system, which consists of steeply dipping en echelon group of faults that strike north-northeast. The system is part of and lies along the flank of the Blue Mountains. Mapping indicates that the fault system extends westward and occurs in the basement beneath the Walla Walla basin.

The source area of the 1936 earthquake appears to be distinct from the seismic environment of the interior of the Columbia Plateau. The level of earthquake activity along th Blue Mountains is higher than that to the west-northwest (Reference 28). Also, the direction of maximum compressive stress appears to be generally north-south in the Plateau, but is generally east-west near the 1936 earthquake area.

Shallow earthquakes having magnitudes of about 6 or larger only occur on geologic structures and they should not be considered to be random events. The only fault within 25 km of the site that is large enough to generate an earthquake of the size of the Milton-Freewater earthquake is the Rattlesnake Mountain fault at a distance of 20 km. No other structures within 25 km distance are judged to be capable of generating a magnitude M_L 6.1 event. Consequently, a hypothesis that such an event can occur randomly in the vicinity of the site is considered not valid. At the request of the NRC, the following methodology was used to estimate site ground motions assuming that the 1936 Milton-Freewater earthquake was a random event and that a similar event could occur close to the site.

The site dependent response spectrum for a magnitude M_L 6.1 earthquake occurring near the site was evaluated by averaging the response spectra computed from accelerograms recorded during earthquakes of magnitude M_L 6.1 $\pm$ 0.3 within an approximate distance range of 0 to 25 km. As presented subsequently in this response, the results of this analysis indicate that the SSE design spectra envelope the statistical site specific response spectra, except in the narrow period range of 0.13 to 0.22 seconds, where it is slightly exceeded for only some of the cases analyzed.

Data Selection

Table 361.017-1 lists the currently available accelerograms recorded during earthquakes of magnitude M_L 6.1 $\pm$ 0.3 within a distance range of 0 to 27 km. The distance criteria used was the closest distance to fault rupture where known; otherwise, hypocentral distance was used.

A group of records was selected from those listed in Table 361.017-1 on the basis of similar site conditions to the WNP-2 plant site. The plant site is underlain by approximately 500 feet of granular alluvial soils underlain by Columbia River basalts. The top 100 feet of soil consists of medium dense to very dense sands and sand gravel mixtures. The soils between a depth of 100 feet to 200 feet consists of very dense cemented sand and gravel mixtures. Below 200 feet, the soils consist of very dense or hard interbedded sand, silt, clay, and gravel of the lower unit of the Ringold formation. These soils extend down to the basalt. Figure 361.017-1 shows the shear wave velocities measured to a depth of 400 feet at the WNP-2 and WNP-1/4 sites. The soil profile is characterized by a large increase in shear wave velocity at a depth of about 100 feet and large decreases in shear wave velocity below a depth of about 250 feet.

Figures 361.017-2 through 361.017-4 shows a comparison of the shear wave velocity profiles at the WNP-2 and WNP-1/4 sites with reported ranges of shear wave velocities for granular alluvium in California (References 3, 11, and 21). As can be seen, with the exception of the high velocity layer between 100 and 250 feet in depth, the WNP-2 and WNP-1/4 sites can be characterized as a deep alluvial site. The presence of the high velocity layer is expected to give the site some of the characteristics of a shallow stiff site, and the low velocity layers between a depth of 200 to 500 feet give the site some of the characteristics of a deep soil site.

Thus, the WNP-2 and WNP-1/4 sites can be considered to possess characteristics of both shallow and deep soil sites. Therefore, recordings obtained on either shallow or deep soil deposits were selected for analysis. Table 361.017-2 lists the selected accelerograms. The data set consists of 70 accelerograms recorded during 12 earthquakes: 30 accelerograms from the 1971 San Fernando earthquake, M_L 6.4; two from the 1972 Managua, Nicargua earthquake, M_L 6.0; 14 from the 1976 Friuli, Italy earthquake sequence, M_L 5.9 to 6.1; 12 from the 1979 Coyote Lake earthquake, M_L 5.7; 2 from the 1980 Livermore earthquake, M_L 5.9; and 10 from the 1980 Mammoth Lakes sequence, M_L 5.7 to 6.2.

The accelerograms in the data set were recorded at 26 different recording stations. The site conditions at each of the recording stations are described in Appendix A. Figure 361.017-5 shows a composite of all of the site shear wave velocity profiles compared with the velocity profiles measured at the plant sites.

<u>Record Processing</u>

The sources of the accelerograms listed in Table 361.017-2 are the California Institute of Technology (CIT), the United States Geological Survey (USGS), the California Division of Mines and Geology (CDMG), and the Comitato Nazionale per l'Enorgia Nucleare, Italy (CNEN). All of the records except those from CNEN were obtained in corrected form. The Friuli data set was obtained in uncorrected form from CNEN. The Friuli accelerograms were then corrected using the processing techniques employed by the other agencies. The general procedure is described by Trifunic (Reference 22) and Trifunic and Lee (Reference 23). The choice of long period filter values was based on the recommendations of Basili and Brady (1978). Based on recent experience with near source recordings, an interpolation time step of 0.01 seconds was used. It should be noted that the records obtained from CDMG for the Mammoth Lakes sequence are in preliminary form.

Data Analysis

The statistical analysis of the data set was performed on the log of spectral acceleration. Studies (Reference 5, 9, and 14) have shown that the variability in recorded ground motions are best modeled by a lognormal distribution. The median, mean and 84th percentile spectral accelerations are computed using the expressions

$$S_a \text{ med} = e^{(\overline{\ln Sa})}$$

$$S_a \text{ mean} = e^{(\overline{\ln Sa} + S(\ln Sa)^2/2)}$$

$$S_a \text{ 84\%} = e^{(\overline{\ln Sa} + S(\ln Sa))}$$

where lnSa is the mean of the natural log of the data set and S(lnSa) is the standard error of the log of the data set.

In developing the statistical spectra at longer periods, not all records were used as many of the accelerograms were processed with a long period motion filter corner frequency of greater than 0.1 H_z. The number of spectra averaged to various periods is tabulated below.

Period Range	Number of Spectra
0.04 - 1.4 sec.	70
1.4 - 2.0 sec.	66
2.0 - 3.0 sec.	60
3.0 - 4.0 sec.	48
4.0 - 5.0 sec.	32

Results and Discussion

Figure 361.107-6 shows the distribution of the data set with respect to magnitude and distance to rupture surface. The mean magnitude is M_L 6.15 and the mean distance is 17.8 km. However, for several of the earthquakes, the location and size of the rupture surface is not known. For these earthquakes, hypocentral distance is plotted on Figure 361.017-6. Using the relationship published by Wyss (Reference 29), a magnitude 6.1 earthquake can be expected to have a rupture area of 89 km^2. Thus, the shortest distance to the rupture surface may be several kilometers less than the hypocentral distance. Figure 361.017-7 shows the distributions of the data set with magnitude and distance when epicentral distance is used for the unknown distance to rupture. The mean distance for this plot is 16 km. The actual mean closest distance to rupture should be somewhere between 16.0 and 17.8 km.

Figures 361.017-8 through 361.017-10 show an overplot of the 70 response spectra for 2%, 5%, and 7% spectral damping, respectively. The peak accelerations range from 0.08 g to 0.44 g. The large scatter in the peak accelerations and response spectra is due partly to the inherent variability in earthquake ground motion, and partly to the range in magnitudes and distances for the individual recordings.

Table 361.017-3 lists the median, mean and 84th percentile peak accelerations for the data set. The lognormal median, mean and 84th percentile spectra computed from the data set are compared with the SSE design response spectra (Regulatory Guide 1.60 spectra anchored to 0.25 g) in Figures 361.017-11 through 361.017-13 for 2%, 5%, and 7% damping, respectively. (The WNP-2 plant has been analyzed and found to be adequate for the Regulatory Guide 1.60 spectra anchored to 0.25 g.) The SSE design spectrum is well above the statistical spectra except in the period range 0.13 to 0.22 seconds where it is slightly exceeded.

The affect of removal of the extremes of the data is illustrated in Figure 361.017-14. Shown are lognormal median and 84th percentile spectra for the data set; and for the data set with the highest and lowest value removed, the 2 highest and 2 lowest removed, the 3 highest and 3 lowest removed, and the 4 highest and 4 lowest removed. The removal of the highest and lowest points result in a significant drop in the 84th percentile spectrum and a slight decrease in the median spectrum.

