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MIRAGLIA,F. Licensing Branch 3

SUBJECT: Forwards responses to numerous open items & questions identified in NRC 801107 ltr & meetings w/NRC during wk of 801215.Direct distribution will be made as part of Amend 23 distribution per svc list provided in util 801029 ltr.

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January 9, 1981

Director, Office of Nuclear Reactor Regulation
Attention: Mr. Frank Miraglia, Branch Chief
Licensing Branch No. 3
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlemen:

Subject: Docket Nos. 50-361 and 50-362
San Onofre Nuclear Generating Station
Units 2 and 3

Enclosed are sixty-three (63) copies of responses to numerous NRC Open Items and questions identified in the NRC letter dated November 7, 1980, and meetings with the NRC staff during the week of December 15, 1980. Enclosure 1 is a list of the responses which are included in Enclosure 2.

Direct distribution of these responses will be made as part of the Amendment 23 distribution and will be in accordance with the service list provided by SCE's letter of October 29, 1979. An affidavit attesting to the fact that distribution has been completed will be provided within ten (10) days of docketing of Amendment 23.

Please let me know if you have any questions or need any additional information.

Very truly yours,

K P Baskin

Enclosure

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ENCLOSURE 1

RESPONSES TO NRC OPEN ITEMS

San Onofre Nuclear Generating Station
Units 2 and 3

January 9, 1981

Open Item No.	Open Item
3	Seawall
4	High Energy Line Break
5	SEB Audit
19	ISI/PSI
20	Appendix G
24	RCP Flywheel Integrity
29	Sump Vortex Test
31	Qualification of Containment Penetrations
32	Cask Drop
34	Condensate Storage Capacity
35	Fire Protection
36	Turbine Disc Integrity
37	Secondary Water Chemistry
40	Emergency Planning (Partial Response)
43	Steam Line and Feed Line Breaks
46	Fuel Building Ventilation
50	Snubber Inspection
55	Diesel Generator Reliability

ENCLOSURE (2)

Responses to NRC Open Items

3. Seawall

Table 131.34-1

SUMMARY OF GOVERNING LOAD INTERACTIONS FOR PRINCIPAL REINFORCED CONCRETE MEMBERS
PERMANENT SEAWALL

Description of Member	Governing Load Combination	Calculated Loads (Per Foot)								Maximum Capacity (Per Foot)					
		Shear (Vu. Kips)		Moment (Mu. ft-Kips)		Sliding (Fh. Kips)		Overturning (Mo. ft-Kips)		Shear (Vu. Kips)	Moment (Mu. ft-Kips)	Sliding (Fr. Kips)		Overturning (Mr. ft-Kips)	
		DBE	OBE	DBE	OBE	DBE	OBE	DBE	OBE	DBE OBE	DBE OBE	DBE	OBE	DBE	OBE
Stem	(1)[a]	24.3	26.18	166.39	177.89					31.4	179				
Heel	(1)[a]	25.07	26.23	188.52	203.24					41.5	365				
Toe	(1)[a]	26.34	28.08	53.64	51.67					41.5	365				
Key	(1)[a]	8.60	11.03	36.10	45.99					48.3	428				
Entire Seawall	(2)[b]					31.04	20.88	258.62	156.01			37.08[b]	50.07[b]	611.01[b]	915.63[b]

[a](1) D + L + H + E for DBE (SRP 3.8.4)
1.4D + 1.7L + 1.7H + 1.9E for OBE

[b](2) D + L + H + E for DBE (SRP 3.8.5)
F.S. > 1.1
D + L + H + E for OBE
F.S. > 1.5

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4. High Energy Line Break

Table 3.6-2
HIGH-ENERGY[(a)] LINES OUTSIDE CONTAINMENT REQUIRING FAILURE ANALYSIS (Sheet 2 of 13) 21

Line Number	Building	Pressure >275 lb/in.^{2}g	Temperature >200F	P&ID Figure Nos.	Comments
Chemical and Volume Control System (CVCS) (cont)					
1208-057-2"-C-FEO	Auxiliary Bldg	Yes	No	9.3-5	Charging
1208-058-2"-C-FEO	Auxiliary Bldg	Yes	No	9.3-5	Charging
1208-059-2"-C-FEO	Auxiliary Bldg	Yes	No	9.3-5	Charging
1208-104-2"-C-FEO	Penetration Bldg	Yes	No	9.3-5	Charging
1208-110-2"-C-HEO	Auxiliary Bldg	Yes	Yes	9.3-5	Letdown
1208-110-2-1/2"-C-HEO	Auxiliary Bldg	Yes	Yes	9.3-5	Letdown
1208-110-3"-C-HEO	Auxiliary Bldg	Yes	Yes	9.3-5	Letdown
Steam System					
1301-001-40"-C-HK1	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam
1301-001-2"-C-HK1	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam
1301-002-40"-C-HK1	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam

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Table 3.6-2
HIGH-ENERGY[a] LINES OUTSIDE CONTAINMENT REQUIRING FAILURE ANALYSIS (Sheet 3 of 13) 21

Line Number	Building	Pressure >275 $lb/in.^2$ g	Temperature >200F	P&ID Figure Nos.	Comments
Steam System (cont)					
1301-002-2"-C-HK1	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam
1301-003-40"-R-HK0	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam
	Turbine Bldg				
1301-004-4"-C-HK1	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam
1301-004-6"-C-HK1	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam
1301-006-28"-R-HK0	Turbine Bldg	Yes	Yes	10.1-1	Main Steam
1301-007-28"-R-HK0	Turbine Bldg	Yes	Yes	10.1-1	Main Steam
1301-008-28"-R-HK0	Turbine Bldg	Yes	Yes	10.1-1	Main Steam
1301-009-28"-R-HK0	Turbine Bldg	Yes	Yes	10.1-1	Main Steam
1301-010-18"-R-HK0	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam
	Turbine Bldg				
1301-012-8"-R-HK0	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam

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Table 3.6-2
HIGH-ENERGY[a] LINES OUTSIDE CONTAINMENT REQUIRING FAILURE ANALYSIS (Sheet 4 of 13) 21

Line Number	Building	Pressure >275 lb/in.² g	Temperature >200F	P&ID Figure Nos.	Comments
Steam System (cont)					
1301-015-6"-C-HK1	Aux Feedwater Tunnel	Yes	Yes	10.1-1	Blowdown
1301-016-6"-C-HK1	Aux Feedwater Tunnel	Yes	Yes	10.1-1	Blowdown
1301-017-4"-D-HK0	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam
1301-017-3"-D-HK0	Cond. Storage Tank Bldg	Yes	Yes	10.1-1	Main Steam
1301-017-6"-D-HK0	Safety Equipment Bldg Cond. Storage Tank Bldg	Yes	Yes	10.1-1	Main Steam
1301-017-6"-D[b]	Safety Equipment Bldg.	Yes	Yes	10.1-1	Main Steam
1301-296-8"-R-HK0	Safety Equipment Bldg Turbine Bldg	Yes	Yes	10.1-1	Main Steam
1301-297-14"-R-HK0	Safety Equipment Bldg Turbine Bldg	Yes	Yes	10.1-1	Main Steam

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(b) Special Schedule 160 Pipe

Table 3.6-2

HIGH-ENERGY[(a)] LINES OUTSIDE CONTAINMENT REQUIRING FAILURE ANALYSIS (Sheet 5 of 13) 21

Line Number	Building	Pressure >275 lb/in.^{2}g	Temperature >200F	P&ID Figure Nos.	Comments	
	Steam System (cont)					
1301-309-34"-C-HK1	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam	
1301-363-34"-C-HK1	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam	
1301-364-40"-R-HK0	Safety Equipment Bldg Turbine Bldg	Yes	Yes	10.4-1	Main Steam	21
1301-367-24"-R-HK2	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam	
1301-370-18"-R-HK0	Safety Equipment Bldg Turbine Bldg	Yes	Yes	10.1-1	Main Steam	23
1301-553-4"-R-HK0	Safety Equipment Bldg	Yes	Yes	10.1-1	Blowdown	
1301-553-6"-R-HK0	Safety Equipment Bldg Aux Feedwater Tunnel	Yes	Yes	10.1-1	Blowdown	21
1301-554-4"-R-HK0	Safety Equipment Bldg	Yes	Yes	10.1-1	Blowdown	
1301-554-6"-R-HK0	Safety Equipment Bldg Aux Feedwater Tunnel	Yes	Yes	10.1-1	Blowdown	

Table 3.6-2
HIGH-ENERGY[a] LINES OUTSIDE CONTAINMENT REQUIRING FAILURE ANALYSIS (Sheet 6 of 13) 21

Line Number	Building	Pressure >275 lb/in.^{2}g	Temperature >200F	P&ID Figure Nos.	Comments
Steam System (cont)					
1301-577-4"-D-HKO	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam
1301-577-6"-D-[b]	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam
1301-578-4"-C-HK1	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam
1301-578-6"-C-HK1	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam
1301-580-26"-C-HK1	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam
1301-583-26"-C-HK1	Safety Equipment Bldg	Yes	Yes	10.1-1	Main Steam
1301-643-4"-R-220	Safety Equipment Bldg	Yes	Yes	10.1-1	Blowdown
1301-644-4"-R-220	Safety Equipment Bldg	Yes	Yes	10.1-1	Blowdown
Condensate and Feedwater System					
1305-025-20"-R-GKO	Safety equipment Bldg Turbine Bldg	Yes	Yes	10.1-7	Main Feedwater

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b. Special Schedule 160 Pipe

Table 3.6-2
HIGH-ENERGY[(a)] LINES OUTSIDE CONTAINMENT REQUIRING FAILURE ANALYSIS (Sheet 7 of 13) 21

Line Number	Building	Pressure >275 lb/in.^{2}g	Temperature >200F	P&ID Figure Nos.	Comments
Condensate and Feedwater System (cont)					
1305-025-28"-R-GKO	Turbine Bldg	Yes	Yes	10.1-7	Main Feedwater
1305-025-30"-R-GKO	Safety Equipment Bldg Turbine Bldg	Yes	Yes	10.1-7	Main Feedwater
1305-026-20"-R-GKO	Safety Equipment Bldg	Yes	Yes	10.1-7	Main Feedwater
1305-028-20"-R-GKO	Turbine Bldg	Yes	Yes	10.1-7	Main Feedwater
1305-028-28"-R-GKO	Turbine Bldg	Yes	Yes	10.1-7	Main Feedwater
1305-048-2"-D-GEO	Cond. Storage Tank Bldg	Yes	No	10.4-9	Auxiliary Feedwater
1305-050-2"-D-GEO	Cond. Storage Tank Bldg	Yes	No	10.4-9	Auxiliary Feedwater
1305-078-2"-D-GKO	Cond. Storage Tank Bldg	Yes	No	10.4-9	Auxiliary Feedwater
1305-079-2"-D-GKO	Cond. Storage Tank Bldg	Yes	No	10.4-9	Auxiliary Feedwater
1305-097-18"-R-GKO	Turbine Bldg	Yes	Yes	10.1-7	Main Feedwater

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Table 3.6-2
HIGH-ENERGY[(a)] LINES OUTSIDE CONTAINMENT REQUIRING FAILURE ANALYSIS (Sheet 8 of 13) 21

Line Number	Building	Pressure >275 lb/in.^{2}g	Temperature >200F	P&ID Figure Nos.	Comments
Condensate and Feedwater System (cont)					
1305-098-6"-D-GKO	Aux Feedwater Tunnel	Yes	No	10.4-9	Auxiliary Feedwater
	Cond. Storage Tank Bldg				
1305-099-6"-D-GKO	Aux Feedwater Tunnel	Yes	No	10.4-9	Auxiliary Feedwater
	Cond Storage Tank Bldg				
1305-100-6"-D-GKO	Cond Storage Tank Bldg	Yes	No	10.4-9	Auxiliary Feedwater
1305-101-6"-D-GKO	Cond Storage Tank Bldg	Yes	No	10.4-9	Auxiliary Feedwater
1305-102-6"-R-GKO	Safety Equipment Bldg	Yes	Yes	10.1-7	Main Feedwater
1305-103-6"-R-GKO	Safety Equipment Bldg	Yes	Yes	10.1-7	Main Feedwater
1305-150-2-D-GKO	Cond. Storage Tank Bldg	Yes	No	10.4-9	Auxiliary Feedwater
1305-151-2-D-GKO	Cond. Storage Tank Bldg	Yes	No	10.4-9	Auxiliary Feedwater

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Table 3.6-2
HIGH-ENERGY[(a)] LINES OUTSIDE CONTAINMENT REQUIRING FAILURE ANALYSIS (Sheet 9 of 13) 21

Line Number	Building	Pressure >275 lb/in.^{2}g	Temperature >200F	P&ID Figure Nos.	Comments
Condensate and Feedwater System (cont)					
1305-180-3"-T-LL1	Safety Equipment Bldg	No	Yes	10.1-7	Aux Steam Cond Return
	Aux Feedwater Tunnel				
	Cond. Storage Tank Bldg				
	Turbine Bldg				
1305-189-20"-C-GK1	Safety Equipment Bldg	Yes	Yes	10.1-7	Main Feedwater
1305-190-20"-C-GK1	Safety Equipment Bldg	Yes	Yes	10.1-7	Main Feedwater
1305-222-6"-C-GK1	Aux Feedwater Tunnel	Yes	No	10.4-9	Auxiliary Feedwater
1305-223-6"-C-GK1	Aux Feedwater Tunnel	Yes	No	10.4-9	Auxiliary Feedwater
1305-294-12"-R-GK0	Safety Equipment Bldg	Yes	Yes	10.1-7	Main Feedwater
1305-295-12-R-GK0	Safety Equipment Bldg	Yes	Yes	10.1-7	Main Feedwater
1305-299-2"-R-GK0	Safety Equipment Bldg	Yes	Yes	10.1-7	Main Feedwater
1305-330-2-D-GK0	Cond. Storage Tank Bldg	Yes	No	10.4-9	Auxiliary Feedwater
1305-331-6-D-GK0	Cond. Storage Tank Bldg	Yes	No	10.4-9	Auxiliary Feedwater
1305-340-2-D-GE0	Cond. Storage Tank Bldg	Yes	No	10.4-9	Auxiliary Feedwater

Table 3.6-2
HIGH-ENERGY[(a)] LINES OUTSIDE CONTAINMENT REQUIRING FAILURE ANALYSIS (Sheet 10 of 13) 21

Line Number	Building	Pressure >275 lb/in.^{2}g	Temperature >200F	P&ID Figure Nos.	Comments
Auxiliary Steam System					
1312-002-6"-T-LL1	Auxiliary Bldg	No	Yes	11.2-3	
1312-004-3"-T-LL1	Auxiliary Bldg	No	Yes	11.2-3	
1312-005-6"-T-LL1	Auxiliary Bldg	No	Yes	11.2-2	
1312-006-4"-T-LL1	Auxiliary Bldg	No	Yes	11.2-1	
1312-007-4"-T-LL1	Auxiliary Bldg	No	Yes	12.2-1	
1312-014-4"-T-LL1	Auxiliary Bldg	No	Yes	11.2-1	
1312-015-4"-T-LL1	Auxiliary Bldg	No	Yes	11.2-1	
1312-016-2"-T-LL1	Auxiliary Bldg	No	Yes	10.1-8	
1312-018-8"-T-LL1	Auxiliary Bldg	No	Yes	10.1-8	
1312-018-10"-T-LL1	Auxiliary Bldg	No	Yes	10.1-8	
	Penetration Bldg				
	Safety Equipment Bldg				
1312-021-2"-T-LL1	Auxiliary Bldg	No	Yes	10.1-8	
	Penetration Bldg	No	Yes	10.1-8	

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Table 3.6-2
HIGH-ENERGY[a] LINES OUTSIDE CONTAINMENT REQUIRING FAILURE ANALYSIS (Sheet 11 of 13) 21

Line Number	Building	Pressure >275 lb/in.² g	Temperature >200F	P&ID Figure Nos.	Comments
Auxiliary Steam System (cont)					
1312-031-2"-T-LL1	Auxiliary Bldg	No	Yes	11.2-1	
1312-032-4"-T-LL1	Auxiliary Bldg	No	Yes	11.2-1	
	Penetration Bldg				
	Safety Equipment Bldg				
1312-038-3"-T-LL1	Auxiliary Bldg	No	Yes	11.2-2	
1312-050-2"-T-LL1	Auxiliary Bldg	No	Yes	11.2-1	
1312-067-2"-T-LL1	Auxiliary Bldg	No	Yes	11.2-3	
1312-069-3"-T-ZZ0	Auxiliary Bldg	No	Yes	11.2-1	
1312-069-4"-T-ZZ0	Auxiliary Bldg	No	Yes	11.2-1	
1312-073-3"-T-ZZ0	Auxiliary Bldg	No	Yes	11.2-1	
1312-074-4"-T-ZZ0	Auxiliary Bldg	No	Yes	11.2-1	

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1/81

Table 3.6-2

HIGH-ENERGY[a] LINES OUTSIDE CONTAINMENT REQUIRING FAILURE ANALYSIS (Sheet 12 of 13) 21

Line Number	Building	Pressure >275 lb/in.^{2}g	Temperature >200F	P&ID Figure Nos.	Comments
Auxiliary Steam System (cont)					
1312-075-2"-T-LL1	Auxiliary Bldg	No	Yes	11.2-1	
1312-076-2"-T-LL1	Auxiliary Bldg	No	Yes	11.2-1	
1312-079-2"-T-LL1	Auxiliary Bldg	No	Yes	11.2-2	
1312-165-2"-T-LL1	Auxiliary Bldg	No	Yes	10.1-8	
High Pressure Nitrogen System					
2418-072-3"-R-KEO	Auxiliary Bldg	Yes	No	3.6-1	
2418-073-1-1/2"-R-KEO	Auxiliary Bldg	Yes	No	3.6-1	
2418-075-3"-R-KEO	Auxiliary Bldg	Yes	No	3.6-1	
2418-091-2"-R-HKO	Penetration Bldg Safety Equipment Bldg	Yes	No	3.6-1	
2418-092-2"-C-HKO	Penetration Bldg	Yes	No	3.6-1	

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Table 3.6-2
HIGH-ENERGY[a] LINES OUTSIDE CONTAINMENT REQUIRING FAILURE ANALYSIS (Sheet 13 of 13) 21

Line Number	Building	Pressure >275 lb/in.^{2}g	Temperature >200F	P&ID Figure Nos.	Comments
High Pressure Nitrogen System (cont)					
2418-102-3"-R-KEO	Auxiliary Bldg	Yes	No	3.6-1	
2418-103-3"-R-KEO	Auxiliary Bldg	Yes	No	3.6-1	
2418-104-3"-R-KEO	Auxiliary Bldg	Yes	No	3.6-1	
2418-111-2"-R-HKO	Aux Feedwater Tunnel	Yes	No	3.6-1	
	Cond. Storage Tank Bldg				
2418-129-3"-R-KEO	Auxiliary Bldg	Yes	No	3.6-1	

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positive displacement charging pumps. Since these pumps cannot provide a reservoir that will sustain thrust after a pipe break, pipe whip dynamic analysis was not performed in accordance with the criteria in paragraph 3.6.2.3.2, and the only consequences of a charging line break is flooding. Section 3.4 describes the effects of flooding and the protection provided in the radwaste area. A second charging path is provided through the high-pressure safety injection line. Each pump is capable of being isolated so that a break in any one of the three charging pump lines will not result in the loss of more than one charging pump or charging path.

3.6A.3.1.2.3 Jet Impingement Analysis

Since the positive displacement charging pumps cannot provide a fluid reservoir, jet impingement analysis was not required in accordance with the criteria in paragraph 3.6.2.3.2.

3.6A.3.1.2.4 Environmental Analysis

A break in the charging line will result in flooding only. Since the fluid released will not flash at ambient pressure, a break in a charging system line will result in a negligible increase in radwaste area pressure. This increase does not affect the operation of essential systems.

4-010.5
4-010.6

3.6A.3.1.3 <u>Auxiliary Steam System Piping</u>

3.6A.3.1.3.1 General Description

The auxiliary steam system lines in the radwaste area are of carbon steel material designed in accordance with ANSI B31.1. The system consists of 2-inch nominal schedule 80- through 10-inch nominal standard weight seamless piping. The location and configuration of the auxiliary steam system lines with respect to structures, equipment, and other piping are shown in drawings 41451, 41452, 41453, 41454, 41455, 41456, 41470, 41471, and 41476, which have been provided as indicated in section 1.8. A 10-inch auxiliary steam line manifold enters the radwaste area from the unit 2 penetration building at elevation 17 ft 6 in. The line rises vertically through room 120A and a piping chase to elevation 57 ft 10 in., where the line runs horizontally south in the building. At approximately the midpoint of the building, the manifold is reduced to an 8-inch line. Branch lines, which vary from 2 inches to 6 inches, supply auxiliary steam to equipment located at elevations 63 ft 6 in. and 50 ft 0 in. A 2-inch line, from the 8-inch manifold at the south end, drops vertically down to elevation 17 ft 6 in., exits the radwaste area, and supplies auxiliary steam to the unit 3 penetration building. The condensate lines return from the using equipment drain to a condensate tank. The condensate is pumped from the tank to a 4-inch return line, which is routed parallel to the 10-inch supply line back down to the unit 2 penetration building at elevation 18 ft. 6 in.

3.6A.3.1.3.2 Pipe Whip Analysis

The auxiliary steam system in the radwaste area consists of the following lines:

	1312-002-6-T-LLI	1312-038-3-T-LLI
	1312-004-3-T-LLI	1312-050-2-T-LLI
23	1312-005-6-T-LLI	1312-006-4-T-LLI
	1312-007-4-T-LLI	1312-067-2-T-LLI
	1312-014-4-T-LLI	1312-069-4-7-ZZO
	1312-015-4-T-LLI	1312-073-3-T-ZZO
23	1312-016-2-T-LLI	1312-069-3-T-ZZO
	1312-018-8-T-LLI	1312-074-4-T-ZZO
	1312-018-10-T-LLI	1312-075-2-T-LLI
23	1312-021-2-T-LLI	1312-076-2-T-LLI
	1312-031-2-T-LLI	1312-165-2-T-LLI
	1312-032-4-T-LLI	

The criteria used in evaluating the effects of a auxiliary steam system line break on safety-related systems and components are described in paragraph 3.6.1.2, listing C. In accordance with paragraph 3.6.2.1.2.2, a review of the piping layout and plant arrangement was made to verify that the effects of auxiliary system piping breaks anywhere in the radwaste area are isolated, physically remote, or restrained by plant design fea-
4-010.5 tures from essential systems or components. In the radwaste area, the
010.6 auxiliary steam system lines are separated from essential systems by concrete walls and ceilings with a minimum thickness of 2 feet. Analysis has shown that the unrestricted motion of any auxiliary steam system line is either physically remote from essential systems or does not have enough energy to damage a 2-foot thick concrete wall. Therefore, discrete piping breaks were not analyzed in the auxiliary steam system lines, and pipe whip restraints are not required. The only consequences of an auxiliary steam system line break is flooding. Section 3.4 describes the effects of flooding and the protection provided in the radwaste area.

3.6A.3.1.3.3 Jet Impingement Analysis

All essential systems and components are either physically remote or protected by the building walls and ceilings from the effects of jet impingement.

3.6A.3.1.3.4 Environmental Analysis

An auxiliary steam system line break in the miscellaneous waste evaporator condensate monitor tank room 120A would result in the maximum pressure within the radwaste area. Analyses showed that a maximum pressure of 9.8 lb/in.^{2}g, resulting from a circumferential break in the 10-inch auxiliary steam line, would be reached in the room. This pressure will not compromise the structural integrity of the room walls, floor, and ceiling.

There are no essential systems or components in this room. The environmental conditions resulting from other breaks in the auxiliary steam system do not affect any essential systems or components, since these systems are either remotely located from or isolated from these breaks by adequate concrete walls or ceilings.

3.6A.3.1.4 High-Pressure Nitrogen System Piping

3.6A.3.1.4.1 General Description

The high-pressure nitrogen system lines in the radwaste area are of stainless steel material designed in accordance with ANSI B31.1 The system consists of 1-1/2-inch and 3-inch nominal schedule 40S seamless piping. The 4-010.5
location and configuration of the nitrogen system lines with respect to 4-010.6
structures, equipment, and other piping are shown in drawings 41414, 41415, 41420, 41433, 41434, 41453, and 41472, which have been provided as indicated in section 1.8. The system is supplied nitrogen at 350 lb/in.^{2}g from a small 8 ft^3 tank and is used to backflush filters in the radwaste area at elevation 37 ft 0 in. The nitrogen supply to the tank is provided by a 1-inch line that is not considered a high energy line per the criteria in paragraph 3.6.2.1.2.3.

3.6A.3.1.4.2 Pipe Whip Analysis

The high-pressure nitrogen system in the radwaste area consists of the following lines:

2418-072-3-R-KEO	2418-102-3-R-KEO
2418-073-1-1/2-R-KEO	2418-103-3-R-KEO
2418-075-3-R-KEO	2418-104-3-R-KEO
	2418-129-3-R-KEO

23

The criteria used in evaluating the effects of a high-pressure nitrogen system line break on safety-related systems and components are described in paragraph 3.6.1.2, listing C. There are no systems required to mitigate the consequences of this break. The thrust is low and will degrade rapidly as the tank is depleted. Sustained thrust will be limited by the 1-inch supply line. In addition, these lines are physically remote and isolated from essential systems by adequate concrete walls and ceilings. Therefore, discrete piping breaks were not analyzed in the high-pressure nitro- 4-010.5
gen system lines and pipe whip restraints are not required. 4-010.6

3.6A.3.1.4.3 Jet Impingement Analysis

All essential systems and components are either physically remote or protected by the building walls and ceilings from the effects of jet impingement.

3.6A.3.1.4.4 Environmental Analysis

4-010.5
4-010.6 A break in a high-pressure nitrogen system line will result in a negligible increase in radwaste area pressure. This increase does not affect the operation of essential systems.

3.6A.3.2 PENETRATION BUILDING

3.6A.3.2.1 Letdown System Piping

3.6A.3.2.1.1 General Description

The letdown system lines in the penetration building are of stainless steel
7-010.5 material designed in accordance with ASME Code, Section III, Class 2 Cri-
7-010.6 teria. The system consists of 2-inch Nominal Schedule 160 seamless pipe. The location and configuration of the letdown system line with respect to structures, equipment, and other piping are shown in drawings 40423, 40424, 40429, 41923, 41924, and 41929, which are provided in accordance with section 1.8. The line enters the penetration building at elevation 37 feet 0 inches. After routing through the isolation valve, it drops to elevation 26 feet 0 inches, where it runs horizontally and exits the penetration building into the radwaste area.

