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PALO VERDE NUCLEAR GENERATING STATION
P.O. BOX 52034 PHOENIX, ARIZONA 85072-2034

10 CFR 50.71(e)

WILLIAM L. STEWART
EXECUTIVE VICE PRESIDENT
NUCLEAR

102-03708-WLS/AKK/GAM
May 22, 1996

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Station P1-37
Washington, DC 20555-0001

Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station (PVNGS)**
Units 1, 2, and 3
Docket Nos. STN 50-528/529/530
Updated Final Safety Analysis Report, Revision 7

In March 1995, APS prepared Revision 7 of the PVNGS Updated Final Safety Analysis Report (UFSAR) in accordance with 10 CFR 50.71(e). That UFSAR update was shipped to the NRC address specified in 10 CFR 50.4, as required by 10 CFR 50.71(e), in March 1995. However, it was recently discovered that the UFSAR, Revision 7 submittal was not received by the NRC headquarters office.

APS is providing one "use-as-original" copy of the original notarized submittal along with 10 copies. It has been confirmed that the UFSAR, Revision 7 update was received by the NRC Region IV Office, the NRC Region IV Walnut Creek Field Office, and the NRC Resident Inspectors' Office at PVNGS. In addition, one copy of the update has been provided to the NRC Project Manager for PVNGS.

Should you have any questions, please contact Scott A. Bauer at (602) 393-5978.

Sincerely,

WL Stewart

WLS/AKK/GAM/rv
Enclosure

cc: L. J. Callan (all w/o enclosure)
K. E. Perkins
C. R. Thomas
K. E. Johnston
A. V. Godwin (ARRA)

A053
1/11

a1001

10 CFR 50.54(a)(3)
10 CFR 50.71(e)

Arizona Public Service Company
P.O BOX 53999 • PHOENIX, ARIZONA 85072-3999

WILLIAM L. STEWART
EXECUTIVE VICE PRESIDENT
NUCLEAR

102-03288-WLS/GAM
March 23, 1995

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Station P1-37
Washington, DC 20555-0001

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, and 3
Docket Nos. STN 50-528/529/530
Updated Final Safety Analysis Report, Revision 7
File: 95-005-419.05

Pursuant to 10 CFR 50.71(e), Arizona Public Service Company (APS) is submitting an original and ten copies of the replacement pages, insertion instructions, and list of effective pages for Revision 7 to the PVNGS Updated Final Safety Analysis Report (UFSAR). One copy is also being provided to the NRC Region IV Office, the Region IV Walnut Creek Field Office, and the NRC Resident Inspectors' Office at PVNGS. The changes included herein were made under the provisions of 10 CFR 50.59 but not previously submitted to the NRC.

Pursuant to 10 CFR 50.54(a)(3), the changes to the quality assurance program description included in this submittal do not reduce the commitments previously accepted by the NRC.

Should you have any questions or require additional information, please contact Scott A. Bauer at (602) 393-5978.

Sincerely,

WL Stewart

WLS/GAM/rv
Enclosure

cc:	K. E. Perkins	(w enclosure)
	L. J. Callan	(w enclosure)
	B. E. Holian	(w/o enclosure)
	K. E. Johnston	(w enclosure)

PVNGS UPDATED UFSAR

REVISION 7

INSERTION INSTRUCTIONS

The following instructions indicate replacement pages and additional or removed pages for incorporating Revision 7 into the Updated Final Safety Analysis Report for the Palo Verde Nuclear Generating Station. Remove the existing pages and insert the replacement and additional pages where indicated by these instructions. Retain these instructions in the front of Volume I as a record of changes.

Location	Remove Pages	Insert Revision 7 Pages
VOLUME I		
List of Effective Pages	1/2 through 57/58	1/2 through 57/58
Master Table of Contents	xiii/xiv	xiii/xiv
	xvii/xviii	xvii/xviii
Chapter 1	1.2-5/1.2-6	1.2-5/1.2-6
	1.3-1/1.3-2	1.3-1/1.3-2
	Figure 1.7-2 Unit 1, Sh 1 of 2 Unit 2, Sh 1 of 2 Unit 3, Sh 1 of 2 Unit 1, Sh 2 of 2 Unit 2, Sh 2 of 2 Unit 3, Sh 2 of 2	Figure 1.7-2 Sh 1 of 4 Sh 2 of 4 Sh 3 of 4 Sh 4 of 4
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Chapter 1 (continued)	1.8-7/1.8-8	1.8-7/1.8-8
	1.8-61/1.8-62 1.8-63/1.8-64	1.8-61/1.8-62 1.8-63/1.8-64
	1.8-71/1.8-72 through 1.8-85/1.8-85.a	1.8-71/1.8-72 through 1.8-85/1.8-85.a
	1.8-93.b/1.8-94 through 1.8-96.a/1.8-96.b	1.8-93.b/1.8-94 through 1.8-96.a/1.8-96.b
	1.9-9/1.9-10	1.9-9/1.9-10
Chapter 2	2.3-13/2.3-14	2.3-13/2.3-13.a 2.3-13.b/2.3-14
	2.3-73/blank	2.3-73/blank
VOLUME III		
Chapter 2 (continued)	2.4-3/2.4-4	2.4-3/2.4-4
	2.4-75/2.4-76 through 2.4-83/2.4-84	2.4-75/2.4-76 through 2.4-83.b/2.4-84
	2.4-123/blank	2.4-123/blank

INSERTION INSTRUCTIONS (Continued)

Location	Remove Pages	Insert Revision 7 Pages
VOLUME V		
Chapter 3	3-xi/3-xii through 3-xxi/3-xxii	3-xi/3-xii through 3-xxi/3-xxii
	3.2-11/3.2-12	3.2-11/3.2-12
	3.2-25/3.2-26	3.2-25/3.2-26
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	3.6-23/3.6-24 through 3.6-27/3.6-28	3.6-23/3.6-24 through 3.6-27/3.6-28
	3.6-35/3.6-36 through 3.6-39/3.6-40	3.6-35/3.6-36 through 3.6-39/3.6-40
	3.6-53/3.6-54	3.6-53/3.6-54
	Figure 3.6-10 through Figure 3.6-19	Figure 3.6-10 through Figure 3.6-19
	Figure 3.6-21 through Figure 3.6-23	Figure 3.6-21 through Figure 3.6-23
	Figure 3.6-27	Figure 3.6-27
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VOLUME VII		
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	Figure 3.8-39	Figure 3.8-39
	3.9-95/3.9-96 through 3.9-101/3.9-102	3.9-95/3.9-96 through 3.9-101/3.9-102
VOLUME VIII		
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	3A-7/3A-8 through 3A-12.a/3A-12.b	3A-7/3A-8 through 3A-12.a/3A-12.b

INSERTION INSTRUCTIONS (Continued)

Location	Remove Pages	Insert Revision 7 Pages
Chapter 3 (continued)	Figure 3A-3	Figure 3A-3
	Figure 3A-4	Figure 3A-4
	Sh 1 of 2	Sh 1 of 2
	Sh 2 of 2	Sh 2 of 2
	-----------	Figure 3A-4A
	Figure 3A-5	Figure 3A-5
	Figure 3A-6	Figure 3A-6
	-----------	Figure 3A-6A
	-----------	Figure 3A-6B
VOLUME X		
Chapter 3 (continued)	Appendix 3E Title Page	Appendix 3E Title Page
	3E-iii/blank	3E-iii/3E-iv through 3E-vii/3E-viii
	3E-1/3E-2 through 3E-13/3E-14	3E-1/3E-2 through 3E-13/3E-14
	-----------	Figure 3E-1 through Figure 3E-56
Chapter 4	4-i/4-ii through 4-vii/4-viii	4-i/4-ii through 4-vii/4-viii
	4.2-67/4.2-68	4.2-67/4.2-68
	4.2-113/4.2-114	4.2-113/4.2-114
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	Sh 2 of 3	
	Sh 3 of 3	
	Figure 4.3-2 Sh 1 of 2 through Figure 4.3-14 Sh 3 of 3	------------
	Figure4.3-17	------------
	Figure 4.3-21	------------
	Figure 4.3-22	------------
	4.4-4.c/4.4-4.d	4.4-4.c/4.4-4.d
	4.4-11/4.4-12	4.4-11/4.4-12

INSERTION INSTRUCTIONS (Continued)

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	4.4-67/blank	4.4-67/blank
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Chapter 5	5-xvii/blank	5-xvii/blank
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	5.1-21/5.1-22	5.1-21/5.1-22
	5.1-41/5.1-42 through 5.1-45/5.1-46	5.1-41/5.1-42 through 5.1-45/5.1-46
	Figure 5.1-1 Unit 1, Sh 1 of 3 Unit 2, Sh 1 of 3 Unit 3, Sh 1 of 3	Figure 5.1-1 Unit 1, Sh 1 of 3 Unit 2, Sh 1 of 3 Unit 3, Sh 1 of 3
	5.2-23/5.2-24 5.2-25/5.2-26	5.2-23/5.2-24 5.2-25/5.2-26
VOLUME XIII Chapter 5 (Continued)	Figure 5.2-2 Sh 1 of 5	Figure 5.2-2 Sh 1 of 5
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	------------- ------------- -------------	Figure 5.4-2 Figure 5.4-3 Figure 5.4-4
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	6.2.2-3/6.2.2-4	6.2.2-3/6.2.2-4
	6.2.2-11/6.2.2-12	6.2.2-11/6.2.2-12
	Figure 6.2.4-1 Sh 7 of 10	Figure 6.2.4-1 Sh 7 of 10
	Figure 6.2.5-1 Unit 1 Unit 2 Unit 3	Figure 6.2.5-1 Unit 1 Unit 2 Unit 3
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	6.3-19/6.3-20 through 6.3-41/6.3-42	6.3-19/6.3-20 through 6.3-41/6.3-42
	6.3-75/6.3-76 through 6.3-83/6.3-84	6.3-75/6.3-76 through 6.3-83/6.3-84
VOLUME XV Chapter 6 (continued)	Figure 6.3-1 Unit 1, Sh 1 of 3	Figure 6.3-1 Unit 1, Sh 1 of 3
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	Unit 3, Sh 2 of 3	Unit 3, Sh 2 of 3
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	Figure 6.5-1	Figure 6.5-1
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	Figure 9.3-3 Unit 1, Sh 1 of 3 through Unit 3, Sh 2C of 3	Figure 9.3-3 Unit 1, Sh 1 of 3 through Unit 3, Sh 2C of 3
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Location	Remove Pages	Insert Revision 7 Pages
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	Figure 9.4-1 Unit 1, Sh 1 of 2 Unit 2, Sh 1 of 3 Unit 3, Sh 1 of 2	Figure 9.4-1 Unit 1, Sh 1 of 2 Unit 2, Sh 1 of 3 Unit 3, Sh 1 of 2
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	Figure 9.5-9 Unit 1, Sh 1 of 8 through Unit 1, Sh 4 of 8 Unit 3, Sh 4 of 8 Unit 1, Sh 5 of 8 Unit 3, Sh 5 of 8 through Unit 3, Sh 8 of 8	Figure 9.5-9 Unit 1, Sh 1 of 8 through Unit 1, Sh 4 of 8 Unit 3, Sh 4 of 9 Unit 1, Sh 5 of 8 Unit 3, Sh 5 of 9 through Unit 3, Sh 9 of 9
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xv	0
xvi	3
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xviii.a	1
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18.II.B-22	O	18.II.F-23	O	18.III.D-8	O
18.II.B-23	O	18.II.F-24	O	18.III.D-9	O
18.II.B-24	O	18.II.F-25	O	18.III.D-10	O
Fig. 18.II.B-1	2	18.II.F-26	O	18.III.D-11	O
		18.II.F-27	O	18.III.D-12	O
18.II.D Tab	--	18.II.F-28	O	18.III.D-13	5
				18.III.D-14	6
18.II.D-1	4	**18.II.G Tab**	--	18.III.D-15	5
18.II.D-2	O			18.III.D-16	5
18.II.D-3	O	18.II.G-1	O	18.III.D-17	O
		18.II.G-2	O		
18.II.E Tab	--			**18A Tab**	--
		18.II.K Tab	--		

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1.2.7 POWER CONVERSION SYSTEM

1.2.7.1 Turbine-Generator

The turbine-generator is an 1800 r/min, tandem compound, six-flow, 43-inch last-stage bucket reheat unit with an electrohydraulic control system.

The rated NSSS power level is 3800 MWt, plus 17 MWt net heat from nonreactor sources, for a total of 3817 MWt per unit. The corresponding turbine-generator gross output is 1304 MWe at 3.5 inches Hg abs backpressure. The nominal net output of PVNGS is 1270 MWe per unit.

The generator is a direct-driven, three-phase, 60 Hz, 24,000V, 1800 r/min, conductor cooled synchronous generator rated at approximately 1559 MVA at 0.90 power factor and 75 psig hydrogen pressure.

1.2.7.2 Main Steam Supply System

The main steam supply system provides steam from the steam generators for the turbine-generator, the feedwater pump turbines, the turbine gland sealing system, condensate and feedwater heating, and main turbine reheat steam as required.

1.2.7.3 Main Condenser

Steam from the low-pressure turbine is exhausted directly downward into the condenser shells through exhaust openings in the bottom of the turbine casings and is condensed. The condenser is a multisection, multipressure condenser, each section serving one double-flow, low-pressure turbine section. The condenser also serves as a heat sink for the turbine bypass system.

1.2.7.3.1 Condenser Air Removal System (CARS)

The condenser air removal system removes air and noncondensable gases from the main condenser and exhausts them to the atmosphere. The CARS consists of four two-stage mechanical vacuum pumps. Three vacuum pumps are used during startup and normal operation. One additional vacuum pump serves as backup to the three pumps in operation.

1.2.7.4 Circulating Water System

The circulating water system provides the main condenser with a continuous supply of cooling water to remove the heat rejected from the turbine thermal cycle. The circulating water system consists of three circular mechanical draft cooling towers and four vertical, motor-driven pumps. The circulating water pumps circulate the cooling water from the cooling tower basins through the main condenser and then back to the cooling towers. Makeup water to compensate for drift, blowdown, and evaporative losses is supplied from the makeup water reservoir.

1.2.7.5 Condensate and Feedwater System

Three condensate pumps take the deaerated condensate from the hotwells of the main condenser and deliver it through the low-pressure feedwater heaters to two feedwater pumps. Drains from moisture separators and reheaters, and the high-pressure feedwater heaters, are pumped into the suction stream of the feedwater pumps by two heater drain pumps, and the drains from low-pressure heaters are cascaded back to the main condenser. The feedwater pumps discharge the total feedwater flow through the high-pressure feedwater heaters to the steam generators.

1.3 COMPARISON TABLES

1.3.1 COMPARISONS WITH SIMILAR FACILITY DESIGNS

Tables 1.3-1 and 1.3-2 present a summary of the characteristics of the Palo Verde Nuclear Generating Station. Table 1.3-1 presents similar reactor core and coolant system data for Pilgrim Station Unit 2 and San Onofre Units 2 and 3. Table 1.3-2 presents similar containment system, engineered safety features, and electrical components data for Farley Units 1 and 2, Calvert Cliffs 1 and 2, and San Onofre Units 2 and 3.

The Pilgrim Station Unit 2 and San Onofre Units 2 and 3 designs were selected for comparison in table 1.3-1 because of the basic similarity of the reactor core and coolant systems. In addition, San Onofre was selected for comparison because this reactor is nearing completion of its operating license application review with the NRC.

1.3.2 COMPARISON OF FINAL AND PRELIMINARY INFORMATION

Table 1.3-3 contains a discussion of significant changes that have been made in plant design since submittal of the PVNGS 1, 2, and 3 PSAR and amendments 1 through 20.

Table 1.3-1

REACTOR CORE AND COOLANT SYSTEM PARAMETERS (Sheet 1 of 9)

Item	Palo Verde	Reference Section	Pilgrim Station Unit 2	San Onofre Units 2 and 3
Hydraulic and Thermal Design Parameters				
Rated core heat output, MWt	3800	4.4	3,456	3,390
Rated core heat output, Btu/h	12,970 x 10^6	4.4	11,800 x 10^6	11,570 x 10^6
Heat generated in fuel, %	97.5	4.4	96.5	97.5
System pressure, nominal, psia	2250	4.4	2,250	2,250
System pressure, minimum steady state, psia	2200	4.4	2,200	2,200
Hot channel factors,				
Heat flux, Fq	2.35	1.3	2.35	2.35
Enthalpy rise, F_H (outlet enthalpy = 699)	1.56	4.4	1.55	1.55
DNB ratio at nominal conditions	1.79 (CE-1)	4.4	2.26 (W-3)	2.07 (CE-1)
Coolant flow				
Total flowrate, lb/h	164.0 x 10^6	5.2	148 x 10^6	148 x 10^6
Effective flowrate for heat transfer, lb/h	157.4 x 10^6	4.4	142.8 x 10^6	142.8 x 10^6
Effective flow area for heat transfer, ft^2	60.9	4.4	54.8	54.7
Average velocity along fuel rods, ft/s	16.4	4.4	16.5	16.3
Average mass velocity, lb/h-ft^2	2.58 x 10^6	4.4	2.60 x 10^6	2.61 x 10^6
Coolant temperatures, ^oF				
Nominal inlet	568	4.4	557.5	553.
Design inlet	564.5	4.4	560.5	556
Average rise in vessel	56	4.4	58.3	58
Average rise in core	59	4.4	60.3	60
Average in core	594	4.4	588	583

actuating level adjustable over a minimum range of 0.01 to 0.03g. Seismic triggers designed for use at an elevated location have an actuating level adjustable over a minimum range which is appropriate for that trigger location such that all triggers actuate at approximately the same earthquake severity.

Refer to subsection 3.7.4 for a description of the PVNGS instrumentation for earthquakes.

<u>REGULATORY GUIDE 1.13</u>: Fuel Storage Facility Design Bases (Revision 0, March 10, 1971)

<u>RESPONSE</u>

The position of Regulatory Guide 1.13 is accepted. Compliance is described in sections 3.5 and 9.4, and subsections 3.8.4, 9.1.2, and 9.1.3.

<u>REGULATORY GUIDE 1.14</u>: Reactor Coolant Pump Flywheel Integrity (Revision 0, October 27, 1971)

<u>RESPONSE</u>

Refer to CESSAR Section 1.8.

<u>REGULATORY GUIDE 1.15</u>: Testing of Reinforcing Bars for Category I Concrete Structures (Revision 1, December 28, 1972)

<u>RESPONSE</u>

The position of Regulatory Guide 1.15 is accepted (refer to section 3.8).

<u>REGULATORY GUIDE 1.16</u>: Reporting of Operating Information (Revision 1, October 1973)

RESPONSE

The position of Regulatory Guide 1.16 is accepted, except for Section C.2, Nonroutine Reports, which is superseded by 10CFR50.72 and 50.73 for nonroutine reports.

REGULATORY GUIDE 1.17: Protection of Nuclear Power Plants Against Industrial Sabotage (Revision 1, June 1973)

RESPONSE

The position of Regulatory Guide 1.17 is accepted with the following exceptions to ANSI 18.17-4.3 regarding employee screening.