Removal of additional extreme data points result in small reductions in the 84th percentile spectra and virtually no change in the median value.

Examination of the data set indicates that for most of the frequency range, the highest spectral accelerations are from the recording obtained during the 5.7 aftershock in the Mammoth Lakes sequence. The recording was obtained at a hypocentral distance of 3.6 km. Since the acceleration from this recording represented the extreme acceleration throughout the period range, the effect of the removal of this record from the data set was evaluated and is shown in Figures 361.017-15 through 361.017-17. The SSE design spectrum completely envelopes the statistical response spectra in this case.

In the above analyses, each individual response spectrum was given equal weight in the calculations of the statistical spectra. The analysis is attempting to model the random occurrence of an earthquake near the site. Given that an earthquake has occurred randomly within a 25 km radius of the site, the probability of the earthquake occurring within a distance band is equal to the ratio of area within the distance band to the total area. These probabilities are compared below with the percentage of the data set which lies in each distance band.

Distance Range	Probability of Random Event In Distance Band	Portion of Data Set In Distance Band
0 - 5 km	0.040	0.086
5 - 10 km	0.120	0.114
10 - 15 km	0.200	0.086
15 - 20 km	0.280	0.286
20 - 25 km	0.360	0.428

This suggests that there are too many records in the data set at the extremes of the distance range and not enough in the middle. A weighted statistical average was performed, with the records in each distance band assigned a weight such that their contributions to the total is equal to the probability of a random event occurring in their distance band. Figures 361.017-18 through 361.017-20 shows the weighted statistical spectra for 2%, 5%, and 7% damping, respectively. As can be seen, the SSE design spectra envelope the statistical spectra except for a slight exceedance in the narrow period range of 0.15 to 0.18 seconds.

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TABLE 361.17-1

Accelerograms from Magnitude M_L 5.7 to 6.4 Earthquake in the Distance Range 0 to 27 kilometers

EARTHQUAKE	DATE Y M D	TIME H M S	MAGNITUDE MB	MAGNITUDE ML	MAGNITUDE MS	DEPTH (KM)	RECORDING STATION	USGS STAT NO	SITE CLASS	DISTANCE TO: HYPOC (KM)	DISTANCE TO: EPIC (KM)	DISTANCE TO: RUPTURE (KM)	RECORD	COMP	PEAK ACELL (G)
IMPERIAL VALLEY, CA	40 518	203640		6.4	7.1	16.0	EL CENTRO ARRAY # 09: IMP VALLEY IRR DIS	117	CDD	19.7	11.5	10.0	A001	S00E	.359
													A001	S90W	.224
SANTA BARBARA, CA	41 630	235055		5.9		16.0	SANTA BARBARA: COUNTY COURTHOUSE	283	CBD	20.4	12.6		U299	N45E	.239
													U299	S45E	.190
KOYNA INDIA	651210	225117		6.0	6.5	4.4	KOYNA DAM SEISMOGRAPH STAT INDIA		DAA	10.0	7.0		K101	LONG	.631
													K101	TRAN	.490
SAN FERNANDO, CA	71 2 9	6 042	6.2	6.4	6.6	8.4	PACOIMA DAM ABUTMENT CA	279	AAA	12.1	8.7	2.8	C041	S14W	.730
													C041	N76W	.730
							8244 ORION BLVD	241	DBD	23.7	22.1	7.4	C048	N00W	.258
													C048	S90W	.140
							LA: 250 E FIRST ST	151	EBB	43.5	42.7	26.3	C051	N36E	.108
													C051	N54W	.133
							LA: 445 FIGUEROA ST	157	EBB	42.7	41.9	25.8	C054	N52W	.150
													C054	S38W	.130
							CASTAIC: OLD RIDGE ROUTE, CDWR SITE	110	ABB	29.7	28.5	24.9	D056	N21E	.335
													D056	N69W	.289
							LA: HOLLYWOOD STORAGE BLDG, 1025 N HIGHLAND	133	EBD	37.9	36.9	21.2	D057	S00W	.115
													D057	N90E	.153
							LA: HOLLYWOOD STORAGE PE LOT	135	ABD	37.9	36.9	21.2	D058	S00W	.187
													D058	N90E	.217
							LA: 1901 AVE OF THE STARS	187	EBD	40.1	39.2	25.3	D059	N46W	.152
													D059	S44W	.164
							LA: 1640 MARENGO	181	DCC	43.5	42.7	26.5	D062	N38W	.139
													D062	S52W	.147
							LA: 3710 WILSHIRE BLVD	217	EBD	40.7	39.9	24.4	D065	S00W	.154
													D065	S90W	.163
							7080 HOLLYWOOD BLVD LA	238	EAB	35.8	34.8	20.3	D068	N00E	.087
													D068	N90E	.102
							LA: 4680 WILSHIRE BLVD	223	EBC	40.3	39.4	24.6	E072	N75W	.088
													E072	N15E	.125
							LA: 3470 WILSHIRE BLVD	209	EBD	40.9	40.0	24.6	E075	N00E	.142
													E075	S90W	.117
							LA: WATER & POWER BLDG, 111 N HOPE	137	EBB	42.4	41.6	25.5	E078	N50W	.137
													E078	S40W	.188

TABLE 361.17-1 (Continued)

EARTHQUAKE	DATE Y M D	TIME H M S	MAGNITUDE MB	ML	MS	DEPTH (KM)	RECORDING STATION	USGS STAT NO	SITE CLASS	DISTANCE TO: HYPOC (KM)	EPIC (KM)	RUPTURE (KM)	RECORD	COMP	PEAK ACELL (G)
SAN FERNANDO, CA	71 2 9	6 042	6.2	6.4	6.6	8.4	LA: 3407 W SIXTH ST	199	DBB	40.6	39.7	24.1	E083	S00W	.168
													E083	N90E	.182
							GLENDALE: 633 E BROADWAY, MUNICIPAL SERV	122	CBD	33.7	32.7	16.7	F088	S70E	.274
													F088	S20W	.227
							LA: 808 S OLIVE ST	175	DBC	43.7	42.8	26.0	F089	S53E	.141
													F089	S37W	.152
							LA: 2011 ZONAL AVE	190	EBB	43.8	43.0	25.8	F092	S62E	.071
													F092	S28W	.083
							LA: 120 N ROBERTSON	142	ECD	38.3	37.3	23.2	F095	S88E	.100
													F095	S02W	.091
							LA: 646 S OLIVE ST	166	EBC	43.4	42.6	26.5	F098	S53E	.252
													F098	S37W	.206
							LA: UCLA REACTOR LAB	140	EBB	39.4	38.4	24.8	F105	S00W	.095
													F105	N90E	.089
							OLD SEISM LAB CIT	266	CAA	37.1	36.1	19.1	G106	S00W	.096
													G106	S90W	.204
							PASADENA: CIT ATHENAEUM	475	CAD	40.8	39.9	23.2	G107	N00E	.103
													G107	N90E	.114
							MILLIKAN LIBRARY, CIT PASADENA CA	264	EAD	40.5	39.6	22.4	G108	N00E	.206
													G108	N90E	.189
							JPL CIT PASADENA CA	267	EAB	32.5	31.3	14.3	G110	S82E	.215
													G110	S08W	.160
							LA: 611 W SIXTH ST	163	EBB	43.2	42.4	26.3	G112	N38E	.106
													G112	N52W	.088
							PALMDALE FIRE STATION	262	AAD	33.3	32.2	25.4	G114	S60E	.118
													G114	S30W	.150
							LA: 15250 VENTURA BLVD	466	DBD	30.5	29.3	15.5	H115	N11E	.225
													H115	N79W	.152
							900 N FREMONT AVE ALHAMBRA	482	EBD	43.8	43.0	25.5	H121	S90W	.121
													H121	S00W	.117
							435 N OAKHURST BEVERLY HILLS	452	EBD	38.0	37.0	23.4	I128	N00E	.062
													I128	S90W	.099
							450 ROXBURY BEVERLY HILLS	455	DBD	39.0	38.1	24.4	I131	N50E	.202
													I131	N40W	.170

TABLE 361.17-1 (Continued)