3.6A.3.2.1.2 Pipe Whip Analysis

An isometric drawing, indicating the location of postulated breakpoints in the letdown line in the penetration building, is provided in figure 3.6A-21. The criteria used in evaluating the effects of a letdown line break on safety-related systems and components are described in paragraph 3.6.1.2.C. Pipe breaks are conservatively postulated at each fitting, valve, or welded attachment. Circumferential breaks only are postulated since the lines are
13 less than 4 inches in diameter.

In accordance with paragraph 3.6.2.1.2.2, a review of the piping layout and plant arrangement was made to verify that the effects of these breakpoints are isolated, physically remote, or restrained by plant design features from essential systems or components. In the penetration building, the letdown system lines are separated from essential systems by concrete walls and ceilings with a minimum thickness of 2 feet. Analysis has shown that the unrestricted motion of any letdown system line is either physically remote from essential systems or does not have enough energy to damage a 2-foot thick concrete barrier. Therefore, pipe whip restraints are not required for these breakpoints.

7-010.5
7-010.6 3.6A.3.2.1.3 Jet Impingement Analysis

All essential systems and components are either physically remote or protected by the building walls and ceilings from the effects of jet impingement.

3.6A.3.3.2 Non-Nuclear Class Main Steam Lines

3.6A.3.3.2.1 General Description

The non-nuclear class main steam lines in the area of the SEB are of carbon steel material designed in accordance with ANSI B31.1. The system consists of 40-inch OD (1.575-inch minimum wall thickness), 24-inch nominal schedule 100, 18-inch nominal schedule 60, 14-inch nominal schedule 80, and 8-inch nominal schedule 80 pipe. The location and configuration of the main steam lines with respect to structures, equipment, and other piping are shown in drawings 40351, 40363, 40478, 40480, 40483, 40486, 41851, 41863, 41978, 41980, 41983, and 41986, which have been provided as indicated in section 1.8. The 40-inch main steam lines originate at the seismic anchors on the SEB roof at elevation 53 ft 7-1/2 in., are routed up to elevation 67 ft 7-5/8 in., and then into the turbine building. The 24-inch main steam equalizer line interconnects the two 40-inch main steam lines. The remaining main steam lines connect to the 40-inch main steam line at elevation 53 ft 7-1/2 in. and are routed into the turbine building.

3.6A.3.3.2.2 Pipe Whip Analysis

The non-nuclear class main steam lines in the area of the SEB consist of the following lines:

1301-003-40-R-HKO	1301-297-14-R-HKO 10-010.5
1301-010-18-R-HKO	1301-364-40-R-HKO 10-010.6
1301-012-8-R-HKO	1301-367-24-R-HK2
1301-296-8-R-HKO	1301-370-18-R-HKO

Isometrics of these lines indicating the location of postulated breakpoints and restraints are provided in figures 3.6A-27 through 3.6A-33. The systems and equipment necessary to mitigate the consequences of a main steam line break are described in paragraph 3.6.1.2.B. Since these lines consists of non-nuclear piping, pipe breaks are postulated at each fitting, valve, or welded attachment. Since these lines are greater than 4 inches in diameter, circumferential or longitudinal breaks are postulated at each breakpoint. There are no essential systems or components in the vicinity of these breakpoints. Nevertheless, pipe whip restraints are provided as necessary that 13 are designed to prevent plastic hinge formation and thereby preclude adverse pipe whip effects on the SEB roof.

3.6A.3.3.2.3 Jet Impingement Analysis

All essential systems and components are either physically remote or protected by the SEB roof from the effects of jet impingement. 10-010.5 10-010.6

3.6A.3.3.2.4 Environmental Analysis

Since these lines are located outside of any structure, a break in these lines will not result in any environmental impact on essential systems or components.

3.6A.3.3.3 Steam Lines to Auxiliary Feedwater Pump Turbine

3.6A.3.3.3.1 General Description

The steam lines to the auxiliary feedwater pump turbine in the area of the SEB are of carbon steel material designed in accordance with the ASME Code, Section III, Class 2 and 3 criteria. The system consists of 6-inch nominal schedule 160, 6-inch nominal schedule 80, and 4-inch nominal schedule 80 seamless pipe. The location and configuration of these lines with respect to structures, equipment, and other piping are shown in drawings 40352, 40362, 40372, 40373, 40400, 41852, 41862, 41872, 41873, and 41900, which have been provided as indicated in section 1.8. The lines originate at both main steam relief valve headers as individual 4-inch lines. Each line is routed through an isolation valve and a check valve. The two lines join into one 6-inch line at elevation 38 ft 0 in. near the north isolation and pressure relief valve enclosure, and then the line is routed in a trench to the seismic anchor at the storage tank building at elevation 27 ft 10 in.

3.6A.3.3.3.2 Pipe Whip Analysis

The steam system to the auxiliary feedwater pump consists of the following lines:

1301-004-6-C-HK1   1301-017-6-D-**
10-010.5 1301-004-4-C-HK1   1301-017-6-D-HKO
10-010.6 1301-578-6-C-HK1   1301-017-4-D-HKO
1301-578-4-C-HK1   1301-577-4-D-HKO
1301-577-6-D-**

**Special Schedule 160 Pipe.

An isometric of these lines, indicating the location of the highest stress node points, postulated breakpoints, and restraints, is provided in figure 3.6A-34. The systems and equipment necessary to mitigate the consequences of a break in these lines are described in paragraph 3.6.1.2.B Lines 1301-004-6, 1301-004-4, 1301-578-6, 1301-578-4, and a portion of the heavy schedule 160 lines 1301-577-6 and 1301-017-6 are designed in accordance with the criteria in paragraph 3.6.2.1.2.2.D. Therefore, pipe breaks are not postulated in the regions between the relief valve headers and the
13 restraint downstream of the isolation valves.

23 Breakpoints were postulated at the terminal ends and at the intermediate locations for the piping system which exceed the criteria outlined in paragraph 3.6.2.1. The locations immediately downstream of the restraint after the isolation valves are considered terminal ends. These restraints, in conjunction with the schedule 160 pipe, are capable of with-
10-010.5 standing the loadings resulting from postulated pipe breaks downstream of
10-010.6 this portion of the piping such that neither valve operability nor the leaktight integrity of the containment is impaired. A single circumferential break is postulated to occur at any one of the breakpoints. Longitudinal breaks are not postulated at the terminal ends because of the
23 pipe's seamless construction. Intermediate longitudinal breaks are

postulated since the criterion for a minimum number of breaks is not 23
satisfied. The pipe whip restraints are designed to prevent hinge formation and thereby preclude adverse pipe whip effects on essential systems and equipment. 13

In accordance with paragraph 3.6.2.1.2.2, a review of the piping layout and plant arrangement was made to verify that the effects of the breakpoints 23
1301-557-1, 1301-017-1, 1301-017-2, 1301-017-3, 1301-017-4, and 1301-017-5 are isolated, physically remote, or restrained by plant design features from essential systems or components. In the area of the SEB, these lines are 13
separated from essential systems by concrete walls and ceilings with a minimum thickness of 2 feet. Analysis has shown that the unrestricted motion of any of these lines is either physically remote from essential systems or does not have enough energy to damage a 2-foot-thick concrete barrier. Therefore, the only pipe whip restraints required are the restraints downstream of the isolation valves.

3.6A.3.3.3.3 Jet Impingement Analysis

The only essential components that must be protected from a steam line 10-010.5
break are the MSIV, the relief valve headers in the same line, and all 10-010.6
branch lines from the relief valve headers up to and including the first isolation valves. Assuming an active failure of the MSIV in the unaffected line, these essential components must be protected to prevent blowdown of both steam generators. All breakpoints are either physically remote or isolated by plant design features from essential systems or components. 13

3.6A.3.3.3.4 Environmental Analysis

The environmental conditions resulting from a break in a steam line to the auxiliary feedwater pump turbine within either isolation and pressure relief valve enclosure do not affect any essential system or component. These systems and components within this enclosure are designed to operate under the more severe environmental conditions resulting from a main steam line pipe break as discussed in paragraph 3.6A.3.3.1.4. All other pipe breaks are located outside of any enclosed structure.

3.6A.3.3.4 <u>Main Feedwater Lines</u> 10-010.5

3.6A.3.3.4.1 General Description 10-010.6

The main feedwater system lines in the area of the SEB are of carbon steel material with portions designed in accordance with ANSI B31.1 and ASME Code, Section III, Class 2 criteria. The system consists of 30-inch OD (1.616-inch minimum wall thickness), 20-inch nominal schedule 100, 12-inch nominal schedule 120, 6-inch nominal schedule 120, and 2-inch nominal schedule 160 pipe. The location and configuration of the main feedwater lines with respect to structures, equipment, and other piping are shown in

drawings 40351, 40352, 40362, 40363, 40372, 40399, 40407, 40478, 40480, 40489, 40490, 40491, 40493, 41851, 41852, 41862, 41863, 41872, 41873, 41899, 41907, 41978, 41980, 41989, 41990, 41991, and 41993, which have been provided as indicated in section 1.8. The 30-inch main feedwater line is routed from the turbine building into the area of the SEB at elevation 58 ft 7-1/2 in. The single line then branches into two 20-inch lines that are routed over the SEB roof at elevation 53 ft 7-1/2 in., and down through the feedwater control valves at elevation 46 ft 0 in. The two 20-inch lines are routed from the feedwater control valve station down into a trench at elevation 27 ft 3 in., then up through the main feedwater isolation valves (MFIV) to containment penetrations 28 and 29 at elevation 32 ft 3 in. The lines from the turbine building to a point immediately upstream of the MFIV's are ANSI B31.1 piping. The lines between the MFIVs and the containment penetrations are ASME Class 2 piping. Two 12-inch feedwater cleanout lines, one for each main feedwater line, connect to the 20-inch line at elevation 27 ft 3 in. and drop down to a normally closed valve at elevation 22 ft 6 in. Two 6-inch feedwater bypass lines, one for each main feedwater line, are routed around the feedwater controls valves within the feedwater control valve station. A 2-inch feedwater/blowdown injection line is routed from bypass line 1305-103-6 through an isolation valve, up over the SEB, and then down to the blowdown system at elevation 44 ft 0 in.

10-010.5
10-010.6

3.6A.3.3.4.2 Pipe Whip Analysis

The main feedwater system in the area of the SEB consists of the following lines:

1305-189-20-C-GK1	1305-102-6-R-GKO
1305-190-20-C-GK1	1305-103-6-R-GKO
1305-025-20-R-GKO	1305-294-12-R-GKO
1305-025-30-R-GKO	1305-295-12-R-GKO
1305-026-20-R-GKO	1305-299-2-R-GKO

Isometrics of these lines, indicating the location of postulated breakpoints and restraints, are provided in figures 3.6A-35 through 3.6A-39. The systems and equipment necessary to mitigate the consequences of a main feedwater line break are described in paragraph 3.6.1.2.B. Since these lines consist largely of non-nuclear piping, pipe breaks are postulated at each fitting, valve, or welded attachment. For all lines, except the 2-inch feedwater/blowdown injection line, circumferential or longitudinal breaks are postulated at each breakpoint. Since the feedwater/blowdown injection line is less than 4 inches in diameter, circumferential breaks only are postulated in this line. A pipe whip restraint is provided to prevent unacceptable damage to the SEB wall. The pipe whip restraint is designed
13 to prevent plastic hinge formation to preclude adverse pipe whip effects on the SEB wall.

In accordance with paragraph 3.6.2.1.2.2, a review of the piping layout and
10-010.5 plant arrangement was made to identify which main feedwater pipe breaks are
10-010.6 isolated, physically remote, or restrained by plant design features from essential systems or components. Between the SEB and the MFIVs, lines 1305-025-20, 1305-026-20, 1305-294-12, and 1305-295-12 are routed in a

concrete trench that will effectively contain these lines. Within the feedwater control valve stations, lines 1305-025-20, 1305-026-20, 1305-102-6, and 1305-103-6 are effectively restrained by plant design features. Line 1305-299-2 is routed remotely from any essential items, and this line does not have enough energy to damage the SEB walls or roof. On the SEB roof, lines 1305-025-20, 1305-026-20, and 1305-025-30 are effectively restrained by plant design features. Therefore, in these areas, pipe whip restraints are not required. 10-010.5 10-010.6 13

3.6A.3.3.4.3 Jet Impingement Analysis

All essential systems and components are either physically remote or protected by the building walls and other plant design features from the effects of jet impingement.

3.6A.3.3.4.4 Environmental Analysis

The environmental conditions resulting from a break in a main feedwater system line within either isolation and pressure relief valve enclosure do not affect any essential system or component. These systems and components within this enclosure are designed to operate under the more severe environmental conditions resulting from a main steam line pipe break as discussed in paragraph 3.6A.3.3.1.4. All other pipe breaks are located outside of any enclosed structure.

3.6A.3.3.5 <u>Blowdown Lines</u>

3.6A.3.3.5.1 General Description

The blowdown system lines in the area of the SEB are of carbon steel material designed in accordance with ANSI B31.1. The system consists of 6- and 4-inch nominal schedule 80 seamless pipe. The location and configuration of the blowdown system lines with respect to structures, equipment, and other piping are shown in drawings 40351, 40362, 40363, 40399, 40407, 40478, 40480, 41851, 41862, 41863, 41899, 41907, 41978, and 41980, which have been provided as indicated in section 1.8. The two blowdown lines are routed from the roof of the auxiliary feedwater enclosure at elevation 44 ft 0 in., up along the isolation and relief valve enclosure to the east wall of the SEB. The lines then run horizontally south along the wall at approximately elevation 59 ft; the lines are then routed up over the SEB roof to the blowdown control valves at elevation 51 ft 7 in, and then the lines are routed to the blowdown flash tank in the turbine building. 10-010.5 10-010.6

3.6A.3.3.5.2 Pipe Whip Analysis

The blowdown system in the are of the SEB consists of the following lines

1301-553-6-R-HKO	1301-554-6-R-HKO
1301-553-4-R-HKO	1301-554-4-R-HKO
1301-644-4-R-ZZO	1301-643-4-R-ZZO

23

The systems and equipment necessary to mitigate the consequences of a blowdown line break are described in paragraph 3.6.1.2.B. In accordance with paragraph 3.6.2.1.2.2, a review of the piping layout and plant arrangement was made to verify that the effects of blowdown system piping breaks anywhere in the SEB area are isolated, physically remote, or restrained by plant design features from essential systems or components. In the SEB area, the blowdown system lines are separated from essential systems by concrete walls and ceilings with a minimum thickness of 2 feet. Analysis has shown that the unrestricted motion of any blowdown system line is either physically remote from essential systems or does not have enough energy to damage a 2-foot thick concrete wall. Therefore, discrete piping breaks were not analyzed in the blowdown system lines and pipe whip restraints are not required.

3.6A.3.3.5.3 Jet Impingement Analysis

All essential systems and components are either physically remote or protected by building walls and other plant design features from the effects of jet impingement.

3.6A.3.3.5.4 Environmental Analysis

Since the blowdown system lines are located outside of any structure, a break in a blowdown system line will not result in any environmental impact on essential systems or components.

3.6A.3.3.6 Auxiliary Steam System and High-Pressure Nitrogen System Piping

10-010.5
10-010.6 3.6A.3.3.6.1 General Description

The auxiliary steam system and high-pressure nitrogen system lines in the area of the SEB are of carbon steel material designed in accordance with ANSI B31.1. These systems consist of 2-inch nominal schedule 160, 3-inch nominal standard weight, 4-inch nominal standard weight, and 10-inch nominal standard weight seamless piping. The location and configuration of these lines with respect to structures, equipment, and other piping are shown in drawings 40353, 40358, 40359, 40360, 40361, 40362, 40363, 40364, 41853, 41858, 41859, 41860, 41861, 41862, 41863, and 41864, which have been provided as indicated in section 1.8. For Unit 2, a 10-inch steam supply manifold, a 4-inch condensate return line, and a 2-inch nitrogen line are routed between the turbine building and the penetration building at approximately elevation 17 ft. These lines are completely contained in a tunnel within the SEB. For Unit 3, the 2-inch nitrogen line only is routed in this tunnel. For both units, a 3-inch condensate return line is routed from the auxiliary steam feedwater pump in the turbine building, up over the SEB roof at elevation 52 ft 0 in., and then down to the condensate storage tank building.

3.6A.3.5 CONDENSATE STORAGE TANK BUILDING

3.6A.3.5.1 Auxiliary Feedwater Lines

3.6A.3.5.1.1 General Description

The auxiliary feedwater lines in the condensate storage tank building are designed in accordance with ASME Code, Section III, Class 3 criteria. The system consists of 6-inch nominal schedule 120 carbon steel material seamless pipe, 2-inch nominal schedule 160 carbon steel material seamless pipe, and 2-inch nominal schedule 80S stainless steel material seamless pipe. The location and configuration of the auxiliary feedwater lines with respect to structures, equipment, and other piping are shown in drawings 40412, 40413, 40414, 40415, 40416, 40417, 40418, 40450, 40451, 40452, 40453, 40455, 40456, 40457, 41912, 41913, 41914, 41915, 41916, 41917, 41918, 41950, 41951, 41952, 41953, 41955, 51956, and 41957, which have been provided as indicated in section 1.8. The two 6-inch auxiliary feedwater lines are routed from the discharge of the three auxiliary feedwater pumps, through isolation valves, and then down into the auxiliary feedwater piping tunnel. Two 6-inch lines with isolation valves interconnect between the auxiliary feedwater lines and provide redundant flow paths for each pump. At the discharge of each pump, a 2-inch iminimum flow line is routed through a flow control orifice back to the T-121 condensate storage tank. 23

3.6A.3.5.1.2 Pipe Whip Analysis

The auxiliary feedwater system in the condensate storage tank building consists of the following lines:

1305-340-2-D-GEO	1305-101-6-D-GKO	
1305-331-6-D-GKO	1305-100-6-D-GKO	
1305-330-2-D-GKO	1305-079-2-D-GKO	23
1305-151-2-D-GKO	1305-078-2-D-GKO	
1305-150-2-D-GKO	1305-050-2-D-GEO	
1305-099-6-D-GKO	1305-048-2-D-GEO	
1305-098-6-D-GKO		

The systems and equipment necessary to mitigate the consequences of an auxiliary feedwater line break are described in paragraph 3.6.1.2.B. The pressure in the auxiliary feedwater system lines is provided by the auxiliary feedwater pumps. Since these pumps cannot provide a reservoir that will sustain thrust after a pipe break, whip dynamic analysis was not performed in accordance with the criteria in paragraph 3.6.2.3.2, and the only consequence of an auxiliary feedwater line break is flooding. Section 3.4 describes the effects of flooding and the protection provided in the condensate storage tank building. 23

3.6A.3.5.1.3 Jet Impingement Analysis

Since the auxiliary feedwater pumps cannot provide a fluid reservoir, jet impingement analysis was not required in accordance with the criteria in paragraph 3.6.2.3.2.

3.6A.3.5.1.4 Environmental Analysis

A break in an auxiliary feedwater line will result in flooding only. Since the fluid released will not flash at ambient pressure, a break in an auxiliary feedwater line will not result in an increase in building pressure.

3.6A.3.5.2 <u>Steam Lines to the Auxiliary Feedwater Pump Turbine</u>

3.6A.3.5.2.1 General Description

The steam lines to the auxiliary feedwater pump turbine are of carbon steel material designed in accordance with the ASME Code, Section III, Class 3
23 criteria. The system consists of 6-inch nominal schedule 80 and 3-inch nominal schedule 80 seamless pipe. The location and configuration of these lines with respect to structures, equipment, and other piping are shown in drawings 40412, 40414, 41912, and 41914, which have been provided as indicated in section 1.8. The 6-inch line enters the condensate storage tank building at elevation 27 ft 10 in. where it is reduced to a 3-inch line. The 3-inch line rises up to elevation 41 ft before it is routed to the turbine stop valve at approximately elevation 31 ft.

3.6A.3.5.2.2 Pipe Whip Analysis

The steam system in the condensate storage tank building consists of the following lines:

1301-017-6-D-HKO
1301-017-3-D-HKO

An isometric drawing of these lines indicating the location of the highest stress node points, postulated breakpoints, and restraint location is provided in figure 3.6A-39A. The systems and equipment necessary to mitigate the consequences of a steam line break are described in paragraph 3.6.1.2.B. Breakpoints were postulated at the terminal ends and at two intermediate locations for the piping system in accordance with the criteria outlined in paragraph 3.6.2.1. A single circumferential break is postulated to occur at any one of the breakpoints. Longitudinal
23 breaks are not postulated at the terminal ends because of the pipe's seamless construction and intermediate longitudinal breaks are not postulated since the criterion for a minimum number of breaks is satisfied.

In accordance with paragraph 3.6.2.1.2.2, a review of the piping layout and plant arrangement was made to verify that the effects of breakpoints 1301-017-5 and 1301-017-8 are isolated, physically remote, or restrained by plant design features from essential systems or components. A pipe whip restraint is provided to prevent excess pipe motion from the effects of breakpoints 1301-017-6 and 1301-017-7. The pipe whip restraint is designed to prevent plastic hinge formation and thereby preclude adverse pipe whip effects on essential systems or components.

Although only two intermediate breakpoints were selected and analyzed, a review of the piping layout was made to verify that the selected intermediate breakpoints are located in the most adverse locations. The effects of any other potential breakpoints are isolated, physically remote, or restrained by plant design features from essential systems or components.

3.6A.3.5.2.3 Jet Impingement Analysis

All breakpoints are either physically remote or isolated by plant design features from essential systems or components. 23

3.6A.3.5.2.4 Environmental Analysis

A 6-inch steam line break in the pump room would result in the maximum pressure within the condensate storage tank building. Analyses showed that a maximum pressure of 2.76 $lb/in.^2g$ and a maximum temperature of 302F would be reached in the room. This pressure will not compromise the structural integrity of the room walls or ceiling. Safety-related components that are required for safe shutdown are qualified for operation in the environmental conditions resulting from this break.

3.6A.3.5.3 Auxiliary Steam System and High-Pressure Nitrogen System Piping

3.6A.3.5.3.1 General Description

The auxiliary steam system and high-pressure nitrogen system lines in the condensate storage tank building are of carbon steel material designed in accordance with ANSI B31.1. These lines consist of 2-inch nominal schedule 160 and 3-inch nominal standard weight seamless piping. The location and configuration of these lines with respect to structures, equipment, and other piping are shown in drawings 40412, 40413, 40415, 40416, 40417, 40418, 41912, 41913, 41915, 41916, 41917, and 41918, which have been provided as indicated in section 1.8. For Unit 2 only, the 2-inch high pressure nitrogen line is routed from the nitrogen storage unit outside of the north wall of the building, is routed adjacent to the building west wall, 11-010.5
and enters the building west wall at elevation 40 ft 6 in. The line 11-010.6
is then routed down to elevation 22 ft 3 in. where it enters the auxiliary feedwater piping tunnel. For both units, the 3-inch auxiliary steam system condensate line enters the building from the auxiliary feedwater piping tunnel at elevation 19 ft 0 in., is routed up to elevation 36 ft 9 in., then is routed adjacent to the building west wall to the T-120 condensate storage tank room, and then is routed up to the condensate storage tank at elevation 60 ft 6 in.

3.6A.3.5.3.2 Pipe Whip Analysis

The auxiliary steam system and high-pressure nitrogen system in the condensate storage tank building consists of the following lines:

1305-180-3-T-LL1	Units 2 and 3
2418-111-2-R-HKO	Unit 2 only

The criteria used in evaluating the effects of an auxiliary steam system or a high-pressure nitrogen system line break on safety-related systems and components are described in paragraph 3.6.1.2.C. In accordance with paragraph 3.6.2.1.2.2, a review of the piping layout and plant arrangement was made to verify that the effects of a pipe break in these systems anywhere in the condensate storage tank building are isolated, physically remote, or restrained by plant design features from essential systems or components. In the building, these lines are physically remote or are separated from essential systems by concrete walls with a minimum wall thickness of 1 foot. Analysis has shown that the unrestricted motion of either of these lines does not have enough energy to damage a 1-foot-thick concrete barrier. Therefore, discrete piping breaks were not analyzed, and pipe whip restraints are not required. The only consequences of a condensate return line break in the building is flooding. Section 3.4 describes the effects of flooding and the protection provided in the condensate
11-010.5 storage tank building.
11-010.6

3.6A.3.5.3.3 Jet Impingement Analysis

All essential systems and components are either physically remote or protected by building walls and other plant design features from the effects of jet impingement.

3.6A.3.5.3.4 Environmental Analysis

A break in either the condensate return or high-pressure and temperature. This increase is much less than the maximum environmental conditions in the building resulting from a break in a steam line as discussed in paragraph 3.6A.3.5.2.4.

3.6A.3.6 TURBINE BUILDING

There are no essential systems or components in the turbine building. However, since the turbine building is adjacent to the safety equipment building (SEB), the high energy lines located in the turbine building that could impact the SEB were evaluated. A review of the piping layout and plant arrangement revealed that the only high energy line which could adversely impact the SEB are those portions of the main steam and main feedwater lines adjacent to the SEB.

12-010.5
12-010.6

3.6A.3.6.1 Main Steam Lines

3.6A.3.6.1.1 General Description

The main steam system lines in the turbine building are of carbon steel material designed in accordance with ANSI B31.1. The system consists of 40-inch OD (1.575-inch minimum wall thickness) and 28-inch OD (1.121-inch minimum wall thickness) piping. The location and configuration of the main

steam lines with respect to structures, equipment, and other piping are shown in drawings 40483, 40487, 40817, 40819, 40826, 40827, 40828, 40829, 40830, 40831, 40834, 40841, 40842, 40844, 41983, 41987, 42321, 42322, 42326, 42327, 42328, 42329, 42330, 42331, 42334, 42341, 42342, and 42344, which have been provided as indicated in section 1.8. Two 40-inch main steam lines enter the turbine building from the SEB roof at approximately elevation 67 ft 7 in., are routed adjacent to the SEB, then drop down to approximately elevation 51 ft 3 in. where the two lines are routed away from the SEB towards the turbine. In the vicinity of the turbine, each main steam line branches into two 28-inch lines that are routed up to the turbine stop valves at approximately elevation 66 ft 7 in.