Unescorted access to sensitive (Type I Vital) areas may be authorized where an individual has a current certification by his employer or PVNGS either:

- to have been in the employer's continuous employment for at least 3 years without evidence adversely reflecting on the employee's reliability or trustworthiness, or
- to have satisfactorily completed the sensitive (Type I Vital) area screening program.

As a temporary measure, interim clearances for unescorted access may be granted as discussed in Section 13.1.5 of the PVNGS Security Plan.

REGULATORY GUIDE 1.18: Structural Acceptance Test for Concrete Primary Reactor Containments (Revision 1, December 28, 1972)

RESPONSE

Regulatory Guide 1.18 established a systematic approach to testing wherein quantitative information is obtained

C. Position C.3

Production welding is monitored and welding qualifications are certified for the conditions described in the interpretations to Regulatory Positions C.1 and C.2.a.

Also see CESSAR Section 1.8.

<u>REGULATORY GUIDE 1.72</u>: Spray Pond Plastic Piping (Revision 0, December 1973)

<u>RESPONSE</u>

Not applicable to PVNGS.

<u>REGULATORY GUIDE 1.73</u>: Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants (Revision 0, January 1974)

<u>RESPONSE</u>

The position of Regulatory Guide 1.73 is accepted (refer to section 3.11). Also see CESSAR Section 1.8.

<u>REGULATORY GUIDE 1.74</u>: Quality Assurance Terms and Definitions (Revision 0, February 1974)

<u>RESPONSE</u>

The position of Regulatory Guide 1.74 is accepted (refer to section 17.2). Also see CESSAR Section 1.8.

<u>REGULATORY GUIDE 1.75</u>: Physical Independence of Electric Systems (Revision 1, January 1975)

RESPONSE

The requirements of Regulatory Guide 1.75 are met as follows:

A. Isolation of non-Class 1E power circuits supplied by a Class 1E source is provided by a circuit interrupting device (circuit breaker) actuated by a safety injection actuation signal (SIAS), except for the circuits feeding the essential lighting system in the control room and remote shutdown panel, the backup supplies for the non-Class 1E instrument buses, and non-Class 1E valves XJ-CHN-UV501 and XJ-CHN-UV536. Class 1E regulating transformers with circuit limiting characteristics are provided as isolation devices to feed these non-Class 1E circuits of essential lighting. Two Class 1E interrupting devices connected in series with proper coordination are provided as isolation devices for the non-Class 1E valves.

B. Isolation of control circuits is provided by photo isolators, relays, or operational amplifiers. The applied isolators provide isolation and separation between the Class 1E and nonsafety-related systems, preventing degradation of the Class 1E system by any occurrence within the nonsafety system.

C. Associated power, control, and instrumentation cables which terminate on isolation devices are treated as Class 1E through the isolation device to its outgoing terminals. Beyond this point, the cables lose their Class 1E preferential treatment. This precludes termination of associated circuits from redundant trains on a common device. Some associated circuit cables without isolation devices are uniquely identified as associated, per Regulatory Guide 1.75, and the identification scheme is in accordance with paragraph 7.1.3.16. In addition, some associated

RESPONSE

The requirements of Regulatory Guide 1.75 are met, ~~as follows:~~ with the following clarifications and/or exceptions:

A. Isolation of non-Class 1E power circuits supplied by a Class 1E source is provided by a circuit interrupting device (circuit breaker) actuated by a safety injection actuation signal (SIAS), except for the circuits feeding the essential lighting system in the control room and remote shutdown panel, the backup supplies for the non-Class 1E instrument buses, and non-Class 1E valves XJ-CHN-UV501 and XJ-CHN-UV536. Class 1E regulating transformers with circuit limiting characteristics are provided as isolation devices to feed these non-Class 1E circuits of essential lighting. Two Class 1E interrupting devices connected in series with proper coordination are provided as isolation devices for the non-Class 1E valves.

B. Isolation of control circuits is provided by photo isolators, relays, or operational amplifiers. The applied isolators provide isolation and separation between the Class 1E and nonsafety-related systems, preventing degradation of the Class 1E system by any occurrence within the nonsafety system. ← ADD INSERT 'A' AS A NEW SENTENCE

C. Associated power, control, and instrumentation cables which terminate on isolation devices are treated as Class 1E through the isolation device to its outgoing terminals. Beyond this point, the cables lose their Class 1E preferential treatment. This precludes termination of associated circuits from redundant trains on a common device. Some associated circuit cables without isolation devices are uniquely identified as associated, per Regulatory Guide 1.75, and the identification scheme is in accordance with paragraph 7.1.3.16. In addition, some associated

Insert 'A': Isolation of the diesel generators' nonsafety-related protective relay circuits from the Class 1E potential transformer circuits is provided with a single isolation fuse.

circuits are provided with two (redundant) isolation devices: i.e., fuses and/or circuit breakers. The identification of these cables is given in section 8.3.1.3.

The Safety Equipment Status System (SESS) described in section 7.5.2.6 provides by-passed and inoperable status indication of safety related equipment. The cables for this associated system enumerated in section 8.3.1.3 are treated as Class 1E and are color-coded as described in section 7.1.3.16. The channels of this system do not have isolation devices between them and the channels of the Class 1E equipment with which they are respectively associated because, in accordance with IEEE 384-1974 as endorsed by Regulatory Guide 1.75, there exist within the SESS key subcomponents (which may include redundant fuses and/or circuit breakers) that prevent credible failures within the SESS from reducing the availability of the Class 1E equipment. These key subcomponents are maintained as Quality Class Q, although they are not safety-related and are not isolation devices as would be required by IEEE 384-1974 between Class 1E or associated circuits and non-Class 1E circuits. 6

D. Where the term "circuit" appears, it is construed to mean power, control, and instrumentation cables.

E. CEDM RSPT Type I and RSPT Type II circuits at the reactor head are run in flexible stainless steel conduits. Due to the configuration and proximity of control element assemblies, minimum separation requirement of 1 inch cannot be maintained.

F. Where 1-hour fire barriers are used, raceways of different separation groups are at least 1 inch apart prior to installation of a separation barrier.

G. In instances where spatial constraints prevent non-Class 1E cables in totally enclosed raceways from maintaining a 1-inch minimum separation distance from Class 1E cables in totally enclosed raceways, analyses are performed demonstrating that failure of the non-Class 1E cables will not prevent the proper functioning of the adjacent 1E circuits.

Further discussion pertaining to Regulatory Guide 1.75 is given in subsection 8.3.1.

For implementation of Regulatory Guide 1.75, refer to paragraphs 8.3.1.1.7 and 8.3.1.4.

REGULATORY GUIDE 1.76: Design Basis Tornado for Nuclear Power Plants (Revision 0, April 1974)

RESPONSE

The position of Regulatory Guide 1.76 is accepted (refer to paragraph 3.3.2.1).

REGULATORY GUIDE 1.77: Assumptions Used for Evaluating a Control Rod Ejection Accident for Pressurized Water Reactors (Revision 0, May 1974)

RESPONSE

Refer to CESSAR Section 1.8.

Table 1.8-1

PVNGS COMPLIANCE WITH REGULATORY GUIDE 1.97 (REVISION 2) REQUIREMENTS

(Sheet 1 of 16) 1

Variable Per Regulatory Guide 1.97 (Rev. 2)	Design Class	Redundancy	Range	Power Supply	Display Locations CR	TSC	EOF	Instrument Tag Numbers	Comments
TYPE "A" VARIABLES									
Pressurizer level (Category 1)	Q1E	Yes	0 to 100%	1E	Yes	Yes	Yes	XJ-RCA-LT-110X XJ-RCB-LT-110Y	Complies with R.G. 1.97 (Rev. 2).
RCS cold leg water temperature (Category 1)	Q1E	Yes	50 to 750F	1E	Yes	Yes	Yes	XJ-RCA-TT-112C1 XJ-RCB-TT-112C2 XJ-RCA-TT-122C1 XJ-RCB-TT-122C2	Complies with R.G. 1.97 (Rev. 2).
RCS hot leg water temperature (Category 1)	Q1E	Yes	50 to 750F	1E	Yes	Yes	Yes	XJ-RCA-TT-112H1 XJ-RCB-TT-112H2 XJ-RCA-TT-122H1 XJ-RCB-TT-122H2	Complies with R.G. 1.97 (Rev. 2).
Containment pressure (Category 1)	Q1E	Yes	-5 to 180 psig	1E	Yes	Yes	Yes	XJ-HCA-PT-353A XJ-HCB-PT-353B	Complies with R.G. 1.97 (Rev. 2).
Steam generator level (Category 1)	Q1E	Yes	See comments	1E	Yes	Yes	Yes	XJ-SGA-LT-1113A XJ-SGB-LT-1113B XJ-SGC-LT-1113C XJ-SGD-LT-1113D XJ-SGA-LT-1123A XJ-SGB-LT-1123B XJ-SGC-LT-1123C XJ-SGD-LT-1123D	Wide range level indication is provided for both steam generators. The indication range is from approximately 143 inches above the tubesheet to approximately 55.5 inches above the steam separator deck. The flow turbulence in the economizer section of the steam generator prevents accurate level measurement down to the tubesheet. Therefore, the lower level tap is located above the economizer section. Plant operating procedures are based on the as-built location of the level taps (i.e., 143 inches above the tubesheest). 1
Steam generator pressure (Category 1)	Q1E	Yes	0 to 1524 psia	1E	Yes	Yes	Yes	XJ-SGA-PT-1013A XJ-SGB-PT-1013B XJ-SGC-PT-1013C XJ-SGD-PT-1013D XJ-SGA-PT-1023A XJ-SGB-PT-1023B XJ-SGC-PT-1023C XJ-SGD-PT-1023D	Complies with R.G. 1.97 (Rev. 2).
RCS pressure (Category 1)	Q1E	Yes	0 to 4000 psig	1E	Yes	Yes	Yes	XJ-RCA-PT-190A XJ-RCB-PT-190B	Complies with R.G. 1.97 (Rev. 2).

Table 1.8-1
PVNGS COMPLIANCE WITH REGULATORY GUIDE 1.97 (REVISION 2) REQUIREMENTS
(Sheet 2 of 16)

Variable Per Regulatory Guide 1.97 (Rev. 2)	Design Class	Redundancy	Range	Power Supply	Display Locations			Instrument Tag Numbers	Comments
					CR	TSC	EOF		
Degrees of subcooling (Category 1)	Q1E	Yes	Varies, see comments	1E	Yes	Yes	Yes	QSPDS A QSPDS B XJ-SHA-TR-003 XJ-SHA-TR-004	Complies with R.G. 1.97 (Rev.2). The following subcooling measurements are provided. Note that each measurement range exceeds the required range of 200F subcooling to 35F superheat: i) QSPDS Trains A and B. Each train provides a measurement of RCS saturation margin using pressurizer pressure and hot and cold leg temperatures, reactor vessel upper head saturation margin using pressurizer pressure and upper head temperature, and CET saturation margin using pressurizer pressure and a representative core exit temperature. ii) XJ-SHA-TR-003. This is a single pen recorder which is located on main control board panel B02. The recorder has a range of 200F superheat to 200F subcooling and displays the upper head saturation margin. iii) XJ-SHA-TR-004. This recorder is located on a main control board panel B02 and has a range of 800F superheat to 200F subcooling. The recorder displays the core exit saturation margin.
Containment hydrogen analyzer (Category 1)	Q1E	Yes	0 to 10%	1E	Yes	Yes	Yes	XJ-HPA-AI-009 XJ-HPB-AI-010 XJ-HPA-UR-009	Complies with R.G. 1.97 (Rev. 2). Instrument tag numbers represent the control room indication. HJ-HPA-UR-009 is a recorder. Non safety related heat trace, which has been determined to be necessary for hydrogen analyzer operability, has been justified to be acceptable for use on analyzer sample piping.
TYPE "B" VARIABLES									
Neutron flux; 10^{-6}% to 100% full power (Category 1)	Q1E	Yes	Exceeds the recommended range	1E	Yes	Yes	Yes	XJ-SEA-NE-001A XJ-SEB-NE-001B	Complies with R.G. 1.97 (Rev. 2).
Control rod position; full in or not full in (Category 3)	R9E	No	Full in or not full in	Non-1E	Yes	Yes	Yes	XJ-SFN-ZI-001	Complies with R.G. 1.97 (Rev. 2). Instrument tag number represents only the control room indication

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Table 1.8-1

PVNGS COMPLIANCE WITH REGULATORY GUIDE 1.97 (REVISION 2) REQUIREMENTS

(Sheet 3 of 16)

1

Variable Per Regulatory Guide 1.97 (Rev. 2)	Design Class	Redundancy	Range	Power Supply	Display Locations CR	TSC	EOF	Instrument Tag Numbers	Comments
RCS soluble boron concentration; 0 to 6000 PPM (Category 3)	R2E	No	0 to 5000 ppm	Non-1E	Yes	Yes	Yes	XJ-CHN-AT-203	Complies with R.G. 1.97 (Rev. 2) with the exception of the range requirement which does not meet the required upper range of 6000 ppm.
RCS cold leg water temp; 50 to 400F (Category 3)	-	-	-	-	-	-	-	-	Complies (see previous listing, Type A variable)
RCS hot leg water temp; 50 to 750F (Category 1)	-	-	-	-	-	-	-	-	Complies (see previous listing, Type A variable)
RCS cold leg water temp; 50 to 750F (Category 1)	-	-	-	-	-	-	-	-	Complies (see previous listing, Type A variable)
RCS pressure; 0 to 4000 psig (for C-E plants) (Category 1)	-	-	-	-	-	-	-	-	Complies (see previous listing, Type A variable)
Core exit temperature 200 to 2300F (Category 3)	Q1E	Yes	32 to 2300F fixed incore	1E	Yes	Yes	Yes	Various	Complies with R.G. 1.97 (Rev. 2).
Coolant level in reactor; bottom of core to top of vessel (Category 1)	Q1E	Yes	Fuel alignment plate to top of vessel	1E	Yes	Yes	Yes	XJ-RIA-LE-001A XJ-RIB-LE-001B XJ-RIA-LE-002A XJ-RIB-LE-002B XJ-RIA-LE-003A XJ-RIB-LE-003B XJ-RIA-LE-004A XJ-RIB-LE-004B XJ-RIA-LE-005A XJ-RIB-LE-005B XJ-RIA-LE-006A XJ-RIB-LE-006B XJ-RIA-LE-007A XJ-RIB-LE-007B XJ-RIA-LE-008A XJ-RIB-LE-008B	Complies with R.G. 1.97 (Rev. 2). See CESSAR Appendix B, Item II.F.2 for description. Level is measured from fuel alignment plate to top of vessel head. Core exit thermocouples provide an indirect indication of level from bottom of core to fuel alignment plate.
Degrees of subcooling; 200F subcooling to 35F superheat (Category 2)	-	-	-	-	-	-	-	-	Complies (see previous listing, Type A variables)

Table 1.8-1

PVNGS COMPLIANCE WITH REGULATORY GUIDE 1.97 (REVISION 2) REQUIREMENTS

(Sheet 4 of 16) 1

Variable Per Regulatory Guide 1.97 (Rev. 2)	Design Class	Redundancy	Range	Power Supply	Display Locations CR	TSC	EOF	Instrument Tag Numbers	Comments
RCS pressure: 0 to 4000 psig for C-E plants (Category 1)	-	-	-	-	-	-	-	-	Complies (see previous listing, Type A variables)
Containment sump water level; narrow range (sump) (Category 2)	Q2E	Yes	0 to 6 ft.	1E	Yes	Yes	Yes	XJ-RDE-LT-410 XJ-RDB-LT-411	Complies with R.G. 1.97 (Rev. 2). 1
Containment sump water level; wide range (bottom of containment to 600,000 gal. level equivalent) (Category 2)	Q1E	Yes	0.5 to 12.5 ft.	1E	Yes	Yes	Yes	XJ-SIA-LT-706 XJ-SIB-LT-707	Complies with R.G. 1.97 (Rev. 2).
Containment pressure; 0 psig to design pressure (Category 1)	-	-	-	-	-	-	-	-	Complies (see previous listing, Type A variables)
Containment isolation valve position (excluding check valves); closed/ not closed (Category 1)	Q1E	No	Open/ closed	1E	Yes	Yes	Yes	Various	Complies with R.G. 1.97 (Rev. 2).
Containment pressure; 10 psia to design pressure (Category 1)	-	-	-	-	-	-	-	-	Complies (see previous listing, Type A variable)
<u>TYPE "C" VARIABLES</u>									
Core exit temperature; 200 to 2300F (Category 1)	-	-	-	-	-	-	-	-	Complies (see previous listing, Type A variable)
Radioactive concentration or radiation level in circulating primary coolant; 1/2 tech. spec. limit to 100 times tech. spec. limit, R/hr. (Category 1)	Q1E	Yes	1 R/hr to 10^5 R/hr	1E	Yes	Yes	Yes	XJ-SQA-RU-150 XJ-SQB-RU-151	Complies with R.G. 1.97 (Rev. 2).