EARTHQUAKE	DATE Y M D	TIME H M S	MAGNITUDE MB	ML	MS	DEPTH (KM)	RECORDING STATION	USGS STAT NO	SITE CLASS	DISTANCE TO: HYPOC (KM)	EPIC (KM)	RUPTURE (KM)	RECORD	COMP	PEAK ACELL (G)
SAN FERNANDO, CA	71 2 9	6 0 42	6.2	6.4	6.6	8.4	1800 CENTURY PARK E L A	425	EBD	39.7	38.8	25.3	I134 I134	N54E S36E	.103 .090
							15910 VENTURA BLVD L A	461	EBD	30.5	29.3	15.0	I137 I137	S81E S09W	.148 .135
							LAKE HUGHES ARRAY #1	125	AAB	30.4	29.2	25.8	J141 J141	N21E S69E	.152 .115
							LAKE HUGHES ARRAY #4	126	AAA	28.5	27.3	24.2	J142 J142	S69E S21W	.200 .159
							LAKE HUGHES ARRAY #9: WARM SPRINGS	127	AAA	27.6	26.3	23.5	J143 J143	N21E N69W	.147 .131
							LAKE HUGHES ARRAY #12: ELIZABETH LAKE	128	ABA	24.5	23.0	20.3	J144 J144	N21E N69W	.374 .288
							15107 VANOWEN ST L A	458	EBD	25.5	24.1	13.1	J145 J145	S00W S90W	.118 .111
							616 S NORMANDY AVE L A	431	EBB	40.7	39.8	24.1	J148 J148	N00E S90W	.116 .117
							LA: 3838 LANKERSHIM BLVD	220	EBA	31.7	30.6	15.3	L166 L166	N00E S90W	.181 .154
							1880 CENTURY PARK EAST L A	440	GBD	39.7	38.8	25.3	N188 N188	N54E N36W	.117 .129
							2500 WILSHIRE BLVD L A	449	EBB	41.4	40.6	25.1	N192 N192	N29E N61W	.104 .107
							LA: GRIFFITH PARK OBSERVATORY	141	AAA	34.9	33.8	17.4	O198 O198	S00W S90W	.188 .180
							1625 OLYMPIC BLVD L A	469	DBB	42.7	41.8	25.8	O199 O199	N28E N62W	.144 .259
							4867 SUNSET BLVD L A	226	EBB	37.0	36.0	20.3	P214 P214	S89W S01E	.162 .167
							LA: 3345 WILSHIRE BLVD	196	GBB	40.8	39.9	24.1	P217 P217	S00W N90E	.122 .097
							SANTA ANITA RESERVOIR, ARCADIA	104	AAA	44.0	43.2	27.0	P221 P221	N03E N87W	.172 .223
							14724 VENTURA BLVD L A	253	DBD	30.5	29.3	15.5	Q233 Q233	S12W N78W	.263 .207

TABLE 361.17-1 (Continued)

EARTHQUAKE	DATE Y M D	TIME H M S	MAGNITUDE MB	ML	MS	DEPTH (KM)	RECORDING STATION	USGS STAT NO	SITE CLASS	DISTANCE TO: HYPOC (KM)	EPIC (KM)	RUPTURE, (KM)	RECORD	COMP	PEAK ACELL (G)
SAN FERNANDO, CA	71 2 9	6 042	6.2	6.4	6.6	8.4	1760 ORCHID ST L A	446	DAB	35.5	34.5	19.6	O236 O236	EAST SOUT	.172 .130
							9100 WILSHIRE BLVD BEVERLY HILLS	416	EBD	39.2	38.3	24.6	O239 O239	SOUT EAST	.126 .171
							LA: 800 W FIRST ST	172	DBB	42.6	41.8	25.5	O241 O241	N37E N53W	.096 .143
							LA: 222 FIGUEROA ST	145	DBB	42.6	41.7	25.5	R244 R244	N53W S37W	.156 .132
							6464 SUNSET BLVD L A	235	EAB	36.4	35.5	20.3	R246 R246	SOUT EAST	.119 .110
							6430 SUNSET BLVD L A	232	EAB	36.5	35.5	20.3	R248 R248	SOUT EAST	.192 .230
							LA: 1900 AVE OF THE STARS	184	EBD	39.9	39.0	25.3	R249 R249	N44E S46E	.084 .093
							LA: 234 FIGUEROA ST	148	EBB	42.7	41.8	25.5	R251 R251	N37E S53E	.208 .189
							LA: 533 S FREMONT AVE	160	EBB	42.8	41.9	25.9	R253 R253	N30W S60W	.256 .232
							6200 WILSHIRE BLVD L A	443	DBD	39.7	38.8	24.8	S255 S255	N08E N82W	.129 .131
							1177 BEVERLY DR L A	413	EBD	40.4	39.5	25.8	S261 S261	N59E N31W	.102 .111
							LA: 3411 WILSHIRE BLVD	202	EBB	40.7	39.9	24.6	S265 S265	SOUT WEST	.111 .132
							LA: 3550 WILSHIRE BLVD	211	EBD	40.8	39.9	24.1	S266 S266	NORT WEST	.167 .135
MANAGUA NICARAGUA (MAIN SHOCK)	721223	029 0	5.6	6.1	6.2	5.0	ESSO REFINERY MANAGUA NICARGUA	3501	ABB	7.5	7.0	5.0	MNO5 MNO5	SOUT EAST	.330 .390
POINT MUGU	73 0 0	0 0 0		6.0	.5	.2	NAVAL RESRCH & EVAL LAB PORT HUENEME, CA	272	BBD	25.0	18.0		PMO1 PMO1	LONG TRAN	.130 .080
OROVILLE CA MAIN SHOCK	75 8 1	122013	5.9	5.7	5.6	8.0	OROVILLE SEISMOGRAPH STATION	1051	AAA	14.9	12.6		OSSA OSSA	N53W N37E	.103 .108
FRIULI SEQUENCE	76 911	1635 0		5.9		6.0	FORGARIA-CORN., ITALY		ABB	15.7	14.5		F138 F138	NORT EAST	.133 .235

361.017-14

TABLE 361.17-1 (Continued)

EARTHQUAKE	DATE Y M D	TIME H M S	MAGNITUDE MB	ML	MS	DEPTH (KM)	RECORDING STATION	USGS STAT NO	SITE CLASS	DISTANCE TO: HYPOC (KM)	EPIC (KM)	RUPTURE (KM)	RECORD	COMP	PEAK ACCEL (G)
FRIULI SEQUENCE	76 911	1635 0		5.9		6.0	SOMPLAGO D.,ITALY - UNDERGROUND		FBA	8.5	6.0		F142	NORT	.063
													F142	EAST	.062
							BUIA, ITALY		ABC	15.2	14.0		F143	NORT	.234
													F143	EAST	.114
							S. ROCCO, ITALY		ABA	15.7	14.5		F139	NORT	.092
													F139	EAST	.091
FRIULI SEQUENCE	76 915	31519		6.1		9.0	S. ROCCO, ITALY		ABA	12.7	9.0		F153	NORT	.069
													F153	EAST	.119
							BUIA, ITALY		ABC	10.8	6.0		F156	NORT	.110
													F156	EAST	.102
							FORGARIA-CORN., ITALY		ABB	13.5	10.0		F152	NORT	.263
													F152	EAST	.218
FRIULI SEQUENCE	76 915	92118		6.0		12.0	TARCENTO, ITALY		ABB	22.5	19.0		F172	NORT	.139
													F172	EAST	.110
							FORGARIA-CORN., ITALY		ABB	23.3	20.0		F168	NORT	.353
													F168	EAST	.336
							S. ROCCO, ITALY		ABA	22.5	19.0		F169	NORT	.145
													F169	EAST	.228
							BUIA, ITALY		ABC	22.5	19.0		F177	NORT	.085
													F177	EAST	.101
COYOTE LAKE, CA	79 8 6	10 522	5.3	5.7	5.6	9.6	COYOTE CREEK (C217)	1445	ABA	9.8	1.8	3.2	CL01	N70E	.230
													CL01	N20W	.160
							GILROY ARRAY STA #1	1408	ABA	18.4	15.7	9.3	CL02	S40E	.130
													CL02	N50E	.100
							GILROY ARRAY STA #2	1409	ABB	17.0	14.0	7.5	CL03	N40W	.260
													CL03	S50W	.200
							GILROY ARRAY STA #3	1410	ABB	16.7	13.6	6.0	CL04	N40W	.270
													CL04	S50W	.260
							GILROY ARRAY STA #4	1411	ABB	15.5	12.2	4.5	CL05	S00E	.260
													CL05	S90E	.240
							GILROY ARRAY # 6: SAN YSIDRO	1413	ABA	14.1	10.3	3.1	CL06	S40E	.340
													CL06	N50E	.420
							SAN JUAN BAUTISTA: 101/156 OVERPASS	1492	BAC	29.4	27.8	17.2	CL07	S67E	.117
													CL07	S23W	.082