3.6A.3.6.1.2 Pipe Whip Analysis

The main steam system in the turbine building consists of the following lines:

1301-003-40-R-HKO	1301-008-28-R-HKO
1301-006-28-R-HKO	1301-009-28-R-HKO 12-010.5
1301-007-28-R-HKO	1301-364-40-R-HKO 12-010.6

Isometrics of these lines, indicating the location of postulated breakpoints and restraints, are provided in figures 3.6A-40 and 3.6A-41. The systems and equipment necessary to mitigate the consequences of a main steam line break are described in paragraph 3.6.1.2.B. Since these lines consist of non-nuclear piping, pipe breaks are postulated at each fitting, valve, or welded attachment. Since these lines are greater than 4 inches in diameter, circumferential or longitudinal breaks are postulated at each breakpoint. The only essential systems or components in the vicinity of these breaks are located inside the SEB. Therefore, pipe whip restraints are provided as necessary on lines 1301-003-40 and 1301-364-40 to prevent unacceptable damage to the SEB walls and roof.

In accordance with paragraph 3.6.2.1.2.2, a review of the piping layout and plant arrangement was made to verify that pipe breaks in lines 1301-006-28, 1301-007-28, 1301-008-28, and 1301-009-28 are isolated, physically remote, or restrained by plant design features from the SEB. Therefore, for these lines, pipe whip restraints are not required.

Additionally the following tributary main steam lines were evaluated:

1301-010-18-R-HKO	1301-297-14-R-HKO
1301-296-8-R-HKO	1301-370-18-R-HKO

In accordance with paragraph 3.6.2.1.2.2, a review of the piping layout and plant arrangement was made to verify that pipe breaks in these tributary lines are isolated, physically remote, or restrained by plant design features from the SEB. Therefore, for these lines, pipe whip restraints are not required. 23

3.6A.3.6.1.3 Jet Impingement Analysis

The only essential items that can be impinged on from a break in the main steam lines are the normal and emergency HVAC inlets to the control room in the auxiliary building. Barriers are provided to protect these inlet ducts from the adverse effects of jet impingement. All other essential systems and components are either physically remote or protected by the SEB walls and roof from the effects of jet impingement.

3.6A.3.6.1.4 Environmental Analysis

Since these lines are located outside of any structure, a break in these lines will not result in any environmental impact on essential systems or components.

3.6A.3.6.2 <u>Main Feedwater Lines</u>

3.6A.3.6.2.1 General Description

The main feedwater system lines in the turbine building are of carbon steel material designed in accordance with ANSI B31.1. The system consists of
12-010.5 30-inch OD (1.616-inch minimum wall thickness), 28-inch OD (1.513-inch
12-010.6 minimum wall thickness), 20-inch nominal schedule 100, and 18-inch nominal schedule 100 piping. The location and configuration of the main feedwater lines with respect to structures, equipment, and other piping are shown in drawings 40481, 40489, 40492, 40817, 40819, 40821, 40826, 40827, 40828, 40830, 40884, 40885, 40886, 40887, 40888, 40889, 40890, 40893, 40894, 40898, 40899, 40900, 40904, 40906, 40908, 40910, 41981, 41989, 41992, 42321, 42322, 42323, 42326, 42327, 42328, 42330, 42384, 42385, 42386, 42387, 42389, 42390, 42391, 42394, 42395, 42399, 42400, 42401, 42405, 42407, 42409, and 42411, which have been provided as indicated in section 1.8. Two 28-inch main feedwater lines exit the first point heaters at approximately elevation 46 ft, are immediately reduced to 20-inch lines that are routed through two isolation valves at elevation 36 ft 9 in., and then down to elevation 26 ft 0 in. where the lines tee into a single 30-inch line. The 30-inch line is routed through the turbine building up to elevation 58 ft 7.5 in. where it enters into the area of the SEB. An 18-inch line connects to the 30-inch line and provides a bypass around the first point heaters.

3.6A.3.6.2.2 Pipe Whip Analysis

The main feedwater system in the turbine building consists of the following lines:

1305-025-30-R-GKO
1305-025-28-R-GKO
1305-025-20-R-GKO
1305-028-28-R-GKO
1305-028-20-R-GKO
1305-097-18-R-GKO

An isometric of these lines, indicating the location of postulated breakpoints is provided in figure 3.6A-42. The systems and equipment necessary 23 to mitigate the consequences of a main feedwater line break are described in paragraph 3.6.1.2.B. Since these lines consist of non-nuclear piping, pipe breaks are postulated at each fitting, valve, or welded attachment. Since these lines are greater than 4 inches in diameter, circumferential or longitudinal breaks are postulated at each breakpoint. Additionally, 1305-180-3-T-LLI auxiliary steam system condensate line was evaluated. The only essential systems or components in the vicinity of these breaks are located inside the SEB. 23

In accordance with paragraph 3.6.2.1.2.2, a review of the piping layout and plant arrangement was made to verify that pipe breaks in lines 1305-025-30, 1305-025-28, 1305-025-20, 1305-028, 1305-028-20, 1305-097-18, and 1305-180-3 are isolated, physically remote, or restrained by plant design features from the SEB. Therefore, for these lines, pipe whip restraints are not required.

3.6A.3.6.2.3 Jet Impingement Analysis

All essential systems and components are either physically remote or protected by the SEB walls and roof from the effects of jet impingement.

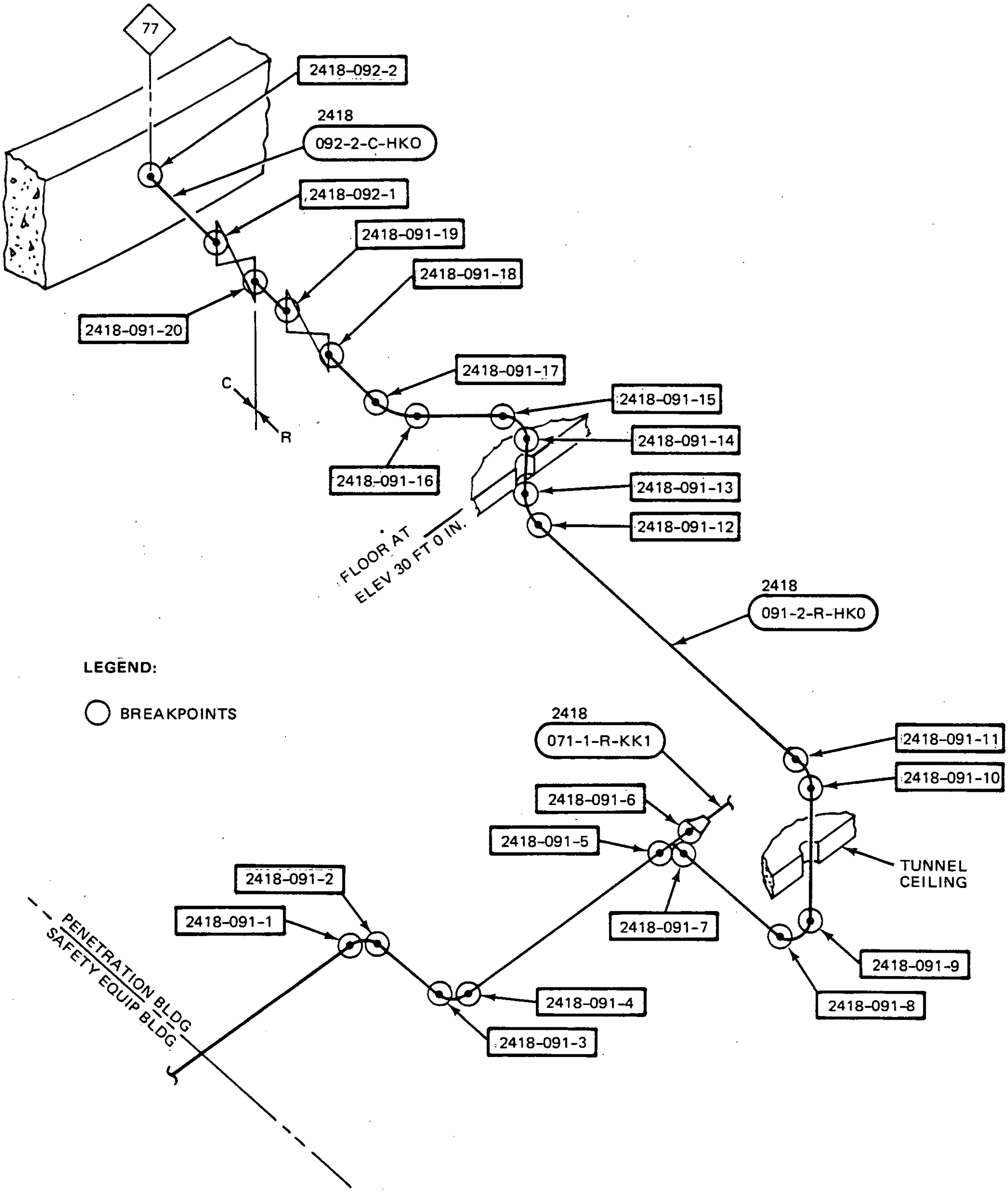
3.6A.3.6.2.4 Environmental Analysis

Since these lines are located outside of any structure, a break in these lines will not result in any environmental impact on essential systems or components.

12-010.5
12-010.6

3.6A.3.7 OUTSIDE AREA AND INTAKE STRUCTURE

The outside area consists of the diesel generator building, service and firewater storage area, and demineralizer area. There are no high energy lines located in either the outside area or the intake structure. Therefore, pipe break analysis is not required.



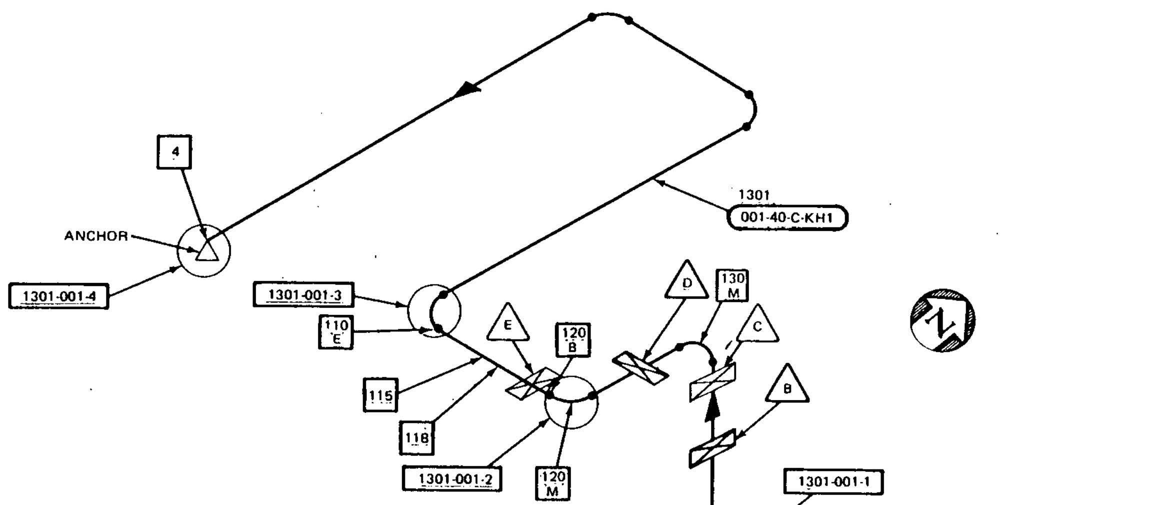
NOTES:

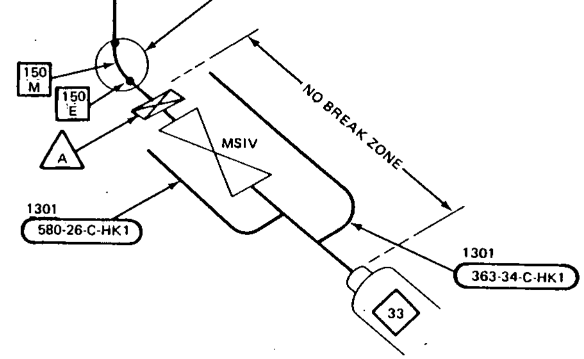
1. BREAKPOINTS POSTULATED AT TERMINAL ENDS AND AT EACH INTERMEDIATE FITTING, VALVE, OR WELDED ATTACHMENT.
2. UNIT 2 SHOWN; UNIT 3 IS OPPOSITE HAND.

SAN ONOFRE
NUCLEAR GENERATING STATION
Units 2 & 3

HIGH-PRESSURE NITROGEN SYSTEM:
LINES 2418-091 AND 2418-092
(PENETRATION BUILDING)
LOCATION OF POSTULATED BREAKPOINTS

Figure 3.6A-22





PIPE BREAK STRESS ANALYSIS

NODE	"A" LONGITUDINAL PRESS. STRESS	"B" SEISMIC ANCHOR MOVEMENT STRESS				"C" OBE INERTIA STRESS	"D" THERMAL STRESS	"E" DEAD WEIGHT STRESS	MAXIMUM PRIMARY PLUS SECONDARY "F" "A"&"B"&"C"&"D"&"E"	STRESS RATIO "F" 1.2 S_N & S_A
		X	Y	Z	S.R.S.S.					
4	6086				27	1208	1361	400	9082	.192
90B	6086				798	238	9751	156	17029	.360
110E	6086				2397	556	12493	30	21562	.456
115	6086				1635	503	6117	322	14663	.310
118	6086				1815	572	5869	200	14542	.308
120B	6086				3927	664	9955	61	20693	.438
120M	6086				4100	606	8321	166	19279	.408
130M	6086				3794	1223	6098	168	17369	.368
150M	6086				4073	1267	8539	56	20021	.424
150E	6086									T.E.*

LEGEND:

RESTRAINT

POSTULATED BREAKPOINT

STRESS NODE POINT

*TERMINAL END

NOTES:

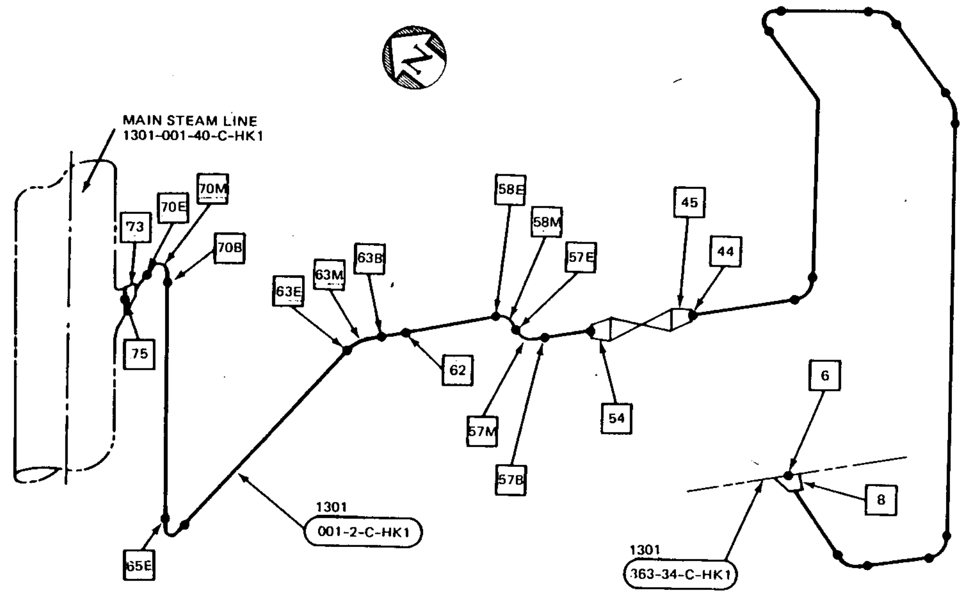
1. EXCEPT FOR TERMINAL ENDS, STRESS RATIOS LESS THAN 0.308 ARE NOT SHOWN FOR CLARITY.
2. 1.2 S_h + S_A = 47,250 LB/IN.2.
3. UNIT 2 SHOWN - UNIT 3 IS OPPOSITE HAND.

SAN ONOFRE NUCLEAR GENERATING STATION
Units 2 & 3

MAIN STEAM SYSTEM: LINE 1301-001-40 (SAFETY EQUIPMENT BUILDING) LOCATION OF HIGHEST STRESS NODE POINTS, POSTULATED BREAKPOINTS, AND RESTRAINTS

Figure 3.6A-23

NODE	LONGITUDINAL PRESSURE STRESS (LB/IN.^{2})	S.A.M. STRESS (LB/IN.^{2})	OBE INERTIA STRESS (LB/IN.^{2})	THERMAL STRESS (LB/IN.^{2})	DEAD WEIGHT STRESS (LB/IN.^{2})	MAXIMUM PRIMARY AND SECONDARY STRESSES LB/IN.^{2})	TOTAL STRESS RATIO
6	1110	0	361	39	111	1621	0.0400
8	1110	0	2146	331	685	4272	0.1055
44	1110	0	998	179	1093	3380	0.0835
45	1110	0	2426	403	4198	8139	0.2009
54	1110	0	1473	789	2847	6219	0.1536
57B	1110	0	855	953	1043	3961	0.0979
57M	1110	0	838	970	926	3844	0.0949
57E	1110	0	817	970	896	3793	0.0937
58M	1110	0	824	972	884	3790	0.0936
58E	1110	0	827	993	806	3736	0.0922
62	1110	0	867	1912	635	4524	0.1117
63B	1110	0	1043	3253	602	6008	0.1483
63M	1110	0	990	3131	546	5777	0.1426
63E	1110	0	932	2997	487	5526	0.1364
65E	1110	0	639	928	562	3239	0.0800
70B	1110	0	851	483	832	3276	0.0809
70M	1110	0	816	571	792	3289	0.0812
70E	1110	0	726	809	671	3316	0.0819
73	1110	0	1924	4840	2253	10127	0.2500
75	1110	0	332	920	447	2809	0.0694



NOTES:

1. EXCEPT FOR TERMINAL ENDS, STRESS RATIOS LESS THAN 0.0800 ARE NOT SHOWN FOR CLARITY.
2. $1.2\ S_h + S_A = 40{,}500$ LB/IN.^{2}.
3. UNIT 2 SHOWN – UNIT 3 IS OPPOSITE HAND.

LEGEND:

☐ STRESS NODE POINT

SAN ONOFRE
NUCLEAR GENERATING STATION
Units 2 & 3

MAIN STEAM SYSTEM : LINE 1301-002-2
(SAFETY EQUIPMENT BUILDING)
LOCATION OF HIGHEST STRESS
NODE POINTS

Figure 3.6A-24

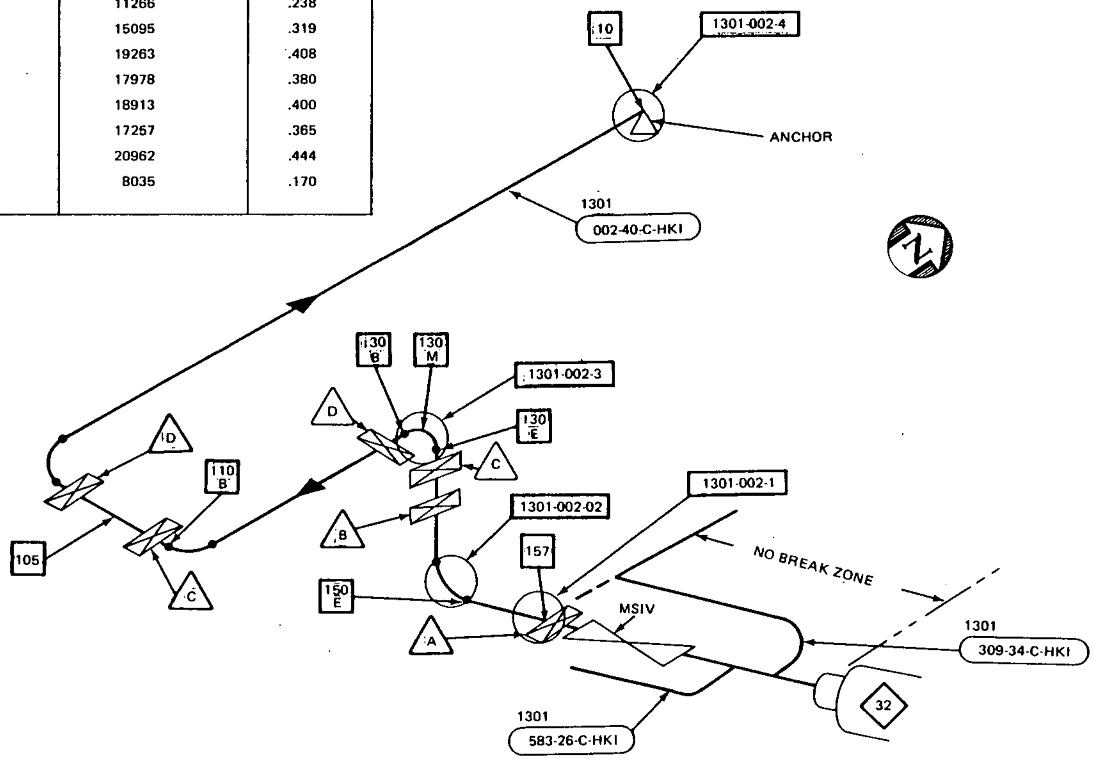
NODE	"A" LONGITUDINAL PRESS. STRESS	"B" SEISMIC ANCHOR MOVEMENT STRESS				"C" OBE INERTIA STRESS	"D" THERMAL STRESS	"E" DEAD WEIGHT STRESS	MAXIMUM PRIMARY PLUS SECONDARY "F" "A"&"B"&"C"&"D"&"E"	STRESS RATIO "F" 1.2 S_N & S_A
		X	Y	Z	S.R.S.S.					
10	6086				160	1547	2891	582	11266	.238
105	6086				2904	1096	4255	754	15095	.319
110B	6086				3368	1004	8612	193	19263	.408
130B	6086				4715	1284	5735	158	17978	.380
130M	6086				4925	849	6954	99	18913	.400
130E	6086				3369	456	7228	118	17257	.365
150E	6086				4403	1915	8399	159	20962	.444
157	6086				575	348	946	80	8035	.170

LEGEND:

- RESTRAINT
- POSTULATED BREAKPOINT
- STRESS NODE POINT

NOTES:

1. EXCEPT FOR TERMINAL ENDS, STRESS RATIOS LESS THAN 0.310 ARE NOT SHOWN FOR CLARITY.
2. $1.2\ S_n + S_A = 47{,}250\ LB/IN^2$.
3. UNIT 2 SHOWN — UNIT 3 IS OPPOSITE HAND.

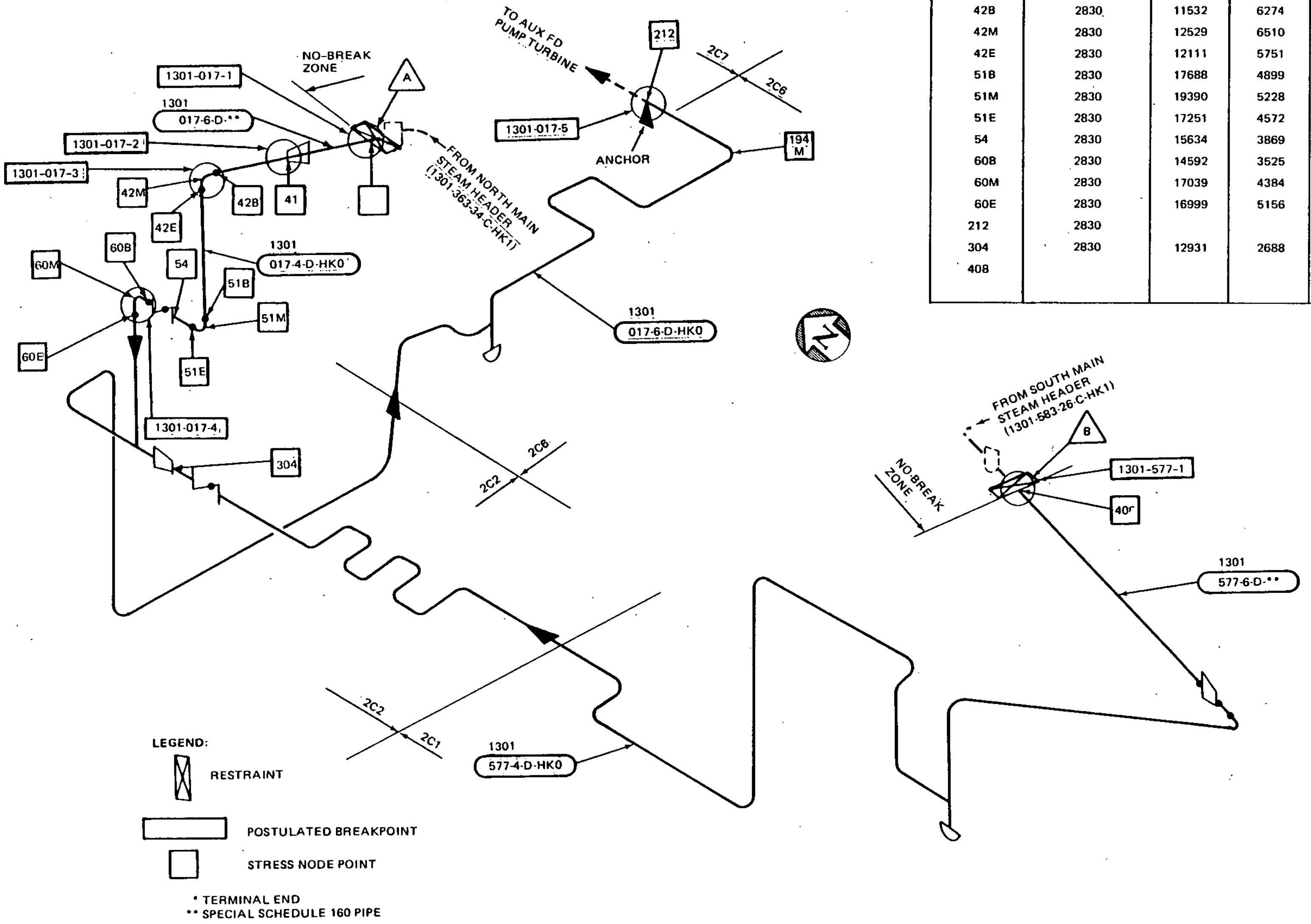


SAN ONOFRE NUCLEAR GENERATING STATION
Units 2 & 3

MAIN STEAM SYSTEM: LINE 1301-002-40 (SAFETY EQUIPMENT BUILDING) LOCATION OF HIGHEST STRESS NODE POINTS, POSTULATED BREAKPOINTS, AND RESTRAINTS.