Table 1.8-1

PVNGS COMPLIANCE WITH REGULATORY GUIDE 1.97 (REVISION 2) REQUIREMENTS

(Sheet 5 of 16)

Variable Per Regulatory Guide 1.97 (Rev. 2)	Design Class	Redundancy	Range	Power Supply	Display Locations CR	TSC	EOF	Instrument Tag Numbers	Comments
Analysis of primary coolant (gamma spectrum; 10 µCi/gm to 10 Ci/gm or TID-14844 source term in coolant volume (Category 3)	S3D	No	Identification of isotope from 10 µCi/ml to 10 Ci/ml	Non-1E	No	No	No	Post accident sampling system	Complies with R.G. 1.97 (Rev. 2); accomplished by post-accident sampling system in conjunction with laboratory analysis.
RCS pressure; 0 to 4000 psig (for C-E plants) (Category 1)	-	-	-	-	-	-	-	-	Complies (see previous listing, Type A variable)
Containment pressure; 10 psia to design pressure (Category 1)	-	-	-	-	-	-	-	-	Complies (see previous listing, Type A variable); PVNGS containment is not subatmoshperic
Containment sump water level • Narrow range (sump) (Category 2) • Wide range (bottom of containment to 600,000 gallon level equivalent) (Category 1)	-	-	-	-	-	-	-	-	Complies (see previous listing, Type B variable)
Containment area radiation; 1 R/hr to 10^4 R/hr (Category 3)	Q1E	Yes	1 to 10^7 R/hr	1E	Yes	Yes	Yes	XJ-SQA-RU-148 XJ-SQB-Ru-149	Complies with R.G. 1.97 (Rev. 2).(e)
Effluent radioactivity - noble gas effluent from condenser air removal system exhaust; 10^{-6} µCi/cc to 10^{-2} µCi/cc (Category 3)	QAG	No	Overall range: 10^{-6} µCi/cc to 10^5 µCi/cc	Non-1E	Yes	Yes	Yes	XJ-SQN-RU-141 XJ-SQN-RU-142	HI/LO range on condenser air removal exhaust. Complies with R.G. 1.97 (Rev. 2) 6
RCS pressure; 0 to 4000 psig for C-E plants (Category 1)	-	-	-	-	-	-	-	-	Complies (see previous listing, Type A variable)

Table 1.8-1

PVNGS COMPLIANCE WITH REGULATORY GUIDE 1.97 (REVISION 2) REQUIREMENTS

(Sheet 6 of 16)

Variable Per Regulatory Guide 1.97 (Rev. 2)	Design Class	Redundancy	Range	Power Supply	Display Locations CR	TSC	EOF	Instrument Tag Numbers	Comments
Containment hydrogen concentration; 0 to 10%, capable of operating from 10 psia up to max. design pressure (Category 1)	-	-	-	-	-	-	-	-	Complies (see previous listing, Type A variable)
Containment pressure; 10 psia to three times design pressure for concrete (Category 1)	-	-	-	-	-	-	-	-	Complies (see previous listing, Type A variable)
Containment effluent radioactivity - noble gases from identified release points; 10^{-6} µCi/cc to 10^{-2} µCi/cc (Category 2)	QAG	No	Overall range: 10^{-6} µCi/cc to 10^{5} µCi/cc	Non-1E	Yes	Yes	Yes	XJ-SQN-RU-143 XJ-SQN-RU-144	Complies with R.G. 1.97 (Rev.2) HI/LO range on plant vent. 6
Radiation exposure rate (inside buildings or areas, e.g., auxiliary bldg., reactor shield bldg., annulus, fuel handling bldg., which are in direct contact with primary containment where penetrations and hatches are located); 10^{-1} to 10^{4} R/hr (Category 2)	QAG	No	10^{-1} to 10^{4} R/hr	Non-1E	Yes	Yes	Yes	Various	Complies with R.G. 1.97 (Rev. 2). 6
Effluent radioactivity noble gases (from buildings as indicated above); 10^{-6} µCi/cc to 10^{3} µCi/cc (Category 2)	QAG QAG Q1E Q1E	No	Overall, 10^{-6} µCi/cc to 10^{5} µCi/cc	Non-1E Non-1E 1E 1E	Yes	Yes	Yes	XJ-SQN-RU-143 XJ-SQN-RU-144 XJ-SQB-RU-145 XJ-SQB-RU-146	Complies with R.G. 1.97 (Rev. 2). 6

Table 1.8-1

PVNGS COMPLIANCE WITH REGULATORY GUIDE 1.97 (REVISION 2) REQUIREMENTS

(Sheet 7 of 16)

Variable Per Regulatory Guide 1.97 (Rev. 2)	Design Class	Redundancy	Range	Power Supply	Display Locations CR	TSC	EOF	Instrument Tag Numbers	Comments
TYPE "D" VARIABLES									
RHR system flow; 0 to 110% design flow (Category 2)	Q1E	Yes	0 to 133% design flow	1E	Yes	Yes	Yes	XJ-SIA-FT-306 XJ-SIB-FT-307 XJ-SIA-FT-338 XJ-SIB-FT-348	Complies with R.G. 1.97 (Rev. 2).
RHR heat exchanger outlet temperature; 32 to 350F (Category 2)	Q1E	No	40 to 400F	1E	Yes	Yes	Yes	XJ-SIA-TE-303X XJ-SIB-TE-303Y	Complies with R.G. 1.97 (Rev. 2) with the exception that our actual ranges are 40 to 400F.
Accumulator tank level; 10% to 90% volume level (Category 2)	Q1E	No	0 to 100%	1E	Yes	Yes	Yes	XJ-SIB-LT-311 XJ-SIB-LT-321 XJ-SIA-LT-331 XJ-SIA-LT-341	Complies with R.G. 1.97 (Rev. 2).
Accumulator tank pressure; 0 to 750 psig (Category 2)	Q1E	No	0 to 750 psig	1E	Yes	Yes	Yes	XJ-SIB-PT-311 XJ-SIB-PT-321 XJ-SIA-PT-331 XJ-SIA-PT-341	Complies with R.G. 1.97 (Rev. 2).
Accumulator tank isolation valve position; open or closed (Category 2)	Q1E	No	0 to 100%	1E	Yes	Yes	Yes	XJ-SIB-ZAL-614 XJ-SIB-ZAL-624 XJ-SIA-ZAL-634 XJ-SIA-ZAL-644	Complies with R.G. 1.97 (Rev. 2).
Boric acid charging flow; 0 to 110% design (Category 2)	Q1E	No	0 to 113%	1E	Yes	Yes	Yes	XJ-CHB-FT-212	Complies with R.G. 1.97 (Rev. 2).
Flow in HPI system; 0 to 110% design flow (Category 2)	Q1E	No	0 to 110%	1E	Yes	Yes	Yes	XJ-SIA-FT-331 XJ-SIA-FT-341 XJ-SIB-FT-311 XJ-SIB-FT-321	Complies with R.G. 1.97 (Rev. 2), one flow transmitter for each injection line into the cold legs.
Flow in LPI system; 0 to 110% design flow (Category 2)	Q1E	No	Exceeds 0 to 110%	1E	Yes	Yes	Yes	XJ-SIA-FT-306 XJ-SIB-FT-307	Complies with R.G. 1.97 (Rev. 2).
Refueling water storage tank level; top to bottom (Category 2)	Q1E	Yes	0 to 100% (span of 712")	1E	Yes	Yes	Yes	XJ-CHA-LT-203A XJ-CHB-LT-203B	Complies with R.G. 1.97 (Rev. 2). 3

Table 1.8-1

PVNGS COMPLIANCE WITH REGULATORY GUIDE 1.97 (REVISION 2) REQUIREMENTS

(Sheet 8 of 16)

Variable Per Regulatory Guide 1.97 (Rev. 2)	Design Class	Redundancy	Range	Power Supply	Display Locations			Instrument Tag Numbers	Comments
					CR	TSC	EOF		
Reactor coolant pump status; motor current (Category 3)	High industrial std.	No	0 to 600A	Non-1E	Yes	Yes	Yes	XJ-RCN-HS-001 XJ-RCN-HS-002 XJ-RCN-HS-003 XJ-RCN-HS-004	Complies with R.G. 1.97 (Rev. 2); current meters associated with each pump in control room.
Primary system safety relief valve positions (including PORV and code valves) or flow through or pressure in relief valve lines; closed/not closed (Category 2)	R9E	No	Closed/open (0 to 100%)	Non-1E (1E backup power supply)	Yes	Yes	Yes	XJ-RCE-ZE-726 XJ-RCE-ZE-727 XJ-RCE-ZE-728 XJ-RCE-ZE-729	Complies with R.G. 1.97 (Rev. 2).
Pressurizer level; bottom to top (Category 1)	-	-	-	-	-	-	-	-	Complies (see previous listing, Type A variable)
Pressurizer heater status; electric current (Category 2)	R9E/Q1E	No	On/off and 0 to 300A (see comments)	Non-1E/1E	Yes	Yes	Yes	Various	Complies with R.G. 1.97 (Rev. 2); breaker status indicating lights at heater control hand switches on main control board. Two banks of backup heaters (150 kW per bank) are provided with Class 1E power. The Class 1E-powered heater banks are also provided with electric current indication with a range from 0 to 300A. All heater banks are provided with electric current indication on ERFDADS.
Quench tank level; top to bottom (Category 3)	R2E	No	0 to 100%	Non-1E	Yes	Yes	Yes	XJ-CHN-LT-268	Complies with R.G. 1.97 (Rev. 2) (reactor drain tank).
Quench tank temperature; 50 to 750F (Category 3)	R9E	No	0 to 750F	Non-1E	Yes	Yes	Yes	XJ-CHN-TT-268	Complies with R.G. 1.97 (Rev. 2).
Quench tank pressure; 0 to design pressure (Category 3)	Q1E	No	0 to 150 psig	1E	Yes	Yes	Yes	XJ-CHA-PT-268	Complies with R.G. 1.97 (Rev. 2).
Steam generator level; from tube sheet to separators (Category 1)	-	-	-	-	-	-	-	-	(See previous listing, Type A variable)

Table 1.8-1

PVNGS COMPLIANCE WITH REGULATORY GUIDE 1.97 (REVISION 2) REQUIREMENTS

(Sheet 9 of 16)

1

Variable Per Regulatory Guide 1.97 (Rev. 2)	Design Class	Redundancy	Range	Power Supply	Display Locations CR	TSC	EOF	Instrument Tag Numbers	Comments
Steam generator pressure; from atmospheric pressure to 20% above the lowest safety valve setting (Category 2)	-	-	-	-	-	-	-	-	Complies (see previous listing, Type A variable)
Safety/relief valve positions or main steam flow; closed/ not closed (Category 2)	R9E	No	Open/ closed 0 to 100%	Non-1E	Yes	Yes	Yes	XJ-SGN-ZE-696 XJ-SGN-ZE-697 XJ-SGN-ZE-698 XJ-SGN-ZE-699 XJ-SGN-ZE-700 XJ-SGN-ZE-701 XJ-SGN-ZE-702 XJ-SGN-ZE-703 XJ-SGN-ZE-704 XJ-SGN-ZE-705 XJ-SGN-ZE-706 XJ-SGN-ZE-707 XJ-SGN-ZE-708 XJ-SGN-ZE-709 XJ-SGN-ZE-710 XJ-SGN-ZE-711 XJ-SGN-ZE-712 XJ-SGN-ZE-713 XJ-SGN-ZE-714 XJ-SGN-ZE-715	Complies with R.G. 1.97 (Rev. 2).
Main feedwater flow; 0 to 110% flow (Category 3)	R9E	No	0 to 110%	Non-1E	Yes	Yes	Yes	XJ-SGN-FT-1112 XJ-SGN-FT-1122	Complies with R.G. 1.97 (Rev. 2).
Auxiliary feedwater flow; 0 to 110% design flow (Category 2)	Q1E	Yes	Exceeds 0 to 110%	1E	Yes	Yes	Yes	XJ-AFA-FT-040A XJ-AFA-FT-040B XJ-AFB-FT-041A XJ-AFB-FT-041B	Complies with R.G. 1.97 (Rev. 2).
Condensate storage tank water level; plant specific (Category 1)	Q1E	Yes	0 to 100%	1E	Yes	Yes	Yes	XJ-CTA-LT-035 XJ-CTB-LT-036	Complies with R.G. 1.97 (Rev. 2).
Containment spray flow; 0 to 110% design flow (Category 2)	Q1E	No	0 to 128%	1E	Yes	Yes	Yes	XJ-SIA-FT-338 XJ-SIB-FT-348	Complies with R.G. 1.97 (Rev. 2).

Table 1.8-1

PVNGS COMPLIANCE WITH REGULATORY GUIDE 1.97 (REVISION 2) REQUIREMENTS

(Sheet 10 of 16)

Variable Per Regulatory Guide 1.97 (Rev. 2)	Design Class	Redundancy	Range	Power Supply	Display Locations CR	TSC	EOF	Instrument Tag Numbers	Comments
Heat removal by the containment fan heat removal system; plant specific (Category 2)	-	-	-	-	-	-	-	-	Complies with R.G. 1.97 (Rev. 2). Indication is by containment atmospheric temperature monitors.(a)
Containment atmosphere temperature; 40 to 400F (Category 2)	Q2E	Yes	40 to 400F	Non-1E	Yes	Yes	Yes	XJ-HCN-TE-42A1 XJ-HCN-TE-42B1 XJ-HCN-TE-42C1 XJ-HCN-TE-42D1 XJ-HCN-TE-42E1	Complies with R.G. 1.97 (Rev. 2).
Containment sump water temperature; 50 to 250F	R9E	No	0 to 250	Non-1E	Yes	Yes	Yes	XJ-SIN-TT-712 XJ-SIN-TT-713	Complies with R.G. 1.97 (Rev. 2).
Makeup flow-in; 0 to 110% design flow (Category 2)	Q1E	No	0 to 150 gal/min	1E	Yes	Yes	Yes	XJ-CHB-FT-212	Complies with R.G. 1.97 (Rev. 2).
Letdown flow-out; 0 to 110% design flow (Category 2)	R9E	No	0 to 150 gal/min	Non-1E	Yes	Yes	Yes	XJ-CHN-FT-202	Complies with R.G. 1.97 (Rev. 2).
Volume control tank level; top to bottom (Category 2)	R9E	Yes	0 to 100%	Non-1E (1E backup power supply)	Yes	Yes	Yes	XJ-CHN-LT-226 XJ-CHN-LT-227	Complies with R.G. 1.97 (Rev. 2), with the exception that the VCT level instruments are not environmentally qualified.(h) 5
Component cooling water temperature to ESF system; 32 to 200F (Category 2)	R2E	No	0 to 200F	Non-1E	Yes	Yes	Yes	XJ-EWN-TT-083 XJ-EWN-TT-084	Complies with R.G. 1.97 (Rev. 2).
Component cooling water flow to ESF system; 0 to 110% design flow (Category 2)	Q2E	No	Exceeds 0 to 110% design	Non-1E (1E back-up power supply)	Yes	Yes	Yes	XJ-EWA-FT-013 XJ-EWB-FT-014	Complies with R.G. 1.97 (Rev. 2).
High level radioactive liquid tank level; top to bottom (Category 3)	R20	No	0 to 110%	Non-1E	Yes (RW, CR)	Yes	Yes	XJ-LRN-LT-004 XJ-LRN-LT-005 XJ-LRN-LT-006	Complies with R.G. 1.97 (Rev. 2).

Table 1.8-1

PVNGS COMPLIANCE WITH REGULATORY GUIDE 1.97 (REVISION 2) REQUIREMENTS

(Sheet 11 of 16)

Variable Per Regulatory Guide 1.97 (Rev. 2)	Design Class	Redundancy	Range	Power Supply	Display Locations CR	TSC	EOF	Instrument Tag Numbers	Comments
Radioactive gas holdup tank pressure; 0 to 150% design pressure (Category 3)	R20	No	0 to 400 psig	Non-1E	Yes	Yes	Yes	XJ-GRN-PIT-023 XJ-GRN-PIT-024 XJ-GRN-PIT-025	Complies with R.G. 1.97 (Rev. 2) with the exception of the 0 to 150% design pressure range requirement.[b]
Emergency ventilation damper position; open/closed status (Category 2)	Q1E	No	Open/closed status	1E	Yes	Yes	Yes	Various	Complies with R.G. 1.97 (Rev. 2).
Status of standby power and other energy sources important to safety (hydraulic, pneumatic); voltages, currents, pressures (Category 2)	Various	Yes	Various	1E/Non-1E	Yes	Yes	Yes	PKA-EI-M41 PKB-EI-M42 PKC-EI-M43 PKD-EI-M44 PBA-EI-S03 PBB-EI-S04 1A-04B 1A-04D 1A-05B 1A-05D 6A-07D	Complies with R.G. 1.97 (Rev. 2). The listed tag numbers are for the following instruments: Voltmeters for the 125 V-dc vital buses, voltmeters for the 4160 V-ac buses, undervoltage annunciators for the 120 V-ac vital buses, and a low pressure annunciator for the atmospheric dump valve nitrogen accumulators.
TYPE "E" VARIABLES									
Containment area radiation - high range; 1 R/hr to 10^7 R/hr (Category 1)	Q1E	Yes	1 to 10^7 R/hr	1E	Yes	Yes	Yes	XJ-SQA-RU-148 XJ-SQB-RU-149	Complies with R.G. 1.97 (Rev. 2).[e]
Radiation exposure rate (inside buildings) or areas where access is required to service equipment important to safety); 10^{-1} R/hr to 10^4 R/hr. (Category 2)	QAG	No	10^{-1} to 10^4 R/hr	Non-1E	Yes	Yes	Yes	Various	Complies with R.G. 1.97 (Rev. 2).
Noble Gases and Vent Flow Rate									
•Containment or purge effluent noble gas radioactivity; 10^{-6} µCi/cc to 10^5 µCi/cc (Category 2)	-	-	-	-	-	-	-	-	Complies with R.G. 1.97 (Rev. 2) - plant vent (see previous listing).

Table 1.8-1

PVNGS COMPLIANCE WITH REGULATORY GUIDE 1.97 (REVISION 2) REQUIREMENTS

(Sheet 12 of 16) 1

Variable Per Regulatory Guide 1.97 (Rev. 2)	Design Class	Redundancy	Range	Power Supply	Display Locations CR	TSC	EOF	Instrument Tag Numbers	Comments
• Containment or purge effluent flowrate; 0 to 110% vent design flow (Category 2)	-	-	-	-	-	-	-	-	Complies with R.G. 1.97 (Rev. 2) - plant vent (see previous listing).(c)
• Reactor shield bldg. annulus (if in design) (Category 2)	-	-	-	-	-	-	-	-	Reactor shield building annulus is not in the PVNGS design.
• Auxiliary building effluent radioactivity (including any building containing primary system gases, e.g., waste gas decay tank); 10^{-6} µCi/cc to 10^{3} µCi/cc (Category 2)	-	-	-	-	-	-	-	-	Complies with R.G. 1.97 (Rev. 2) (see plant vent radiation monitor).
• Auxiliary building effluent flowrate; 0 to 110% vent design flow (Category 2)	-	-	-	-	-	-	-	-	Complies with R.G. 1.97 (Rev. 2) - plant vent.(c)
• Condenser air removal system exhaust; 10^{-6} µCi/cc to 10^{5} µCi/cc (Category 2)	-	-	-	-	-	-	-	-	Complies with R.G. 1.97 (Rev. 2) (see previous listing, Type C variables).
• Condenser air removal system exhaust flowrate; 0 to 110% vent design flow (Category 2)	-	-	-	-	-	-	-	-	Complies with R.G. 1.97 (Rev. 2).(c)
• Common plant vent or multipurpose vent discharging any of above release (if containment purge is included); 10^{-6}µCi/cc to 10^{4} µCi/cc (Category 2)	-	-	-	-	-	-	-	-	Complies with R.G. 1.97 (Rev. 2) (see previous listing, Type C variables).

Table 1.8-1

PVNGS COMPLIANCE WITH REGULATORY GUIDE 1.97 (REVISION 2) REQUIREMENTS

(Sheet 13 of 16)

Variable Per Regulatory Guide 1.97 (Rev. 2)	Design Class	Redundancy	Range	Power Supply	Display Locations CR	TSC	EOF	Instrument Tag Numbers	Comments
• Common plant vent or multipurpose vent discharging any of above releases; 0 to 100% vent design flow (Category 2)	-	-	-	-	-	-	-	-	Complies with R.G. 1.97 (Rev. 2).(c)
• Vent from steam generator safety relief valves or atmospheric dump valves; 10^{-1} µCi/cc to 10^{3} µCi/cc (Category 2)	QAG	No	10^{-1} µCi/cc to 10^{3} µCi/cc	Non-1E	Yes	Yes	Yes	XJ-SQN-RU-139 XJ-SQN-RU-140	Complies with R.G. 1.97 (Rev. 2). 6
• Vent from steam generator safety relief valves or atmospheric dump valves; duration of release in seconds and mass of steam per unit time (Category 2)	-	-	-	-	-	-	-	-	Complies with R.G. 1.97 (Rev. 2). Information available through CRACS for valve position and time.
• All other identified release points; 10^{-6} µCi/cc to 10^{2} µCi/cc (Category 2)	-	-	-	-	-	-	-	-	No other identified release points.
• All other identified release points; 0 to 110% vent design flow (Category 2)	-	-	-	-	-	-	-	-	No other identified release points.
Particulates and Halogens									
All identified plant release points (except steam generator safety relief valves or atmospheric steam dump valves and condenser air removal system exhaust). Manual grab sampling with onsite analysis capability; 10^{-3} µCi/cc to 10^{2} µCi/cc (Category 3)	-	-	-	-	-	-	-	-	Complies (see previous listing).