TABLE 361.17-1 (Continued)

EARTHQUAKE	DATE Y M D	TIME H M S	MAGNITUDE MB	ML	MS	DEPTH (KM)	RECORDING STATION	USGS STAT NO	SITE CLASS	DISTANCE TO: HYPOC (KM)	EPIC (KM)	RUPTURE (KM)	RECORD	COMP	PEAK ACELL. (G)
COYOTE LAKE, CA	79 8 6	10 522	5.3	5.7	5.6	9.6	SAN JUAN BAUTISTA: 101/156 OVERPASS (C	1492	DAC	29.4	27.8	17.2	CL08 CL08	S67E S23W	.120 .110
							SAN JUAN BAUTISTA (C126)	1377	ABB	29.4	27.8	15.6	CL10 CL10	S57E N33E	.090 .110
LIVERMORE SEQUE NCE : SHOCK A	80 124	11 0 9		5.9		5.9	SAN RAMON: EASTMAN KODAK BLDG (C	1418	ABB	17.7	16.7	17.6	LA01 LA01	S00E S90W	.148 .063
							SAN RAMON FIRE STATION (C134)	1383	ABB	18.2	17.2	21.7	LA02 LA02	N70E N20W	.042 .053
							ANTIOCH	1308	ACD	20.3	19.5	28.5	LA03 LA03	N00E N90W	.010 .040
							WALNUT CREEK: FIDELITY SAVINGS (C364)		DBA	25.2	24.2	33.1	LA04 LA04	S00E S90E	.027 .031
							PLEASANT HILL: CITIZENS SAVINGS (C348)		DBD	26.4	25.7	35.0	LA05 LA05	N90E N00E	.028 .028
							DELTA PUMPING PLANT (CDWR)	1030		17.5	16.5	9.9	LA22 LA22	LONG TRAN	
							DEL VALLE DAM	1265	ABB	25.9	25.2	12.9	LA23 LA23	S66W S24E	.240 .140
							LIVERMORE VA HOSPITAL, BUILDING 62	1226	EBD	24.8	24.1	12.9	LA24 LA24	S52E N38E	.120 .180
MAMMOTH LAKES SHOCK A	80 525	93345		6.1		8.9	CONVICT CREEK	1324	ACD	9.0	1.5		ML01 ML01	S00E N90E	.464 .428
							MAMMOTH LAKES HIGH SCHOOL GYM (C	1490	BAD	14.0	10.8		ML02 ML02	S74W N16W	.327 .262
							LONG VALLEY DAM	1444	AAA	15.6	12.8		ML03 ML03	N90E N00E	.275 .432
							LONG VALLEY DAM	1444	AAA	15.6	12.8		ML04 ML04	N90E N00E	.069 .110
MAMMOTH LAKES SHOCK B	80 525	94927		6.0		13.8	CONVICT CREEK	1324	ACD	16.3	8.6		ML11 ML11	S00E N90E	.200 .170
							MAMMOTH LAKES HIGH SCHOOL GYM (C	1490	BAD	14.2	3.5		ML12 ML12	S74W N16W	.370 .430
							LONG VALLEY DAM	1444	AAA	24.4	20.1		ML13 ML13	N90E N00E	.070 .190

TABLE 361.17-1 (Continued)

EARTHQUAKE	DATE Y M D	TIME H M S	MAGNITUDE MB	ML	MS	DEPTH (KM)	RECORDING STATION	USGS STAT NO	SITE CLASS	DISTANCE TO: HYPOC (KM)	EPIC (KM)	RUPTURE (KM)	RECORD	COMP	PEAK ACELL (G)
MAMMOTH LAKES SHOCK B	80 525	94927		6.0		13.8	LONG VALLEY DAM	1444	AAA	24.4	20.1		ML14	N90E	.010
													ML14	N00E	.040
MAMMOTH LAKES SHOCK C	80 525	124451		6.1		16.4	CONVICT CREEK	1324	ACD	17.0	6.1		ML21	S00E	.193
													ML21	N90E	.239
							LONG VALLEY DAM	1444	AAA	19.9	11.9		ML22	N90E	.190
													ML22	N00E	.494
							LONG VALLEY DAM	1444	AAA	19.9	11.9		ML23	N90E	.062
													ML23	N00E	.110
MAMMOTH LAKES AFTERSHOCK	80 525	1336 0		5.7		2.3	CONVICT CREEK	1324	ACD	3.6	2.8		ML41	SOUT	.440
													ML41	EAST	.370
MAMMOTH LAKES SHOCK D	80 527	75057		6.2		14.2	CONVICT CREEK	1324	ACD	18.6	12.0		ML31	S00E	.331
													ML31	N90E	.267
							LONG VALLEY DAM	1444	AAA	20.0	14.0		ML32	N90E	.412
													ML32	N00E	.994
							LONG VALLEY DAM	1444	AAA	20.0	14.0		ML33	N90E	.172
													ML33	N00E	.243
							CDMG TEMP STAT AT PARADISE LODGE	19	AAA	24.5	20.0		ML34	S30E	.119
													ML34	N60E	.090

NUMBER OF DATA POINTS = 222

EBK2,N

TABLE 361.17-2

Accelerograms Recorded at Selected Recording Stations from Magnitude M_L 5.7 to 6.4 Earthquake in the Distance Range 0 to 27 kilometers

EARTHQUAKE	DATE Y M D	TIME H M S	MAGNITUDE MB	ML	MS	DEPTH (KM)	RECORDING STATION	USGS STAT NO	SITE CLASS	DISTANCE TO: HYPOC (KM)	EPIC (KM)	RUPTURE (KM)	RECORD	COMP	PEAK ACCEL (G)
SAN FERNANDO, CA	71 2 9	6 042	6.2	6.4	6.6	8.4	8244 ORION BLVD	241	DBD	23.7	22.1	7.4	C048 C048	N00W S90W	.258 .140
							CASTAIC: OLD RIDGE ROUTE, CDWR SITE	110	ABB	29.7	28.5	24.9	D056 D056	N21E N69W	.335 .289
							LA: HOLLYWOOD STORAGE PE LOT	135	ABD	37.9	36.9	21.2	D058 D058	S00W N90E	.187 .217
							LA: 1640 MARENGO	181	DCC	43.5	42.7	26.5	D062 D062	N38W S52W	.139 .147
							LA: 3407 W SIXTH ST	199	DBB	40.6	39.7	24.1	E083 E083	S00W N90E	.168 .182
							LA: 808 S OLIVE ST	175	DBC	43.7	42.8	26.0	F089 F089	S53E S37W	.141 .152
							PALMDALE FIRE STATION	262	AAD	33.3	32.2	25.4	G114 G114	S60E S30W	.118 .150
							450 ROXBURY BEVERLY HILLS	455	DBD	39.0	38.1	24.4	I131 I131	N50E N40W	.202 .170
							LAKE HUGHES ARRAY #1	125	AAB	30.4	29.2	25.8	J141 J141	N21E S69E	.152 .115
							1625 OLYMPIC BLVD L A	469	DBB	42.7	41.8	25.8	O199 O199	N28E N62W	.144 .259
							14724 VENTURA BLVD L A	253	DBD	30.5	29.3	15.5	Q233 Q233	S12W N78W	.263 .207
							1760 ORCHID ST L A	446	DAB	35.5	34.5	19.6	Q236 Q236	EAST SOUT	.172 .130
							LA: 800 W FIRST ST	172	DBB	42.6	41.8	25.5	Q241 Q241	N37E N53W	.096 .143
							LA: 222 FIGUEROA ST	145	DBB	42.6	41.7	25.5	R244 R244	N53W S37W	.156 .132
							6200 WILSHIRE BLVD L A	443	DBD	39.7	38.8	24.8	S255 S255	NO6E N82W	.129 .131
MANAGUA NICARAGUA (MAIN SHOCK)	721223	029 0	5.6	6.1	6.2	5.0	ESSO REFINERY MANAGUA NICARAGUA	3501	ABB	7.5	7.0	5.0	MN05 MN05	SOUT EAST	.330 .390
FRIULI SEQUENCE	76 911	1635 0		5.9		6.0	FORGARIA-CORN., ITALY		ABB	15.7	14.5		F138 F138	NORT EAST	.133 .235