Figure 3.6A-25

NODE	LONGITUDINAL PRESSURE STRESS (LB/IN.^{2})	SAM STRESS (LB/IN.^{2})	OBE INERTIA STRESS (LB/IN.^{2})	THERMAL STRESS (LB/IN.^{2})	DEAD WEIGHT STRESS (LB/IN.^{2})	MAXIMUM PRIMARY AND SECONDARY STRESSES (LB/IN.^{2})	TOTAL STRESS RATIO
38							T.E.*
41	2830	26290	2141	12854	1162	45277	1.118
42B	2830	11532	6274	12108	423	33167	0.819
42M	2830	12529	6510	11098	562	33526	0.828
42E	2830	12111	5751	9426	539	30657	0.757
51B	2830	17688	4899	3536	299	29252	0.722
51M	2830	19390	5228	3097	282	30827	0.761
51E	2830	17251	4572	3766	236	28656	0.708
54	2830	15634	3869	6668	467	29468	0.728
60B	2830	14592	3525	7970	618	29535	0.729
60M	2830	17039	4384	9673	663	34589	0.854
60E	2830	16999	5156	11768	674	37427	0.924
212	2830						T.E.*
304	2830	12931	2688	10629	1416	30494	0.753
408							T.E.*

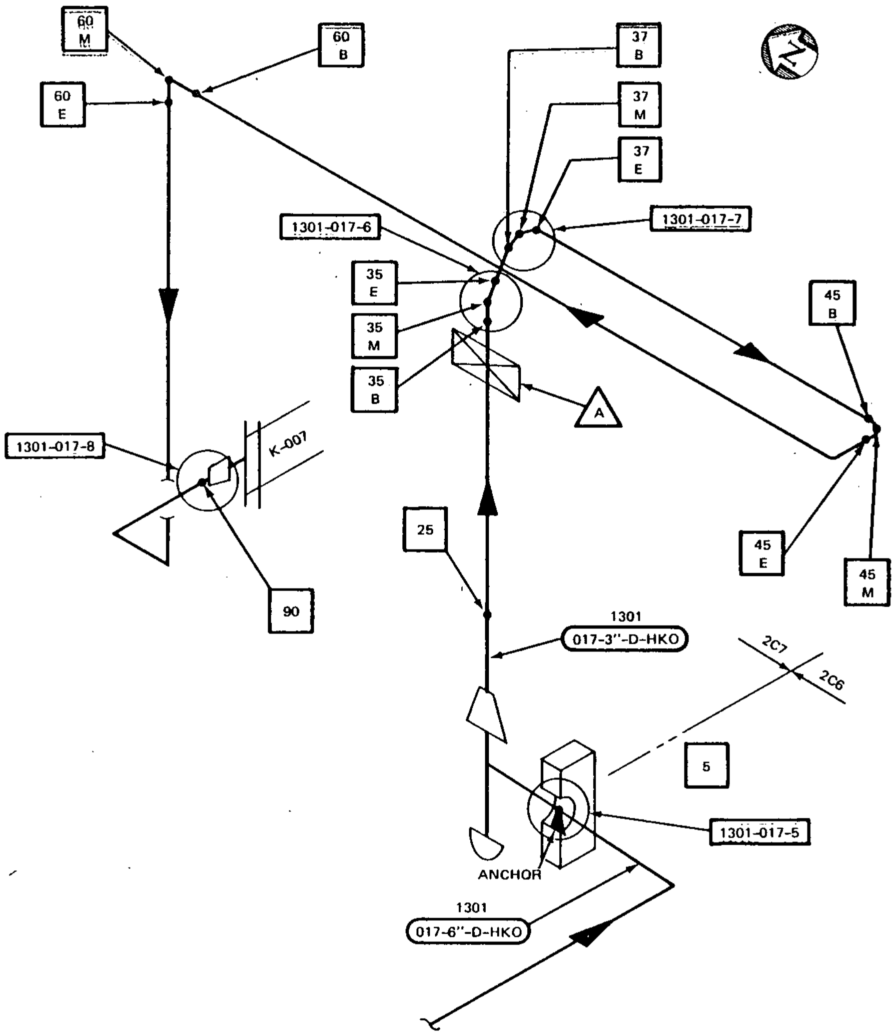


NOTES:
1. EXCEPT FOR TERMINAL ENDS, STRESS RATIOS LESS THAN 0.708 ARE NOT SHOWN FOR CLARITY.
2. $1.2\ S_h + S_A = 40{,}500$ LB/IN.^{2}
3. UNIT 2 SHOWN; UNIT 3 IS OPPOSITE HAND.

SAN ONOFRE NUCLEAR GENERATING STATION Units 2 & 3

MAIN STEAM SYSTEM: LINES 1301-017-6, 1301-017-4, 1301-577-6, AND 1301-577-4 (SAFETY EQUIPMENT BUILDING) LOCATION OF HIGHEST STRESS NODE POINTS, POSTULATED BREAKPOINTS, AND RESTRAINTS

Figure 3.6A-34



NODE	LONGITUDINAL PRESSURE STRESS (LB/IN.^{2})	S.A.M. STRESS (LB/IN.^{2})	OBE INERTIA STRESS (LB/IN.^{2})	THERMAL STRESS (LB/IN.^{2})	DEAD WEIGHT STRESS (LB/IN.^{2})	MAXIMUM PRIMARY AND SECONDARY STRESSES (LB/IN.^{2})	TOTAL STRESS RATIO
5	3365	NONE	849	3842	926	8982	0.2218
25	2376		1718	14458	199	18751	0.4630
35B	2376		1624	21352	127	25479	0.6291
35M	2376		1625	21955	129	26085	0.6441
35E	2376		1592	22231	130	26329	0.6501
37B	2376		1328	24625	130	28459	0.7027
37M	2376		1212	24399	119	28106	0.6940
37E	2376		1070	21409	90	24945	0.6159
45B	2376		570	9860	107	12913	0.3188
45M	2376		485	10725	85	13671	0.3376
45E	2376		382	10078	80	12916	0.3189
60B	2376		1126	19154	51	22707	0.5607
60M	2376		1161	20728	35	24300	0.6000
60E	2376		1201	20580	27	24184	0.5971
90	2376		753	1322	95	4546	0.1122

LEGEND:

RESTRAINT

POSTULATED BREAKPOINT

STRESS NODE POINT

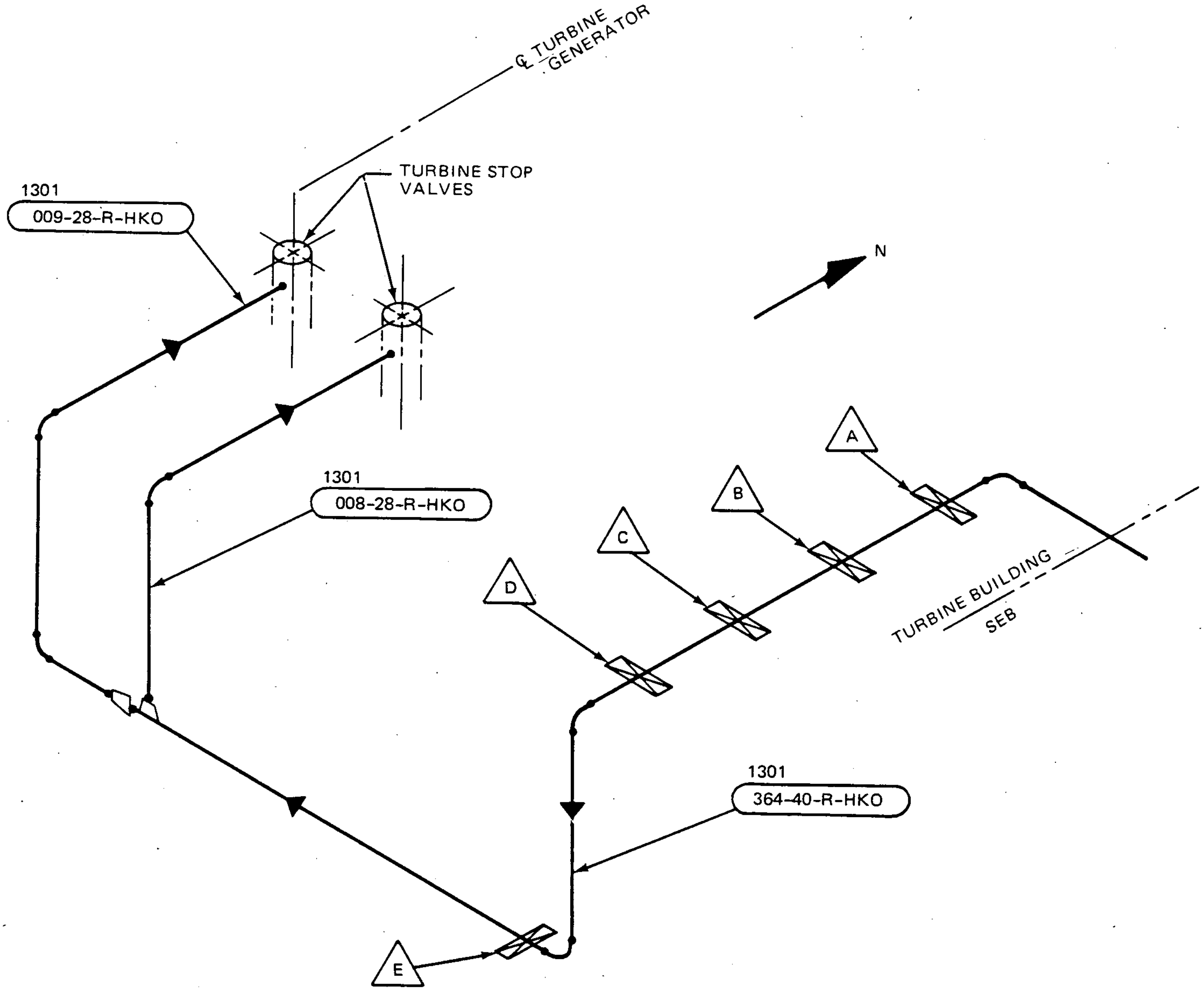
NOTES:

1. EXCEPT FOR TERMINAL ENDS, STRESS RATIOS LESS THAN 0.310 ARE NOT SHOWN FOR CLARITY.
2. $1.2\ S_n + S_A = 47{,}250$ LB/IN^2.
3. UNIT 2 SHOWN — UNIT 3 IS OPPOSITE HAND.

SAN ONOFRE
NUCLEAR GENERATING STATION
Units 2 & 3

MAIN STEAM SYSTEM: LINES 1301-017-6 AND 1301-017-3 (CONDENSATE STORAGE TANK BUILDING) LOCATION OF HIGHEST STRESS NODE POINTS, POSTULATED BREAKPOINTS, AND RESTRAINTS

Figure 3.6A-39A



LEGEND:

RESTRAINTS

WELDPOINTS

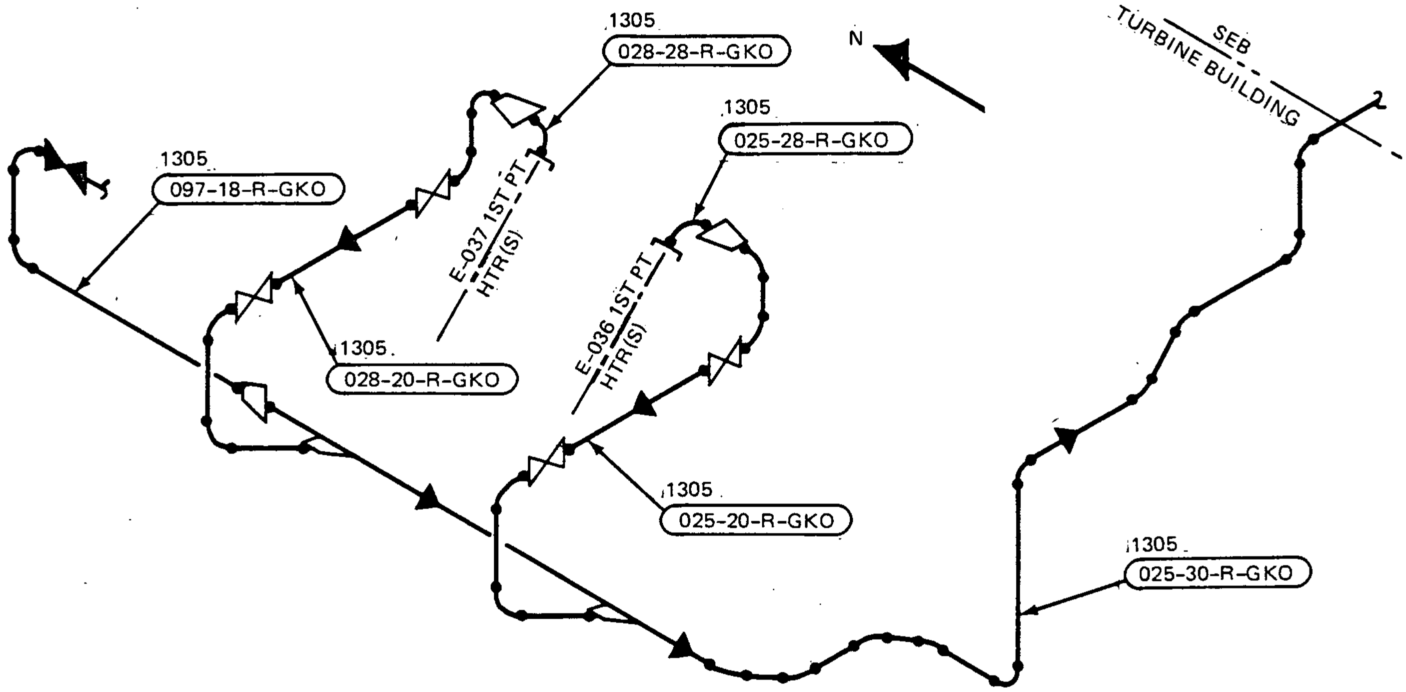
NOTES:

1. BREAKPOINTS POSTULATED AT TERMINAL ENDS AND AT EACH INTERMEDIATE FITTING, VALVE, OR WELDED ATTACHMENT.
2. UNIT 2 SHOWN. UNIT 3 IS OPPOSITE HAND.

SAN ONOFRE NUCLEAR GENERATING STATION Units 2 & 3

MAIN STEAM SYSTEM: LINES 1301-364-40, 1301-008-28 AND 1301-009-28 (TURBINE BUILDING) LOCATION OF POSTULATED BREAKPOINTS AND RESTRAINTS

Figure 3.6A-41



LEGEND:

● WELDPOINTS

NOTES:

1. BREAKPOINTS POSTULATED AT TERMINAL ENDS AND AT EACH INTERMEDIATE FITTING, VALVE, OR WELDED ATTACHMENT.
2. UNIT 2 SHOWN. UNIT 3 IS OPPOSITE HAND.
3. LINES 1305-025-30, 1305-025-28, 1305-025-20, 1305-028-28, 1305-028-20, AND 1305-097-18.

SAN ONOFRE NUCLEAR GENERATING STATION Units 2 & 3

MAIN FEEDWATER SYSTEM: LINES (SEE NOTE 3) (TURBINE BUILDING) LOCATION OF POSTULATED BREAKPOINTS

Figure 3.6A-42

5. SEB Audit

NRC STRUCTURAL AUDIT

Item

Supplementary response to Auxiliary Building Action Items from the NRC Structural Audit. This supplementary response also addresses the following items: Containment Structure, item 2; Fuel Handling Building, item 2; Safety Equipment Building, item 2; and Intake Structure, item 4.

Response

In response to the request of the NRC staff, exterior shear walls of all the Seismic Category I buildings have been analyzed for a torsion equivalent to a 5 percent eccentricity in addition to actual geometric eccentricity.

The torsional moment was generally calculated by applying the base shear response of the building at an eccentricity of 5% of the maximum play dimension of the building. An exception was made in the case of the Auxiliary Building where a torsional excitation corresponding to a 5% eccentricity was used as input to the three-dimensional model. Torsional response at the basemat level was obtained and distributed to the individual shear walls. This provides a more precise result than the conservative static approach used in the other buildings. The results of these evaluations are summarized in the attached table in terms of calculated and allowable loads for governing elements at the base of the structure.

GOVERNING ELEMENT LOADS FOR SEISMIC CATEGORY I STRUCTURES SUBJECT TO SEISMIC LOADING INCLUDING TORSIONAL EFFECTS (Sheet 1 of 2)

Structure/Element	Element Load or Stress (in-plane shear stress, unless noted)		
	DBE Original Analyses	DBE Including Torsion (5%)	Allowable
Containment Building			
Interior Structure			
S-E secondary shield wall	0.176 ksi	0.187 ksi	0.256 ksi
South secondary shield wall	0.147 ksi	0.163 ksi	0.256 ksi
Exterior Shell			
Tangential shear (1)	135 k/ft	142 k/ft	645 k/ft
Membrane Forces			
Hoop	235 k/ft	238 k/ft (2)	235 k/ft
Meridional	63 k/ft	65 k/ft	389 k/ft
Auxiliary Building (3)			
Control Area			
North wall	0.264 ksi	0.294 ksi	0.443 ksi
West wall	0.413 ksi	0.446 ksi	0.443 ksi 0.470 ksi (4)
Radwaste Area			
North wall	0.377 ksi	0.407 ksi	0.443 ksi
East wall	0.377 ksi	0.422 ksi	0.443 ksi
Safety Equipment Building			
North wall	0.191 ksi	0.233 ksi	0.408 ksi
South wall	0.145 ksi	0.168 ksi	0.369 ksi
West wall	0.149 ksi	0.170 ksi	0.269 ksi

GOVERNING ELEMENT LOADS FOR SEISMIC CATEGORY I STRUCTURES SUBJECT TO SEISMIC LOADING INCLUDING TORSIONAL EFFECTS (Sheet 2 of 2)

Structure/Element	Element Load or Stress (in-plane shear stress, unless noted)		
	DBE Original Analyses	DBE Including Torsion (5%)	Allowable
<u>Diesel Generator Building</u>			
North & South walls	0.110 ksi	0.124 ksi	0.464 ksi
West wall	0.197 ksi	0.215 ksi	0.464 ksi
<u>Fuel Handling Building</u>			
North wall	0.213 ksi	0.253 ksi	0.298 ksi
South wall	0.220 ksi	0.253 ksi	0.443 ksi
East wall	0.188 ksi	0.209 ksi	0.443 ksi
<u>Intake Structure</u>(5)			
East wall	-	V=36 k/ft	V=42 k/ft
	-	M=134 k-ft/ft	M=354 K-ft/ft
North & South walls	-	V=16 k/ft	V=104 k/ft
	-	M=383 k-ft/ft	M=1330 k-ft/ft
<u>Tank Building</u>	-	-	-

Notes:

(1) Tangential shear by itself does not govern, but it affects the hoop and meridional membrane forces which accordingly are also tabulated.

(2) Calculated stress is only 1% higher than the allowable value which was conservatively calculated by using a straight line interaction curve.

(3) Stresses tabulated under "original analyses" correspond to structural dynamic analysis revised to represent the as-built configuration of the building by deletion of the heavy concrete enclosure above the existing roof.

(4) The increased allowable strength is based on higher actual material strengths tested for concrete and reinforcing steel.

(5) Tabulated loads correspond to "out-of-plane" loading which is governing and results from lateral soil pressure at the outer corners of the structure.

(6) The Tank Building does not have lumped masses associated with elevated floors above loose mat, therefore there are no seismic lateral loads that would be aggravated by torsion.

19. ISI/PSI

SER OPEN ITEM NO. 19

ISI/PSI

SCE response to NRC question 121.36 described high energy lines subjected to augmented ISI. During meetings held the week of December 15, 1980, the NRC requested information relative to high energy lines excluded from augmented ISI.

SCE has reviewed the criteria for augmented inservice inspection and based on this review has found that the original response was correct.

Other high energy systems which were not identified in SCE's original response are the Charging, LPSI, HPSI and Letdown systems. The reasons for excluding them from augmented ISI are:

(A) Systems which only operate in an emergency are considered low use systems and are exempt from augmented ISI per BTP-APCSB 3-1. For this reason, the HPSI system was excluded from augmented ISI.

(B) LPSI, Charging and Letdown systems have been examined by the High Energy Line Break Analysis (HELBA) Program. This analysis indicated that breaks within these systems (i.e., lines between containment isolation valves) will have inconsequential effects on essential systems or components. SCE considers SRP Section 6.6 II.8 to be applicable only to high energy piping whose failure could produce deleterious effects to the plant. For this reason the LPSI, Charging and Letdown systems were excluded from augmented ISI.

20. Appendix G

Question 121.21

Data presented in Tables 5.2-5, 5.2-5A, 121.11-1 through 121.11-27, 121.12-1, and 121.12-2, either do not meet, or are not adequate to determine if the requirements of Appendix G, 10 CFR Part 50 are met. Therefore, to help demonstrate compliance with Appendix G, 10 CFR Part 50, supply the following:

(1) for the reactor vessel beltline materials, provide full Charpy V-notch curves, including data points, reported in impact energy and lateral expansion, both as a function of temperature;

(2) for welds and weld heat-affected-zones in the bletline region, provide fracture toughness data from either available data or additional tests. Include transition temperature data, upper shelf energy data, and the significant variables that affect fracture toughness properties, e.g., weld wire, flux, base metal combinations, and heat treatment. Correlate this information with data already presented in Tables 121.11-1 through 121.11-27, and provide analyses of the additional data to demonstrate compliance with all the fracture toughness requirements of Appendix G.

(3) for all reactor vessel beltline materials, define an initial reference temperature, RT_{NDT}, and the most limiting RT_{NDT}. Provide details of the method used to establish both values.

Response

(1) Beltline materials Charpy test resluts for Units 2 & 3 are shown on figures 121.21-1 through 121.21-12 respectively. The data points have been included. Tables 121.21-1 through 121.21-12 provide the data in tabular form corresponding to the figures. Revised FSAR figures 5.2-5 through 5.2-13, 5.2-17 through 5.2-26, 5.2-30, 5.2-31, 5.2-36, 5.2-38, and 5.2-47 show the Charpy test results.

For those materials which were not tested in accordance with 10CFR50, Appendix G, a conservative estimate of the RT_{NDT} temperature has been derived using the procedures outlined in MTEB Position 5.2, Fracture Toughness Requirements. For three plates in the San Onofre Unit 2 reactor vessel beltline, the difference between the requirements of 10CFR50, Appendix G, and what testing was performed was solely in the orientation of the Charpy specimens. Data was generated from 0 to 100% shear fracture and the method of MTEB 5.2, Paragraph B1.1(3)(b), was used to determine RT_{NDT}s. That is, for the temperature at which 50 ft-lbs and 35 mils lateral expansion was obtained (with longitudinally oriented specimens), 20F was added to this value to provide a conservative estimate of the temperature that would have been acquired if transversely oriented specimens were tested.

(2) The prescribed testing for weld materials in San Onofre Units 2 & 3 include drop weight testing and three Charpy tests at 10F. Additional testing on some of the same heats of weld wire and lots of flux used in San Onofre Units 2 & 3 has been done to qualify the material to later Code editions for use on other vessels. The best available information was previously provided in tables 121.11-1 through 121.11-22. Revised information, showing actual data for upper shelf energy is given in tables 121.21-13 through 121.21-21. Where not otherwise noted, the RT_{NDT} has been determined in accordance with 10CFR50, Appendix G, and the upper shelf energy reported is, as a minimum, the average of a group of tests where all specimens demonstrate 100% shear fracture.

Figures 121.21-13 and 121.21-14, 121.21-15 and 121.21-16, provide additional Charpy V-notch test results for the weld and HAZ materials of San Onofre Units 2 and 3, respectively.

The surveillance weldment for Unit 2 was fabricated using 3/16-inch diameter bare wire of Type Mil B-4, heat number 90130 with Linde Type 0091 flux, lot number 0842, the same heat of weld wire and lot of flux as used in the reactor pressure vessel. Heat treatment of the surveillance material is equivalent to the teat treatment accorded the reactor vessel.

The surveillance weldment for Unit 3 was fabricated using 3/16-inch diameter bare wire of Type Mil B-4, heat number 90069 with Linde flux type 124, lot number 0951, the same heat of weld wire and lot of flux as used in the reactor pressure vessel. Heat treatment of the surveillance material was equivalent to the heat treatment accorded the reactor pressure vessel.

(3) Initial RT_{NDT}'s for all beltline materials exclusive of HAZ were reported in FSAR tables 5.2-5, 5.2-5A, and additionally provided tables 121.11-1 through 121.11-22, 121.12-1, and 121.12-2. Unless otherwise specified by footnote, all values were established consistent with 10CFR50, Appendix G. RT_{NDT}'s for the surveillance HAZ and weld material are presented in table 121.21-22. These values were determined in accordance with 10CFR50, Appendix G.

The most limiting beltline region initial value of RT_{NDT} for San Onofre Unit 2 is from table 5.2-5 of the FSAR, for plate C-6404-3 where the RT_{NDT} = 18F. The most limiting beltline region initial value of RT_{NDT} for Unit 3 is that of the HAZ material tested in the baseline surveillance program where the RT_{NDT} = 74F, (table 121.21-22).

(4) During discussions with the NRC in December, 1980, it was understood
that additional fracture toughness data was required for the reactor
23 coolant system piping. Accordingly, FSAR tables 5.2-8, 5.2-8A,
5.2-8B, 5.2-8C, and 5.2-8D have been modified to include Charpy data
along with the fracture toughness information previously provided.

Reference

FSAR subsection 5.2.3; NRC Questions 121.11 and 121.12. FSAR figures 5.2-5 through 5.2-13, 5.2-17 through 5.2-26, 5.2-30, 5.2-31, 5.2-36, 5.2-38, and 5.2-47 have been revised. FSAR tables 5.2-8, 5.2-8A, 5.2-8B, 5.2-8C and 5.2-8D have also been revised. 23

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Table 5.2-8
SAN ONOFRE UNIT 2 - PIPING FRACTURE TOUGHNESS DATA (Sheet 1 of 5) 23

Piece Number	Drawing Number	Code Number	Material	Location	DW NDT (°F)	RT_{NDT} (°F)	Charpy Data - Transverse Specimens: CV 50 ft-lb Temp °F	Charpy Data - Transverse Specimens: 35 mils Lateral Expansion Temp °F
502-02A	E235-188	M-1409-3	SA516 Gr. 70	Pipe Segment	-10	+60[(a)]	120	70
502-02B	E235-188	M-1409-4	SA516 Gr. 70	Pipe Segment	-10	+60[(a)]	120	70
502-02A	E235-188	M-1409-1	SA516 Gr. 70	Pipe Segment	-10	+40[(a)]	100	70
502-02B	E235-188	M-1409-2	SA516 Gr. 70	Pipe Segment	-10	+40[(a)]	100	70
502-04A&B	E235-188	M-1410-1 to 3	SA516 Gr. 70	Pipe Segment	-10	+ 0[(a)]	60	50
502-04B	E235-188	M1401-8	SA516 Gr. 70	Pipe Segment	-10	0[(a)]	60	50
502-04A&B	E235-188	M-1410-4 to 7	SA516 Gr. 70	Pipe Segment	-10	+10[(a)]	70	50
502-06A	E235-189	M-1411-1	SA516 Gr. 70	Pipe Segment	-20	+40[(a)]	100	80

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a. ASME Section III Article NB-2330
b. ASME Section III Article NB-2332 (Lowest Service Temperature).