Table 1.8-1

PVNGS COMPLIANCE WITH REGULATORY GUIDE 1.97 (REVISION 2) REQUIREMENTS

(Sheet 14 of 16)

Variable Per Regulatory Guide 1.97 (Rev. 2)	Design Class	Redundancy	Range	Power Supply	Display Locations CR	TSC	EOF	Instrument Tag Numbers	Comments
Environs Radiation and Radioactivity									
Radiation exposure meters (continuous indication at fixed locations)	QAG	No	10^{-1} to 10^{4} R/hr	Non-1E	No	No	No	Various	Complies with R.G. 1.97 (Rev. 2). Has alarm siren and light locally 6
Airborne radiohalogens and particulates (portable) sampling with onsite analysis capability); 10^{-9} μCi/cc to 10^{-3} μCi/cc (Category 3)	R3D	No	10^{-9} μCi/cc to 10^{-3} μCi/cc	Portable	No	No	No	Portable samplers	Complies with R.G. 1.97 (Rev. 2).
Plant and environs radiation (portable instrumentation); photons: 10^{-3} R/hr to 10^{4} R/hr, beta radiations and low energy photons: 10^{-3} rads/hr to 10^{4} rads/hr (Category 3)	High industrial grade	No	Exceeds this range	Portable	No	No	No	Portable samplers	Complies with R.G. 1.97 (Rev. 2).
Plant and environs radioactivity (portable instrumentation); multichannel gamma-ray spectrometer (Category 3)	High industrial grade	No	Multi channel	Portable	No	No	No	Portable samplers	Complies with R.G. 1.97 (Rev. 2).
Wind direction; 0 to 360° (±5° accuracy with a deflection of 15°), starting speed of 1 mph, damping ration between 0.4 and 0.6, distance constant less than or equal to 2 meters. (Category 3)	High industrial grade	Yes	Exceeds requirement	Non-1E	Yes	Yes	Yes	Met tower	Complies with R.G. 1.97 (Rev. 2).
Wind speed; 0 to 67 mph (±0.5 mph accuracy for wind speeds less than 25 mph), with a starting threshold of less than 1.0 mph. (Category 3)	High industrial grade	Yes	(d)	Non-1E	Yes	Yes	Yes	Met tower	Complies with R.G. 1.97 (Rev. 2) except for range requirement.(d)

Table 1.8-1

PVNGS COMPLIANCE WITH REGULATORY GUIDE 1.97 (REVISION 2) REQUIREMENTS

(Sheet 15 of 16)

Variable Per Regulatory Guide 1.97 (Rev. 2)	Design Class	Redundancy	Range	Power Supply	Display Locations			Instrument Tag Numbers	Comments
					CR	TSC	EOF		
Estimation of atmospheric stability; based on vertical temperature difference from primary system, -9F to 18F and ±.3F accuracy per 164' intervals, or analogous range for alternative stability estimates. (Category 3)	High industrial grade	Yes	(f)	Non-1E	Yes	Yes	Yes	Met tower	Complies with R.G. 1.97 (Rev. 2) except for range requirement.[f]
Accident Sampling Capability Primary coolant and sump (grab sample); gross activity 10 μCi/ml to 10 Ci/ml, gamma spectrum (isotopic analysis), boron content 0 to 6000 ppm, chloride content 0 to 20 ppm, dissolved hydrogen 0 to 2000 cc (STP)/kg, dissolved oxygen 0 to 20 ppm, pH 1 to 13 (Category 3)	S3D	No	10 μCi/ml to 10 Ci/ml; 100 to 6000 ppm boron; 0.2 to 20 ppm chloride; 24[i] to 2000 cc/kg hydrogen; 13[i] to 20 ppm oxygen; 57 to 2000 cc/kg total dissolved gas; 1 to 13 pH	Non-1E	No	No	No	Post-accident sampling system	Complies with R.G. 1.97 (Rev. 2), with the exception of the lower end of the range requirements for boron, chloride, dissolved hydrogen and dissolved oxygen as shown.[g] For surveillance, primary coolant and sump samples are taken; only one of the samples need be analyzed if the required ranges are met. 6
Containment air (grab sample); hydrogen content 0 to 10%, oxygen content 0 to 30%, gamma spectrum: (isotopic analysis) (Category 3)	S3D	No	1 to 20% hydrogen; 0.5 to 20% oxygen; isotopic analysis	Non-1E	No	No	No	Post-accident sampling system	Complies with R.G. 1.97 (Rev. 2), with the exception of the range requirements for hydrogen and oxygen as shown.[g]

Table 1.8-1

PVNGS COMPLIANCE WITH REGULATORY GUIDE 1.97 (REVISION 2) REQUIREMENTS

(Sheet 16 of 16)

a. Heat removal by containment fan heat removal system indication is accomplished using the containment atmospheric temperature monitors listed within Regulatory Guide 1.97.

b. Radioactive gas holdup tank pressure (decay tank pressure) range requirement is not met. Actual range is 0 to 400 psig; design pressure is 380 psig (150% of design pressure is 570 psig).

c. Vent flow calculations are performed using the design flow of heating, ventilation, and air conditioning fans versus measured flow.

d. Wind speed requirements of Regulatory Guide 1.97 are exceeded except the range of 0 to 67 mph. The actual range of 0 to 50 mph has proven adequate by historical data.

e. During extreme temperature ramp rates (i.e., LOCA or MSLB), the radiation monitors may indicate higher radiation levels than actually detected. The radiation indication may exceed the accuracy requirements of R.G. 1.97, in that the inaccuracy may be a factor of six. This anomaly lasts for a short duration (less than 5 minutes) into the event. The anomaly is reported and investigated in MI Qualification Report 13-10407-N997-562-1, reviewed in letter to the NRC, Docket 50-528/529/530, letter no. 161-00667-EEVB/BJA, dated 11/20/87, and calculation 13-MC-SQ-A01 performed to address the specific temperatures at PVNGS.

f. PVNGS utilizes two ranges of vertical temperature difference (delta temperature). One range is -6F to +6F with the portion from -5F to +5F being calibrated. The range from -6F to 18F is for extended range indication beyond ±6F. Thus, PVNGS meets the ranges required by Regulatory Guide 1.23 (normalized for the PVNGS tower height) for the Pasquill categories indicated that are used for the atmospheric stability class calculations. The PVNGS delta temperature range has also proven to be adequate and reliable based on historical data at the location. Note that the NRC has approved this deviation (see letter from G. W. Knighton, NRC, to E. E. VanBrunt, Jr., ANPP, dated June 18, 1985).

g. The Post Accident Sampling System measurement ranges were submitted to the NRC by letter dated August 19, 1985 (ANPP-33238). The NRC approved these ranges in Supplement 9 of the SER (refer to section 22.2 of SSER 9). The ranges were further updated under 10 CFR 50.59.

h. The primary function of the VCT level transmitters is to provide an alarm indication in the control room of possible loss of VCT water level. The transmitters are not environmentally qualified; they do not specifically comply with R.G. 1.97 and are not required to mitigate any design basis events. However, they are in compliance with the NRC Branch Technical Position RSB 5-1 for a Class 2 Plant which states in part that "Compliance will not be required if it can be shown that correction for single failure by manual actions inside or outside of containment or return to hot standby until manual actions (repairs) are found to be acceptable for the individual plant."

i. The ranges shown for PASS dissolved hydrogen and dissolved oxygen measurement capability are for the most limiting of the three PVNGS units. See table 9.3-4 for each specific unit's range capability. 6

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Table 1.8-2
LOOSE PARTS MONITORING SYSTEM CONFORMANCE EVALUATION
(Sheet 1 of 2)

Regulatory Guide 1.133, Rev. 1 Regulatory Positions	PVNGS Conformance to the Regulatory Positions
1. System characteristics	
a. Sensor locations	No exception
b. System sensitivity	No exception
c. Channel separation	No exception
d. Data acquisition system	A four-channel tape recorder with switchable automatic channel selection is provided. Separate tape recorder channels are not provided for each sensor. Power is supplied from a 120 V-ac normal (non-seismically qualified) instrument bus, which has a Class 1E backup source.
e. Alert level	No exception
f. Capability for sensor channel operability test	No exception
g. Operability for seismic and environmental conditions	The LPMS components will be qualified to meet the normal environmental parameters of the areas in which they are installed.

Table 1.8-2

LOOSE PARTS MONITORING SYSTEM CONFORMANCE EVALUATION

(Sheet 2 of 2)

Regulatory Guide 1.133, Rev. 1 Regulatory Positions	PVNGS Conformance to the Regulatory Positions
h. Quality of system	No exception
i. System repair	No exception
2. Establishing the alert level	No exception
3. Using the data acquisition modes	No exception
4. Content of safety analysis reports	No exception to this section or section 7.7.
5. Technical specification for the loose parts detection system	No exception. Refer to paragraph 3.3.3.7 of the Palo Verde Technical Specifications.
6. Notification of a loose part	No exception

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RESPONSE

Position C.2 of Regulatory Guide 1.137 is accepted with the following exceptions to the Guide and the referenced standard (ANSI N195-1976):

A. ASTM D2276, Particulate Contaminant in Aviation Turbine Fuels, will replace ASTM D2274-70, Oxidation Stability of Distillate Fuel Oil (Accelerated Method), as outlined in Appendix B of ANSI N195-1976. The
6 specification for particulate contamination will be 10 mg/l, maximum.

B. Fuel oil sampling will be in accordance with ASTM D4057-81, Manual Sampling of Petroleum and Petroleum Products. This replaces ASTM D270-1975, Standard Method of Sampling Petroleum and Petroleum Products, which has been deleted as an ASTM standard.

C. A high level alarm is not provided on the underground storage tanks. These tanks serve only the diesel generators and are refilled only to replace fuel used during periodic testing. Safety grade level indication is provided in the main control room so that the refueling may be monitored.

D. Internal corrosion protection is not provided. Periodic (every 92 days) checks of fuel quality combined with low humidity and low rainfall at the site (see section 2.3) will preclude water accumulation and subsequent corrosion.

E. The fuel sampling connection is located within the vault above the tank. This connection can also be used as a stick gauge connection. The vault is approximately 6 feet high, which allows adequate access and use of a hinged stick gauge. This location precludes missile damage to a connection aboveground.

F. Clarification: Analyses performed to determine if the diesel fuel storage tank contents meet the "remaining applicable specifications" described in Position C.2.a (specifications other than viscosity or water and sediment) should be completed within two weeks of obtaining the sample. These analyses are typically performed by a third-party laboratory, located offsite. 6

G. Clarification: Fuel oil contained in the supply tank not meeting the "remaining applicable specifications" described in Position C.2.a (specifications other than viscosity or water and sediment) should, in a short period of time (about a week from identification), be replaced or returned to specification via processing.

<u>REGULATORY GUIDE 1.140</u>: Design, Testing and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants (Revision 0, March 1978)

<u>RESPONSE</u>

Information contained in Regulatory Guide 1.140 is utilized as discussed in sections 9.4 and 11.3, and in table 1.8-3.

<u>REGULATORY GUIDE 1.141</u>: Containment Isolation Provisions for Fluid Systems (Revision 0, April 1978)

<u>RESPONSE</u>

The position of Regulatory Guide 1.141 is accepted (refer to subsection 6.2.4) except for the following. An exception is taken to Regulatory Guide 1.141 for the CVCS charging linecontainment isolation valve CHA-HV-524. This valve does not meet the guidance of Section 4.2.2 of ANSI N271-1976 which requires all power-operated isolation valves to be capable of remote manual actuation from the control room. The power supply for this valve is removed by locking open its breaker at MCC PHA-M3520. The restoration of the power supply requires local operator action at the MCC. This exception to lock open valve CHA-HV-524 ensures that a flow path is available for charging or auxiliary spray flow by preventing inadvertent operation of the valve.

1.9.2.4.1 Containment Spray System (CESSAR Appendix 6A, Section 7.14/FSAR paragraph 6.5.2.8 (RA) 7.1.4)

Containment spray system (CSS) actuation and flow delivery occurs on a preestablished schedule given in Section 6.3 of CESSAR Appendix 6A. This schedule determines flow conditions in various analyses that take credit for a train of the CSS functioning to mitigate the consequences of postulated transients. The maximum time to establish rated flow given in CESSAR Appendix 6A, Section 7.1.4, is 58 seconds after receipt of CSAS. For PVNGS, CSS rated flow will be delivered in greater than 58 seconds (table 6.2.1-7). The exception to the CESSAR interface requirement for the CSS flow delivery time is only significant in the determination of the in-containment equipment qualification temperature parameters. However, under the worst case temperature conditions (i.e., main steam line 7.16 square feet slot break at 102% power, loss of one containment spray train, and no loss of offsite power), the calculated temperature transient of paragraph 6.2.1.8 is bounded by the equipment qualification environment of table 3E-1. Combustion Engineering has also committed to qualify 3
safety-related equipment within their scope to the same environment. By this analysis, the delay in delivery of rated flow to the CSS has been shown to have no adverse consequences under postulated transients.

1.9.2.4.2 Containment Spray System (CESSAR Appendix 6A, Section 7.13.14/FSAR paragraph 6.5.2.8 (RA) 7.13.14)

The head loss requirements of CESSAR Appendix 6A are not applicable to the PVNGS design due to the addition of the auxiliary spray headers. The analyses of both train A and train B of the containment spray system have shown that either train of the system will operate satisfactorily and meet the design flow requirements independent of the other train during all modes of operation. The design flow includes the additional flow for auxiliary spray headers.

1.9.2.4.3 Iodine Removal System (IRS) (CESSAR Appendix 6B, Section 7.6.1/FSAR paragraph 6.5.2.8 (RB) 7.6.1)

An independent environmental control system is not necessary to assure that the equipment in the IRS would not exceed their qualification temperatures assuming loss of normal HVAC. Long-term pump operation with loss of all HVAC results in a maximum room temperature of 107F (assuming an initial room temperature of 104F and 8 hours operation of both pumps). This temperature is well below the IRS equipment qualification temperature of 120F (CESSAR Section 3.11).

1.9.2.4.4 Engineered Safety Features Monitoring (CESSAR Section 7.5.1.1.3/FSAR paragraph 7.5.1.1.3)

The PVNGS design has two Class 1E wide range refueling water tank (RWT) level indicator channels with Class 1E indicators on the remote shutdown panel and one Class 1E indicator channel in the control room. The second channel in the control room is Class 1E with the exception of the isolated non Class 1E indicator and indicator power supply. This arrangement is acceptable in that both Class 1E channels are displayed on the remote shutdown panel and there are four narrow range Class 1E level indicator channels in the control room which are redundant for the volume of the RWT required to mitigate the consequences of a LOCA.

1.9.2.4.5 Spent Fuel Pool (CESSAR Section 9.1.4.6/FSAR paragraph 9.1.4.7)

CESSAR Section 9.1.4.6 requires 23 feet of water cover for a fuel rod assembly lying horizontally on top of the fuel racks. The PVNGS design has 22 feet coverage at the low water alarm level. This 1-foot difference has a negligible effect on the shielding provided by the spent fuel pool. In the evaluation of a fuel handling accident, Regulatory Guide 1.25 permits an overall iodine decontamination factor of 100 for pool depths during dust storms. Measurements were made at 10, 40, and 75 feet above ground level. The major conclusions of the study were:

A. Dust storms are short duration events characterized by extremely high particulate concentrations. Short-term particulate concentrations in excess of 100 milligrams per cubic meter can occur. No apparent variation of mass loading with height was observed.

B. The size distribution of dust storm particulates is greatly biased towards the 20- to 100-micron range. Approximately 60% of the total particulate concentration was in the 20- to 53-micron range and approximately 22% in the 53- to 106-micron range.

C. The mass loading during nondust storm conditions was very low in comparison to dust storm events. A geometric mean of 61.3 micrograms per cubic meter was observed during the season of study (June 9 to September 8, 1978). Because higher particulate concentrations are normally measured during summer conditions, a lower annual geometric mean would be expected. A decrease in small-sized particulates concentration with height was also observed for nondust storm days.

A more detailed discussion of the program, its results, and general dust storm characteristics based on long-term data from Phoenix is provided in reference 13. Refer to sections 6.4 and 9.4 for a discussion of dust loading on HVAC filter systems.

2.3.1.2.7 Snowload

Because of the lack of measurable snowfall in this section of the state, the extreme winter precipitation load (snowload) considered in the design of safety-related plant structures is only 10 pounds per square foot. The normal winter precipitation load used for design (100 year return snowpack) is 5 pounds per square foot.[10],[14]

2.3.1.2.8 High Air Pollution Potential

The frequency of low-level inversions is an important consideration in determining the dispersion capability of the atmosphere. The occurrence of low-level inversions or isothermal layers based at or below a 500-foot elevation in the site region is approximately 45% of the total hours on an annual basis. Seasonally, the greatest frequency of inversions, based on percent of total hours, occur during the winter and is approximately 57%. The summer has the lowest inversion frequency, occurring approximately 35% of the time. The majority of these inversions are nocturnal in nature.[15]

The mixing height, defined as "the height above the surface through which relatively vigorous vertical mixing occurs,"[16] is also a consideration in determining the potential for the atmosphere to disperse pollutants. The average seasonal and annual mixing heights (based on morning and afternoon measurements) for the site region are as follows:

Mean Annual and Seasonal Mixing Heights
for the PVNGS Site Area[16]

	Mixing Height (ft)
Winter	2625
Spring	4760
Summer	5740
Fall	3855
Annual	4245

2.3.1.2.9 Ultimate Heat Sink

The meteorological discussion concerning the ultimate heat sink performance evaluation is provided in subsection 9.2.5.

20. Turner, D. B., "A Diffusion Model for An Urban Area," Journal of Applied Meteorology, 3:1:83-91, February 1964.

21. Fisher, G. E., "FOG Model Description," NUS-TM-S-185 (July 1974).

22. Petterssen, D., "Weather Analysis and Forecasting," Vol. II, McGraw-Hill, New York (1956).

23. Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," U.S. Nuclear Regulatory Commission, August 1979.

24. Yanskey, G. R., Markee, E. H., and Richter, A. T., Climatography of the National Reactor Testing Station, IDO-12048, ESSA, Figures 3-4, January 1966.

25. NRC Staff Question 322.14-PVNGS, August 13, 1975.

26. Sagendorf, J. F. and Goll, J. T., "XOQDOQ, Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations." Draft NUREG-0324, September 1977.

27. Evaluation of Compliance with Appendix I of 10CFR50, Palo Verde Nuclear Generating Station Units 4 and 5, NUS Report No. 3112, 1978.

28. NUS-TM-260 "NUSPUF, A Segmented Plume Dispersion Program for the Calculation of Average Concentration Time-Department Meteorological Regime," March 1976.