TABLE 361.17-2 (Continued)

EARTHQUAKE	DATE Y M D	TIME H M S	MAGNITUDE MB	ML	MS	DEPTH (KM)	RECORDING STATION	USGS STAT NO	SITE CLASS	DISTANCE TO: HYPOC (KM)	EPIC (KM)	RUPTURE (KM)	RECORD	COMP	PEAK ACELL (G)
FRIULI SEQUENCE	76 911	1635 0		5.9		6.0	BUIA, ITALY		ABC	15.2	14.0		F143	NORT	.234
													F143	EAST	.114
FRIULI SEQUENCE	76 915	31519		6.1		9.0	BUIA, ITALY		ABC	10.8	6.0		F156	NORT	.110
													F156	EAST	.102
							FORGARIA-CORN., ITALY		ABB	13.5	10.0		F152	NORT	.263
													F152	EAST	.218
FRIULI SEQUENCE	76 915	92118		6.0		12.0	TARCENTO, ITALY		ABB	22.5	19.0		F172	NORT	.139
													F172	EAST	.110
							FORGARIA-CORN., ITALY		ABB	23.3	20.0		F168	NORT	.353
													F168	EAST	.336
							BUIA, ITALY		ABC	22.5	19.0		F177	NORT	.085
													F177	EAST	.101
COYOTE LAKE, CA	79 8 6	10 522	5.3	5.7	5.6	9.6	GILROY ARRAY STA #2	1409	ABD	17.0	14.0	7.5	CL03	N40W	.260
													CL03	S50W	.200
							GILROY ARRAY STA #3	1410	ABD	16.7	13.6	6.0	CL04	N40W	.270
													CL04	S50W	.260
							GILROY ARRAY STA #4	1411	ABD	15.5	12.2	4.5	CL05	S00E	.260
													CL05	S90E	.240
							SAN JUAN BAUTISTA: 101/156 OVERPASS (C	1492	DAC	29.4	27.8	17.2	CL07	S67E	.117
													CL07	S23W	.082
							SAN JUAN BAUTISTA: 101/156 OVERPASS (C	1492	DAC	29.4	27.8	17.2	CL08	S67E	.120
													CL08	S23W	.110
							SAN JUAN BAUTISTA (C126)	1377	ABB	29.4	27.8	15.6	CL10	S57E	.090
													CL10	N33E	.110
LIVERMORE SEQUE NCE : SHOCK A	80 124	11 0 9		5.9		5.9	DEL VALLE DAM	1265	ABB	25.9	25.2	12.9	LA23	S66W	.240
													LA23	S24E	.140
MAMMOTH LAKES SHOCK A	80 525	93345		6.1		8.9	CONVICT CREEK	1324	ACD	9.0	1.5		ML01	S00E	.464
													ML01	N90E	.428
MAMMOTH LAKES SHOCK B	80 525	94927		6.0		13.8	CONVICT CREEK	1324	ACD	16.3	8.6		ML11	S00E	.200
													ML11	N90E	.170
MAMMOTH LAKES SHOCK C	80 525	124451		6.1		16.4	CONVICT CREEK	1324	ACD	17.0	6.1		ML21	S00E	.193
													ML21	N90E	.239
MAMMOTH LAKES AFTERSHOCK	80 525	1336 0		5.7		2.3	CONVICT CREEK	1324	ACD	3.6	2.8		ML41	SOUT	.440
													ML41	EAST	.370
MAMMOTH LAKES SHOCK D	80 527	75057		6.2		14.2	CONVICT CREEK	1324	ACD	18.6	12.0		ML31	S00E	.331
													ML31	N90E	.267

NUMBER OF DATA POINTS = 70

TABLE 361.017-3

STATISTICAL MAGNITUDE, DISTANCE, AND PEAK ACCELERATIONS
(FOR ANALYSIS DATA SETS)

Data Set	Number of Records	Mean Magnitude (M_L)	Mean Distance (km)		Peak Acceleration (g)		
			Rupture-Hypocentral	Rupture-Epicentral	Median	mean	84th percentile
Complete set	70	6.12	17.6	16.1	0.174	0.191	0.270
Complete set with highest and lowest value removed	68	6.13	17.8	16.2	0.174	0.189	0.264
Complete set with Mammoth Lakes M_L 5.7 record removed	68	6.14	18.0	16.4	0.170	0.185	0.258
Complete set weighted by area	70	6.11	17.1	15.3	0.170	0.186	0.261

THREE-LETTER CLASSIFICATION CODE FOR
TABLES 361.017-1 AND 361.017-2

FIRST LETTER: Structure Type and Instrument Location

Designation	Description
A	Free-field instrument or one-story structure; the instrument is located at the lowest level of the structure and within ± several feet of the ground surface.
B	Two to four-story structure of light construction; the instrument is located at the lowest level of the structure and within ± several feet of the ground surface.
C	Two to four-story structure of light construction; the instrument is located below the ground surface at the lowest level of the structure.
D	Structure of heavy construction; the instrument is located at the lowest level of the structure and within ± several feet of the ground surface.
E	Structure of heavy construction; the instrument is located below the ground surface at the lowest level of the structure.
F	Structure housing instrument is buried below the ground surface.
G	Structure of light or heavy construction; the instrument is located at the ground surface or below, but is not at the lowest level of the structure.

SECOND LETTER: Deep Local Geology

Designation	Description
A	Hard Rock; competent, typically with $V_S \geq 4000$ fps; generally includes metamorphic and intrusive igneous rocks.
B	Soft Rock; less competent, typically with $2000 \leq V_S \leq 4000$ fps; generally includes sedimentary and extrusive igneous rocks.
C	Old Alluvium; unconsolidated sediments of Miocene age or older; typically may have some "soft rock" characteristics, i.e., $V_S \geq 2000$ fps.
D	Recent Alluvium; unconsolidated sediments of Pliocene age or younger.

THREE LETTER: Near-Surface Geology

Designation	Description
A	Rock; the instrument is founded on rock material or a very thin (less than 10 to 15 feet) of soil over rock; typically is on a ridge or hillside.
B	Shallow Soil; the instrument is founded in or on soil up to 150 to 200 feet thick over rock material; typically is in a narrow canyon, near the edge of a valley or on a hillside.
C	Deep Narrow Soil; the instrument is founded in or on soil at least 200 to 300 feet thick over rock material in a narrow canyon or valley not more than several kilometers wide.
D	Deep Broad Soil; the instrument is founded in or on soil at least 200 to 300 feet thick over rock material in a broad canyon or valley.

APPENDIX A

The site descriptions and shear wave velocity profiles presented in this appendix are compiled from two primary sources of data, the Shannon & Wilson reports (References 16 through 21) and the work by Duke and Leeds (Reference 6), Duke et al (Reference 7), and Eguchi et al (Reference 8). Where specific information was not available about the site geology, the site conditions were estimated from geologic maps and the shear wave velocities were estimated from published data for similar soils.

A-1 8244 Orion Avenue (Holiday Inn)

The former recording station at 8244 Orion Avenue is designated USGS Station No. 241. The instrument is located on the ground floor of a seven-story building. The site is underlain by an estimated 1000 feet of recent aluvium and pleistocene sediments overlying Miocene sedimentary rocks (Reference 7). The shear wave velocity profile published by Duke et al (Reference 7) for the site is shown in Figure 361.017-A1.

A-2 Old Ridge Route, Castaic

The Old Ridge Route Recording Station at Castaic is designated USGS Station No. 110. The instrument is housed in a sheet-metal prefabricated instrument shelter on the crest of a small ridge. The instrument is underlain by weathered sedimentary rock, grading into fresh rock at depth. The measured shear wave profile is shown in Figure 361.017-A2 (References 7 and 18). The measured shear wave velocities indicate the subsurface material becomes rock-like at a depth of 100 feet.