Table 5.2-8
SAN ONOFRE UNIT 2 - PIPING FRACTURE TOUGHNESS DATA (Sheet 2 of 5) 23

Piece Number	Drawing Number	Code Number	Material	Location	DW NDT (°F)	RT_{NDT} (°F)	Charpy Data - Transverse Specimens	
							CV 50 ft-lb Temp °F	35 mils Lateral Expansion Temp °F
502-08B	E235-189	M-1412-1	SA516 Gr. 70	Pipe Segment	-20	+40[a]	100	80
502-06B	E235-189	M-1411-2	SA516 Gr. 70	Pipe Segment	-10	+10[a]	70	50
502-08A	E235-189	M-1412-2	SA516 Gr. 70	Pipe Segment	-10	-10[a]	70	50
502-08B	E235-189	M-1412-3	SA516 Gr. 70	Pipe Segment	-10	+40[a]	100	80
502-08A	E235-189	M-1412-4	SA516 Gr. 70	Pipe Segment	-10	+40[a]	100	80
502-06B	E235-189	M-1411-3	SA516 Gr. 70	Pipe Segment	-10	+40[a]	100	90
502-06A	E235-189	M1411-4	SA516 Gr. 70	Pipe Segment	-10	+40[a]	100	90
502-10A&B	E235-188	M-1413-1	SA516 Gr. 70	Pipe Segment	-20	+40[a]	100	60
502-12A&B	E235-188	M-1414-1	SA516 Gr. 70	Pipe Segment	-20	+40[a]	100	90

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Table 5.2-8
SAN ONOFRE UNIT 2 - PIPING FRACTURE TOUGHNESS DATA (Sheet 3 of 5) 23

Piece Number	Drawing Number	Code Number	Material	Location	DW NDT (°F)	RT_{NDT} (°F)	Charpy Data - Transverse Specimens: CV 50 ft-lb Temp °F	Charpy Data - Transverse Specimens: 35 mils Lateral Expansion Temp °F
502-14A&B	E235-189	M-1415-1	SA516 Gr. 70	Pipe Segment	-10	+10[a]	70	50
502-16A&B	E235-188	M-1416-1	SA516 Gr. 70	Pipe Segment	-20	+10[a]	70	60
502-16A	E235-188	M-1416-2	SA516 Gr. 70	Pipe Segment	-10	+40[a]	100	70
502-20A&B	E235-188	M-1418-1	SA516 Gr. 70	Pipe Segment	+10	+40[a]	100	80
502-20A&B	E235-188	M-1418-2	SA516 Gr. 70	Pipe Segment	-20	+40[a]	100	60
502-18A&B	E235-189	M-1417-1	SA516 Gr. 70	Pipe Segment	-10	+40[a]	70	50

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Table 5.2-8
SAN ONOFRE UNIT 2 - PIPING FRACTURE TOUGHNESS DATA (Sheet 4 of 5)

Piece Number	Drawing Number	Code Number	Material	Location	DW NDTT (°F)	RT_{NDT} (°F)	Test Temp. (°F)	Energy (ft-lb)				Lateral Expansion (mils)			
								1	2	3	Avg	1	2	3	Avg
507-02	E-235-182	M-1424-1 and 2	SA182 Gr. F1	Charging inlet nozzle	-20	+40[(a)]	+80	51	65	70	62	49	58	65	57.3
508-2	E-235-183	M-1425-1	SA182 Gr. F1	Safety injection nozzle	0	0[(a)]	+60	100	120	106	108.6	68	82	71	73.6
508-02	E-235-183	M-1425-2	SA182 Gr. F1	Safety injection nozzle	0	0[(a)]	+60	93	85	80	86	69	72	60	63.6
508-02	E-235-183	M-1425-3	SA182 Gr. F1	Safety injection nozzle	0	0[(a)]	+60	82	95	83	86.6	56	67	62	61.6
508-02	E-235-183	M-1425-4	SA182 Gr. F1	Safety injection nozzle	0	0[(a)]	+60	62	66	67	65	56	59	58	57.6
507-07	E-235-182	M-1419-1	SA105 Cl 11	Surge nozzle	+20	+60[(a)]	+120	55	57	53	55	55	59	55	56.3

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Table 5.2-8
SAN ONOFRE UNIT 2 - PIPING FRACTURE TOUGHNESS DATA (Sheet 5 of 5) 23

Piece Number	Drawing Number	Code Number	Material	Location	Lowest Service Temp. Per NB-2332	Test Temp.	Energy Absorbed (ft-lb)				Lateral Expansion (mils)			
							S1	S2	S3	Avg.	S1	S2	S3	Avg.
506-02	E-235-181	M-1421-1 and 2	SA105 C1 2	Spray nozzle	+80	+80	49	41	43	44.3	46	41	44	43.6
506-06	E-235-181	M-1422-1 through	SA105 C1 2	Letdown drain or drain nozzle	+100	+100	37	38	35	36.6	45	45	45	45
506-10	E-235-181	M-1423-1	SA105	Drain nozzle	+100	+100	37	38	35	36.6	45	45	45	45

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Table 5.2-8A
SAN ONOFRE UNIT 3 PIPING FRACTURE TOUGHNESS DATA (PLATES)

Piece No.	Drawing Number	Code Number	Material	Location	RT_{NDT} (°F)[a]	DW NDTT (°F)	Charpy Data - Transverse Specimens: CV 50 ft. lb. Temp (°F)	Charpy Data - Transverse Specimens: 35 Mils Lat. Exp. Temp (°F)
502-02A&B	E 235-773-02	M1600-1&2	SA-516GR70	Straight Segment	+40	-30	100	70
502-02A&B	E 235-773-02	M1600-3&4	SA-516GR70	Straight Segment	+60	-40	120	20
502-04A&B	E 235-773-02	M1601-1,2&3	SA-516GR70	Straight Segment	+0	-20	60	40
502-04B	E 235-773-02	M1601-4	SA-516GR70	Straight Segment	+0	-20	60	40
502-04A&B	E 235-773-02	M1601-5&6	SA-516GR70	Straight Segment	+20	-20	80	40
502-04A&B	E 235-773-02	M1601-7&8	SA-516GR70	Straight Segment	+20	-20	80	40
502-06A	E 235-774-02	M1602-1	SA-516GR70	Straight Segment	+30	-20	90	50
502-08A	E 235-774-02	M1603-1	SA-516GR70	Straight Segment	+30	-20	90	50
502-06B	E 235-774-02	M1602-1&2	SA-516GR70	Straight Segment	+20	-10	80	50
502-08A	E 235-774-02	M1603-3	SA-516GR70	Straight Segment	+20	-10	80	50
502-06A	E 235-774-02	M1602-3	SA-516GR70	Straight Segment	+30	-30	90	50
502-08B	E 235-774-02	M1603-2	SA-516GR70	Straight Segment	+30	-30	90	50
502-06B	E 235-774-02	M1602-4	SA-516GR70	Straight Segment	+40	-30	100	30
502-08B	E 235-774-02	M1603-4	SA-516GR70	Straight Segment	+40	-30	100	30
502-10A&B	E 235-773-02	M1604-1	SA-516GR70	Elbow Segment	+10	-20	70	50
502-12A&B	E 235-773-02	M1605-1	SA-516GR70	Elbow Segment	+0	-40	60	30
502-14A&B	E 235-774-02	M1606-1	SA-516GR70	Elbow Segment	-10	-40	50	20
502-16A&B	E 235-773-02	M1607-1	SA-516GR70	Elbow Segment	+30	-40	90	30
502-16A&B	E 235-773-02	M1607-2	SA-516GR70	Elbow Segment	-30	-30	30	30
502-18A&B	E 235-774-02	M1608-1	SA-516GR70	Elbow Segment	-10	-40	50	20
502-20A&B	E 235-773-02	M1609-1	SA-516GR70	Elbow Segment	+20	-20	80	40
502-20A&B	E 235-773-02	M1609-2	SA-516GR70	Elbow Segment	+10	-30	70	40

a. ASME Code, Section III, Subsection NB-2331, Paragraph (a) 4.

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Table 5.2-8B
SAN ONOFRE UNIT 3 PIPING FRACTURE TOUGHNESS DATA (FORGINGS)

Piece Number	Drawing Number	Code Number	Material	Location	RT_{NDT} (°F)	DW NDT (°F)	Test Temp (°F)	Charpy Energy Absorbed S1	Charpy Energy Absorbed S2	Charpy Energy Absorbed S3	Charpy Energy Absorbed Avg	Mils Lateral Expansion S1	Mils Lateral Expansion S2	Mils Lateral Expansion S3	Mils Lateral Expansion Avg
507-07	E235-763	M-1613-1	SA541 CL1	Surge Nozzle	-10[a]	-10	50	52.0	50.0	58.0	53.3	54	51	49	51.3
509-02	E235-763	M-1614-1	SA541 CL1	Shutdown Cooling	-10[a]	-10	50	66.0	76.0	71.0	71.0	61	66	64	64.3
507-02	E235-763	M-1619-1,2	SA182 GRB1	Charging Inlet Nozzle	+00[a]	0	60	58.0	56.0	55.0	59.6	52	57	50	53.6
508-02	E235-764	M-1620-1,4	SA182 GRB1	Safety Injection Nozzle	+10[a]	10	70	70.0	65.0	93.0	76.6	50	46	68	54.0

Piece Number	Drawing Number	Code Number	Material	Location	Lowest Service Temp (°F)	Test Temp (°F)	Charpy Data Energy Absorbed S1	Charpy Data Energy Absorbed S2	Charpy Data Energy Absorbed S3	Charpy Data Energy Absorbed Avg	Charpy Data Mils Lateral Expansion S1	Charpy Data Mils Lateral Expansion S2	Charpy Data Mils Lateral Expansion S3	Charpy Data Mils Lateral Expansion Avg
508-06	E235-763	M-1611-1,4	SA105 C12	Letdown Drain and Drain Nozzle	+40	40	203.0	198.0	168.0	189.0	75	70	67	70.0
506-10	E235-763	M-1612-1	SA105 C12	Drain Nozzle	+40	40	203.0	198.0	168.0	189.0	76	70	67	70.6
506-02	E235-762	M-1610-1,2	SA105 C12	Spray Nozzle	+40	40	65.0	62.0	112.0	83.0	50	49	76	59.6

a. ASME Code Section III, Subsection NB2331, Paragraph (a) 1 through (a) 3.

b. ASME Code Section III, Subsection NB2332, "Lowest Service Temperature".

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Table 5.2-8C
SAN ONOFRE UNITS 2 AND 3 PIPE HAZ FRACTURE TOUGHNESS DATA 5

23

Detailed Weld Procedure No.	Weld Procedure Qualification Test No.	No. of Arcs	RT_{NDT} (a) (°F)	DW NDTT	Charpy Data - Transverse	
					Cv 50 Ft. lb. Temp. °F	35 Mils Lat. Exp. Temp. °F
SAAMA102-0	S-1.1-111	Single-arc	+10	10.0	70	70
MA-203-00	SM1.12-104	Single-arc	+0	0.0	60	60
MA-203-01	SM1.12-104	Single-arc	-50	-50.0	10	10
MA-101-00	SM1.1-135	Single-arc	-40	-40.0	20	20
MA-103-02	SM1.1-135	Single-arc	-40	-40.0	20	20
MA-107-03	SM1.1-135	Single-arc	-40	-40.0	20	20
MA-113-00	SM1.1-135	Single-arc	-40	-40.0	20	20
MA-115-01	SM1.1-135	Single-arc	-40	-40.0	20	20

a. ASME Code, Section III, Subsection NB2331, Paragraphs (a) 1 through (a) 3.

Table 5.2-8D
SAN ONOFRE UNITS 2 AND 3 PIPE WELD FRACTURE TOUGHNESS DATA 5

Weld Procedure Test No.	Material	Code Number	Material Joined	RT_{NDT} (a) (°F)	DW NDT (°F)	Charpy Data - Transverse	
						Cv 50 ft. lb. Temp °F	35 Mils. Lat. Exp. Temp °F
SM1.12-103	Himangmoly	0344	A516 GR70 - to - A533 GPB G11	-40	-40.0	20	20
SM1.12-103	Himangmoly	0351	A516 GR70 - to - A533 GRB C13	+0	-30.0	60	50
SM1.12-104	Himangmoly	0351	A516 GR70 - to - A533 GRB C11	-20	-20.0	40	40
SM1.12-103	Himangmoly	0351	A516 GR70 - to - A533 GRB C11	-10	-20.0	50	50
MA-11-A(6)	SFA-5.1	CABHD	A516 GR70 - to - A516 GR 70	-50	-50.0	10	10
S-1.1-133	SFA-5.1	JAODD	A516 GR70 - to - A516 GR 70	-40	-40.0	20	20
S-1.1-133	SFA-5.1	CAAEE	A516 GR70 - to - A516 GR 70	-30	-30.0	10	10
S-1.1-133	SFA-5.1	HAAEE	A516 GR70 - to - A516 GR 70	-20	-20.0	40	40
MA-11-A(6)	SFA-5.1	LABHC	A516 GR70 - to - A516 GR 70	-50	-50.0	10	10
S-1.1-133	SFA-5.1	AAAFD	A516 GR70 - to - A516 GR 70	-40	-40.0	10	10
S-1.1-133	SFA-5.1	JAOAE	A516 GR70 - to - A516 GR 70	-50	-50.0	10	10
S-1.1-133	SFA-5.1	LAAIE	A516 GR70 - to - A516 GR 70	-60	-60.0	0	0
S-1.1-111	-MILB4E7016	-	A516 GR70 - to - A516 GR 70	-40	-60.0	20	20
SH1.12-104	SFA-5.1	-	A516 GR70 - to - A533 GRBU1	-40	-40.0	20	20
SM1.1-135	SFA-5.1	-	A516 GR70 - to - A516 GR70	-40	-40.0	20	20
SM1.1-153	F-7018	-	A516 GR70 - to - A516 GR70	-40	-40.0	20	20
SM1.1-133	SFA-5.1	-	A516 GR70 - to - A516 GR70	-50	-50.0	10	10

23

a. ASME Code, Section III, Subsection NB2331, Paragraphs (a) through (a) 3.

Table 5.2-9
SAN ONOFRE UNITS 2&3 REACTOR COOLANT PUMP MATERIALS FRACTURE TOUGHNESS DATA
DRAWING NUMBER 509790, MATERIAL - SA 105 Cl 2

Heat Number	Location	Test Temp (^oF)	RT_{NDT}(a)	Charpy ft-lb @ 0^o Position				Charpy ft-lb @ 180^o Position				Mils Lat. Exp. @ 0^o Position				Mil Lat. Exp. @ 180^o Position			
				1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
215315	Lower Driver Mount Flange Unit 2	10	30	38	48	38	41.3	--	--	--	---	35	37	33	35	--	--	--	--
9857	Lower Driver Mount Flange Unit 3	70	90	37	44	44	41.6	38	23	22	27.6	36	40	35	37	33	22	19	24.6
		70		52	34	46	44	33	34	64	43.6	41	36	39	38.6	31	44	52	42.3

(a) MTEB 5-2, Section 1.1, Paragraph 4

15

24. RCP Flywheel Integrity

Question 121.43

As required by Paragraph C.1.c of Safety Guide 14, demonstrate that the minimum fracture toughness of the flywheel plate material, ASTM 543, Grade I, Type B, is equivalent to a dynamic stress intensity factor (K_{IC} dynamic) of at least 100 ksi $\sqrt{in}$ at the normal operating temperature of the flywheel by either 1) justifying that the normal operating temperature is 212°F (Table 121.26-1) or 2) that the material has greater than 50 ft-lbs absorbed energy at the normal operating temperature.

Response

The temperature of 212F for the Charpy impact testing was chosen to insure that the upper energy shelf of the material was attained. This was performed to satisfy the criteria specified by Paragraph C.1.b of Safety Guide 14. It is noted that the normal operating temperature of the flywheel is 120F; however, Safety Guide 14, Paragraph C.1.b specifically states that the Charpy impact testing be performed at the upper energy shelf of the material and not at its normal operating temperature.

The minimum fracture toughness of the flywheel plate material was demonstrated to be equivalent to a dynamic stress intensity factor (K_{IC} dynamic) of at least 100 ksi $\sqrt{in}$ by satisfying the requirements of Paragraph C.1.c (3) of Safety Guide 14.

The lower bound fracture toughness curve (figure 121.43-1) is based on static fracture toughness data[1] for A-543 Grade B Class 1 material and dynamic fracture toughness data[2] for HY80, a material very similar to A-543. Dynamic fracture toughness data for A-543 is not available in the literature. The reported mechanical and chemical composition of A-543 and HY80 are tabulated in table 121.43-1.

In accordance with paragraph C.1.C(3) of Regulatory Guide 1.14, Rev. 0, the lower bound curve shown in figure 121.43-1 has been translated along the temperature coordinate until a K_{IC} value of 45 ksi $\sqrt{in}$ is indicated at an NDT temperature of -100F. The -100F is the highest NDT temperature obtained from drop weight tests for actual flywheels as reported in response to NRC Question 121.26. The translated curve shows that 100 ksi $\sqrt{in}$ occurs at approximately 0F. 23

References

No FSAR changes were made. NRC Question 121.26 Response.

1. E. Landerman and S. E. Yanichko, "Determination of Fracture Toughness of Heavy-Section Pressure Vessel Steels Using A Fracture Mechanics Approach," Welding Research Council Bulletin No. 120, February 1967, p. 16.

2. A. K. Shoemaker and S. T. Rolfe, "The Static and Dynamic Low Temperature Crack Toughness Performance of Seven Structural Steels," Engineering Fracture Mechanics 2, 319 (1971).

Table 121.43-1

MECHANICAL PROPERTIES AND CHEMICAL COMPOSITION
OF A543 GRADE B CLASS 1 AND HY80 STEEL.

	A543 Gr. B Cl. 1	HY80
Tensile Strength, ksi	103.4	99.0
Yield Strength @0.2%, ksi	86.3	84.0
Elongation, %	28.0	25.0
Reduction of Area, %	68.9	74.9
NDT Temperature, °F	-110	-120
23 Carbon	0.15	0.16
Manganese	0.32	0.28
Phosphorus	0.013	0.011
Sulfur	0.020	0.016
Silicon	0.28	0.22
Nickel	3.55	2.26
Chromium	1.85	1.46
Molybdenum	0.50	0.30
Copper	0.06	--
Aluminum	<0.004	0.016
Vanadium	--	0.005
Titanium	--	0.005

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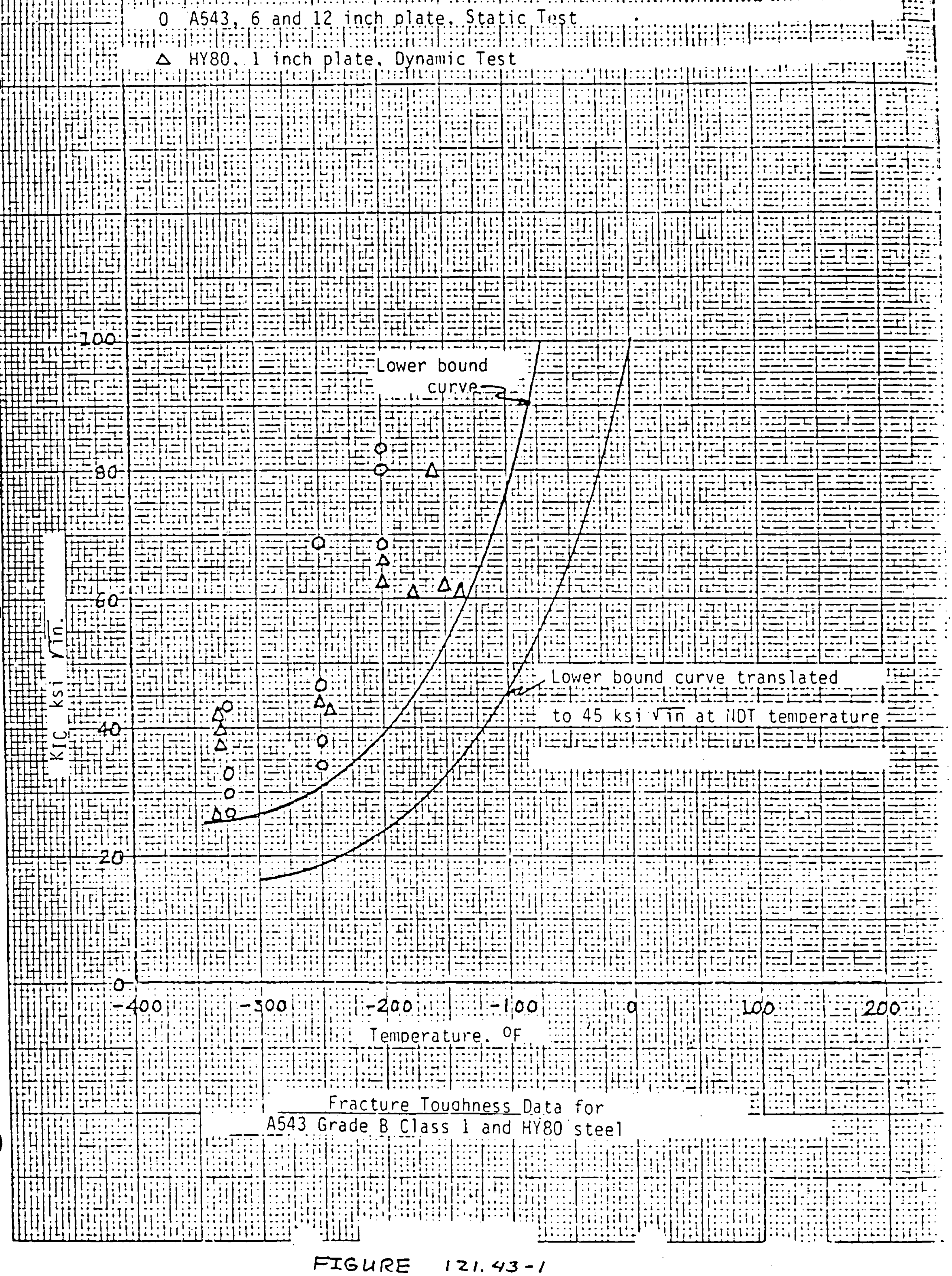


Fracture Toughness Data for A543 Grade B Class 1 and HY80 steel

FIGURE 121.43-1

29. Sump Vortex Test

Question 212.160

During our reviews of license applications we have identified concerns related to the containment sump design and its effect on long term cooling following a Loss of Coolant Accident (LOCA).

These concerns are related to (1) creation of debris which could potentially block the sump screens and flow passages in the ECCS and the core, (2) inadequate NPSH of the pumps taking suction from the containment sump, (3) air entrainment from streams of water or steam which can cause loss of adequate NPSH, (4) formation of vortices which can cause loss of adequte NPSH, air entrainment and suction of floating debris into the ECCS and (5) inadequate emergency procedures and operator training to enable a correct response to these problems. Preoperational recirculation tests performed by utilities have consistently identified the need for plant modifications.

The NRC has begun a generic program to resolve this issue. However, more immediate actions are required to assure greater reliability of safety system operation. We therefore require you take the following actions to provide additional assurance that long term cooling of the reactor core can be achieved and maintained following a postulated LOCA.

a. Establish a procedure to perform an inspection of the containment, and the containment sump area in particular, to identify any materials which have the potential for becoming debris capable of blocking the containment sump when required for recirculation of coolant water. Typically, these materials consist of: plastic bags, step-off pads, health physics instrumentation, welding equipment, scaffolding, metal chips and screws, portable inspection lights, unsecured wood, construction materials and tools as well as other miscellaneous loose equipment. "As licensed" cleanliness should be assured prior to each startup.

   This inspection shall be performed at the end of each shutdown as soon as practical before containment isolation.

b. Institute an inspection program according to the requirements of Regulatory Guide 1.82, item 14. This item addresses inspection of the containment sump components including screens and intake structures.

c. Develop and implement procedures for the operator which address both a possible vortexing problem (with consequent pump cavitation) and sump blockage due to debris. These procedures should address all likely scenarios and should list all instrumentation available to the operator (and its location) to aid in detecting problems which may arise, indications the operator should look for, and operator actions to mitigate these problems.

d. Pipe breaks, drain flow and channeling of spray flow released below or impinging on the containment water surface in the area of the sump can cause a variety of problems; for example, air entrainment, cavitation and vortex formation.

   Describe any changes you plan to make to reduce vortical flow in the neighborhood of the sump. Ideally, flow should approach uniformly from all directions.

e. Evaluate the extent to which the containment sump(s) in your plant meet the requirements for each of the items previously identified; namely debris, inadequate NPSH, air entrainment, vortex formation, and operator actions.

The following additional guidance is provided for performing this evaluation.

(1) Refer to the recommendations in Regulatory Guide 1.82 (Section C) which may be of assistance in performing this evaluation.

(2) Provide a drawing showing the location of the drain sump relative to the containment sumps.

(3) Provide the following information with your evaluation of debris:

(a) Provide the size of openings in the fine screens and compare this with the minimum dimensions in the pumps which take suction from the sump (or torus), the minimum dimension in any spray nozzles and in the fuel assemblies in the reactor core or any other line in the recirculation flow path whose size is comparable to or smaller than the sump screen mesh size in order to show that no flow blockage will occur at any point past the screen.

(b) Estimate the extent to which debris could block the trash rack or screens (50 percent limit). If a blockage problem is identified, describe the corrective actions you plan to take (replace insulation, enlarge cages, etc.).