Table 2.4-1

WATER STORAGE DAMS LOCATED UPSTREAM OF THE SITE

Name of Dam	Name of Reservoir	River	Distance From Site (river miles)	Height of Dam (feet)	Drainage Area (square miles)	Reservoir Capacity (acre-feet)	Surface Area (acre-feet)
Coolidge	San Carlos	Gila	150	250	12,886	1,205,000	18,847
Roosevelt	Roosevelt	Salt	108	280	5,830	1,382,000	17,300
Horse Mesa	Apache Lake	Salt	91	305	5,870	245,000	2,660
Mormon Flat	Canyon Lake	Salt	81	224	6,030	58,000	950
Stewart Mountain	Saguaro Lake	Salt	71	207	6,130	70,000	1,260
Horseshoe	Horseshoe	Verde	105	194	6,100	143,000	2,720
Bartlett	Bartlett	Verde	87	287	6,160	179,000	2,770
Waddell	Lake Pleasant	Agua Fria	53	175	1,459	164,000	3,690

F. Painted Rock Dam is a flood control dam on the Gila River about 40 miles downstream from Gillespie Dam. When the Painted Rock Reservoir is full, the tailwater would not reach the foot of the Gillespie Dam.

The Painted Rock Dam is earthfilled to a height of 181 feet and crest length of 4780 feet, forming a reservoir with a capacity of 2,493,000 acre-feet, including 200,000 acre-feet for sedimentation.

Surface water diversion downstream from the site occurs at Gillespie Dam, where water from irrigation is diverted into the Enterprise Canal and Gila Bend Canal. Because of the poor quality of water in the canals, there is little direct diversion of canal water for irrigation.

A review of the files of the Arizona State Land Department, Water Rights Division, indicates that there are four diverters of surface water from the Gila River located south of the confluence with Centennial Wash.

These rights are located on the Gila River between Gillespie Dam (sec. 28, T.2 S, R.5 W.) and Painted Rock Dam (sec. 18 and 19, T.4 S, R.7 W.).

Application No. A-1920, Permit 1227, Certificate 1824, was issued to A. E. Pettit for 5 million gallons per year for stockwatering and for 2400 acre-feet per year for irrigation (on the basis of 3.75 acre-feet per year for 640 acres). The place of use is E1/2 sec. 23, NE1/4 and E1/2NW1/4 sec. 26, and W1/2NW1/4 sec. 25, all in T.4 S., R.8 W. The priority date is June 17, 1938.

Application No. A-2608, Permit 1866, was issued to S. L. and Alice Narramore and W. O. and Eliza Narramore for 3729 acre-feet/per year for irrigation (on the basis of 6 acre-feet per year for 620 acres). The place of use is N1/2NW NE and NW and

There are also several diversion dams with no water storage capacity. Figure 2.4-3 shows the locations of the dams. Seismically induced failure of these dams was assumed. The effect of the worst permutation of dam failures on the site was evaluated. This worst case was assumed when sequential, total failure of major dams on the Gila River and its tributaries would occur with simultaneous arrival of the peak discharge at the point in the Gila River nearest the plant site. In this manner a maximum discharge into the Gila River and its flood plain would result.

The assumption was made that Roosevelt Dam on the Salt River, Horseshoe Dam on the Verde River, Coolidge Dam on the Gila River, and Waddell Dam on the Agua Fria River fail instantaneously and completely from seismic shock. The resulting flood waves would demolish Horse Mesa, Mormon Flat, and Stewart Mountain Dams on the Salt River and Bartlett Dam on the Verde River. The flood waves generated by the dam failures on the four rivers would flow down the canyons of the respective rivers to the valleys downstream, would flow through and spread into these valleys, and would reach the point in the Gila River nearest the plant site at the same time. Reservoirs were assumed full at the time of failure.

In addition, a standard project flood (SPF) was assumed to be in progress at the time of the dam failures, with the peak discharge arriving at the point in the Gila River nearest the plant site at the same instant as the maximum peak caused by the dam failures. For this extremely conservative approach, the results indicate the maximum water surface elevation at the point in the Gila River nearest the plant site would be ~~797~~ 900, which is ~~154~~ 51 feet below the plant grade for Unit 3.

2.4.4.1 Dam Failure Permutations

The principal water storage dams of the Gila River system upstream from the plant site are shown in figure 2.4-3.(23),(24),(25)

There are also several diversion dams with no water storage capacity. Figure 2.4-3 shows the locations of the dams. Seismically induced failure of these dams was assumed. The effect of the worst permutation of dam failures on the site was evaluated. This worst case was assumed when sequential, total failure of major dams on the Gila River and its tributaries would occur with simultaneous arrival of the peak discharge at the point in the Gila River nearest the plant site. In this manner a maximum discharge into the Gila River and its flood plain would result.

The assumption was made that Roosevelt Dam on the Salt River, Horseshoe Dam on the Verde River, Coolidge Dam on the Gila River, and Waddell Dam on the Agua Fria River fail instantaneously and completely from seismic shock. The resulting flood waves would demolish Horse Mesa, Mormon Flat, and Stewart Mountain Dams on the Salt River and Bartlett Dam on the Verde River. The flood waves generated by the dam failures on the four rivers would flow down the canyons of the respective rivers to the valleys downstream, would flow through and spread into these valleys, and would reach the point in the Gila River nearest the plant site at the same time. Reservoirs were assumed full at the time of failure.

In addition, a standard project flood (SPF) was assumed to be in progress at the time of the dam failures, with the peak discharge arriving at the point in the Gila River nearest the plant site at the same instant as the maximum peak caused by the dam failures. For this extremely conservative approach, the results indicate the maximum water surface elevation at the point in the Gila River nearest the plant site would be 797, which is 154 feet below the plant grade for Unit 3.

2.4.4.1 Dam Failure Permutations

The principal water storage dams of the Gila River system upstream from the plant site are shown in figure 2.4-3.[(23),(24),(25)] Coolidge Dam is on the Gila River approximately 150 river miles upstream from the site. Completed in 1928, the dam is a concrete, multiple dome structure 250 feet high and 920 feet long at the crest. Maximum water depth at the dam is approximately 140 feet. San Carlos Reservoir is formed by Coolidge Dam. The reservoir has a capacity of 1,205,000 acre-feet and a surface area of 18,847 acres. The drainage area above the dam is 12,886 square miles. The U.S. Bureau of Indian Affairs is the operating agency of Coolidge Dam. Reservoir use includes irrigation, flood control, fish and wildlife conservation, and generation of hydroelectric power.

Theodore Roosevelt Dam is on the Salt River approximately 108 river miles upstream from the plant site. The dam was completed in 1911 and is a thick arch, cyclopean masonry structure 280 feet high and 723 feet long at the crest. Maximum water depth at the dam is approximately 225 feet. Roosevelt Lake is formed by the dam. The lake has a capacity of 1,382,000 acre-feet and a surface area of 17,300 acres. The drainage area above the dam is 5830 square miles. The operating agency of Theodore Roosevelt Dam is the Salt River Project. Lake use includes storage of irrigation, flood control, generator of hydroelectric power, recreation, and fish and wildlife conservation.

Horse Mesa Dam is on the Salt River approximately 91 river miles upstream from the site. Completed in 1927, the dam is a concrete, thin arch-type structure 305 feet high and 660 feet long at the crest. Maximum water depth at the dam is approximately 266 feet. Apache Lake is formed by Horse Mesa Dam. The lake has a capacity of 245,138 acre-feet and a surface area of 2660 acres. The drainage area above the dam is 5870 square miles. The operating agency for Horse Mesa Dam is the Salt River Project. Lake use includes storage for irrigation, flood control, generation of hydroelectric power, recreation, and fish and wildlife conservation.

Coolidge Dam is on the Gila River approximately 150 river miles upstream from the site. Completed in 1928, the dam is a concrete, multiple dome structure 250 feet high and 920 feet long at the crest. Maximum water depth at the dam is approximately 140 feet. San Carlos Reservoir is formed by Coolidge Dam. The reservoir has a capacity of 1,205,000 acre-feet and a surface area of 18,847 acres. The drainage area above the dam is 12,886 square miles. The U.S. Bureau of Indian Affairs is the operating agency of Coolidge Dam. Reservoir use includes irrigation, flood control, fish and wildlife conservation, and generation of hydroelectric power.

Theodore Roosevelt Dam is on the Salt River approximately 108 river miles upstream from the plant site. The original dam was completed in 1911 and modified in 1991-1995, and is a thick arch, cyclopean masonry structure ~~280~~ 356 feet high and ~~723~~ 1210 feet long at the crest. Maximum water depth at the dam is approximately ~~225~~ 241 feet. Roosevelt Lake is formed by the dam. The lake has a capacity of ~~1,382,000~~ 1,609,000 acre-feet and a surface area of ~~17,300~~ 19,199 acres. The drainage area above the dam is 5830 square miles. The operating agency of Theodore Roosevelt Dam is the Salt River Project. Lake use includes storage of irrigation, flood control, generator of hydroelectric power, recreation, and fish and wildlife conservation.

Horse Mesa Dam is on the Salt River approximately 91 river miles upstream from the site. Completed in 1927, the dam is a concrete, thin arch-type structure 305 feet high and 660 feet long at the crest. Maximum water depth at the dam is approximately 266 feet. Apache Lake is formed by Horse Mesa Dam. The lake has a capacity of 245,138 acre-feet and a surface area of 2660 acres. The drainage area above the dam is 5870 square miles. The operating agency for Horse Mesa Dam is the Salt River Project. Lake use includes storage for irrigation, flood control, generation of hydroelectric power, recreation, and fish and wildlife conservation.

Mormon Flat Dam is on the Salt River approximately 81 river miles upstream from the site. The dam was completed in 1925 and is a concrete, thin arch structure 224 feet high and 380 feet long at the crest. Maximum water depth at the dam is approximately 142 feet. Canyon Lake is formed by the dam. The lake has a capacity of 57,852 acre-feet and a surface area of 950 acres. The Salt River Project is the operating agency for Mormon Flat Dam. Lake use includes storage for irrigation, flood control, generation of hydroelectric power, recreation, and fish and wildlife conservation.

Stewart Mountain Dam is on the Salt River approximately 71 river miles above the site. Completed in 1930, the dam is a concrete, thin arch-type structure 207 feet high and 1260 feet long at the crest. Maximum water depth at the dam is 116 feet. Saguaro Lake is formed by the dam. The lake capacity is 69,765 acre-feet with a surface area of 1260 acres. The drainage area above the dam is 6130 square miles. The operating agency for Stewart Mountain Dam is the Salt River Project. Lake use includes storage for irrigation, flood control, generation of hydroelectric power, recreation, and fish and wildlife conservation.

Horseshoe Dam is on the Verde River approximately 105 river miles upstream from the site. Completed in 1945, the dam is an earth and rock fill-type structure 194 feet high and 1140 feet long at the crest. Maximum water depth at the dam is approximately 111 feet. Horseshoe Reservoir is formed by the dam. Reservoir capacity is 142,830 acre-feet with a surface area of 2720 acres. The drainage area above the dam is 6100 square miles. The Salt River Project is the operating agency for Horseshoe Dam. Reservoir use includes storage for irrigation, industrial use, municipal water supply, flood control, and fish and wildlife conservation.

Bartlett Dam is on the Verde River approximately 87 river miles upstream from the plant site. The dam was completed in 1939 and is a concrete, multiple arch-type structure 287 feet high and 800 feet long at the crest. Maximum water depth at the dam is 178 feet. Bartlett Lake is formed by the dam. The reservoir capacity is 179,480 acre-feet with a surface area of 2770 acres. The drainage area above the dam is 6160 square miles. The Salt River Project is the operating agency of Bartlett Dam. Lake use includes storage for irrigation, flood control, recreation, and fish and wildlife conservation.

Waddell Dam is on the Agua Fria River approximately 53 river miles upstream from the site. Completed in 1928, the dam is a concrete slab and buttress-type structure 175 feet high and 1680 feet long at the crest. Maximum water depth at the dam is approximately 111 feet. Lake Pleasant is formed by Waddell Dam. The lake has a capacity of 163,820 acre-feet and a surface area of 3690 acres. The drainage area above the dam is 1459 square miles. The Maricopa County Municipal Water Conservation District No. 1 is the operating agency of Waddell Dam. The lake uses include storage for irrigation, flood control, generation of hydroelectric power, recreation, and fish and wildlife conservation.

Reservoir capacities for the eight water storage reservoirs represent design capacities. Present day capacities are probably less, due to silting of the reservoirs.

The effect of seismically-induced failure of Roosevelt Dam on the Salt River, Horseshoe Dam on the Verde River, Coolidge Dam on the Gila River, and Waddell Dam on the Agua Fria River, with the resulting flood waves causing domino-type failure of downstream dams, was evaluated. No evaluation of the ability of the dams to withstand a seismic event was determined. Each dam is assumed to be capable of failing totally and instantaneously, producing a maximum flow. Instantaneous failure is used to yield a conservative analysis.

Bartlett Dam is on the Verde River approximately 87 river miles upstream from the plant site. The dam was completed in 1939 and is a concrete, multiple arch-type structure 287 feet high and 800 feet long at the crest. Maximum water depth at the dam is 178 feet. Bartlett Lake is formed by the dam. The reservoir capacity is 179,480 acre-feet with a surface area of 2770 acres. The drainage area above the dam is 6160 square miles. The Salt River Project is the operating agency of Bartlett Dam. Lake use includes storage for irrigation, flood control, recreation, and fish and wildlife conservation.

Waddell Dam is on the Agua Fria River approximately 53 river miles upstream from the site. The new dam was completed in 1993. ~~Completed in 1928~~. The dam is an ~~a concrete slab and buttress type~~ earth fill structure ~~175~~ 348 feet high and ~~1680~~ 4900 feet long at the crest. Maximum water depth at the dam is approximately ~~111~~ 277 feet. Lake Pleasant is formed by Waddell Dam. The lake has a capacity of ~~163,820~~ 852,600 acre-feet and a surface area of ~~3690~~ 9966 acres. The drainage area above the dam is 1459 square miles. The Maricopa County Municipal Water Conservation District No. 1 is the operating agency of Waddell Dam. The lake uses include storage for irrigation, flood control, generation of hydroelectric power, recreation, and fish and wildlife conservation.

Reservoir capacities for the eight water storage reservoirs represent design capacities. Present day capacities are probably less, due to silting of the reservoirs.

The effect of seismically-induced failure of Roosevelt Dam on the Salt River, Horseshoe Dam on the Verde River, Coolidge Dam on the Gila River, and Waddell Dam on the Agua Fria River, with the resulting flood waves causing domino-type failure of downstream dams, was evaluated. No evaluation of the ability of the dams to withstand a seismic event was determined. Each dam is assumed to be capable of failing totally and instantaneously, producing a maximum flow. Instantaneous failure is used to yield a conservative analysis.

The flood calculation is based upon the assumption that all major dams in the watershed fail in a fashion which would maximize flow at the site. Reservoirs are assumed filled to capacity and the antecedent flow condition is assumed to be an SPF as determined by the U.S. Army Corps of Engineers.(3) Diversion dams along the water courses which have no water storage capacity are ignored in the analysis as a further step toward conservatism.

A rational approach to determining effective peak discharge from dam failures was to consider that for each river, all the stored water released from a dam failure will have passed the point of entry to the respective valleys within 24 hours. Accordingly, a dimensionless hydrograph was developed with the 24-hour base length. This is analogous to a unit hydrograph, in that superposition is assumed to calculate the peak discharge resulting from multiple dam failures. By summing the total storage in each reservoir and distributing this volume in the dimensionless hydrograph, the peak discharges from each reservoir are superimposed upon each other. Thus, the dam failure hydrograph shown in figure 2.4-21 consists of a vertical rise to the peak discharge rate at time zero and an arbitrary but conservative recession shape to hour 24. The volume of the hydrograph is assumed equal to the total storage in the reservoir before failure. A base length of 24 hours was chosen for the hydrograph at the canyon outlet as a reasonable estimate of the time required to drain the canyons from the discharge of the reservoir farthest upstream.

The volume of water stored behind Coolidge Dam when the reservoir is full is 1,205,000 acre-feet. Using the hydrograph, during the first hour of flow at the entrance to the Gila River Valley, the hydrograph indicates that a total of 158,284 acre-feet of water would pass. The average flow during the first hour was computed to be 1.9 million cubic feet per second.

For the Salt and Verde system of rivers and dams, the difference in time of travel between a flood wave in the Verde River and one in the Salt River was considered negligible. Total volume of water stored behind the dams of the Salt and Verde Rivers when the reservoirs are full is 2,077,065 acre-feet. Using the hydrograph, it was computed that 272,810 acre-feet of water would enter the valley during the first hour of flow. The average flow during the first hour was computed to be 3.3 million cubic feet per second, and at peak discharge, 3.5 million cubic feet per second.

The volume of water stored in Lake Pleasant when full is 163,820 acre-feet. Using the hydrograph, it was computed that 21,515 acre-feet of water would enter the valley during the first hour of flow. The average flow during the first hour was computed as 260,000 cubic feet per second and at peak discharge, 280,000 cubic feet per second.

The terrain south of the Salt River in the vicinity of the city of Mesa is relatively low and flat for many miles southward all the way to the south side of the Gila River. If a flow of 3.5 million cubic feet per second were to enter the Salt River Valley via the Salt River, 400,000 cubic feet per second would spill southward into the Gila River Valley in the vicinity of the city of Chandler. The remaining 3.1 million cubic feet per second would remain in the Salt River Valley.

2.4.4.2 Unsteady Flow Analysis of Potential Dam Failures

The dam failure hydrographs developed in the preceding section were used as the input hydrographs to the valley topographic relief encountered in the Gila River and its tributaries.

Domino-type failure of all dams was studied with timing such that the peak discharges from each of the four rivers arrive at the point in the Gila River nearest the plant site simultaneously.

For the Salt and Verde system of rivers and dams, the difference in time of travel between a flood wave in the Verde River and one in the Salt River was considered negligible. Total volume of water stored behind the dams of the Salt and Verde Rivers when the reservoirs are full is 2,299,470 ~~2,077,065~~ acre-feet. Using the hydrograph, it was computed that 302,033 ~~272,810~~ acre-feet of water would enter the valley during the first hour of flow. The average flow during the first hour was computed to be 3.7 ~~3.3~~ million cubic feet per second, and at peak discharge, 3.9 ~~3.5~~ million cubic feet per second.

The volume of water stored in Lake Pleasant when full is 852,600 ~~163,820~~ acre-feet. Using the hydrograph, it was computed that 111,988 ~~21,515~~ acre-feet of water would enter the valley during the first hour of flow. The average flow during the first hour was computed as 1,355,000 ~~260,000~~ cubic feet per second and at peak discharge, 1,460,000 ~~280,000~~ cubic feet per second.

The terrain south of the Salt River in the vicinity of the city of Mesa is relatively low and flat for many miles southward all the way to the south side of the Gila River. If a flow of 3.5 million cubic feet per second were to enter the Salt River Valley via the Salt River, 400,000 cubic feet per second would spill southward into the Gila River Valley in the vicinity of the city of Chandler. The remaining 3.1 million cubic feet per second would remain in the Salt River Valley.

2.4.4.2 Unsteady Flow Analysis of Potential Dam Failures

The dam failure hydrographs developed in the preceding section were used as the input hydrographs to the valley topographic relief encountered in the Gila River and its tributaries.

Domino-type failure of all dams was studied with timing such that the peak discharges from each of the four rivers arrive at the point in the Gila River nearest the plant site simultaneously.