A-3 Hollywood Storage PE Lot

The recording station at the Hollywood Storage Building 5 Parking Lot is designated USGS Station No. 135. The instrument was located in a metal shed 112 feet west of the Hollywood Storage Building. Data from a boring drilled at the site (Reference 19) indicates that the accelerograph is underlain by 146 feet of alluvium overlying silts and clays of the Repetto Formation. Figure 361.017-A3 shows the downhole shear wave measurements obtained in the boring. Also shown are shear wave velocities measured by Duke et al (Reference 7) using surface refraction techniques.

A-4 1640 Marengo Street

The former recording station at 1640 Marengo Street is designated USGS Station No. 181. The instrument is located on the ground floor of a seven-story building. The recording station is within 2000 feet of the USGS Station No. 190 at 2011 Zonal Avenue, which is in an area underlain by a thin alluvial cover overlying Miocene shale and sandstones (Reference 17). The USGS (Reference 24) reports that the station No. 181 is underlain by at least 50 feet of alluviumm. The shear wave velocity profile shown in Figure 361.017-A4 is estimated from published data for recent alluvium (Reference 3) and Miocene sedimentary rock (Reference 21).

A-5 3407 West Sixth Street

The recording station at 3407 West Sixth Street (Mutual Building) in Los Angeles is designated USGS Station No. 199. The instrument is located on the ground floor of the eight-story office and parking structure. The soil profiles published by Jennings & Strand (Reference 13) indicate the site is underlain by approximately 20 feet of alluvial deposits consisting of Pleistocene clay, silt, sand, and gravel. The shear wave velocity profile measured by Shannon & Wilson, Inc. (Reference 17) is shown in Figure 361.017-A5.

A-6 808 South Olive Street

The former recording station at 808 South Olive Street, Los Angeles, is designated USGS Station No. 175. The instrument is located on the ground level of a 8-level garage. The site is located approximately 3000 feet south of the Figueroa Street site investigated by Shannon & Wilson, Inc. (Reference 20). The area is characterized by recent alluvium overlying Plicene and Miocene sedimentary rocks. Figure 361.017-A6 shows the estimated shear wave velocity profile for the site. The shear wave velocities assigned to the alluvium are average values reported for similar materials (Reference 3). The shear wave velocities in the Miocene sedimentary rocks are assumed to be similar to those measured by Shannon & Wilson, Inc. (Reference 20) at the Figueroa Street site.

A-7 Palmdale Fire Station

The recording station at the Palmdale Fire Station is designated USGS Station No. 262. The instrument is located on the ground floor of a single story building. The site is underlain by an unknown depth of granular alluvium over granitic basement rocks. The shear wave velocity profile shown in Figure 361.017-A7 was estimated from the relationship published by Campbell and Duke (Reference 3) for recent alluvium.

A-8 450 North Roxbury, Beverly Hills

The former recording station at 450 North Roxbury is designated USGS Station No. 455. The instrument was located on the ground floor of a 10-story building. The site is underlain by at least 60 feet of recent alluvium (Reference 24). Figure 361.017-A8 shows the shear wave velocities measured at the site by Eguchi et al (Reference 8).

A-9 Lake Hughes Array No. 1

The recording station at the Los Angeles County Fire Station No. 78 is designated USGS Station No. 125. The instrument is located in a one-story fire truck garage. The site is underlain by more than 55 feet of alluvial deposits which overlie granitic bedrock at an unknown depth (Reference 4). The alluvial soils between the surface and 55 feet in depth consist of loose to medium dense sands with gravel and cobbles. The shear wave velocity profile reported by Duke et al (Reference 7) is shown in Figure 361.017-A9.

A-10 1625 West Olympic Boulevard, Los Angeles

The former recording station at 1625 West Olympic Boulevard is designated USGS Station No. 469. The instrument is located on the ground floor of a 10-story building. The site is approximately 5000 feet southwest of the Figueroa Street site investigated by Shannon & Wilson (1979c) in an area characterized by shallow alluvium overlying Miocene sedimentary rocks. The shear wave velocity profile measured by Duke and Leeds (Reference 6) is shown in Figure 361.017-A10.

A-11 14724 Ventura Boulevard, Los Angeles

The recording station at 14724 Ventura Boulevard, Los Angeles, is designated USGS Station No. 253. The recording instrument is located on the ground floor of a 14-story, reinforced concrete shear wall office tower. The soil profiles published by Jennings & Strand (Reference 13) indicate that the site is underlain by unconsolidated recent alluvium. This material is approximately 60 feet thick, consisting of clay, silt, sand, and gravel. Rocks of the upper Miocene Modelo Formation and the middle Miocene Topanga Formation underlie the alluvium (Reference 7). The shear wave velocity profile measured by Shannon & Wilson, Inc. (Reference 17) is shown on Figure 361.017-A11.

A-12 1760 North Orchid Street, Los Angeles

The former recording station at 1760 North Orchid Street is designated USGS Station No. 446. The instrument is located on the ground floor of a 23-story building. The site is approximately 500 feet north of the Hollywood Storage Building near the base of the Santa Monica Mountain. The site is underlain by at least 60 feet of alluvium (Reference 24) overlying Miocene sedimentary rocks. The shear wave velocity profile shown in Figure 361.017-A 12 is based on the velocities measured in the alluvial soils at the Hollywood Storage Building (Reference 19) and velocities measured in Miocene sedimentary rocks (Reference 21).

A-13 800 West First Street

The recording station at 800 West First Street, Los Angeles, is designated USGS Station No. 172. The instrument is located on the ground floor of a 32-story apartment house. The building is situated on a topographic high and is underlain by fractured, weathered shale. The shale is 120 feet below the surface, as determined by foundation engineering borings. The shear wave velocity profile shown in Figure 361.017-A13 was measured at the nearby station at 222 Figueroa Street (Reference 20).

A-14 222 Figueroa Street, Los Angeles

The recording station at 222 Figueroa Street, Los Angeles, is designated USGS Station No. 145. The instrument is located on the ground floor of a 17-story concrete structure. The site is underlain by 5 to 22 feet of fill overlying a sequence of alluvial sand, silt, and clay. The alluvium extends to between 26 and 33 feet below the surface, where it overlies the shale of the upper Miocene Puente Formation. Figure 361.017-A14 shows the shear wave velocity measured by Shannon & Wilson, Inc. (Reference 20).

A-15 6200 Wilshire Boulevard

The recording station at 6200 Wilshire Boulevard, Wilshire Medical Building, is designated USGS Station No. 443. The instrument is located on the ground floor of the 16-story building. The site is underlain by a sequence of Pleistocene older alluvium and terrace deposits. The upper most 130 feet consists of about 49 feet of firm clay, silt, and dense sand overlying 55 feet of asphaltic sand. The lowermost 26 feet consists of firm sandy silt and dense silty sand. The shear wave velocity profile reported by Shannon & Wilson, Inc. (Reference 16) is shown in Figure 361.017-A15.

A-16 Esso Refinery, Managua, Nicaragua

The recording station at the Esso Refinery is designated USGS Station No. 3501. The instrument is located in a tin shelter next to the main office building. Soil borings indicate that the site is underlain by approximately 150 feet of alluvial deposits of sands, clays, and gravels. Below the alluvial deposits fractured basalt and basalt fragments were encountered. The basalt fragments are underlain by a thick sequence of interbedded volcanic and alluvial deposits. The measured shear wave velocity profile reported by Faccioli et al (Reference 10) is shown in Figure 361.017-A16.

A-17 Forgaria-Cornino Italy

The site of the temporary recording station at Forgaria-Cornino is underlain by approximately 50 feet of alluvial deposits. The alluvial material is underlain by a sloping bedrock consisting of marly sandstone and sandstone (Muzzi and Vallini, 1977). Figure 361.017-A17 shows the shear wave velocity profile for the site estimated from measured velocities in similar materials (Muzzi and Pugilese, 1977, and Reference 25).

A-18 Buia, Italy

The temporary station at Buia, Italy, is underlain by a deep alluvial deposit of sand, clay, and gravel (Reference 2). The shear wave velocities in the alluvial soils, shown in Figure 361.017-A18, are assumed to be similar to those reported for Tarcento by Weston Geophysical (Reference 25).