(c) For each type of thermal insulation used in the containment, provide the following information:

(i) type of material including composition and density,

(ii) manufacturer and brand name,

(iii) method of attachment,

(iv) location and quantity in containment of each type,

(v) an estimate of the tendency of each type to form particles small enough to pass through the fine screen in the suction lines.

(d) Estimate what the effect of these insulation particles would be on the operability and performance of all pumps used for recirculation cooling. Address effects on pump seals and bearings.

23

Response

a. The concerns expressed by the NRC regarding potential containment emergency sump blockage due to the inadvertant presence of debris are addressed by SCE's commitment to comply with the cleanliness and housekeeping guidelines of Regulatory Guide 1.39 as described in subsection 3A.1.39 of the FSAR. Plant maintenance procedures ensure that "as licensed" cleanliness is restored prior to each startup.

b. As stated in FSAR subsection 3A.1.82 and table 3A-2, SCE is consistent with the recommendations of Item 14 of Regulatory Guide 1.82.

c. As discussed with the NRC During meetings of the week of December 15, 1980, SCE will provide individuals on the Technical Support Center staff with appropriate training to identify and mitigate possible problems resulting from emergency sump vortexing. These individuals will have the responsibility of verifying system operation when in the recirculation mode and are in direct communication with the control room operators should mitigating action be necessary. The training will include familiarization with the sump testing and report, with NPSH requirements, and with instrument indications that might be associated with sump vortexing. 23

d. Pipe break events in the vicinity of the emergency sump are postulated in accordance with the HELBA criteria presented in FSAR Chapter 3.6. The only pipe break events that are local to the emergency sump are in the shutdown cooling line. The results of the high energy line break analysis are presented in figures 212.160-1 and 212.160-2. By review of these figures it can be seen that jet impingement on the sump structure does not occur. The effect of jet impingement on the water surface is not a concern since the RCS will be depressurized prior to the initiation of recirculation.

The location of the containment drain sump is shown in figure 212.160-3. A review of this figure demonstrates that the drain sump is physically remote from the emergency sump, thus precluding vortex formation near the emergency sump due to drain flow. There are also no floor drains in the vicinity of the containment emergency sump.

The impingement by spray flow on the containment water surface is prevented by the concrete floors located above the emergency sump at elevations 30'0" and 45'0". Comparison of the grated portions of these floors, as shown in figures 212.160-4, 5, and 6, indicates that direct impingement from the containment sprays is not possible. Because a large fraction of the floor at elevation 30'0" consists of grating, significant buildup of spray flow will not occur, thus precluding spray channeling problems. There is no curbing in the vicinity of the sump which could cause channeling of the spray flow.

e. The containment emergency sumps have been designed in accordance with the criteria presented in Regulatory Guide 1.82. The locations of the emergency sumps and the drain sump are provided in figure 212.160-3.

The sump suction piping in each emergency sump is surrounded by a screen structure to prevent debris from entering the pumps. These screen structures have a mesh sizing of 0.090 inch, based on the minimum core channel opening through which the safety injection system must pump. This also ensures that the performance of the containment spray system will not be impaired since the spray pumps and nozzles are capable of passing particles of up to 0.25 inches (reference FSAR paragraph 6.2.2.1.2.5).

Significant blockage of the trash rack is precluded by insulation design. The encapsulated insulation and the reflective insulation used inside the secondary shield wall are installed in preformed plates ranging in size from 1 foot by 1 foot to 3 feet by 6 feet. These plates are designed to sink to the containment floor should they become removed from the piping. A 1:1 scale model test of the emergency sump and trash rack has indicated that the minimum required recirculation flow could be maintained with as much as 90% blockage of the trash rack (reference 1).

23 Thermal insulation used inside containment consists primarily of metallic reflective insulation for primary system components and encapsulated non-metallic insulation for secondary system components. The composition, method of attachment, location, and quantity of each type of insulation is provided in FSAR paragraph 6.2.2.1.2.6. The reflective insulation does not contain material which could form particles small enough to pass through the fine screens in the suction lines. The encapsulated insulation is designed to insure that the non-metallic insulation remains inside the stainless steel jacket following an accident.

Reference

See FSAR section 3.6 and paragraphs 6.2.2.1.2.5 and 6.2.2.1.2.6, and Regulatory Guide 1.82. No FSAR change was made.

(1) "Final Report on Hydraulic Model Studies of Containment Emergency Sump Recirculation Intakes", Western Canada Hydraulic Laboratories Ltd.

Question 212.161

As the result of our review of your response to our question 212.127 and the "Final Report on Hydraulic Model Studies of Containment Emergency Sump Recirculation Intakes" for SONGS 2&3, we have the following specific questions:

a. What is the influence of north sump operation on south sump performance? Flow straightening by trash racks does not resolve concerns associated with resultant flow stratification.

b. Are there any high pressure pipes in the vicinity of the sumps; if so, how is jet impingement accommodated by the sump design?

c. Are there any drain holes in the ceiling in the vicinity of the sumps; if so, how was the potential for air entrainment accommodated in the design?

d. Address the influence of flow path "C" on the north sump; why isn't the north sump modeled when a failure of pumps in the south sump could lead to counterclockwise rotational patterns from paths B, C and D in the north sump? If this is because of symmetry, show that the tests envelop rotational velocities.

e. Section 5.2 of the sump pump test report indicates that the NPSH required for the spray pump is 24.0 ft. The data you provided in response to our question 212.133 show that the NPSH required for the spray pump is 13.0 ft. Clarify the discrepancy and confirm that all HPSI pumps and spray pumps have sufficient margin in NPSH during the recirculation mode.

Response

a. Operation of the north sump will not have a detrimental effect on the performance of the south sump. The tests performed on the 1:1 scale model of the sump imposed flow and blockage conditions which were more conducive to vortex formation and high intake losses than any of the effects which could result from simultaneous operation of the adjacent sump. The tests have shown that the trash rack will remove flow angularity, swirls, and circulation generated by the adjacent sump or any other components (Reference 1).

b. High energy pipe break effects in the vicinity of the sumps are addressed in the response to NRC Question 212.160. 23

c. All drains in the ceiling above the sumps are piped to the central drain system, which is piped to the containment drain sump. This design prevents drain flow effects on the containment water surface. The effects of grating in the ceiling above the sump are addressed in the response to NRC Question 212.160. There are no containment basement floor drains in the vicinity of the containment emergency sump.

d. Rotational flow patterns established outside the trash racks will not have a detrimental effect on sump flow. The tests on the 1:1 scale model have shown that the trash racks will remove any flow angularity or circulation.

e. The value of 24.0 ft. previously reported as the containment spray pump NPSH is the maximum allowable value. As-built tests of the spray pumps indicate a required NPSH of 13.0 ft., significantly below the maximum value of 24.0 ft. Pump characteristic curves for the containment spray pumps are presented in FSAR figure 6.2-39. The response to NRC Question 212.133 provides the correct NPSH margins and demonstrates
23 that adequate NPSH is available for all ECCS pumps.

Reference

See responses to NRC Questions 212.133 and 212.160, and FSAR figure 6.2-39. No FSAR change was made.

(1) "Final Report on Hydraulic Model Studies of Containment Emergency Sump Recirculation Intakes", Western Canada Hydraulic Laboratories Ltd., Jan, 1979.

31. Qualification of Containment Penetrations

Question 040.51

Provide a description of the physical arrangement utilitized in your design to connect the field cables inside containment to the containment penetrations, e.g., connectors, splices, or terminal blocks. Provide supportive documentation that these physical interfaces are qualified to withstand a LOCA or steam line break environment.

Response

The field cables inside the containment are connected to the containment electrical penetration assemblies, utilizing electrical connector assemblies, terminal blocks and splices. The connections are made inside the electrical penetration assembly termination boxes.

Westinghouse, the supplier of the electrical penetration assemblies, has
19 qualified the electrical connector assemblies used for Class 1E service to
the LOCA and MSLB environment, to satisfy the electrical connector assem-
13 blies' operability requirements. The qualification environment is
described in FSAR section 3.11. Supportive documentation for the quali-
23 fication is included in revised FSAR table 3.11A-1.

The splices used for Class 1E service inside the containment electrical
penetration assembly termination boxes are made up of termination lugs
and Raychem Thermofit Type WCSF-N and MCK-N heat-shrinkable sleeves. The
23 termination lugs and Type WCSF-N and MCK-N heat-shrinkable sleeves are
qualified to withstand a LOCA or MSLB environment. The qualification
environment is described in FSAR section 3.11. The supportive documenta-
tion for the qualification is included in revised FSAR table 3.11A-1.

23

Reference

FSAR section 3.11. See revised FSAR table 3.11A-1.

Table 3.11A-1
RESULTS OF NON-NSSS EQUIPMENT ENVIRONMENTAL TESTS/ANALYSES (Sheet 2 of 2)

Equipment	Manufacturer (Model No.)	Qualification Method (Type Test, Operating Experience, Analysis, Combined Qualification, On-going Qualification)	Aging Simulation	Temperature Profile	Pressure Profile	Humidity (%)	Chemical Spray (pH)	Radiation Exposure (rads)	Summary of Results
Cable and wire connectors	AMP Inc. (AMP Power, PIDG, or Solistrand)	Type Test	120 hours at 163C	0-4s 280F 4s - 6 min. 24s 350F 6 min. 24s - 3h 352F 3h - 3h 21 min. 323F 3h 21 min. - 6h 323F 6h - 6h 54 min. 253F 6h 54 min. - 96h 253F	0-4s 80 lb/in.^{2}g 4s - 6 min. 24s 122 lb/in.^{2}g 6 min. 24s - 3h 121 lb/in.^{2}g 3h - 3h 21 min. 77 lb/in.^{2}g 3h 21 min. - 6h 77 lb/in.^{2}g 6h - 6h 54 min. 14 lb/in.^{2}g 6h 54 min. - 96h 14 lb/in.^{2}g	100	9 for 4 days	$2x10^8$	AMP test reports ELR-186-10/S-174, GPR 575-98, and GPR-575-99 document that equipment is qualified for intended service.
Hydrogen Recombiner	Westinghouse (N/A)	Type Test	80 normal recombiner heatup and cooldown cycles followed by 6 post-LOCA steam pressure, temperature, and spray transients	0-4h - Saturation for 85 lb/in.^{2}a 4-24h - Saturation for 35 lb/in.^{2}a 1-22 days varies between 138F and 200F	0-4h 85 lb/in.^{2}a 4-24h 35 lb/in.^{2}a 1-22 days 20 lb/in.^{2}a	100	10 for 25h	$2x10^8$	Westinghouse report No. WCAP-7709-L documents that equipment is qualified for intended SONGS 2&3 service.
Heat-shrinkable insulation	Raychem (WCSF)	Type Test	7 days at 150C	0-10h 351F 10h-4d22h 275F 4d22h-30d22h 212F	0-10h 70 lb/in.^{2}g 10h-4d22h 31 lb/in.^{2}g 4d22h-30d22h 10 lb/in.^{2}g	100	9.5 for 9 days	$2x10^8$	Franklin Institute report F-C4033-3 documents that equipment is qualified for intended SONGS 2&3 service.
Electrical Connector Assemblies	Westinghouse Electric Corp. (Amphenol "N" type)	Type Test	100 Hours at 134C	0.2h 268F 0.3h 308F 0.7-2.8h 312F 3.0h 255F 4.0-27.h 250F	0.0h Ambient 0.2h 26 lb/in.^{2}g 0.3h 60 lb/in.^{2}g 0.7-1.0h 65 lb/in.^{2}g 2.0-2.8h 68 lb/in.^{2}g 3.0h 18 lb/in.^{2}g 4.0-27.h 15 lb/in.^{2}g	100	>9.5	$2.2x10^8$	Westinghouse test report No. PEN-TR-79-29 documents that equipment is qualified for intended SONGS 2&3 service.
Heat Shrinkable Connection Kits	Raychem (MCK-N)	Type Test	1500 Hours 150C	0-4 min. 390F 4 min. - 12 min. 370F 12 min. - 32.2h 314F 32.2 - 56.2h 298F 56.2 - 80.2h 285F 80.2 - 152.2h 272F 152.2 - 200.2h 250F 200.2 - 248.2h 240F 248.2 - 382.2h 230F 382.2 - 720h 210F	0 - 32.2h 66 lb/in.^{2}g 32.2 - 56.2h 47 lb/in.^{2}g 56.2 - 80.2h 39 lb/in.^{2}g 80.2 - 152.2h 27 lb/in.^{2}g 152.2 - 200.2h 15 lb/in.^{2}g 200.2 - 248.2h 10 lb/in.^{2}g 248.2 - 382.2h 6 lb/in.^{2}g 382.2 - 720h 0 lb/in.^{2}g	100	10.5 for 30 days	$2.0-2.9x10^8$	Raychem test report No. QP-S023 documents that equipment is qualified for intended SONGS 2&3 Service

32. Cask Drop

Question 010.69

The FSAR does not contain sufficient information to demonstrate that a spent fuel cask drop accident caused by a failure of the cask handling system cannot result in unacceptable conditions because of damages to the spent fuel or excessive spent fuel pool water loss. Utilizing the guidelines in NUREG-0612 "Control of Heavy Loads at Nuclear Power Plants" July, 1980, including the analysis methodology in Appendix A, provide the results of an analysis that, along with detailed drawings and sketches as necessary, demonstrates either that such an accident is very unlikely or that the consequences are within allowable limits.

Response

An analysis of potential spent fuel cask drop accidents was performed consistent with the guidelines of NUREG-0612. The results of this analysis are discussed in revised FSAR paragraph 9.1.4.3 and revised FSAR figure 9.1-16.

23

Reference

Revised FSAR paragraph 9.1.4.3 and revised FSAR figure 9.116.

Dry sipping of fuel assemblies can be conducted, if required, during normal fuel handling operations. A removable control console is installed on the refueling machine with connections to a nitrogen gas supply, the fuel hoist, and the facility waste gas system. Fuel is raised into the hoist box in the normal manner and the water displaced by applying a pressurized nitrogen gas at the top of the sealed hoist box. When the box is allowed to refill, this gas is passed through a scintillation counter and the gas evacuated to the waste system. The console contains the necessary controls for gas flow and for recording of gas activity levels. Once the hoist box is reflooded, the fuel assembly is discharged in the normal manner.

At the completion of the refueling operation, the transfer valve is manually closed. The upper guide structure is reinserted in the vessel and the in-core instrumentation placed in position. The drive shaft extensions are reconnected to the CEAs. The water in the refueling pool is lowered, using one of the low-pressure safety injection pumps. The head is then lowered until the drive shaft extensions enter the control element drive mechanisms. Lowering of the head is continued until it is seated. Then the studs are installed and the head is bolted down, and the transfer tube blind flange installed. The refueling pool seal between the reactor vessel flange and the pool is removed. CEDM and in-core instrument cabling is reconnected. The cooling ducts are reconnected to the shroud, the vessel vent piping installed, and the missile shield placed in position.

9.1.4.3 Safety Evaluation

9.1.4.3.1 Containment Polar and Cask Handling Cranes

The containment polar crane and cask handling crane, including all supports, are designed as Seismic Category I systems and equipment, as described in table 3.2-1. As such, a complete analysis is made for the operating basis and design basis earthquakes to ensure complete stability under loaded and unloaded conditions. Where analytical means do not give positive assurance 17
that the crane or any part of it will not fall off the rails, the stability of the crane components is ensured by a system of restraining devices that remain effective during crane operating motion. The containment polar crane support consists of embedded brackets adequately anchored to the containment wall to safely resist the eccentric loads induced by the crane rail loads. The cask handling crane is restrained by upkick lugs which engage the trolley and the bridge trucks to their rails.

Failure of any part of the cask handling cranes, or any other crane capable of carrying major loads, does not cause any damage to spent fuel or safety-related equipment. Positive protection against dropping the spent fuel shipping cask into the spent fuel storage pool is provided by the basic layout of the spent fuel storage pool, fuel transfer system, and fuel handling arrangement which make it impossible to pass the cask over the spent fuel storage racks. The cask is assigned a separate laydown area in the spent fuel pool, designated as the cask loading pit. The cask is geometrically isolated from movement over the spent fuel storage area or new fuel storage racks because the cask handling crane does not extend across

these areas. The design of the cask loading pit considers the loading
resulting from impact of the fuel transfer cask. No major loads may be
moved over the spent fuel storage area since no crane other than the spent
fuel handling machine extends over this area. The fuel handling building
layout is designed to prevent damage to essential equipment or release of
6 radioactivity as a result of a fuel handling cask drop.

Fuel transfer cask drops were analyzed using the guidelines of NUREG-0612,
Control of Heavy Loads at Nuclear Power Plants, July 1980. The analysis
23 considered the approach and orientation of the cask with respect to the
pool, maximum impact loads from a rigid cask dropping on exposed structural
members, and the restricted travel path of the cask. The cask cannot fall
into the spent fuel pool by basic layout and credit is not taken for energy
absorbing devices.

Design features that prevent damaging spent fuel and essential equipment are:

23 A. During cask handling operations, the fuel transfer cask cannot
travel over the spent fuel pool where spent fuel is stored due
to physical limitations in crane travel (refer to figure 9.1-16).
There are no conceivable cask drops, including a tilted cask that
hits the edge of the spent fuel pool, that could result in dropping a cask directly into the spent fuel pool.

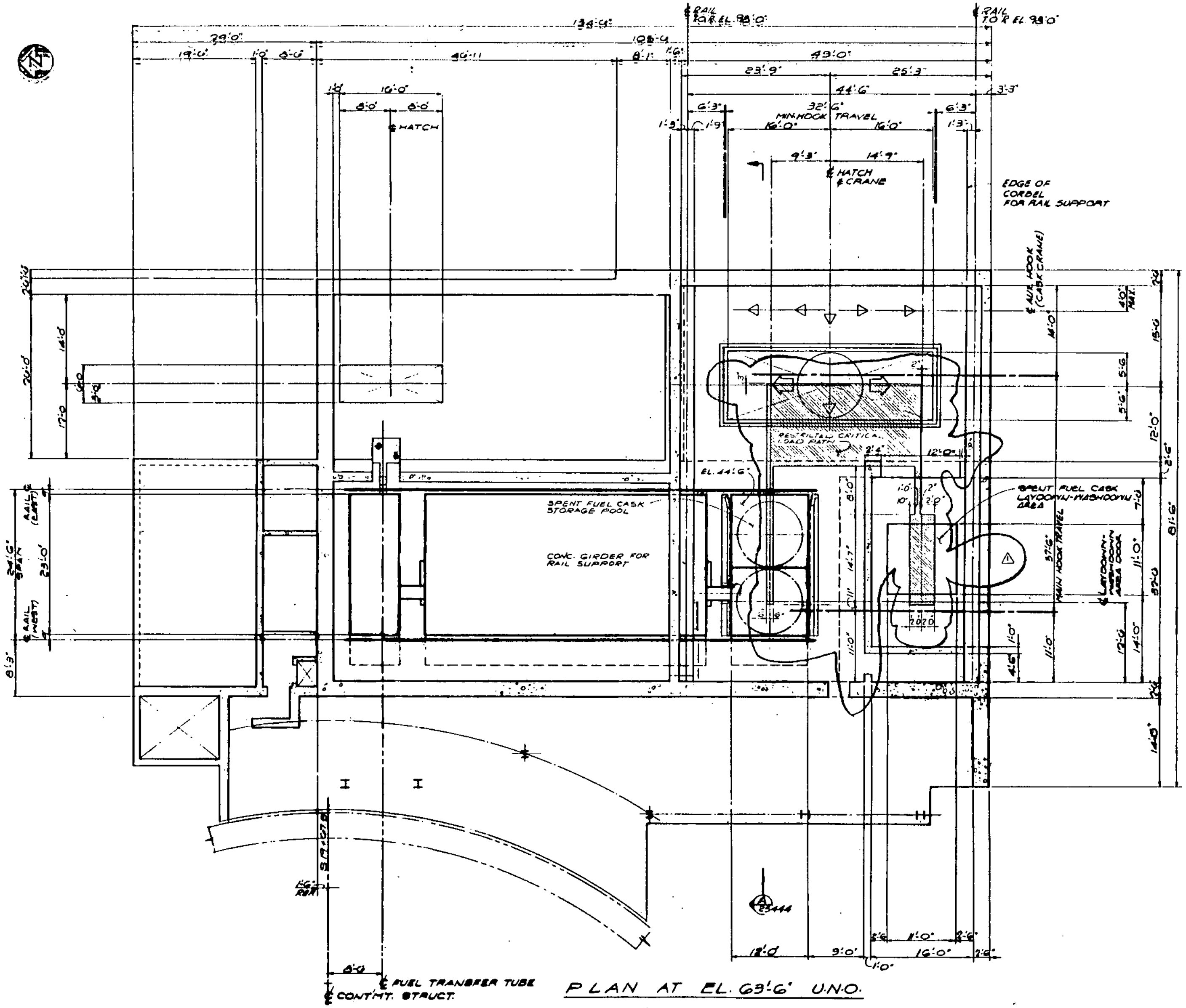
23 B. Exposure to cask drop exists only in the spent fuel cask storage
pool which is adjacent to the spent fuel pool. A 4-foot-thick
reinforced concrete wall separates the spent fuel pool from the
spent fuel cask storage pool. This separation concrete wall
insures that a cask dropped into the spent fuel cask storage pool
will not damage the spent fuel racks in the spent fuel pool.

C. The east-west direction of cask approach and regress into the spent
fuel cask storage pool insures that a dropped or tilted cask will
not directly impact the 4-foot-thick separation wall. Refer to
figures 9.1-16, 9.1-17, and 9.1-18. The prescribed East-West
direction of travel for the crane is dictated by critical path
limit switches provided in the cask handling crane. Operation of
the crane with travel path restricted by critical path limit
23 switches is enforced by administrative control. In addition,
physical obstructions consisting of 12 inch square steel posts
and a 1-ft thick, 20-ft high concrete wall are provided to preclude operator-initiated movement of the cask along paths other
than the prescribed east-west direction of travel. The physical
obstructions are not crash barriers but are effective to preclude
crane movement of the cask over unauthorized paths in the event
that administrative controls failed to enforce operation of the
crane under critical path mode.

D. During handling operations, the fuel transfer cask does not travel over essential equipment. There is no essential equipment located on the operating floor of the fuel handling building. The

operating floor is designed to withstand a cask drop of 6 inches, which is the maximum lift height obtainable over the floor. This provides a protective barrier for the spent fuel pool heat exchanger and cooling pumps which are located at the lower elevations below the operating floor of the fuel handling building.

23 E. During handling operations, the fuel transfer cask is not exposed to a direct drop of more than 30 feet onto an unyielding surface. The maximum lift height (34 feet to grade) occurs at a point above the open hatch to the rail car. Administrative controls will be employed to ensure that the 3-foot-high rail car, a yielding surface, is in place during cask handling operations. The resultant maximum drop, therefore, will be less severe than a 30-foot drop onto an unyielding surface.



NOTES

1. ⇦ DEPICTS TRAVEL PATH OF MAIN HOOK (CASK CRANE).
2. ◁ DEPICTS TRAVEL PATH OF AUX. HOOK (CASK CRANE).
3. CASK CRANE UNIT 3 AS SHOWN UNIT 3 OPPOSITE HAND ABOUT E-W AXIS.
4. FOR TECHNICAL DESCRIPTION OF RESTRICTED CRITICAL LOAD PATH AND CRITICAL PATH LIMIT SWITCHES FOR RESTRICTING HORIZ. AND VERT. TRAVEL OF MAIN HOOK SEE WHITING CORP. DWG. S023-209-3-60.

SAN ONOFRE
NUCLEAR GENERATING STATION
Units 2 & 3

FUEL HANDLING BUILDING
CASK HDLG. CRANE TRAVEL & CLEARANCE REQ'MTS - PLAN

Figure 9.1-16

34. Condensate Storage Capacity

Table 1.8-7
SUPPLEMENTARY DATA (Sheet 5 of 5)

Document Number	Title	
---	"Geomorphic Analysis of Fault E, Camp Pendleton, California." Roy J. Shlemon and Associates, September 1977. Enclosures 4 of Geotechnical Studies, Northern San Diego County, California, October 1977.	17
---	1977 Unpublished Seismic Reflection Profiles, Fugro, Inc.	
---	Seismic Margin Evaluation for Typical Reactor Coolant System Components.	
---	"Examination of the Vertical Ground Motion Characteristics of the October 15, 1979 Imperial Valley Earthquake."	19 112.35-39
CEN-91(A)	Arkansas Power and Light Company Arkansas Nuclear One-Unit #2 Precritical Vibration Monitoring Program Visual Inspection of Reactor Internals With Photographic Documentation. (Photographs of the ANO-2 internals have not been included because the inspection results showed no problems.)	21
---	"Watertight Reliability of Condensate Storage Tank and its Concrete Enclosure Walls under DBE and Tornado Events", dated December 15, 1980. (63 copies)	23 010.65
---	"So. Cal. Pressurizer - Brittle Fracture Evaluation, Calc. No. PRS-705"	22

REFERENCES

1. "Prestressed Concrete Nuclear Reactor Containment Structures," BC-TOP-5, Revision 1, Bechtel Power Corporation, San Francisco, California, December 1972.

2. "Full Scale Buttress Test for Prestressed Nuclear Containment Structures," BC-TOP-7, Bechtel Corporation, San Francisco, California, August 1971 (Reprinted September 1972).

3. "Tendon End Anchor Reinforcement Test," BC-TOP-8, Bechtel Corporation, San Francisco, California, November 1971.

4. "Containment Building Liner Plate Design Report," BC-TOP-1, Revision 1, Bechtel Power Corporation, San Francisco, California, December 1972, including supplemental information entitled
1-130.10 "Additional Information Requested by the Atomic Energy Commission on BC-TOP-1, Revision 1, Containment Building Liner Plate Design Report," dated September 1973.

5. Eringer, A. C., Naghdi, A. K., and Thiel, C. C., State of Stress in Circular Cylindrical Shell with a Circular Hole, Welding Research Council Bulletin No. 102, January 1965.

6. "Seismic Analyses of Structures and Equipment for Nuclear Power Plants," BC-TOP-4A, Revision 3, Bechtel Power Corporation, San Francisco, California, November 1974.

7. "Qualification of an Alternative Electrode Control Program for AWS D1.1" ANPP submittal to NRC, dated March 15, 1978, Docket Numbers STN-50-528, STN-50-529, STN-50-530.

12 8. "Moisture Control of Low Hydrogen Covered Arc-Welding Electrodes at Palo Verde Nuclear Generating Station, Units 1, 2 and 3" is the subject of the letter addressed to Mr. E. E. Van Brunt, Jr of Arizona Public Service Company from NRC, dated April 24, 1978, referring to Docket No. STN-50-528, STN-50-259, STN-50-350.