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Data developed by the U.S. Army Corps of Engineers for the Gila and Salt Rivers were used to calculate diminution of peak discharge from the dam failure flood waves during the time of travel. The Corps of Engineers synthesized a PMF for the Gila and Salt River systems. Routing the PMF hydrograph downstream caused a diminution in peak discharge from approximately 5 to 10%.(3)

Diminution of peak discharge during time of travel of the dam failure waves through the valleys would be greater than during a PMF. This conservative approach assumed the percentage diminution of flow would be the same as developed by the Corps of Engineers for a PMF in the Salt River. Diminution of peak discharge between McDowell Damsite (proposed dam) and the mouth of the Salt River during a PMF would be 10% of discharge at McDowell Damsite. From the mouth of the Salt River to Gillespie Dam, the diminution of peak discharge during a PMF was computed as 5.2% of peak discharge at the mouth of the Salt River.(3) Applying these figures to the peak discharge remaining in the Salt River from multiple dam failures indicates a peak discharge at the point in the Gila River nearest the plant site would be on the order of ~~2.7~~ 3.0 million cubic feet per second.

Diminution of peak discharge in the Gila River from assumed failure of Coolidge Dam was computed on a mileage basis from the Army Corps of Engineers figures for the Salt River. The Salt River data indicated a diminution of peak discharge amounting to 0.21% of peak at the entrance to the valley for each mile of river channel in the valley. Flow in the Gila River Valley travels 90 miles from the entrance to the valley to the point opposite the plant site. At 0.21% per mile, total diminution of peak discharge would be 19% of the 2 million cubic feet per second entering the valley. Computed peak discharge reaching the point nearest the plant site was approximately 1.6 million cubic feet per second.

Data developed by the U.S. Army Corps of Engineers for the Gila and Salt Rivers were used to calculate diminution of peak discharge from the dam failure flood waves during the time of travel. The Corps of Engineers synthesized a PMF for the Gila and Salt River systems. Routing the PMF hydrograph downstream caused a diminution in peak discharge from approximately 5 to 10%.[3]

Diminution of peak discharge during time of travel of the dam failure waves through the valleys would be greater than during a PMF. This conservative approach assumed the percentage diminution of flow would be the same as developed by the Corps of Engineers for a PMF in the Salt River. Diminution of peak discharge between McDowell Damsite (proposed dam) and the mouth of the Salt River during a PMF would be 10% of discharge at McDowell Damsite. From the mouth of the Salt River to Gillespie Dam, the diminution of peak discharge during a PMF was computed as 5.2% of peak discharge at the mouth of the Salt River.[3] Applying these figures to the peak discharge remaining in the Salt River from multiple dam failures indicates a peak discharge at the point in the Gila River nearest the plant site would be on the order of 2.7 million cubic feet per second.

Diminution of peak discharge in the Gila River from assumed failure of Coolidge Dam was computed on a mileage basis from the Army Corps of Engineers figures for the Salt River. The Salt River data indicated a diminution of peak discharge amounting to 0.21% of peak at the entrance to the valley for each mile of river channel in the valley. Flow in the Gila River Valley travels 90 miles from the entrance to the valley to the point opposite the plant site. At 0.21% per mile, total diminution of peak discharge would be 19% of the 2 million cubic feet per second entering the valley. Computed peak discharge reaching the point nearest the plant site was approximately 1.6 million cubic feet per second.

Diminution of peak discharge of the flood wave arising on the Agua Fria River was calculated at 10% of peak discharge entering the valley using 0.21% per mile loss for the 49 miles of valley through which the flood wave travels. Accordingly, of 280,000 cubic feet per second hydrograph peak entering the valley, a peak of approximately 250,000 cubic feet per second would reach the point in the Gila River nearest the plant site.

Diminution of peak discharge of overspill from the Salt River entering Gila River Valley would be extremely high, since it would spread out approximately 15 miles while flowing overland. The amount of diminution of peak discharge is likely to be 50%, but a more conservative approach would be to use a figure of 25%. Of the 400,000 cubic feet per second of overspill, peak discharge in the Gila River arriving at the point nearest the plant site was calculated as 300,000 cubic feet per second.

The SPF as determined by the Army Corps of Engineers on the Gila River below the mouth of the Agua Fria River is 3700,000 cubic feet per second, and at Gillespie Dam, 350,000 cubic feet per second.[3] For the river point nearest the plant site, a figure of 360,000 cubic feet per second was considered reasonable for peak discharge of the SPF.

Source of Peak	Peak Discharge (10^6 ft^3/s)
Agua Fria flood wave	0.25
Salt/Verde flood wave	2.70
Gila (Coolidge Dam) flood wave	1.60
Gila River SPF	0.36
Total	4.91

Thus, with simultaneous arrival of the peak discharges from multiple dam failures on the four rivers during a SPF at the

Diminution of peak discharge of the flood wave arising on the Agua Fria River was calculated at 10% of peak discharge entering the valley using 0.21% per mile loss for the 49 miles of valley through which the flood wave travels. Accordingly, of ~~200,000~~ 1,460,000 cubic feet per second hydrograph peak entering the valley, a peak of approximately ~~250,000~~ 1,300,000 cubic feet per second would reach the point in the Gila River nearest the plant site. → Add 'INSERT A'

Diminution of peak discharge of overspill from the Salt River entering Gila River Valley would be extremely high, since it would spread out approximately 15 miles while flowing overland. The amount of diminution of peak discharge is likely to be 50%, but a more conservative approach would be to use a figure of 25%. Of the 400,000 cubic feet per second of overspill, peak discharge in the Gila River arriving at the point nearest the plant site was calculated as 300,000 cubic feet per second.

The SPF as determined by the Army Corps of Engineers on the Gila River below the mouth of the Agua Fria River is ~~3700,000~~ 370,000 cubic feet per second, and at Gillespie Dam, 350,000 cubic feet per second.(3) For the river point nearest the plant site, a figure of 360,000 cubic feet per second was considered reasonable for peak discharge of the SPF.

Source of Peak	Peak Discharge (10^6 ft^3/s)
Agua Fria flood wave	~~0.25~~ 2.66
Salt/Verde flood wave	~~2.70~~ 3.00
Gila (Coolidge Dam) flood wave	1.60
Gila River SPF	0.36
Total	~~4.91~~ 7.62

Thus, with simultaneous arrival of the peak discharges from multiple dam failures on the four rivers during a SPF at the

Insert A

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A less conservative approach would be to utilize the "Inundation Studies" by the Bureau of Reclamation, U.S. Department of the Interior,[39] which estimates approximately 2,660,000 cubic feet per second would reach the point in the Gila River nearest the plant site.

2.4-82, Insert A

point in the Gila River nearest the site, the total cumulative peak discharge is approximately ~~5~~ 7.6 million cubic feet per second.

2.4.4.3 <u>Water Level at the Site</u>

Using the cross-section data ~~discussed in paragraph 2.4.3.5,~~ and inundation maps (39)(40) of the Salt, Verde and Agua Fria river systems, a slope-area computation indicates that a floodwater surface elevation of ~~797~~ 900 would accommodate a peak discharge of ~~5.1~~ 7.6 million cubic feet per second at the selected point in the Gila River, ~~154~~ 51 feet lower than the plant grade for Unit 3. Accordingly, a peak discharge of ~~5~~ 7.6 million cubic feet per second resulting from domino-type failure of dams in the Gila River system upstream from the site with timing such that the peaks from each river arrive simultaneously at the point in the Gila River nearest to the plant site during a SPF, will in no way endanger the plant.

Wind waves superimposed upon these water surface elevations will not affect the site.

2.4.5 PROBABLE MAXIMUM SURGE AND SEICHE FLOODING

The plant site is near no large bodies of water for which surge or seiche flooding would apply. The potential for flooding surge or seiche does not exist in this area.

2.4.6 PROBABLE MAXIMUM TSUNAMI FLOODING

The site is near no large bodies of water for which tsunami flooding would apply. The potential for flooding by tsunami does not exist in this area.

2.4.7 ICE EFFECTS

There are no historical data to indicate the possibility of site flooding due to ice jams. Ephemeral desert streams in the site area are not subject to ice formation, due to the infrequency of flow and the desert climate.

point in the Gila River nearest the site, the total cumulative peak discharge is approximately 5 million cubic feet per second.

2.4.4.3 Water Level at the Site

Using the cross-section data discussed in paragraph 2.4.3.5, a slope-area computation indicates that a floodwater surface elevation of 797 would accommodate a peak discharge of 5.1 million cubic feet per second at the selected point in the Gila River, 154 feet lower than the plant grade for Unit 3. Accordingly, a peak discharge of 5 million cubic feet per second resulting from domino-type failure of dams in the Gila River system upstream from the site with timing such that the peaks from each river arrive simultaneously at the point in the Gila River nearest to the plant site during a SPF, will in no way endanger the plant.

Wind waves superimposed upon these water surface elevations will not affect the site.

2.4.5 PROBABLE MAXIMUM SURGE AND SEICHE FLOODING

The plant site is near no large bodies of water for which surge or seiche flooding would apply. The potential for flooding surge or seiche does not exist in this area.

2.4.6 PROBABLE MAXIMUM TSUNAMI FLOODING

The site is near no large bodies of water for which tsunami flooding would apply. The potential for flooding by tsunami does not exist in this area.

2.4.7 ICE EFFECTS

There are no historical data to indicate the possibility of site flooding due to ice jams. Ephemeral desert streams in the site area are not subject to ice formation, due to the infrequency of flow and the desert climate.

Climatological data for Phoenix for a 13-year period indicate that the maximum daily temperature has exceeded 32F on every day of the 13-year period of record. For the same period of record, the maximum number of days per year that the daily minimum temperature was 32F and below was 14 days.[26]

Outdoor safety-related facilities are protected from subfreezing temperatures. Pipes are installed underground. The mass of water in the essential spray ponds and safety-related tanks will not freeze because subfreezing temperatures have too short a duration.

2.4.8 COOLING WATER CANALS AND RESERVOIRS

2.4.8.1 Canals

No cooling water canals are utilized on this project.

2.4.8.2 Reservoirs

2.4.8.2.1 Essential Service Spray Ponds

The only reservoirs used to impound safety-related plant cooling water are the essential spray ponds. Two rectangular ponds are provided for each unit (subsection 9.2.1).

The maximum water surface and adjacent grade elevations for the ponds are shown in figure 2.4-4. The ponds are designed as Seismic Category I structures to remain functional following the safe shutdown earthquake (SSE).

2.4.8.2.2 Station Makeup Reservoir

Makeup water is stored onsite in a below-grade impoundment east of the power block area as shown in figure 2.4-2. Total surface area corresponding to normal operating elevation is 80 acres with an active storage capacity of approximately 1950 acre-feet.

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36. Prickett, T. A., and Lonnquist, C. G., "Selected Digital Computer Techniques for Groundwater Resources Evaluation," Illinois State Water Survey, Bulletin 55, 1971. |1

37. "Climatic Atlas of the United States," U.S. Department of Commerce, Environmental Science Services Administration, Environmental Data Service, June 1968.

38. Harr, M. E., Groundwater and Seepage, McGraw-Hill, New York, N.Y., 1962.

39. Bureau of Reclamation, U.S. Department of the Interior, "Inundation Studies, NEW WADDELL DAM, Arizona," August 1990 and Inundation Maps, Dated August 1992.

40. Bureau of Reclamation, U.S. Department of the Interior, "Final Report on Inundation Mapping Project, Salt and Verde River Systems, Phoenix Metropolitan Area", Including Appendices A through W, Contract No 3-CP-30-00260, Prepared by Salt River Project, Phoenix, Arizona, January, 1984.

36. Prickett, T. A., and Lonnquist, C. G., "Selected Digital Computer Techniques for Groundwater Resources Evaluation," Illinois State Water Survey, Bulletin 55, 1971. 1

37. "Climatic Atlas of the United States," U.S. Department of Commerce, Environmental Science Services Administration, Environmental Data Service, June 1968.

38. Harr, M. E., Groundwater and Seepage, McGraw-Hill, New York, N.Y., 1962.

CONTENTS (cont)

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TABLES

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FIGURES

FIGURES (cont)

FIGURES (cont)

FIGURES (cont)

Table 3.2-1

QUALITY CLASSIFICATION OF STRUCTURES, SYSTEMS, AND COMPONENTS (Sheet 9 of 40)

Principal Components	Location	Principal Construction Codes and Standards	Seismic Category	PVNGS Quality Assurance Class	Regulatory Guide 1.26 Quality Group Classification	ANSI N18.2 Safety Class
Reactor vessel head lifting gear	C	na	na(e)	na(aa)	na	na
Internals lifting gear	C	na	na(e)	na(aa)	na	na
Fuel pool cooling and cleanup system						
Fuel pool pump motors	FB	IEEE-323/ 344/334	I	Q	na	na
Fuel pool pumps	FB	III-3	I	Q	C	3
Fuel pool cleanup pumps	FB	(q)	na	na	D	NNS
Fuel pool heat exchangers	FB	III-3	I	Q	C	3
Demineralizers	FB	VIII	na	na	D	NNS
Filters	FB	VIII	na	na	D	NNS
Strainers	FB	na	na	na	D	NNS
Valves and piping						
Containment penetration	C	III-2	I	Q	B	2
From second isolation valve to RHR heat exchanger	FB,AB	III-3	I	Q	C	3
From second isolation valve to refueling water storage tank	FB	III-3	I	Q	C	3
Cooling loop	FB	III-3	I	Q	C	3
Cleanup loop	FB	B31.1(t)	na	na	D	NNS
Other	FB,AB	B31.1(t)	na	na	D	NNS
Supports and hangers	FB,AB	III-NF(n)	(h)	(h)	na	2,3,NNS
10. Water systems						
Essential spray pond system						
ESPS pumps	OU	III-3	I	Q	C	3
ESPS pump motors	OU	IEEE-323/ 344/334	I	Q	na	na
Diesel generator cooler	DG	III-3	I	Q	C	3
Spray headers, nozzles	OU	III-3	I	Q	C	3
Piping	OU/AB/ DG	III-3	I	Q	C	3
To safety-related components						
Valves						
To safety-related components	OU/AB/ DG	III-3	I	Q	C	3
Supports and hangers	OU/AB/ DG	III-NF(n)	(h)	(h)	na	3

Table 3.2-1

QUALITY CLASSIFICATION OF STRUCTURES, SYSTEMS, AND COMPONENTS (Sheet 10 of 40)

Principal Components	Location	Principal Construction Codes and Standards	Seismic Category	PVNGS Quality Assurance Class	Regulatory Guide 1.26 Quality Group Classification	ANSI N18.2 Safety Class
Circulating water system (nonsafety-related)						
Main condenser (refer to steam and power conversion system)						
Cooling tower (mechanical part)	OU	na	na	na	na	na
Circulating water pumps	OU	(g)	na	na	D	NNS
Piping and valves	TG,OU	B31.1	na	na	D	NNS
Support and hangers	TG,OU	na	(h)	(h)	na	na
Essential cooling water system						
Pumps	AB	III-3	I	Q	C	3
Pump motors	AB	IEEE-323/ 344/334	I	Q	na	na
Heat exchangers	AB	III-3	I	Q	C	3
Surge tanks	AB	III-3	I	Q	C	3
Chemical addition tanks	AB	API-620	na	na	D	NNS
Piping from ECWS to NCWS	AB	B31.1	na	na	D	NNS
Piping other	C,AB	III-3	I	Q	C	3
Valves	C,AB	III-3	I	Q	C	3
Supports and hangers	C,AB	III-NF(n)	(h)	(h)	na	3, NNS
Nuclear cooling water system						
Pumps	OU	(g)	na	na	D	NNS
Pump motors	OU	na	na	na	na	na
Heat exchangers	OU	VIII	na	na	D	NNS
Surge tank	AB	API-620	na	na	D	NNS
Chemical addition tank	OU	API-620	na	na	D	NNS
Containment penetration	C,AB	III-2	I	Q	B	2
Piping to and from fuel pool heat exchanger	AB,FB	III-3	I	Q	C	3
Piping, other	C,AB	B31.1	na	na	D	NNS
Valves, containment isolation	C,AB	III-2	I	Q	B	2
Valves, to and from fuel pool heat exchanger	AB,FB	III-3	I	Q	C	3
Valves, other	C,AB	B31.1	na	na	D	NNS
Supports and hangers	C,AB	III-NF(n)	(h)	(h)	na	3,NNS

Table 3.2-1

QUALITY CLASSIFICATION OF STRUCTURES, SYSTEMS, AND COMPONENTS (Sheet 23 of 40)

Principal Components	Location	Principal Construction Codes and Standards	Seismic Category	PVNGS Quality Assurance Class	Regulatory Guide 1.26 Quality Group Classification	ANSI N18.2 Safety Class
ESF switchgear room normal AHU						
Fan	CB	na	na	na	na	na
Filter	CB	na	na	na	na	na
Cooling coil	CB	B31.1	na	na	na	NNS
Heating coil	CB	na	na	na	na	na
Ductwork	CB	SMACNA	na(e)	na(ee)	na	na
Dampers	CB	SMACNA	na(e)	na(ee)	na	na
Supports and hangers	CB	na	(h)	(h)	na	NNS
Battery room normal exhaust fans	CB	na	na(e)	na(ee)	na	na
Smoke exhaust system						
Fan	CB	na	na	na	na	na
Dampers	CB	SMACNA	na	na	na	na
Ductwork	CB	SMACNA	na	na	na	na
ESP pump house exhaust system						
Exhaust fan	OU	IEEE-323/344/334	I	Q	na	3
Ductwork	OU	SMACNA	I	Q	na	3
16. Fire protection system						
Fire suppression and actuation systems	See below	NFPA/ANI(t)	na	(y)	na	NNS
Fire water storage tanks and interconnecting pipe to fire pumps	OU	NFPA/ANI(t)	na	(y)	na	NNS
Fire pumps and associated drivers, controllers, fuel supplies	OU	NFPA/ANI(t)	na	(y)	na	NNS
Fire water underground main piping (Quality Class break at isolation valve discharge flange for NQR sections of system)	OU	NFPA/ANI(t)	na	(y)	na	NNS
Fire suppression system water riser supply branch piping	AB, CB, DG FB, RW, MS	NFPA/ANI(t)	na	(y)	na	NNS
Water, CO_2, and Halon fixed fire suppression and actuation systems	AB, CB, DG FB, RW, MS	NFPA/ANI(t)	na	(y)	na	NNS
CO_2 storage tank and associated piping and components	CB, OU	NFPA/ANI(t)	na	(y)	na	NNS
Supports and hangers	AB, CB, DG FB, RW, MS	NFPA/ANI(t)	(h)	(y)	na	NNS
Fire hydrants for exterior fire exposure protection	OU	NFPA/ANI(t)	na	(y)	na	NNS
Fire detection and alarm systems (QK and FP systems)	See below					
Panels	AB, CB, C, FB DG, RW, MS, OU	NFPA	na	(y)	na	NNS

Table 3.2-1

QUALITY CLASSIFICATION OF STRUCTURES, SYSTEMS, AND COMPONENTS (Sheet 23a of 40)