A-19 Tarcento, Italy

The temporary recording station at Tarcento, Italy, was located on approximately 60 feet of alluvial soils overlying marl and sandstone (Reference 2). The shear wave profile shown in Figure 361.017-A19 is estimated from velocities measured in similar materials (Reference 25).

A-20 Gilroy Array Station No. 2

The recording station at the Mission Trails Motel is designated USGS Station No. 1409. The instrument is located on the ground floor of a single story building. The site is underlain by in excess of 500 feet of recent alluvium consisting of medium dense to dense sands (Reference 15). The shear wave profile shown in Figure 361.017-A20 is estimated from the data presented by Fumal (Reference 11) for similar materials.

A-21 Gilroy Array Station No. 3

The recording station at the Gilroy Sewage Plant is designated USGS Station No. 1410. The instrument is located on the ground floor of a single story building. The site is underlain by approximately 1000 feet of recent alluvium (Reference 15). The soils are expected to be very similar to Gilroy Array Station No. 2. The estimated shear wave velocity profile is shown in Figure 361.017-A20.

A-22 Gilroy Array Station No. 4

The recording station at San Ysidro School is designated USGS Station No. 1411. The instrument is located on the ground floor of a single story building. The site is underlain by in excess of 500 feet of recent alluvium (Reference 15). The soils are expected to be very similar to Array Stations 2 and 3. The estimated velocity profile is shown in Figure 361.017-A20.

A-23 San Juan Bautista 101/156 Overpass

The recording station at the Highway 101/156 overpass is designated USGS Station No. 1492. Instruments are located at the ground level on two support columns of a freeway overpass. The site is underlain by an unknown depth of upper Pleistocene terrace gravels (Reference 1). The shear wave velocity profile shown in Figure 361.017-21 is estimated from the data published by Fumel (Reference 11) for gravelly soil.

A-24 24 Polk Street, San Juan Bautista

The recording station at 24 Polk Street is designated USGS Station No. 1377. The instrument is located on the ground floor of a single story building. The site is underlain by an unknown depth of upper Pleistocene terrace gravels (Reference 1). The shear wave velocity profile, shown in Figure 361.017-A21, is estimated from the data published by Fumel (Reference 11) for gravelly soils.

A-25 Del Valle Dam

The recording station at Del Valle Dam is designated USGS Station No. 1265. The instrument is located in an instrument shelter at the downstream toe of an earth dam in a narrow canyon. The site is underlain by shallow alluvium of unknown depth overlying cretaceous sandstones and shales (Reference 12). The velocity profile shown in Figure 361.017-A22 is estimated from measured velocities in similar materials (Reference 11).

A-26 Convet Creek, Mammoth

The recording station at the Fish and Game Experimental Station near Mammoth Lakes is designated USGS Station No. 1324. The instrument is located on the ground floor of a single story building. The site is underlain by in excess of 100 feet of alluvium (Reference 24). The alluvium is expected to be very coarse grained deposits of sand and gravel. The velocity profile shown in Figure 361.017-23 was estimated from the compression wave velocities measured by Duke and Leeds (Reference 6) for similar soils at Bishop, California.

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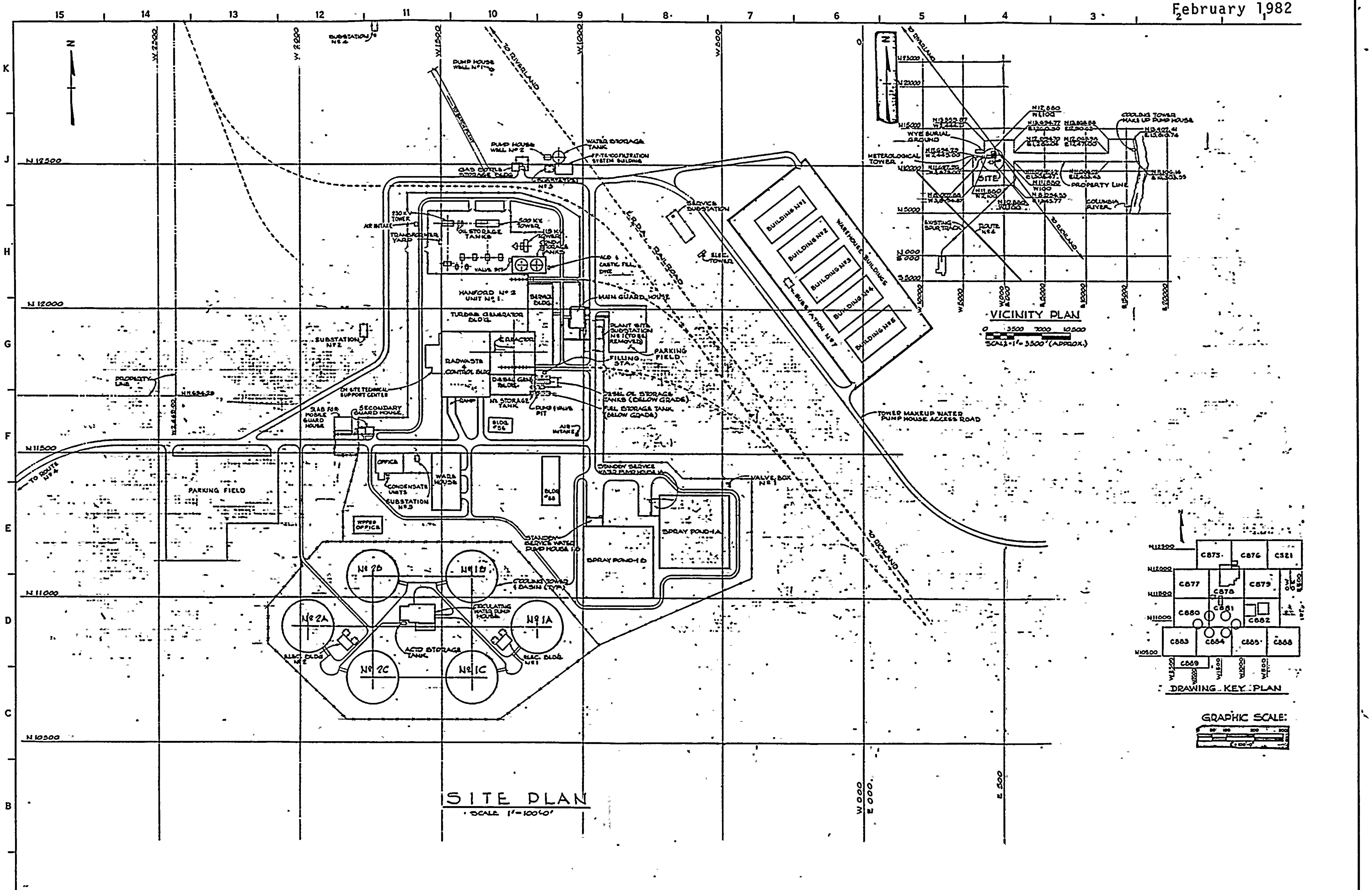

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	OVERALL SITE & VICINITY PLAN	FIGURE 371. 016-1

Q. 421.013

Describe the provisions for notifying the NRC for review and acceptance of changes (1) in the accepted QA program description as presented or referenced in the SAR or SSAR prior to implementation, and (2) in organizational elements within 30 days after announcement. (Note: editorial changes or personnel reassignments of a non-substantive nature do not require NRC notification.)

Response:

The Supply System as a matter of policy has submitted substantive changes to the QA Program and organizational elements within the limitations as noted in the question.

Q. 421.014

On page 14 modify the second paragraph to provide an additional commitment to "comply with 10 CFR 50.55a and the regulatory position of the regulatory guides specified in Appendix C.3 of the FSAR." In addition, modify Appendix C.3 to address the following regulatory guides or describe acceptable alternatives: 1.28-Rev. 2; 1.29-Rev. 3; 1.30; 1.39-Rev. 2; 1.74; 1.116; 1.123-Rev. 1; 1.144-Rev. 1; and 1.146.

Response:

The Supply System has referenced 10 CFR Part 50, as well as other pertinent parts of Title 10, in the second paragraph of 17.1.1. This reference includes acknowledgement that regulatory requirements, codes and standards are applicable to the design and construction of the plant.