9. "Containment Structural Post-Tensioning System Surveillance Test
13-131.25 Report" for 1975, 1976, and 1978. Rancho Seco Nuclear Generating Station Docket No. 50-312, Operating License DPR-54.

10. "Watertight Reliability of Condensate Storage Tank and its Concrete
23 Enclosure Walls under DBE and Tornado Events", dated December 15, 1980.

35. Fire Protection

Question FQ015.56

It is our position that you provide an engineered oil containment and collection system for the reactor coolant pumps to protect against a pressurized oil spray igniting and affecting other safety related equipment or pumps. The installation must satisfy Reg. Guide 1.29, paragraph C.2. Reference Q015.30.

Response

An engineered oil containment and collection system for the reactor coolant pumps will be installed. The installation will satisfy Regulatory Guide 1.29, paragraph C.2.

Reference

None.

Question FQ015.60

It is our position that all areas which contain redundant safe shutdown systems which are not separated by three-hour fire rated barriers should be provided with an automatic, wet-pipe sprinkler system designed to cover the entire area as well as an early warning smoke detection system. In addition, to allow for possible thermal lag or failure of the suppression system, in those areas where the redundant systems are separated by less than 20 ft. of clear, open air space, an ASTM #E119 rated fire barrier which will completely enclose one of the redundant systems should be provided. The barrier should protect the circuit integrity/equipment availability of that system for one hour under fire test conditions. Areas where such protection is required include the following fire zones:

12 Cable Riser Gallery

13A Emergency HVAC Unit Room 309A

15 Rooms 308A and B, ESF Switchgear Rooms

22 Auxiliary Feedwater Pump Room

23 Spent Fuel Pool Heat Exchanger Room

29 Cable Riser Galleries

30 Electrical Tunnel Elev. 30'-6"

32B Fan Room - 233, 234 - Train B

36 Spent Fuel Pool Pump Room

42 Cable Riser Galleries

44 Intake Structure

48 CCW Heat Exchangers and Piping Rooms, Elev. 8'-0"

63 Corridor, Elev. 50'-0", Control Building

67 Cable Riser Galleries, Radwaste Area, Elev. 63'-6"

72 Corridor 442, Elev. 70'

78 Corridor Room 105

83 Salt Water Cooling Tunnel, Train A, Train B

84 Safety Equipment Building, Elev. 8', A/C Room No. 017

In lieu of the one-hour fire rated barrier, an alternate shutdown system can be provided.

Where safe shutdown capability cannot be assured by barriers, suppression and detection systems, it is our position that an alternate shutdown system should be provided. Such areas include the following fire zones:

5 Cable Riser Gallery

31 Control Room Complex

41 Cable Spreading Room

The alternate shutdown system should be completely independent of the area for which it is being provided such that a fire in either area which damages redundant systems will not affect the shutdown capability from the other area. Reference Q015.44a.

Response

As stated in response to Question FQ15.12, exposure fire barriers are provided for redundant safe shutdown cables separated by less than 20 feet, as required, with the exception of the containment, cable spreading room and control room. This wrapping concept, as a barrier, has been tested to ASTM E-119 temperature profiles and has an approximate 1-hour fire rating.

In addition to the wrapping, automatic suppression systems are provided in those fire zones where fire severity exceeds 1 hour. Automatic suppression systems were not provided for zones with less than a 1-hour fire loading for the following reasons: 23

1. Wrapping provides an approximate 1-hour protection thereby maintaining integrity of at least one of the safe shutdown trains.

2. Fire barrier ratings exceed the fire severity, which is less than 1-hour, in each zone. Also, as stated in response to Question FQ015.27, the tests showed that the existing construction of the walls provides protection in excess of 2 hours.

3. Manual fire fighting capability is provided in all areas containing redundant safe shutdown systems as required. As stated in response to Question FQ015.9, this capability will exist even after a safe shutdown earthquake.

Although these provisions are considered adequate protection to ensure the capability for safe shutdown of the plant with the fire hazards involved, additional automatic suppression systems will be installed to provide coverage in all areas containing safe shutdown systems which are not separated by 3-hour fire rated barriers. The supression systems will be dry or wet pipe depending on the existing fire water system capability and area configuration. 23

Smoke detectors are provided for early warning of incipient fires in all areas of high safety-related cable tray concentration outside the containment, as stated in response to Question FQ015.44(d).

As stated in the response to Questions 015.34 and 015.44, alternate shutdown features exist to provide remote safe shutdown capability that is electrically and physically independent of the control room (zone 31) and cable spreading room (zone 41). The cable riser gallery (zone 5), contains only one of the two redundant trains required for safe shutdown of the plant. Thus at least one train will be available for safe shutdown remote from the fire zone, as stated in the revised Fire Hazards Analysis, Zone 5 section.

Reference

See revised Fire Hazards Analysis, Section II, Zone 5, paragraph IIC (2), page II-24.

36. Turbine Disc Integrity

OPEN ITEM 36

TURBINE DISC INTEGRITY

Question 121.29, Part b.(4)

Provide the following information for each LP turbine:

b. For each disc:

(4) keyway temperatures

Response

The initial response from SCE was that there are no keyways in the discs.

In response to NRC request for additional information, SCE has determined that:

(a) the assembly of the discs to the shaft was accomplished with the application of approved lubricants (e.g., boiled linseed oil) to the shaft at a Shrinking temperature not to exceed 400°C.

(b) bore temperatures (°F) for each disc on the LP turbine at full load steady state conditions are anticipated as:

Disc No.	Upstream Temp.	Downstream Temp.
1	406	351
2	314	260
3	243	223
4	211	195
5	184	174
6	182	251

37. Secondary Water Chemistry

NRC CHEMICAL ENGINEERING BRANCH
SECONDARY WATER CHEMISTRY QUESTIONS
RECEIVED DECEMBER 16, 1980

Question 1

Combustion Engineering has updated the Chemistry Manual CENPD-28, revision 2 (January 1976) in January 1978, to include an alarm setpoint for conductivity and a chloride concentration limit in steam generator blowdown, and to modify the corrective actions for off-limit chemistry in steam generator blowdown. These CE updated information should be incorporated into your secondary water chemistry monitoring program. Although the CE recommended chloride concentration limit has been included in Table 1.1-1, Operating Chemistry Limits, Secondary System - Steam Generator Blowdown, of the Secondary Water Chemistry Monitoring Program, it should also be included in Section 6.3.5, Steam Generator Blowdown, on page 3 of the Chemical Procedure S023-III-2.3. Table 1.1-1 of the Secondary Water Chemistry Monitoring Program should include the CE recommended alarm setpoint for conductivity in steam generator blowdown. The CE modified corrective actions for off-limit chemistry in steam generator blowdown should be incorporated into Section 5.0, Procedure(s) Defining Off-Control Point Chemistry, on page 21 of the secondary Water Chemistry Monitoring Program.

Response

The recommended alarm set point for conductivity in steam generator blowdown has been included in Table 1.1-1 of the Secondary Water Chemistry Monitoring Program.

The CE recommended chloride concentration limit is now included in Section 6.3.6, Steam Generator Blowdown, on page 4 of the Chemical Procedure S023-III-2.3. Revision 2.

The CE modified corrective actions for off-limit chemistry in steam generator blowdown is addresed in reference 5.1.1, Combustion Engineering Power Systems, "Chemistry Manual CENPD-28," Rev. 2, January, 1976 (updated January, 1978), given in Section 5.0, Procedure(s) Defining Off-Control Point Chemistry, on page 21, of the Secondary Water Chemistry Monitoring Program.

Reference

Secondary Water Chemistry Monitoring Program For San Onofre Nuclear Generating Station, Units 2 and 3, January, 1981 (Revision 1)

Chemical Procedure S023-III-2.3, Revision 2, Secondary System Chemical Limits and Sampling Frequencies

NRC CHEMICAL ENGINEERING BRANCH
SECONDARY WATER CHEMISTRY QUESTIONS
RECEIVED DECEMBER 16, 1980

Question 2

In Section 1.2.3.1, Wet Storage - Short Duration, on page 12, it states that normal operating limits will be maintained for wet storage of short duration. Table 1.2-3 on the same page lists the limits for steam generator at wet storage - short duration. These limits are different from these in Table 1.1-1 for steam generator blowdown during normal operation. The limits in both Table 1.1-1 and Table 1.2-3 differ from the CE recommended values for wet layup in steam generator:

	Table 1.2-3 Wet Storage Short Duration	Table 1.1-1 Normal Operation	CE Recommendation
pH	9.0 ± 0.5	8.2 - 9.2	9.8 - 10.2
Conductivity	$<$15 umho/cm	7 umho/cm	N/A
Hydrazine	$1.5 \times 0_2$ (15 ug/1)	NA	200 ± 50 ppm
Ammonia	NA	NA	$<$10 ppm
Nitrogen	NA	NA	$>$5 psig

Response

The Secondary Water Chemistry Monitoring Program, page 12, has been clarified by defining quasi-normal operating limits for wet storage of short duration.

High hydrazine concentrations (circa 200 ppm) are not desirable for Short Duration Wet Storage (4 days) because of the large quantity of ammonia produced upon return to service:

$$2N_2H_4 \xrightarrow{>250^oF} 2\ NH_3 + N_2 + H_2$$

These lower hydrazine levels account for the differences between the CE pH values and those listed.

Reference

Secondary Water Chemistry Monitoring Program For San Onofre Nuclear Generating Station, Units 2 and 3, January, 1981 (Revision 1)

NRC CHEMICAL ENGINEERING BRANCH
SECONDARY WATER CHEMISTRY QUESTIONS
RECEIVED DECEMBER 16, 1980

Question 3

Section 1.2.3.2, Wet Storage - Extended Duration on page 13 gives the limit for nitrogen blanket pressure as 3.0 $\pm$ 2.0 psig. The CE recommended value is $>$5 psig.

Response

The Secondary Water Chemistry Monitoring Program, pages 13 and 14, now reflects the CE recommended value of $>$5 psig N_2.

Reference

Secondary Water Chemistry Monitoring Program For San Onofre Nuclear Generating Station, Units 2 and 3, January, 1981 (Revision 1)

SECONDARY WATER CHEMISTRY

Monitoring Program

For

San Onofre Nuclear Generating Station Units 2 and 3

January, 1981
(Revision 1)

Secondary Water Chemistry Monitoring Program

San Onofre Nuclear Generating Station
Units 2 and 3

1.0 Identification of Critical Control Points, their Parameters and Sampling Frequencies.

1.1 Normal Chemistry Control

1.1.1 Steam generator secondary side water chemistry control is accomplished in accordance with manufacturer's requirements by:

1.1.1.1 A close control of the feedwater to limit the amount of impurities that can be introduced into the steam generator.

1.1.1.2 A continuous blowdown of the steam generator to reduce concentrating effects of the steam generator.

1.1.1.3 Chemical addition to establish and maintain an environment that minimizes system corrosion.

1.1.1.4 By preoperational cleaning of the feedwater system.

1.1.1.5 Minimizing feedwater oxygen content prior to entry into the steam generator.

1.1.2 Secondary water chemistry is based on the zero solids treatment method. This method employs the use of volatile additives to maintain system pH and to scavenge dissolved oxygen present in the feedwater.

1.1.2.1 Ammonium hydroxide is added to the secondary system to establish and maintain alkaline conditions in the condensate/feedwater heater trains and in the steam generators. Since, ammonium hydroxide is a volatile substance it will not concentrate in the liquid phase of the steam generators, but will quickly reach an equilibrium level that will provide a protective alkaline environment throughout the secondary water/steam cycle.

1.1.2.2 Hydrazine is added to scavenge dissolved oxygen present in the feedwater; and to promote the formation of a protective oxide layer on metal surfaces by keeping these layers in a reduced chemical state.

1.1.2.3 Pumps are provided to inject ammonium hydroxide and hydrazine into the feedwater heater trains at a point downstream of the condensate pump discharge.

Hydrazine must be injected continuously to maintain feedwater residual as a result of thermal decomposition in the steam generators; whereas, ammonium hydroxide is injected only as necessary, since it is thermally stable and loss from the system is minimal.

1.1.2.4 Operating chemistry limits for steam generator water and steam, and for condensate/feedwater are given in Tables 1.1-1, -2, -3, -4 and -5.

1.1.3 Effectiveness of Normal Chemistry Control

1.1.3.1 Alkaline conditions within the feedwater trains and steam generators reduce general corrosion at elevated temperatures and tend to decrease the release of soluble corrosion products from metal surfaces. These conditions promote formation of a protective metal oxide film and thus reduce the transport of corrosion products into the steam generators.

1.1.3.2 Hydrazine also promotes formation of a metal oxide film by the reduction of ferric oxide to magnetite. Ferric oxide may be loosened from the metal surfaces and be transported by the feedwater. Magnetite, however, provides an adhesive, protective layer on carbon steel surfaces. Hydrazine also promotes formation of protective metal oxide layers on copper surfaces.

1.1.3.3 Removal of oxygen from the secondary waters is also essential in reducing corrosion. Oxygen dissolved in water causes general corrosion that can result in pitting of ferrous metals, particularly carbon steel. Oxygen is removed from the steam cycle condensate in the main condenser deaerating section. Additional oxygen protection is obtained by chemical injection of hydrazine into the condensate stream. Maintaining a residual level of hydrazine in the feedwater ensures that any dissolved oxygen not removed by the main condenser is scavenged before it can enter the steam generator.

1.1.3.4 The presence of free hydroxide (OH) can cause rapid corrosion (caustic stress corrosion) if it is allowed to concentrate in a local area. Free hydroxide is avoided by maintaining proper pH control and by minimizing impurity ingress into the steam generator.

Zero solids treatment is a control technique whereby both soluble and insoluble solids are kept at a minimum within the steam generator. This is accomplished by maintaining strict surveillance over

the possible sources of feedtrain contamination (e.g., main condenser cooling water leakage, air inleakage, and subsequent corrosion product generation in the low pressure drain system, etc.). Solids are also excluded, as discussed above, by injecting only volatile chemicals to establish conditions that reduce corrosion and, therefore, reduce transport of corrosion products into the steam generator.

1.1.3.5 In addition to minimizing the sources of contaminants entering the steam generator, continuous blowdown is employed to reduce their concentration. With the low solids level that results from employing the above procedures, the accumulation of scale and deposits on steam generator heat transfer surfaces and internals is limited. Scale and deposit formations can alter the thermal hydraulic performance in local regions to such an extent that they create a mechanism that allows impurities to concentrate to high levels, and thus could possibly cause corrosion. Therefore, by limiting the ingress of solids into the steam generator, the effect of this type of corrosion is reduced.

1.1.3.6 Because they are volatile; the chemical additives do not concentrate in the steam generator and do not represent chemical impurities that can themselves cause corrosion.

1.1.3.7 System design and operating practices are directed toward the goal of corrosion protection which, at the same time, provides an excellent environment for the suppression of iodine emissions in steam. Secondary water chemistry suppresses formation of volatile species of iodine in the steam generators, and converts volatile iodine to non-volatile iodine compounds.

1.1.3.8 The condenser air ejector iodine partition factor used for radionuclide release analysis is discussed in subsection 11.3.3, SONGS 2/3 FSAR.

TABLE 1.1-1
OPERATING CHEMISTRY LIMITS
SECONDARY SYSTEM - STEAM GENERATOR BLOWDOWN

Parameter	Normal*	Analysis Frequency	Transient Limit**	Consider Immediate Shutdown#
pH @ 25°C	8.2-9.2	(Continuous Monitor) 1/day	7.5 - 8.2 9.2 - 9.5	<6.5 or >10.5
Conductivity @ 25°C	<7 μmho/cm***	(Continuous Monitor) 1/day	≤15 μmho/cm	NA
Chloride	<100 μg/l****	1/day	NA	NA
Suspended Solids	<1 mg/l	1/week	≥10 mg/l	NA
Free Hyrodxide	(Analyze when pH is outside normal range)			>5 mg/l
Silica	<1 mg/l	1/week	10 mg/l	NA
Dose Equivalent I-131	<0.01 μCi/ℓ	3/week	NA	NA

* The normal chemistry conditions can be maintained by a coastline plant using sea water cooling but with little or no condenser leakage. If the normal specifications are exceeded, immediate investigation of the problem is initiated, sampling frequency increased to the abnormal level (at least once per 2 hours), and blowdown increased. If condenser leakage is indicated, leak isolation procedures are instituted.

** The transient steam generator limits are allowed to permit operations with minor system fault conditions until the affected component can be isolated and/or repaired. If the abnormal limits are exceeded for greater than 4 hours, shutdown procedures are considered.

*** Alarm set at 4.0 μmho/cm (CE Recommendation).

****CE limit.

\# NA indicates that no action other than correcting parameters back to acceptable limits is required.

TABLE 1.1-2
OPERATING CHEMISTRY LIMITS
SECONDARY SYSTEM - MAIN STEAM

Parameter	Normal	Analysis Frequency	Transient Limit	Consider Immediate Shutdown
Cation Conductivity @ 25°C	<0.5 μmho/cm	1/day	NA	>2 μmho/cm

TABLE 1.1-3
OPERATING CHEMISTRY LIMITS
SECONDARY SYSTEM - CONDENSATE STORAGE TANK

Parameter	Normal	Analysis Frequency	Transient Limit	Consider Immediate Shutdown
pH @25°C	5.5 - 8.0	1/day	NA	NA
Conductivity @ 25°C	<1 μmho/cm	1/day	≤2 μmho/cm	NA
Suspended Solids	<1 mg/l	1/week	NA	NA
Chloride	<50 μg/ℓ	1/day	≤50 μg/ℓ	NA
Silica	<10 μg/l	1/day	NA	NA

TABLE 1.1-4
OPERATING CHEMISTRY
SECONDARY SYSTEM - CONDENSATE PUMP DISCHARGE

Parameter	Normal*	Analysis Frequency	Transient Limit**	Consider Immediate Shutdown
pH @ 25°C	8.8 - 9.2	(Continuous Monitor) 1/day	7.5 - 8.8 9.2 - 9.5	NA
Conductivity @ 25°C	≤4 μmho/cm	(Continuous Monitor) 1/day	NA	NA
Cation Cond. @ 25°C	<0.5 μmho/cm	(Continuous Monitor) 1/day	≤1.5 μmho/cm	NA
Dissolved O_2	<10 μg/l	1/day	≤100 μg/l	≥100 μg/l
Sodium	<1 μg/l	(Continuous Monitor) 1/day	≤ 10 μg/l	NA
Ammonia	≤1 μg/l	1/day	NA	NA
Chloride	<50 μg/l***	1/day	≤50 μg/ℓ	NA
Iron	<10 μg/l	3/week	≤30 μg/l	NA
Copper	<10 μg/l	3/week	≤10 μg/l	NA
Silica	<10 μg/l	1/week	NA	NA

* The normal chemistry conditions can be maintained by a coastline plant using sea water cooling but with little or no condenser leakage. If the normal specifications are exceeded, immediate investigation of the problem is initiated, sampling frequency increased to the abnormal level (at least once per 2 hours), and blowdown increased. If condenser leakage is indicated, leak isolation procedures are instituted.

** The abnormal condensate/feedwater limits are allowed to permit operations with minor system fault conditions until the affected component can be isolated and/or repaired. If the abnormal limits are exceeded for greater than 4 hours, shutdown procedures are considered.

*** CE recommends that chloride concentrations be less than the Lower Detectable Limit (LDL).

CE also recommends that copper be eliminated from the system. Since Units 2/3 feedwater heaters contain copper alloy tubing, limits for copper have been established at <10 μg/l.

TABLE 1.1-5
OPERATING CHEMISTRY LIMITS
SECONDARY SYSTEM - FEEDWATER HEATER TRAIN

Parameter	Normal*	Analysis Frequency	Transient Limit**	Consider Immediate Shutdown
pH @ 25°C	8.8 - 9.2	(Continuous Monitor) 1/day	7.5 - 8.8 9.2 - 9.5	NA
Conductivity @ 25°C	≤4 μmho/cm	(Continuous Monitor) 1/day	NA	NA
Cation Cond. @ 25°C	<0.5 μmho/cm	(Continuous Monitor) 1/day	NA	NA
Dissolved O_2	<5 μg/l	1/shift	<100 μg/l	≥100 μg/l
Hydrazine	10-50 μg/l (min. 10 + 2X O_2)	1/day	NA	NA
Ammonia	<1 mg/l	1/day	NA	NA
Dissolved Solids	<1 mg/l	1/week	NA	NA
Copper	<10 μg/l	3/week	≤10 μg/l	NA
Iron	<10 μg/l	3/week	≤30 μg/l	NA
Tritium	$<10^{-4}$ μCi/mℓ	3/week	10^{-4} μCi/mℓ (Run Stm. Gen. Leak Rate)	NA

* The normal chemistry conditions can be maintained by a coastline plant using sea water cooling but with little or no condenser leakage. If the normal specifications are exceeded, immediate investigation of the problem is initiated, sampling frequency increased to the abnormal level (at least once per 2 hours), and blowdown increased. If condenser leakage is indicated, leak isolation procedures are instituted.

** The abnormal condensate/feedwater limits are allowed to permit operations with minor system fault conditions until the affected component can be isolated and/or repaired. If the abnormal limits are exceeded for greater than 4 hours, shutdown procedures are considered.

*** CE recommends that chloride concentrations be less than the Lower Detectable Limit (LDL).

CE also recommends that copper be eliminated from the system. Since Units 2/3 feedwater heaters contain copper alloy tubing, limits for copper have been established at <10 μg/l.

1.2 Outage Protection - Chemistry Control

The most common form of corrosion encountered in the steam generator and feedwater/condensate system results from oxygen attached in the presence of water. During secondary plant operation, continual dearation and continuous feed of a chemical oxygen scavenger will effectively eliminate oxygen from the system. However, during outages the techniques required to prevent corrosion must often be modified. Outage protection as described in this section consists of applying the proper safeguards to minimize such corrosion.

1.2.1 Startup Conditions

In preparation for unit startup, two or more condensate pumps are used to circulate treated (N_2H_4 & NH_3) demineralized water (at 7,500 gpm) from the four main condenser hot well quadrants through the feedwater trains, and back to the main condenser. The purpose of this operation is to remove loosely adherent ferric oxide (Fe_2O_3) that may have accumulated during the unit outage period.

The condensate pumps are then shutdown, the condensate/feedwater system is drained, and then refilled with treated demineralized water. It is at this stage that startup protection chemical limits will have an influence on the progress of the unit startup.

Following the pre-startup flush, dump and refill, circulation of the condensate/feedwater system is re-established at 7,500 gpm; hydrazine and ammonia feeds are initiated; gland sealing steam from the auxiliary boiler is valved to the main turbine seals and to the seals of both feedwater pump turbines; vacuum is established on the main condenser; and steam (from auxiliary boiler) is admitted to the shell side of the 4th point heaters to bring the condensate/feedwater system to a temperature of 180°F. The purpose of these operations is to purge the system of dissolved oxygen, convert ferric oxide (Fe_2O_3) to magnetite (Fe_3O_4) and to stabilize the system pH.

To aid in system cleanup, a side stream flow of 1,250 gpm is passed through the blowdown ion-exchanger to remove Fe_3O_4 and other contaminants before returning the processed effluent to the main condenser hotwells.

Coincidental with the cleanup of the condensate/feedwater system, the steam generators are filled, and their volumes maintained, with treated (N_2H_4 and NH_3) demineralized water by way of the auxiliary feedwater system.

Upon completion of unit startup, the entire system should be operating within normal chemical limits (See Section 1.1).

1.2.1.1 Hotwells

Prior to system startup each hotwell quadrant is sampled and analyzed for pH, conductivity, chloride and suspended solids to determine if the water therein is acceptable for circulation through the feedwater heater trains.

All hotwells which do not meet feedwater specifications given in Table 1.2-1 are pumped down to minimum level--overboarding the water to the circulating water outfall--and refilled with demineralized water from the secondary plant condensate storage tank.

1.2.1.2 Feedwater Systems

Each feedwater train will be analyzed for dissolved oxygen hydrazine, pH, conductivity (specific and cation) and suspended solids. The concentration of hydrazine in the feedwater system will be maintained at a concentration ratio of 4:1 (N_2H_4 to O_2) in order to inhibit the corrosive effects of oxygen and to assure a reducing environment for the conversion of ferric oxide to magnetite.

The feedwater system will not be allowed to feed the steam generators until the water meets the startup specifications for both systems as stated in Table 1.2-1.

1.2.1.3 Steam Generators

Each steam generator will be sampled and analyzed for dissolved oxygen, hydrazine, pH, conductivity, suspended solids and chloride. Blowdown through the blowdown ion exchangers will be initiated as required to clean up the system.

TABLE 1.2-1

OUTAGE PROTECTION - STARTUP CONDITIONS

	Hotwells	Feedwater	Steam Gens.	Steam Gen. Aux. Fdwtr.	Aux. Blr.	Aux. Blr. Deaerator
pH @ 25°C	9.0 ± 0.2	9.0 ± 0.2	9.0 ± 0.5	9.0 ± 0.2	9.0 ± 0.5	9.0 ± 0.2
Conductivity (Specific) @ 25°C	<10 µmho/cm	<10 µmho/cm	<15 µmho/cm	<15 µmho/cm	<15 µmho/cm	<10 µmho/cm
Conductivity (Cation) @ 25°C	<1.5 µmho/cm	1.5 µmho/cm	NA	NA	NA	NA
Chloride	≤0.1 mg/l	NA	≤0.1 mg/l	NA	<1.0 mg/l	NA
Suspended Solids	<10 mg/l	<10 mg/l	<10 mg/l	<10 mg/l	<10 mg/l	<10 mg/l
Dissolved Oxygen	<10 µg/l	<10 µg/l	<10 µg/l	<10 µg/l	<10 µg/l	<10 µg/l
Hydrazine	NA	4xO_2 µg/l	NA	4xO_2 µg/l	NA	4xO_2 µg/l

1.2.2 Shutdown Conditions

1.2.2.1 Feedwater System

Increase hydrazine feed to maximum as soon as shutdown operations commence. Hydrazine should be maintained at a concentration 1.5 times (or greater) the dissolved oxygen concentration.