Principal Components	Location	Principal Construction Codes and Standards	Seismic Category	PVNGS Quality Assurance Class	Regulatory Guide 1.26 Quality Group Classification	ANSI N18.2 Safety Class
Fire and smoke detectors	AB, CB, C, FB DG, RW, MS, OU	NFPA	na	(y)	na	NNS
Backup power supplies	AB, CB, C, FB DG, RW, MS, OU	NFPA	na	(y)	na	NNS
Alarms/annunciators (includes control room communication console, security computer, dorado racks and concentrators)	AB, CB, C, FB DG, RW, MS, OU	NFPA	na	(y)	na	NNS
AC power sources	All	na	na	na	na	NNS
Supports and hangers	AB, CB, C, FB DG, RW, MS, OU	na	(h)	na	na	NNS
Fire barriers	See below					
Fire walls, floors, ceilings, partitions	AB, CB, C, FB, corridor, DG, RW, MS, OU	na	(h)	(y)	na	NNS
Acoustical ceilings	AB, CB, corridor	na	(h)	(y)	na	NNS
Fire doors	AB, CB, C, FB, corridor, DG, RW, MS, OU	NFPA	(h)	(y)	na	NNS
Fire dampers	AB, CB, C, FB, corridor, DG, RW, MS, OU	na	(h)	(y)	na	NNS
Penetration seals, seismic gap seals, fire breaks	AB, CB, C, FB, corridor, DG, RW, MS, OU	na	(h)	(y)	na	NNS
Radiant energy shields	C	na	(h)	(y)	na	NNS
Fire-proofing (structural, electrical raceway, HVAC and electrical supports	AB, CB, MS, C, corridor	na	(h)	(y)	na	NNS
RCP lube oil collection system	C	III/B31.1	I	(y)	na	NNS
Emergency lighting system						
8-hour-designed emergency lighting systems	AB, CB, DG, MS, TG, OU	na	(h)	(y)	na	NNS

Table 3.2-1

QUALITY CLASSIFICATION OF STRUCTURES, SYSTEMS, AND COMPONENTS (Sheet 31 of 40)

Principal Components	Location	Principal Construction Codes and Standards	Seismic Category	PVNGS Quality Assurance Class	Regulatory Guide 1.26 Quality Group Classification	ANSI N18.2 Safety Class
23. Solid radwaste system (p)						
Tanks						
Spent resin tanks	RW	VIII,Div I	na	na	D(AUGM) (o)	NNS
Remainder	RW	API-650	na	na	D(AUGM) (o)	NNS
Pumps						
Resin transfer/dewatering pump	RW	HIS(g)	na	na	D	NNS
Remainder	RW	HIS (g)	na	na	D(AUGM) (o)	NNS
Piping	RW	B31.1	na	na	D(AUGM) (o)	NNS
Valves	RW	B31.1(t)	na	na	D(AUGM) (o)	NNS
Supports and hangers	RW	na	(h)	(h)	na	NNS
Waste/cement mixer	RW	na	na	na	D(AUGM) (o)	NNS
24. Water reclamation system	WR	(v)	na	na	na	na
25. Structures						
Buildings						
Diesel generator building	DG	(a)	I	Q	na	na
Radwaste building	RW	(a)	na	na(aa)	na	na
Control building	CB	(a)	I	Q	na	na
Fuel building	FB	(a)	I	Q	na	na
Containment building	C	(a)	I	Q	na	2
Equipment hatch	C	III-MC(gg)	I	Q	na	2
Personnel air locks	C	III-MC	I	Q	na	2
Liner plate	C	(c)	I	Q	na	2
Penetration assemblies	C	III-2(m)	I	Q	na	2
Fuel transfer tube penetration	C	(c)	I	Q	na	2
Fuel transfer tube housing	C	III-MC	I	Q	na	2
Crane supports	C	(a)	I	Q	na	na
Auxiliary building	AB	(a)	I	Q	na	na
Main steam support structure	MS	(a)	I	Q	na	na
Turbine generator building	TG	(a)	na	na	na	na
Miscellaneous Structures						
Control room ceiling structure (horseshoe area)	CB	IEEE-344	I	Q	na	na
Condensate tank foundation	OU	(a)	I	Q	na	na
Essential spray ponds including essential spray-pond water intake structure	OU	(a)	I	Q	na	na

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Table 3.2-1

QUALITY CLASSIFICATION OF STRUCTURES, SYSTEMS, AND COMPONENTS (Sheet 32 of 40)

Principal Components	Location	Principal Construction Codes and Standards	Seismic Category	PVNGS Quality Assurance Class	Regulatory Guide 1.26 Quality Group Classification	ANSI N18.2 Safety Class
Refueling water tank foundation	OU	(a)	I	Q	na	na
Reservoir	OU	(a)	na	na	na	na
BOP cooling towers including circulating water intake structure	OU	(a)	na	na	na	na
26. Water reclamation plant (structures)	WR	(v)	na	na	na	na
27. Water reclamation supply system	WR,OU	(v)	na	na	na	na
28. Radiation monitoring system						
Control room cabinets	CB	IEEE-344	I	Q	na	na
Remote indication and control units	CB	IEEE-323/344	I	Q	na	na
SRMS interface units	CB	IEEE-323/344	I	Q	na	na 6
Control room DCU	CB	na	na	na(aa)	na	na
Health phyics DCU	AB	na	na	na(aa)	na	na
Monitors						
Control room ventilation intake	CB	III-3, IEEE-323/344	I	Q	na	na
Fuel pool area	FB	IEEE-323/344	I	Q	na	na
Fuel building ventilation exhaust	FB	III-3, IEEE-323/344	I	Q	na	na
Refueling machine area	C, AB	IEEE-323/344	I	Q	na	na
Containment building purge exhaust	AB	III-3, IEEE-323/344	I	Q	na	na
Containment building atmosphere	AB	III-3, IEEE-323/344	I	Q	na	na
Post-accident purge area A	AB	IEEE-323/344	I	Q	na	na
Post-accident purge area B	AB	IEEE-323/344	I	Q	na	na
Essential cooling water	AB	B31.1	na	na(aa)	D	na
Steam generator blowdown	AB	B31.1	na	na(aa)	D	na
Nuclear cooling water	AB	B31.1	na	na(aa)	D	na
Auxiliary steam cond receiver tank inlet	AB	B31.1	na	na(aa)	D	na
Auxiliary building vent. exhaust filter inlet	AB	B31.1	na	na(aa)	D(ff)	na
Auxiliary building lower level vent. exhaust	AB	B31.1	na	na(aa)	D(ff)	na
Auxiliary building upper level vent. exhaust	AB	B31.1	na	na(aa)	D(ff)	na
Condenser vac pump/gland seal exhaust	TG	B31.1	na	na(aa)	D	na
Waste gas decay tank	RW	B31.1	na	na(aa)	D	na

Table 3.2-1

QUALITY CLASSIFICATION OF STRUCTURES, SYSTEMS, AND COMPONENTS (Sheet 33 of 40)

Principal Components	Location	Principal Construction Codes and Standards	Seismic Category	PVNGS Quality Assurance Class	Regulatory Guide 1.26 Quality Group Classification	ANSI N18.2 Safety Class
Plant vent	TG	B31.1	na	na(aa)	D	na
Radwaste bldg. vent. exhaust filter inlet	RW	B31.1	na	na(aa)	D	na
Waste gas system area comb. vent. exh.	RW	B31.1	na	na(aa)	D	na
Operating level area	C, AB	na	na	na(aa)	na	na
Incore inst. area	C, AB	na	na	na(aa)	na	na
Control room area	CB	na	na	na(aa)	na	na
New fuel area	FB	na	na	na(aa)	na	na
Solid waste process station area	RW	na	na	na(aa)	na	na
Solid waste storage area	RW	na	na	na(aa)	na	na
Loading bay area	RW	na	na	na(aa)	na	na
Radiochem lab area	AB	na	na	na(aa)	na	na
Central calibration facility area	OU	na	na	na(aa)	na	na
Central machine shop area	RW	na	na	na(aa)	na	na
Sample room area	AB	na	na	na(aa)	na	na
Waste solidification system process control area	RW	na	na	na(aa)	na	na
Portable area	All	na	na	na(aa)	na	na
Movable airborne	All	B31.1	na	na(aa)	D	na
Portable/movable monitor connection boxes	All	na	na	na(aa)	na	na
29. Accident-related meteorological data collection equipment	OU	na	na	na(ii)	na	na

NOTES

1. Location

AB = Auxiliary building

CB = Control building

C = Containment building

FB = Fuel building

DG = Diesel generator building

OU = Outside

Table 3.2-1

QUALITY CLASSIFICATION OF STRUCTURES, SYSTEMS, AND COMPONENTS (Sheet 34 of 40)

1. Location (continued)

RW = Radwaste building

TG = Turbine building

SB = Service building

MS = Main steam support structure

WR = Water reclamation plant

2. Principal Construction Codes and Standards

I	= ASME Boiler and Pressure Vessel Code, Section I
III-1,2,3,MC	= ASME Boiler and Pressure Vessel Code, Section III, Class 1, 2, 3, or MC
III-NF,NG	= ASME Boiler and Pressure Vessel Code, Section III, Section NF or Section NG
VIII	= ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 or Division 2
ASTM A:	= American Society for Testing and Materials: A242, Abrasion Resistant Steel; A447, Type 2, Castings, High Temperature
B9.1	= ANSI B9.1, Safety Code for Mechanical Refrigeration
B31.1	= ANSI B31.1.0, Code for Pressure Piping
SMACNA	= Sheet Metal and Air Conditioning Contractors National Association, Inc.
HEI	= Heat Exchange Institute
TEMA C	= Tubular Exchanger Manufacturers Association, Class C
ASTM C	= American Society for Testing and Materials; C64, C106, Fire Brick; C155, Insulating Brick; C213, Castable Refractory (Regular); C401, Castable Refractory (Insulating), C612 Class 5, Insulating Block
ASTM D3299-74	= Filament Wound Glass-Fiber Reinforced Polyester Chemical Resistant Tanks
PS 15-69	= National Bureau of Standards - Voluntary Product Standard PS 15-69 - Custom Contact-Molded Reinforced-Polyester Chemical Resistant Process Equipment
HIS	= Hydraulic Institute Standards
IEEE-279	= Institute of Electric and Electronic Engineers, Criteria for Protection Systems for Nuclear Power Generating Stations, 1971
IEEE-308	= Institute of Electric and Electronic Engineers, Standard Criteria for Class 1E Electric Systems for Nuclear Power Generating Stations, 1971
IEEE-317	= Institute of Electric and Electronic Engineers, Standard for Electrical Penetration Assemblies in Containment Structures for Nuclear Fueled Power Generating Stations, September 1972
IEEE-323	= Institute of Electric and Electronic Engineers, Standard for Qualifying Class 1 Electric Equipment for Nuclear Power Generating Stations, 1974
IEEE-334	= Standard for Type Tests of Continuous Duty Class 1E Motors for Nuclear Power Generating Stations - 1974
IEEE-338	= Institute of Electric and Electronic Engineers, Trial-Use Criteria for the Periodic Testing of Nuclear Power Generating Station Protection Systems, 1971
IEEE-344	= Institute of Electric and Electronic Engineers, Guide for Seismic Qualification of Class 1 Electronic Equipment for Nuclear Power Generating Stations, 1975
IEEE-379	= Institute of Electric and Electronic Engineers, Trial-Use Guide for the Application of the Single-Failure Criterion to Nuclear Power Generating Station Protection Systems
IEEE-383	= Institute of Electric and Electronic Engineers, Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generation Stations
IEEE-384	= Trial-Use Standard Criteria for Separation of Class 1E Equipment
IEEE-387	= Institute of Electric and Electronic Engineers, Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations, 1972
IEEE-420	= Trial-Use Guide for Class 1E Control Switchboards for Nuclear Power Generating Stations - 1973

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Table 3.6-1

HIGH ENERGY LINES[(a)] WITHIN CONTAINMENT (Sheet 5 of 9)

Line Number	Line Function	Operating Pressure (>275 psig)	Operating Temperature (>200F)	Figure Number/P&ID Reference	Size (in.)	Comments
Reactor Coolant (continued)						
RC-060	Loop 1A Drain	Yes	Yes	3.6-22/ 13-M-RCP-001	2	
RC-051	Loop 1 Shutdown Cooling	Yes	Yes	3.6-22/ 13-M-RCP-001	16	
RC-070	Loop 2 Drain	Yes	Yes	3.6-22/ 13-M-RCP-001	2	
RC-068	Loop 2 Shutdown Cooling	Yes	Yes	3.6-15/ 13-M-RCP-001	16	
RC-089	Loop 2B Drain	Yes	Yes	3.6-22/ 13-M-RCP-001	2	
RC-091	Loop 2B Letdown	Yes	Yes	3.6-21/ 13-M-RCP-001	2	
RC-096	Loop 2A Drain	Yes	Yes	3.6-22/ 13-M-RCP-001	2	

Table 3.6-1

HIGH ENERGY LINES[(a)] WITHIN CONTAINMENT (Sheet 6 of 9)

Line Number	Line Function	Operating Pressure (>275 psig)	Operating Temperature (>200F)	Figure Number/P&ID Reference	Size (in.)	Comments
Chemical & Volume Control						
CH-001	Loop 2B Letdown	Yes	Yes	3.6-21/ 13-M-CHP-001	2	
CH-002	Loop 2B Reg HX	Yes	Yes	3.6-21/ 13-M-CHP-001	2	
CH-008	Aux Spray	Yes	Yes	3.6-23/ 13-M-CHP-001	2	
CH-009	Aux Spray	Yes	Yes	3.6-23/ 13-M-CHP-001	2	
CH-003	To Regen HX	Yes	No	3.6-27/ 13-M-CHP-001	3	
CH-004	To Loop 2A	Yes	Yes	3.6-27/ 13-M-CHP-001	3	
CH-005	To Loop 2A	Yes	Yes	3.6-27/ 13-M-CHP-001	3	
Safety Injection						
SI-207	To Loop 1A	Yes	No	3.6-16/ 13-M-SIP-002	14	

Table 3.6-1
HIGH ENERGY LINES[(a)] WITHIN CONTAINMENT (Sheet 7 of 9)

Line Number	Line Function	Operating Pressure (>275 psig)	Operating Temperature (>200F)	Figure Number/P&ID Reference	Size (in.)	Comments
Safety Injection (continued)						
SI-206	To Loop 1A	Yes	No	3.6-16/ 13-M-SIP-002	14	
SI-203	To Loop 1A	Yes	No	3.6-16/ 13-M-SIP-002	12	
SI-223	To Loop 1B	Yes	No	3.6-17/ 13-M-SIP-002	14	
SI-222	To Loop 1B	Yes	No	3.6-17/ 13-M-SIP-002	14	
SI-221	To Loop 1B	Yes	No	3.6-17/ 13-M-SIP-002	12	
SI-160	To Loop 2A	Yes	No	3.6-18/ 13-M-SIP-002	14	
SI-159	To Loop 2A	Yes	No	3.6-18/ 13-M-SIP-002	14	
SI-156	To Loop 2A	Yes	No	3.6-18/ 13-M-SIP-002	12	

Table 3.6-1

HIGH ENERGY LINES[a] WITHIN CONTAINMENT (Sheet 8 of 9)

Line Number	Line Function	Operating Pressure (>275 psig)	Operating Temperature (>200F)	Figure Number/P&ID Reference	Size (in.)	Comments
<u>Safety Injection (continued)</u>						
SI-179	To Loop 2B	Yes	No	3.6-19/ 13-M-SIP-002	14	
SI-178	To Loop 2B	Yes	No	3.6-19/ 13-M-SIP-002	14	
SI-175	To Loop 2B	Yes	No	3.6-19/ 13-M-SIP-002	12	
SI-240	Loop 1 Shutdown Cooling	Yes	Yes	3.6-14/ 13-M-SIP-002	16	
SI-248	Loop 1 Shutdown Cooling	Yes	Yes	3.6-14/ 13-M-SIP-002	3	
SI-193	Loop 2 Shutdown Cooling	Yes	Yes	3.6-15/ 13-M-SIP-002	16	
SI-199	Loop 2 Shutdown Cooling	Yes	Yes	3.6-15/ 13-M-SIP-002	3	

Table 3.6-1

HIGH ENERGY LINES[(a)] WITHIN CONTAINMENT (Sheet 9 of 9)

Line Number	Line Function	Operating Pressure (>275 psig)	Operating Temperature (>200F)	Figure Number/P&ID Reference	Size (in.)	Comments
Safety Injection (continued)						
SI-303	SI Tank Drain	Yes	No	3.6-16/ 13-M-SIP-002	2	Pressurized by Nitrogen
SI-304	SI Tank Drain	Yes	No	3.6-17/ 13-M-SIP-002	2	Pressurized by Nitrogen
SI-305	SI Tank Drain	Yes	No	3.6-18/ 13-M-SIP-002	2	Pressurized by Nitrogen
SI-306	SI Tank Drain	Yes	No	3.6-19/ 13-M-SIP-002	2	Pressurized by Nitrogen

Table 3.6-2

HIGH ENERGY LINES[a] OUTSIDE CONTAINMENT

(Sheet 1 of 7)

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Line Number	Line Function	Operating Pressure (>275 psig)	Operating Temperature (>200F)	Figure/P&ID	Size (in.)	Building	Comments
Main Steam							
SG-095	MSIV Bypass	Yes	Yes	3.6-20/13-M-SGP-001	4	MSSS	(b)
SG-100	MSIV Bypass	Yes	Yes	3.6-20/13-M-SGP-001	4	MSSS	(b)
SG-059	Steam Dump	Yes	Yes	3.6-20/13-M-SGP-001	12	MSSS	(c)
SG-070	Steam Dump	Yes	Yes	3.6-20/13-M-SGP-001	12	MSSS	(c)
SG-084	Steam Dump	Yes	Yes	3.6-20/13-M-SGP-001	12	MSSS	(c)
SG-103	Steam Dump	Yes	Yes	3.6-20/13-M-SGP-001	12	MSSS	(c)
SG-206	From SG-033	Yes	Yes	3.6-20/13-M-SGP-001	28	MSSS	
SG-065	Safety Relief	Yes	Yes	3.6-20/13-M-SGP-001	24	MSSS	(d)
SG-066	Safety Relief	Yes	Yes	3.6-20/13-M-SGP-001	24	MSSS	(d)
SG-067	Safety Relief	Yes	Yes	3.6-20/13-M-SGP-001	24	MSSS	(d)
SG-068	Safety Relief	Yes	Yes	3.6-20/13-M-SGP-001	24	MSSS	(d)
SG-069	Safety Relief	Yes	Yes	3.6-20/13-M-SGP-001	24	MSSS	(d)
SG-207	From SG-036	Yes	Yes	3.6-20/13-M-SGP-001	28	MSSS	
SG-076	Safety Relief	Yes	Yes	3.6-20/13-M-SGP-001	24	MSSS	(d)

a. Greater than 1-inch diameter (per BTP MEB 3-1 and BTP ASB 3-1).

b. No pipe breaks between isolation valves.

c. No break zone; high energy only up to dump valve.

d. No break zone; high energy only up to relief valve.