The Supply System has addressed Regulatory Guides 1.30, 1.74, and 1.116 in Appendix C.3. Regulatory Guides 1.144, Revision 1 and 1.146 are currently being evaluated. We will add statements of conformance on these two guides to Appendix C.3 on or before September 1, 1981, and will incorporate into the next amendment to the FSAR.

The remaining regulatory guide revisions listed in the question have been evaluated by the Supply System. In these instances, regulatory guide conformance statements on the revision levels specified in Appendix C.3 are considered to provide for adequate quality per our project commitments.

Q. 421.015

Identify existing or proposed QA procedures to reflect that each criterion of 10CFR50, Appendix B will be met by documented procedures.

Response:

The Design and Construction QA Program, in QAR 2-1, provides a matrix of procedures vs. criteria. This matrix has been added to 17.1.1.2.

Q. 421.016

Provide a description of how management (above or outside the QA organization) regularly assesses the scope, status, adequacy and compliance of the QA program to 10CFR50, Appendix B. These measures should include:

a. Frequenct contact with program status through reports, meetings, and/or audits.

b. Performance of an annual assessment preplanned and documented. Corrective action is identified and tracked.

Response:

a. General staff meetings are held weekly by the WNP-2 Program Director. The Project QA Manager attends and quality-related topics are an agenda item. In addition, the project prepares a WNP-2 Program Director's Monthly Program Review Report which addresses quality-related topics. This Managing Director, in turn, is briefed from the report, as required, on the status of the project.

b. A formal preplanned and documented management assessment of the QA Program at WNP-2 is conducted annually. This assessment is described in the Corporate Design and Construction QA Program, QAR-18, and includes identification and tracking of corrective action.

12. Safety-related instrument and control systems are identified in Chapter 7, Table 7.1-1, and are under QA Program control. A footnote to this effect has been added to Table 3.2-1.

13. All of the items in Section 13 a) through l) are safety-related and controlled by the QA Program with the following clarifications.

    a) Diesel generator packages, including auxiliaries, are safety-related to the extent as defined in Table 3.2-1, Item 38.

    b) Valve operators are considered with the valves where they are installed and are addressed in Table 3.2-1 under the system the valve is installed in.

    c) Conduit and cable trays and their supports for Class IE cables and those whose failure may damage other safety-related items are safety-related and controlled by the QA Program.

    d) Instrumentation, control, power cables, transfers, inverters, etc., are considered with the system for which they are installed. If the system is a safety-related system it is controlled by the QA Program.

    e) Fire-rated penetration seals for cable systems will be under the control of the Supply System Operational QA Program.

14. All of the items in Section 14 a) through d) are safety-related and controlled by the QA Program with the following clarifications.

    a) Conduit and cable trays and their supports for Class IE cables and those whose failure may damage other safety-related items are safety-related and controlled by the QA Program.

    b) Battery racks are considered with the batteries.

c) Protective relays and control panels are considered with the equipment panel they service. (Item 13d above is applicable.)

15. The normal operation fixed area and airborne monitoring systems are discussed in 12.3.4. These systems are not safety-related and, therefore, are not controlled by the QA Program.

The post-accident high range radiation monitoring system for the drywell and containment is safety-related and the components are controlled by the QA Program.

Portable radiation monitoring is not a "structure, system, or component" requiring entry in Table 3.2-1. Control of these monitors as well as calibration of all radiation monitors is provided for by the appropriate WNP-2 Administrative Procedures. These procedures are subject to the pertinent requirements of the Supply System Operational QA Program.

16. The normal operation and post-accident process and effluent radioactivity monitoring systems are discussed in 7.5 and 11.5.

The only radioactivity monitoring components that are controlled by the QA Program are the radiation monitors for the main steam line, reactor building ventilation monitor, and the containment atmosphere radiation monitor. These monitors are covered in Items 9 and 48 of Table 3.2-1.

Portable radioactivity monitoring is not a "structure, system, or component" requiring entry in Table 3.2-1. Control of these monitors as well as calibration of all radioactivity monitors is provided by the appropriate WNP-2 Administrative Procedures. These procedures are subject to pertinent requirements of the Supply System Operational QA Program.

2. Tables 14.2-2, 14.2-3 and 14.2-4 have been modified to more clearly define the WNP-2 Startup Test Program.

   Tables 14.2-2 and 14.2-4 have been modified to reflect commitments made in our response to 423.30.11b.

1. Amendment 13, February 1981, modified the shutdown from outside the main control room startup test description to indicate that the shutdown cooling mode of RHR would be utilized from the remote shutdown panel in this demonstration. The Supply System position on generating a reactor scram and MSIV isolation to initiate the plant shutdown is also advanced in the Amendment 13 change to Test #28. In summary, that position states that the capability exists to manually scram and isolate from outside the control room. However, the plant emergency operating procedure for control room evacuation directs the operations staff to manually scram and isolate. The Supply System intends to perform these plant capability demonstrations under the guidance of established emergency operating procedures to the extent practical. To require initiation of a reactor scram and isolation from outside the control room does not provide any additional assurance of plant safety. Unless specifically directed to do otherwise, we intend to perform the remote shutdown demonstration as outlined in 14.2.12.3.28.

   The Supply System reiterates its position with regard to the referenced Regulatory Guide 1.68.2 exception. The capability easily exists to effect a reactor scram and MSIV isolation from outside the control room. However, our normal operating and emergency operating procedures must be used to conduct the Startup Test Program. These requirements on STP #28 are contrary to our plant procedures; therefore, we cannot support performing the test in the manner prescribed.

   For purposes of this test, reactor scram and MSIV isolation will be accomplished from the control room.

A caution will be added to the WNP-2 emergency procedures to direct an operator to open the RPS MG set output breakers in the event that reactor scram and MSIV isolation cannot be accomplished during control room evacuation.

m. From a minimum critical power ratio, MCPR, standpoint, recirculation pump trips are inconsequential in that no reduction in safety margin or approach to an operating limit is experienced. The recirculation pump trips are mainly included in the Startup Test Program to provide reactor internals vibration forcing function transients. Performance of a two-pump trip at TC-6 is impractical because it would cause a reactor scram. Table 14.2-4 reflects the Supply System's intentions for recirculation system testing. Section 14.2.7.2 has been modified to reflect this position. In addition, the recirculation system test description (14.2.12.3.30.3) has been changed to eliminate the discrepancy noted.

The design dynamic response of the plant to a simultaneous trip of both recirculation pumps at 100% power produces a reactor scram. Our test program does not produce transients solely to confirm that a reactor scram occurs when it should. All data pertinent to a two-pump trip from high power transient is obtained in conjunction with other tests; therefore, it is not necessary to include this specific test in the program.

The WNP-2 position is that the turbine trip at 100% power transient envelopes the simultaneous[2] recirculation pump trip transient. The following engineering analysis is provided to demonstrate that the two-pump trip is enveloped and not required.

The design dynamic response of the plant to a simultaneous trip of both recirculation pumps at 100% power produces a reactor scram. Our test program does not initiate transients solely to confirm that a reactor scram occurs when it should. All data pertinent to a two-pump trip from high power transient is obtained in conjunction with other tests (e.g., STI #27 performed @ 100% power). A two recirculation pump trip transient is performed in the test program from Test

Regulatory Guide 1.108 is not applicable to WNP-2 but WNP-2 will comply with the intent of this regulatory guide. Diesel Generator testing is designed to meet the requirements of IEEE-387, 1977 and the intent of Regulatory Guide 1.108, Rev. 0.

Diesel Generators are tested to demonstrate full load and overload capabilities, redundancy and non-interdependence, load rejection capabilities, synchronizing and load shifting, load acceptance during normal and accident conditions, capabilities and operation of support systems (i.e., lube oil, fuel oil and starting air), starting time, voltage and frequency stability and functional capabilities will be verified under hot and cold conditions.

These tests are described in the Standby AC Power System Preoperational Test (14.2.12.1.37), the Loss of Power and Safety Testing Preoperational Test (14.2.12.1.37) and the Loss of Turbine Generator and Offsite Power Test (14.2.12.3.31).

WNP-2 will comply with Regulatory Guide 1.108, Rev. 1, 1977. Test abstract (14.2.12.1.37) indicating compliance to Regulatory Guide 1.108, Rev. 1, 1977 will be provided (indicating the 69/N start test).

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