Table 3.6-3

METHODS OF PROTECTION OF SAFETY-RELATED SYSTEMS FROM HIGH AND MODERATE ENERGY LINE BREAKS (Sheet 1 of 6)

System	Separation[a]	Floor Drains and Curbs	Jet Impingement (JI) Barriers/Rest[b]	Pipe Whip Restraints[b]	Other
Reactor coolant (incl PZR spray and surge lines) (RCS)	E	N/A	Yes (SG,SDC)	Yes (SG, SDC)	Plastic analysis on surge line for JI effects.
Steam generating (incl main steam and main feed) (SG)	L,E	Yes (in MSSS)	Yes (RCS)	Yes (RCS)	No break zone in MSSS (augmented inservice inspection)
Safety injection (SI)	L,E,R	Yes (in aux bldg)	No	Yes (SDC, RCS)	Plastic analysis on SI lines for JI effects.
Shutdown cooling (SDC)	L,E,R	Yes (in aux bldg)	No	Yes (RCS)	Plastic analysis on SDC lines for JI effects.
Containment spray (CS)	E,R	Yes (in aux bldg)	Yes (SG)	Yes (SG)	

Table 3.6-3

METHODS OF PROTECTION OF SAFETY-RELATED SYSTEMS FROM HIGH AND MODERATE ENERGY LINE BREAKS (Sheet 2 of 6)

System	Separation[a]	Floor Drains and Curbs	Jet Impingement (JI) Barriers/Rest[b]	Pipe Whip Restraints[b]	Other
Auxiliary feed (AF)	L,E,R	Yes (in MSSS)	N/A	N/A	
CVCS (charging) (CH)	R[c]	Yes (in aux bldg)	No	No	
Nuclear sampling (incl post-accident sampling sampling system (SS)	L,E,R	Yes (in aux bldg)	No	No	
Radiation monitors (PAPA'S only)	L[d]	Yes (in aux bldg)	No	No	
Hydrogen control	L[d]	Yes (in aux bldg)	No	No	

Table 3.6-3

METHODS OF PROTECTION OF SAFETY-RELATED SYSTEMS FROM HIGH AND MODERATE ENERGY LINE BREAKS (Sheet 3 of 6)

System	Separation[a]	Floor Drains and Curbs	Jet Impingement (JI) Barriers/Rest[b]	Pipe Whip Restraints[b]	Other
Ess cooling water (EW)	L,R	Yes (in aux bldg)	N/A	N/A	
Ess chill water (EC)	L,R	Yes (in aux bldg)	N/A	N/A	
Ess spray pond (ES)	L,R	Yes (in aux bldg)	N/A	N/A	
Control bldg HVAC	L,E,R	Yes	N/A	N/A	
Fuel bldg HVAC	L,E,R	Yes	N/A	N/A	
Diesel gen bldg HVAC	L,E,R	Yes	N/A	N/A	
Diesel gen	L,E,R	Yes	N/A	N/A	

Table 3.6-3

METHODS OF PROTECTION OF SAFETY-RELATED SYSTEMS FROM HIGH AND MODERATE ENERGY LINE BREAKS (Sheet 4 of 6)

System	Separation[a]	Floor Drains and Curbs	Jet Impingement (JI) Barriers/Rest[b]	Pipe Whip Restraints[b]	Other
Diesel fuel oil and transfer	L,E,R	Yes	N/A	N/A	
Class 1E electrical power	L	Yes (in aux bldg)	Yes (SG, CH, SI, SDC, AS, RCS)	N/A	
ESFAS (incl post-accident monitoring)	L	Yes (in aux bldg)	Yes (SG, CH, SI, SDC, AS, RCS)	N/A	
Reactor protective	L,E	N/A	N/A	N/A	
Excore monitors	L	N/A	N/A	N/A	
Main control board	L,E,R	Yes	N/A	N/A	

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Table 3.6-3

METHODS OF PROTECTION OF SAFETY-RELATED SYSTEMS FROM HIGH AND MODERATE ENERGY LINE BREAKS (Sheet 5 of 6)

System	Separation[a]	Floor Drains and Curbs	Jet Impingement (JI) Barriers/Rest[b]	Pipe Whip Restraints[b]	Other
Containment isolation					
• Penetration assemblies	L	N/A	N/A	N/A	
• Isolation valves	L	N/A	N/A	N/A	No break zone in MSSS (SG)
• Equipment hatch	L	N/A	N/A	N/A	
• Emergency personnel hatch	L	N/A	N/A	N/A	
• Personnel lock	L	N/A	N/A	N/A	
• Liner plate	L[e]	N/A	Yes (SG)	Yes (SG)	No break zone in MSSS (SG)
• Test connections	L	N/A	N/A	N/A	
• Piping between penetration assy's and isolation valves	L	N/A	N/A	N/A	

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Table 3.6-3

METHODS OF PROTECTION OF SAFETY-RELATED SYSTEMS FROM HIGH AND MODERATE ENERGY LINE BREAKS (Sheet 6 of 6)

Notes:

a. Separation from high or moderate energy break effects is accomplished by the following methods in decreasing order of preference:

- Layout (L)
- Enclosure (E)
- Redundancy (R)

b. Protection is provided from break effects originating in system listed in parentheses.

c. CVCS (charging) is required for nonaccident forced shutdown only. (SI provides reactor inventory for MS line break and LOCA.)

d. Monitors are separated from LOCA-induced jet impingement or pipe whip effects. Not required for any other design basis pipe break scenario.

e. Liner plate is separated from LOCA-induced jet impingement or pipe whip effects and is protected from MSLB whip and impingement effects by restraints or barriers. Not required for any other HELB scenario.

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The design criteria define acceptable types of isolation for safety-related elements and for high energy lines from similar elements of the redundant train. Separation is accomplished by:

- Routing the two groups through separate compartments, or
- Physically separating the two groups by a specified minimum distance, or
- Separating the two groups by structural barriers.

The design criteria assure that a postulated failure of a high energy line or a safety-related element cannot take more than one safety-related train out of service. The failure of a component or subsystem of one train may cause failure of another of the same train; for example, a B train high energy pipe may cause failure of a B train electrical tray, but not failure of an A train electrical tray. The capability of shutting the plant down safely under such a failure will, therefore, remain intact.

Given the separation criteria above and the pipe break criteria in paragraph 3.6.2.1.1, the effects of high energy pipe breaks are not analyzed where it is determined that all essential systems, components, and structures are sufficiently physically remote from a postulated break in that piping run.

3.6.2 DETERMINATION OF BREAK LOCATIONS AND DYNAMIC EFFECTS ASSOCIATED WITH THE POSTULATED RUPTURE OF PIPING

This section describes the design bases for locating postulated breaks in high energy piping inside and outside of containment, the procedures used to define the jet thrust reaction at the break location, and the procedures used to define the jet impingement loading on adjacent essential structures, systems, and components.

3.6.2.1 Criteria Used to Define Break and Crack Locations and Configuration

The criteria for postulating break locations in high energy piping are described below.

3.6.2.1.1 High Energy Piping Other Than RCS Main Loop

3.6.2.1.1.1 High Energy Piping. Piping is considered high energy if, during normal plant conditions, it is either in operation or is maintained pressurized under conditions where either (or both) of the following conditions are met:

- Maximum operating temperature exceeds 200F, or
- Maximum operating pressure exceeds 275 psig.

Piping is not considered to be high energy if the piping run or branch run operates for less than 2% of the time that the system qualifies as a moderate energy system (as defined in paragraph 3.6.2.1.2).

3.6.2.1.1.2 Break Locations. In any given piping system, there are a limited number of locations which are more susceptible to failure by virtue of stress or fatigue than the remainder of the system. In determining the rupture locations, system parameters are based on those associated with specified seismic events and operational plant conditions. The specified seismic event is the OBE; the operational plant conditions include normal reactor operation, upset conditions, and testing conditions. Where required, postulated pipe breaks are selected as described below and are analyzed to demonstrate the capability to place the plant in a safe shutdown condition.

A. ASME Section III, Code Class 1 Piping Within Containment

For ASME Section III, Code Class 1 piping, breaks are postulated to occur at the following locations (i.e., at weld joints where the piping incorporates a fitting, valve, or welded attachment) in each piping run or branch run:

1. The terminal ends

2. At intermediate locations where the following are met:

   a. the stress range S_n exceeds 2.4 S_m, where S_m is the design stress intensity as defined in Section III of the ASME Code, or

   b. the stress range S_n as calculated by Equation 10 of Paragraph NB-3653 exceeds 2.4 S_m and the stresses computed by Equations 12 and 13 of Paragraph NB-3653 are greater than 2.4 S_m, or

   c. If fatigue analysis is performed, any intermediate location between terminal ends where the cumulative usage factor under loading associated with operational plant conditions and an OBE exceed 0.1 of the Code allowable.

3. Where the stresses calculated for a particular run of piping between terminal ends are everywhere less than the stress limits stated above such that all intermediate pipe break locations would be considered unlikely, then a minimum of two intermediate locations of highest stress or usage factor are selected.

In the absence of a Class 1 stress analysis, breaks are conservatively postulated at terminal ends and at all fittings, valves, or welded attachments.

B. ASME Section III, Code Class 2 and 3 Piping Within Containment

For ASME Section III, Code Class 2 and 3 piping, breaks are postulated to occur at the following locations (i.e., at weld joints where the piping incorporates a fitting, valve, or welded attachment) in each piping run or branch run:

1. The terminal ends

2. At all intermediate locations between terminal ends where the primary plus secondary stresses derived on an elastically calculated basis under the loadings associated with the normal and upset plant conditions and an OBE exceed 0.8 ($1.2S_h + S_A$), where S_h and S_A are the allowable stress at maximum (hot) temperature and the allowable stress for thermal expansion, respectively, as defined in Article NC-3600 of ASME Code, Section III.

3. If fatigue analysis is performed, any intermediate location between terminal ends where the cumulative usage factor exceeds 0.1 under loading associated with the normal and upset plant condition and an OBE

4. Where the stresses calculated for a particular piping run between terminal ends are at all points below the limits stated above such that all intermediate pipe break locations would be considered unlikely, then the two intermediate locations exhibiting the highest stresses are the locations where ruptures are postulated to occur.

C. Fluid System Piping Penetrating Containment

Pipe breaks are not postulated in portions of ASME Code, Section III, Class 2 high energy fluid system piping between containment isolation valves or, where no isolation valve is used inside containment, between the first rigid pipe connection to the containment penetration or the first pipe whip restraint inside containment and the outside isolation valve, provided that the piping meets the following requirements:

1. The piping is designed to meet the requirements of NE-1120 of ASME Code, Section III.

2. The maximum stress ranges as calculated by Equations 9 and 10 in Paragraph NC-3652 of the ASME Code, Section III, considering normal and upset plant conditions (i.e., sustained loads, occasional loads, and thermal expansion) and an OBE event are less than 0.8 (1.2 S_h + S_A).

3. The maximum stress as calculated by Equation 9 in Paragraph NC-3652 under loadings resulting from a postulated piping failure of fluid system piping beyond these portions of piping is less than 1.8 S_h.

4. Welded attachments to portions of piping or direct welding to the outer surface of the piping for pipe supports or pipe restraint are avoided, except where detailed stress analyses or tests are performed.

5. The number of circumferential or longitudinal welds in piping and branch connections is minimized.

6. The length of the piping run is minimized.

7. The augmented inservice inspection of the circumferential and longitudinal welds will be performed in accordance with section 6.6.

8. Geometric discontinuities such as pipe-to-valve section transitions, branch connections, and changes in pipe wall thicknesses are designed to minimize discontinuity stresses.

9. The piping run beyond the isolation valve outside the containment is restrained such that excessive pipe loads following a postulated pipe break are not transmitted to the isolation valve, which would impair the ability of the valve to perform its required function; or the piping run can be shown to have insufficient energy to cause damage to the isolation valve; or the break can be shown not to result in unacceptable consequences, as described in the protection criteria of section 3.6.

10. Penetration is designed to withstand loadings resulting from a postulated piping failure inside the containment so that neither isolation valve operability nor, in the case of a main steam line break, the leaktight integrity of the containment is impaired.

2 Pressure-temperature analysis, assuming a one square foot nonmechanistic break of the main steam line, was performed to establish design parameters for the main steam support structure.

The COPDA[2] code was used with the MSSS modeled as an 11-node system.

Flow formulations between compartments included ideal gas, incompressible liquid, and Moody two-phase blowdowns. The pressure and temperature profiles obtained were used to establish design loadings and environmental parameters for the main steam support structure above ground level.

3.6.2.5 Material Submitted for the Operating License Review

3.6.2.5.1 RCS Main Loop Piping

Although a summary of the dynamic analyses applicable to the RCS main loop piping and component supports that determine the loading resulting from postulated RCS pipe breaks is covered in paragraph 3.9.1.4, these analyses are no longer required by 10CFR50, Appendix A, Criterion 4.

3.6.2.5.2 High Energy Piping Other Than RCS Main Loop

This section summarizes the dynamic analyses applicable to high energy piping systems and associated supports that determine the loading resulting from postulated pipe breaks.

A. The implementation of the stress criteria in paragraph 3.6.2.1.1 is shown in figures 3.6-2 through 3.6-30 which provide the location and number of postulated breaks on which the dynamic analyses are based. Analyses performed provide the postulated break orientation, such as the circumferential and/or longitudinal breaks, for each postulated break.

B. The implementation of criteria for inservice inspection is shown in section 6.6. The design of pipe whip restraints is described in paragraph 3.6.2.3.2. Figures 3.6-2 through 3.6-30 provide the location and number of pipe whip restraints required to protect essential systems.

C. The jet thrust and impingement functions and the pipe break analysis are derived from reference 1. The resulting whip and impingement restraints are presented in figures 3.6-2 through 3.6-30.

D. To ensure that their design-intended functions will not be impaired to an unacceptable level of integrity or operability as the result of high energy pipe breaks, essential systems and components are protected by:

1. Physical separation from high energy systems, or
2. Enclosing either the high energy systems or the safety-related features in protective structures, or
3. Where neither 1. nor 2. above is practical, providing pipe restraints or protective barriers to ensure the operability of the safety-related features.

E. Protective assembly design and locations are shown in figures 3.6-2 through 3.6-30. Examination of all process piping welds required by the inservice inspection program can be accomplished without additional access openings.

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QUESTION 10A.21 (NRC Question 282.2) (10.3.5)

Provide the steam generator secondary water chemistry control and monitoring program, addressing the following:

1. Sampling schedule for the critical parameters and of control points for these parameters for each mode of operation: normal operation, hot startup, cold startup, hot shutdown, cold wet layup;

2. Procedures used to measure the values of the critical parameters;

3. Process sampling points;

4. Procedure for the recording and management of data;

5. Procedures defining corrective actions[a] for off-control point chemistry conditions; and

6. The procedure identifying (a) the authority responsible for the interpretation of the data and (b) the sequence and timing of administrative events required to initiate corrective action.

Verify that the steam generator secondary water chemistry control program incorporates technical recommendations of the NSSS. Any significant deviations from NSSS recommendations should be noted and justified technically.

In addition to the secondary water chemistry monitoring and control program, we require monitoring of the steam condensate at the effluent of the condensate pump. The monitoring of the condensate is for the purpose of detecting condenser leakage.

a. Branch Technical Position MTEB 5-3 describes the acceptable means for monitoring secondary side water chemistry in PWR steam generators, including corrective actions for off-control point chemistry conditions. However, the staff is amenable to alternatives, particularly to Branch Technical Position B.3.b(9) of MTEB 5-3 (96-hour time limit to repair or plug confirmed condenser tube leaks).

RESPONSE: (Item numbers correspond to those of the question.)

0 1. The response is given in paragraph 10.3.5.1.

2. Procedures for measuring the values of critical parameters will reflect C-E technical recommendations or exceptions will be technically justified in subsection 10.3.5.

   The following industry procedures reflect the most recent C-E technical recommendations for measuring the respective parameters.

Parameter	Procedure
pH	ASTM, Part 31, Procedure D1293, Method B
Conductivity	ASTM, Part 31, Procedure D1125, Method B
Suspended Solids	Standard Methods, Procedure 208D or ASTM, Part 31, Procedure D1888
Silica	ASTM, Part 31, D859, Method B

3. Process sampling points are listed in paragraph 10.4.6.2.3.

4. The response is given in paragraph 10.3.5.1.

0 5. The response is given in paragraph 10.3.5.1.

6. The response is given in paragraph 10.3.5.1.

   The steam generator secondary water chemistry control program is described in paragraph 10.3.5.1 which references CESSAR Section 10.3.4.1, which reflects C-E's technical recommendations. Technical recommendations are met by the existing design. There are no significant deviations from NSSS steam generator chemistry recommendations.

RESPONSE: (Item numbers correspond to those of the question.)

0 1. The response is given in paragraph 10.3.5.1.

2. Procedures for measuring the values of critical parameters will reflect C-E technical recommendations or exceptions will be technically justified in subsection 10.3.5.

The following industry procedures reflect the most recent C-E technical recommendations for measuring the respective parameters.

Parameter	Procedure
pH	ASTM, Part 31, Procedure D1293, Method B
Conductivity	ASTM, Part 31, Procedure D1125, Method B
Suspended Solids	Standard Methods, Procedure 208D or ASTM, Part 31, Procedure D1888
Silica	ASTM, Part 31, D859, Method B

3. Process sampling points are listed in paragraph 10.4.6.2.3.

4. The response is given in paragraph 10.3.5.1.

0 5. The response is given in paragraph 10.3.5.1.

6. The response is given in paragraph 10.3.5.1.

The steam generator secondary water chemistry control program is described in paragraph 10.3.5.1 ~~which references CESSAR Section 10.3.4.1,~~ which reflects C-E's technical recommendations. Technical recommendations are met by the existing design. There are no significant deviations from NSSS steam generator chemistry recommendations.

Paragraph 10.4.6.2.3 describes the method of continuously monitoring for indication of condenser leaks, which is to continuously monitor each section of the condenser hotwell, instead of monitoring condenser pump discharge.

Question 10A.22 (NRC Question 410.25) (10.3)

In order to prevent blowdown of more than one steam generator, verify that the main steam isolation valves are designed to stop full main steam flow at the maximum design differential pressure in both directions in the event of a main steam line break in one steam line upstream of an MSIV and corresponding single failure (to close) in an MSIV to the other steam generator.

RESPONSE: The response is given in subsection 10.1.2 and table 10.1-1. 0

Question 10A.23 (NRC Question 410.26) (10.4.5)

The evaluation of potential flooding of essential plant areas as a result of a circulating water system failure indicates that the water level would eventually reach plant grade at which point the water leaves the turbine building. Verify that this water can not enter safety-related structures through openings at grade or describe the protection provided for safety-related equipment from such an occurrence.

RESPONSE: The response is given in paragraph 10.4.5.2. 0

Question 10A.24 (NRC Question 410.27) (10.4.7)

It is our position that you commit to perform a steam generator/feedwater water hammer test in accordance with the guidance for preheat type steam generators as identified in NUREG/CR-1606, "An Evaluation of Condensation-Induced Water

Hammer in Preheat Steam Generators." The following procedure should be followed:

"Run the plant at approximately 15% of full power by using feedwater through the downcomer nozzle at the lowest feedwater temperature that the plant Standard Operating Procedure (SOP) allows. Switch the feedwater at that temperature from the downcomer nozzle to the economizer nozzle by following the SOP. Observe and record the transient that follows."

0 RESPONSE: The response is given in paragraph 10.4.7.4.