TABLE 1.2-2

OUTAGE PROTECTION - SHUTDOWN CONDITIONS

	Feedwater	Steam Gens.	Aux. Blr.	Aux. Blr. Deaerator
pH @ 25°C	9.0 $\pm$ 0.2	9.0 $\pm$ 0.5	9.0 $\pm$ 0.5	9.0 $\pm$ 0.2
Hydrazine	$\geq$2 X 0_2 µg/ℓ	$\geq$2 X 0_2 µg/ℓ	$\geq$2 X 0_2 µg/ℓ	$\geq$2 0_2 µg/ℓ

Shutdown limits for the auxiliary feedwater (to steam generators) system are the same as the startup limits stated in Table 1.2-1.

1.2.3 Outage Conditions

The type and extent of outage protection to be utilized for a given outage will depend upon the duration of that outage, the type of maintenance to be performed during the outage and the requirements for unit availability.

Outage conditions exist whenever the steam generators are at a temperature less than 227°F and/or 5 lb/in^2 gauge, while the pressure of the system is in the process of being reduced. Outage conditions are defined for two situations--wet storage and dry storage; and for durations--short and extended. Short duration is defined as four days or less; and extended duration is defined as greater than four days, up to two months. For outages greater than two months, dry storage is the only method of outage protection that should be utilized.

Outage protection for systems ancillary to the major components of the secondary system given are in Table 1.2-6.

1.2.3.1 Wet Storage - Short Duration ($t_{outage} \leq 4$ days)

Wet storage methods should be applied during short term outages or whenever unit availability must be maintained.

Vacuum should be maintained on the main condenser and on the shell side of the 5th and 6th point heaters. The main circulating water pumps should also be operating.

Pegging steam should be maintained on the shell side of the 1st through 4th point heaters and on the steam generators.

Wet storage outage conditions will be monitored no less than twice weekly; and samples taken from the hotwells will be analyzed for pH, conductivity and chloride, and those taken from the feedwater and steam generators for pH, conductivity, dissolved oxygen and hydrazine. Quasi-normal operating limits will be maintained for wet storage outage protection of short duration. The system will be circulated for 30 minutes prior to sampling -- if at all possible.

NOTE: Quasi-normal operating limits are normal limits that are less restrictive; thus, allowing more flexibility during outage periods.

TABLE 1.2-3
OUTAGE PROTECTION
Wet Storage - Short Duration ($t_{out} \leq$ 4days)*

	Hotwells	Feedwater Heaters	Steam Generators	Aux. Blr.	Aux. Blr. Deaerator
pH @ 25°C	9.0 ± 0.2	9.0 ± 0.2	9.0 ± 0.5	9.0 ± 0.5	9.0 ± 0.2
Conductivity (Specific) @ 25°C	<10 µmho/cm	<10 µmho/cm	<15 µmho/cm	<15 µmho/cm	<10 µmho/cm
Chloride	<0.15 mg/l	NA	<0.15 mg/l	<1.0 mg/l	NA
Dissolved Oxygen	<100 µg/l	<10 µg/l	<10 µg/l	<10 µg/l	<10 µg/l
Hydrazine	NA	$\geq 2 \times O_2$	$\geq 2 \times O_2$	$\geq 2 \times O_2$	$\geq 2 \times O_2$

* Vacuum on main condenser; steam pegging on shell side of feedwater heaters and steam generators.

1.2.3.2 Wet Storage - Extended Duration (4 days $< t_{outage}$ <2 months)

If vacuum cannot be maintained on main condenser and on the shell side of the 5th and 6th point heaters, then these systems must be drained while still hot ($\geq 90^{\circ}$F). Also, if the main circulating water pumps are shutdown, the water boxes should be drained.

If steam pegging protection is not available, then a nitrogen overpressure of 5 psig should be applied to the steam generators; and the shell sides of the 1st through 4th point heaters should be flooded with demineralized water treater with 200 μg/ℓ hydrazine. These protective measures should be done prior to breaking vacuum on the main condenser and prior to the attainment of ambient temperature.

Wet storage outages of extended duration should be monitored at least twice weekly; and samples taken from the steam generators and feedwater heaters shell side should be analyzed for pH, conductivity and hydrazine; and checked for nitrogen overpressure. The pH, hydrazine and nitrogen overpressure within these systems should be maintained at 10.0 ± 0.2, 200 ± 50 N_2H_4, and ≥5.0 psig N_2, respectively. Prior to sampling, the system should be circulated for 30 minutes -- if at all possible.

TABLE 1.2-4
OUTAGE PROTECTION
Wet Storage - Extended Duration (4days < t_{outage} <2 months)*

	Feedwater Heaters		Steam		Aux. Blr.
	Tube Side	Shell Side	Generators	Aux. Blr.	Deaerator
pH @ 25°C	10.0 ± 0.2	10.0 ± 0.2	10.0 ± 0.2	10.0 ± 0.2	9.0 ± 0.2
Hydrazine	200 ± 50 mg/l	200 ± 50 mg/l	200 ± 50 mg/l	200 ± 50 mg/l	100 ± 50 mg/l
Dissolved Oxygen	100 μg/l	NA	100 μg/l	100 μg/l	100 μg/l

* No vacuum on main condenser, hotwells drained; N_2 overpressure on shell side of feedwater heaters and on steam generators.

1.2.3.3 Dry Storage (t_{outage} > 2 months)

Hotwells should be drained while above ambient temperature (~ 92°F) and access panels opened to allow thorough drying of internal condenser surfaces.

Feedwater heaters tube side and shell side should be drained while above ambient temperature (6th, 5th and 4th @ > 115°F; 3rd and 2nd @ > 220°F; and 1st @ 240°F).

In addition, heater shell sides should be drained under a nitrogen overpressure atmosphere of 5.0 psig.

Steam generators must be drained hot--beginning at 240°F.--under a nitrogen overpressure atmosphere.

Monitor and record, at least once per week, the nitrogen pressure on all heat exchange equipment under nitrogen atmosphere protection. Make adjustments as required to maintain N_2 at ≥ 5.0 psig.

TABLE 1.2-5
OUTAGE PROTECTION
Dry Storage - Extended Duration (t_{out} > 2 months)

All systems drained under following condition:

	Hotwells	Feedwater Heaters Tube Side	Feedwater Heaters Shell Side	Steam Generators	Aux. Blr.	Aux. Blr. Deaerator
pH @ 25°C	9.0 ± 0.2	9.0 ± 0.2	9.0 ± 0.2	9.3 ± 0.3	9.3 ± 0.3	9.0 ± 0.2
Hydrazine	NA	$>4xO_2$ µg/l	NA	$>4xO_2$ µg/l	$>4xO_2$ µg/l	$>4xO_2$ µg/l
Temp. °F	≈90	(Between 90 & 240)		~240	90 - 240	~240
N_2 over-press. (≥ 5 psig)	No	No	Yes	Yes	No	No

1.2.4 Outage Protection - Ancilliary Systems

TABLE 1.2-6

OUTAGE PROTECTION - ANCILLIARY SYSTEMS

System Designation	System	Internal Clean. Class*	Tentative Flush Method***	Outage Protection Pre-Startup	Outage Protection Post Startup
	MAIN POWER CYCLE				
ADA/AEA	Condensate/Feedwater Sys.	C/D	PF	(See	6.2.3)
ALA	Auxiliary Feedwater	C	PF	1	2
AQA	Condensate & FW Chemical Feed	C	PF	1	3
APA	Condensate Transfer & Storage	C	WC/PF	2	2
CGA	Condenser Air Removal	D	SF	1	None
ANA	Demineralized Wtr. M.U & Transfer	B	PF	2	2
AFA	Feedwater Heaters Extractions	C	WC/PF	1	None
ABA-B	Main Steam	C	WC	1	None
ACA	Main Turbine	C	WC	1	None
ACA	Main Turbine L.P. Exhaust Spray	C	PF	1	None
BMA	Steam Gen. Blowdown Processing	C/D	SF	1	None
RCA	Turbine Plant Sampling	C/D	PF	1	None
	TURBINE-GENERATOR CONTROLS				
CAA	Steam Seals	C	PS	1	None
CBA	Main Turbine & Gen. Lube Oil	C	PF	1/3	3
CCA	Generator H_2 & CO_2	C	PF	1/3	3
CDA	Hydrogen Seal Oil	C	PF	1/3	3
CFA	Lube Oil Storage, Transf. & Purif.	C	PF	1/3	3
CEA	Main Turbine Controls	C	PF	1/3	3

System Designation	System	Internal Clean. Class*	Tentative Flush Method***	Outage Protection Pre-Startup	Post Startup
CEA	Stator Water Cooling	C	PF	1/2	2
	CIRCULATING WATER				
DAA	Main Circ. Water	D	HC	1/3	None
DCA	Traveling Screens & Fish Handlg.	D	PF	1/3	3/4
DDA	Chlorine Injection	D	HC/SF	1/3	None
DEA	Amertap	D	HC/SF	1/3	None
	COOLING & CHILLED WATER				
EBA	Turbine Plant Cooling Water	D	PF	2/***	2
EPA	Salt Water Cooling	D	HC	1/3	None
GBA/GJA/ GND	Chilled Water (Normal and emergency, all systems)	D	PF	2/***	2
	AUXILIARY STEAM				
FAA	Auxiliary Boiler	C	CC	(See	1.2.3)
FBA	Auxiliary Steam	C	PS/SF	1	None
FCA-B	Auxiliary Turbines	C	SF	1	None
	ANCILLIARY SERVICES				
KAA	Compressed Air (Service)	D	PB	1/3	3
KBA	Critical Compressed Air (Instr.)	C	PB	1/3	3
KDA	Domestic Water	D	PF	1/3	3
EAA	Service Water	D	PF	1/3	3
KCA	Fire Protection, Water	D	PF/PB	1/3	3
KCB	Fire Protection, Halon	D	PB	1/3	3
KCC	Fire Protection, CO_2	D	PB	1/3	3
KHA	Services, Nitrogen, L.P.	B/C	PB	1/3	3
KHA	Services, Nitrogen, H.P.	B/C	PB	1/3	3

System Designation	System	Internal Clean. Class*	Tentative Flush Method***	Outage Protection Pre-Startup	Outage Protection Post Startup
KLA	Service Hydrogen	B/C	PB	1/3	3
KJA-B	Standby Diesel Eng. Water	C	PF	1/3	3
KJA-B	Standby Diesel Eng. Air	C	PB	1/3	3
	MISCELLANEOUS				
JAA	Aux. Boiler Fuel Oil	C	PF/PB	1/3	3
JEA	Standby Diesel Fuel Oil	C	PF/PB	1/3	3
	NON-RADIOACTIVE DRAINS;				
LEA	Oily Waste	D	HC	1/3	None
LFA	All Turbine Plt., Gravity	D	DF	1/3	None
LFB	Diesel Bldg. Gravity	D	DF	1/3	None

* INTERNAL CLEANNESS CLASS:

A, B, C and D: ANSI Standard N45.2.1-1973

** TENTATIVE FLUSH METHOD:

CC Chemically Cleaned by Startup
DF Drains Flushed Open
HC Manually Cleaned Before Filling — No Wiping
PB Gas Blown Procedure
PF Proof Flush Procedure
PS Steam Blown Procedure
SF Flushed or Blown as a Part of Startup Procedure
WC Manually Cleaned and Wiped

OUTAGE PROTECTION:

1. Lay up clean and dry; ANSI Standard N45.2.1.

2. Use normal operating limits for outage protection control; Station Order SO23-E-2 and Chemical Procedure SO23-III-2.3.

3. Normal system fluid.

4. Wash screens with service water.

*** A Procedure Change Notice (PCN) may be required for outage protection of various in-service subsystems -- such as the Units 2/3 air compressor cooling loop — prior to plant startup. These PCN's will be issued by the Units 2/3 Chemical/Radiation Protection Supervisor or Operations Supervisor, as required.

1.3 Attachment

1.3.1 Chemical Procedure SO23-III-2.3 "Secondary System Chemical Limits and Sampling Frequencies; (currently under revision).

1.3.2 Chemical Procedure SO23-III-2.38 "Secondary System Outage Protection;" (currently under revision).

2.0 Identification of Procedures Used to Measure Critical Parameters.

2.1 San Onfore Nuclear Generating Station - Secondary System Analyses (All test procedures are currently under revision).

Parameter	Procedure Number	Procedure Title
Ammonia	SO23-III-2.1	Spectrophotometric Determination of Ammonia with Nessler's Reagent
Oxygen, Low	SO23-III-2.2	Dissolved Oxygen by Indigo Carmine
Limits, Normal Operation	SO23-III-2.3	Secondary System Chemical Limits and Sampling Frequencies
Chloride	SO23-III-2.5	Determination of Chloride Ion by Mercuric Nitrate Titration
Chromate	SO23-III-2.7	Spectrophotometric Determination of Chromate by Color Density of CrO_4-2 Ion
Chromium	SO23-III-2.8	Spectrophotometric Determination of Chromium with S-Diphenylcarbazide
Conductivity and Cation Conductivity	SO23-III-2.9	Conductivity and Cation Conductivity
Copper	SO23-III-2.11	Copper by Atomic Absorption
Copper	SO23-III-2.13	Spectrophotometric Determination of Copper by DEDTC
Fluoride	SO23-III-2.15	Spectrophotometric Determination of Fluoride Ion with Zirconium-SPADNS Complex
Hardness	SO23-III-2.16	The Titrametric Determination of Calcium, Magnesium and Total Hardness
Hydrazine, Low	SO23-III-2.17	Determination of Hydrazine with p-Dimenthyl Aminobenzaldehyde
Hydrazine, High	SO23-III-2.18	Titrametric Determination of High Concentrations of Hydrazine (10-100 mg/l)

Parameter	Procedure Number	Procedure Title
Hydroxide	S023-III-2.19	Determination of Hydroxide Ion by Titrametric Method
Iron	S023-III-2.20	Iron by Atomic Absorption
Iron	S023-III-2.21	Iron by Bathophenanthroline Method
Iron	S023-III-2.22	Spectrophotometric Determination of Iron by Orthophenanthroline
Iron	S023-III-2.23	Iron with TPTZ
Oxygen, High	S023-III-2.26	Determination of Dissolved Oxygen by Thiosulfate Titration with Starch Indicator
pH	S023-III-2.27	pH, Hydrogen Ion Concentration, Potentiometric Determination
Silica	S023-III-2.28	Spectrophotometric Determination of Soluble Silica
Sodium	S023-III-2.29	Sodium by Atomic Absorption
Sulfate	S023-III-2.30	Determination of Sulfate in Water
Sulfide	S023-III-2.31	Sulfide by Spectrophotometric Method
Turbidity	S023-III-2.32	Turbidity Measurements
Sample Location	S023-III-2.34	Secondary System Local and Central Sample Points
Sodium	S023-III-2.35	Sodium by Specific Ion Electrode
Solids	S023-III-2.36	Total and Suspended Solids
Chloride	S023-III-2.37	Chloride Analysis by Specific Ion Electrode
Outage Protection	S023-III-2.38	Secondary System Outage Protection
Fluoride	S023-III-1.15	Fluoride Analysis by Specific Ion Electrode
Sulfide	S023-III-2.43	Sulfide Analysis by Specific Ion Electrode

2.2 Attachment

2.2.1 None

3.0 Identification of Process Sampling Points

3.1 Attachments

3.1.1 Chemical Procedure SO23-III-2.34, "Secondary System Local and Central Sample Points;" (currently under revision).

3.1.2 P&I Diagrams

40193-6 Secondary Sampling System (Sheet 1 of 2)
40194-6 Secondary Sampling System (Sheet 2 of 2)

4.0 Procedure for the recording and management of data

4.1 The disposition of any analysis data form used in conjunction with any secondary system chemical procedure is stated in Section 7. RECORDS of each procedure.

4.1.1 Example - Section 7. RECORDS, Chemical Procedures SO23-III-2.35, Sodium Analysis by Ion Selective Electrode:

The results of secondary (turbine) plant analyses -- specifically the hotwells and condensate pump discharge -- shall be recorded on PSSO (2/3)-1042-9 "Daily Turbine Plant Summary Sheet."

Copies of PSSO (2/3)-1042-8 data sheets shall be filed in the turbine plant file for future reference, after being reviewed by the Chemical-Radiation Protection Foreman.

All original PSSO (2/3)-1042-8 data sheets shall be transmitted to EDM* on a monthly basis and filed under encode number CN05-AX2 (SO2/3).

*EDM - Edison Document Management.

4.2 Attachments (all currently under revision)

4.2.1 Chemical Procedure SO23-III-2.21, "Spectrophotometric Determination of Iron with Bathophenanthroline."

4.2.2 Chemical Procedure SO23-III-2.35, "Sodium Analysis by Selective Ion Electrode."

4.2.3 Chemical Procedure SO23-III-2.36, "Total and Suspended Solids."

5.0 Procedure(s) Defining Off-Control Point Chemistry

Corrective Action, and Sequence and Timing Required to Initiate. Reference should be made to Section 1.0 and Tables 1.1-1 through 1.1-5; and to the following documents:

5.1 References

5.1.1 Combustion Engineering Power Systems, "Chemistry Manual CENPD-28," Rev. 2, January 1976 (Updated January, 1978).

5.1.2 Combustion Engineering Power Systems, "Criteria for Cleanliness and Cleaning of Nuclear Components," Rev. 2, March 1971.

5.1.3 ANSI (Standard N45.2.1, "Cleaning of Fluid Systems and Associated Components During Construction Phase of Nuclear Power Plants," 1973.

5.1.4 Bechtel Power Corporation, "Cleanness Verification and Control Manual," Rev. 1, Job 10079, May 1979.

5.1.5 San Onofre Nuclear Generating Station, Units 2 and 3 Final Safety Analysis Report (FSAR) Sections 9.2.3 "Make-up Demineralizer System," 9.3.2 "Process Sampling System," and 10.3.5 "Secondary Water Chemistry (PWR)."

5.1.6 Branch Technical Position MTEB 5-3, "Monitoring of Secondary Side Water Chemistry in PWR Steam Generators," Rev. 1.

6.0 Procedure(s) Identifying Authority Responsible for the Interpretation of Data

The authority ultimately responsible for the interpretation of secondary system chemistry is the site Chemical-Radiation Protection Engineer. The documents which delineate the various levels of responsibility are listed below:

6.1 References:

6.1.1 Station Order SO23-E-2, "Operation, Maintenance and Control of Heat Exchange Equipment;" (currently under revision).

6.1.2 Station Order SO23-E-3, "Outage Protection;" (currently under revision).

6.1.3 SONGS Units 2/3 Chemical Procedures SO23-III-Series, Section 7. RECORDS; (All are currently under revision for reformating and updating).

6.1.4 San Onofre Nuclear Generating Station Units 2 and 3, Final Safety Analysis Report (FSAR), Section 16.6 ADMINISTRATION CONTROLS.

Balog/Medford:ca

ATTACHMENTS

1. Chemical Procedure S023-III.-2.3, "Secondary System Chemical Limits and Sampling Frequencies," Revision 2.

2. Chemical Procedure S023-III-2.38, "Secondary System Outage Protection," Revision 1.

3. Chemical Procedure S023-III-2.38, "Secondary System Local and Central Sample Points," Revision 1.

4. P&I Diagrams --
   40193-6 Secondary Sampling System (sheet 1 of 2)
   40194-6 Secondary Sampling System (sheet 2 of 2)

5. Chemical Procedure S023-III-2.21, "Spectrophotometric Determination of Iron with Bathophenanthroline."

6. Chemical Procedure S023-III-2.35, "Sodium Analysis by Selective Ion Electrode."

7. Chemical Procedure S023.III-2.36, "Total and Suspended Solids."

SECONDARY SYSTEM CHEMICAL LIMITS AND SAMPLING FREQUENCIES

1.0 OBJECTIVE

1.1 This procedure specifies the chemical limits and routine sampling and analysis frequencies deemed necessary to adequately monitor and control all turbine plant and auxiliary water systems during normal and abnormal plant operation. These limits and sampling frequencies are generally in agreement with the recommendations of Combustion Engineering and are in specific agreement with the applicable Technical Specifications. The site Chemical Engineer has the responsibility for the final interpretation of anaylses data and shall dictate the corrective action or course of action to be taken.

2.0 REFERENCES

2.1 Combustion Engineering Power Systems Chemistry Manual CENPD-28, Revision 2, January, 1976.

2.2 San Onofre Nuclear Generating Station Units 2 and 3 Final Safety Analysis Report.

2.3 S-CE-5369 "C-E Steam Generator Chemical Seminar," February 9, 1979.

2.4 Westinghouse sponsored, "U.S. Plant Chemists Meeting," April 23, 24, 1979.

3.0 PREREQUISITES

3.1 None.

4.0 PRECAUTIONS AND LIMITATIONS

4.1 Adherence to the following chemical control limits is necessary if the plant is to attain the design lifetime.

4.2 Check the applicable radiation and contamination survey information before performing your job. Use the survey information to assist in maintaining your exposure ALARA.

5.0 CHECK-OFF LISTS

5.1 None.

6.0 PROCEDURE

6.1 Method: None.

6.2 Calculations: None.

6.3 Acceptance Criteria

6.3.1 The following are the chemical limits and analytical frequencies for normal, transient and immediate shutdown conditions. Parameters found to be out of the normal range should be reported to the responsible Foreman. A second sample should be analyzed to confirm the out-of-limit condition. Out-of-limit parameters should be sampled and analyzed two or more times per shift until the parameter can be returned to the normal range.

.1 Operation in the transient limit range for any chemical parameter is permissible for up to four(4) hours. A shutdown should be considered if the chemical parameter cannot be returned to the normal range within four (4) hours. Chemical parameters found in the immediate shutdown range indicate a serious system dysfunction and may require an immediate shutdown to preserve equipment and/or prevent relesase of significant quantities of radioactive materials.

6.3.2 Condensate Storage Tank (T-120); Auxiliary Feedwater Storage Tank (T-121)

PARAMETER	NORMAL LIMITS	ANALYSIS FREQUENCY	TRANSIENT LIMIT	IMMEDIATE SHUTDOWN
pH @25°C	5.5-8.0	1/day	NA	NA
Conductivity @25°C	<1 μmho/cm	1/day	≤2 μho/cm	NA
Suspended Solids	<1 mg/ℓ	1/week	NA	NA
Chloride	<50 μg/ℓ	1/day	≤50 μg/ℓ	NA
Silica	<10 μg/ℓ	1/day	NA	NA

6.0 PROCEDURE (continued)

6.3 Acceptance Criteria (continued)

	PARAMETER	NORMAL LIMITS	ANALYSIS FREQUENCY	TRANSIENT LIMIT	IMMEDIATE SHUTDOWN
6.3.3	Hotwells				
	Cation Cond. @25°C	<0.5 μmho/cm	Continuous 1/day	≤1.5 μmho/cm	NA
	Sodium	<1 μg/ℓ	Continuous 1/day	≤10 μg/ℓ	NA
	Chloride	<50 μg/ℓ*	1/day	≤50 μg/ℓ	NA
6.3.4	Condensate Pump Discharge				
	pH @25°C	8.8-9.2	Continuous 1/day	7.5-8.8 9.2-9.5	NA
	Conductivity @25°C	≤4 μmho/cm	Continuous 1/day	NA	NA
	Cation Cond. @25°C	<0.5 μmho/cm	Continuous 1/day	≤1.5 μmho/cm	NA
	Dissolved O_2	<10 μg/ℓ	1/day	<100 μg/ℓ	≥100 μg/ℓ
	Sodium	<1 μg/ℓ	Continuous 1/day	≤10 μg/ℓ	NA
	Chloride	<50 μg/ℓ*	1/day	≤50 μg/ℓ	NA
	Ammonia	≤1 mg/ℓ	1/day	NA	NA
	Iron	<10 μg/ℓ	3/week	≤30 μg/ℓ	NA
	Copper	<10 μg/ℓ	3/week	≤10 μg/ℓ	NA
	Silica	<10 μg/ℓ	1/week	NA	NA

* Less Than Lower Detectable Limit

6.0 PROCEDURE (continued)

6.3 Acceptance Criteria (continued)

	PARAMETER	NORMAL LIMITS	ANALYSIS FREQUENCY	TRANSIENT LIMIT	IMMEDIATE SHUTDOWN
6.3.5	High Pressure Feedwater Heater Outlet				
	pH @25°C	8.8-9.2	Continuous 1/day	7.5-8.8 9.2-9.5	NA
	Conductivity @25°C	≤4 μmho/cm	Continuous 1/day	NA	NA
	Cation Cond. @25°C	<0.5 μmho/cm	Continuous 1/day	NA	NA
	Dissolved O_2	<5 μg/ℓ	1/day	<100 μg/ℓ	≥100 μg/ℓ
	Hydrazine	10-50 μg/ℓ (min. of $10+2xO_2$)	1/day	NA	NA
	Ammonia	≤1 mg/ℓ	1/day	NA	NA
	Copper	<10 μg/ℓ	3/week	≤10 μg/ℓ	NA
	Iron	<10 μg/ℓ	3/week	≤30 μg/ℓ	NA
	Tritium	$<10^{-4}$ μCi/ml	3/week	10^{-4} μCi/ml run Stm.Gen. leak rate	NA
6.3.6	Steam Generator Blowdown				
	pH @25°C	8.2-9.2	Continuous 1/day	7.5-8.2 9.2-9.5	<6.5 or >10.5
	Conductivity @25°C	<7 μmho/cm*	Continuous 1/day	≤15 μmho/cm	NA
	Cation Cond.	<1.0 μmho/cm	1/day	≤1.5 μmho/cm	NA
	Chloride	<100 μg/ℓ**	1/day	≤100 μg/ℓ	NA

* Alarm Set at 4 μmho/cm
** CE Limit

6.0 PROCEDURE (continued)

6.3 Acceptance Criteria (continued)

6.3.6 Steam Generator Blowdown (continued)

PARAMETER	NORMAL LIMITS	ANALYSIS FREQUENCY	TRANSIENT LIMIT	IMMEDIATE SHUTDOWN
Suspended Solids	<1 mg/ℓ	1/week	≤10 mg/ℓ	NA
Free Hydroxide (Analyze when pH is above transient range)				>5 mg/ℓ
Silica	<1 mg/ℓ	1/day	≤10 mg/ℓ	NA
Sodium	<100 μg/ℓ	1/day	≤100 μg/ℓ	NA
Dose Equivalent I-131	<0.01 μCi/ℓ	3/week	NA	>0.01 μCi/ℓ
Gross Activity	(Not yet available)	3/week	NA	NA

6.3.7 Main Steam

PARAMETER	NORMAL LIMITS	ANALYSIS FREQUENCY	TRANSIENT LIMIT	IMMEDIATE SHUTDOWN
pH @25°C	8.8-9.2	1/day	NA	NA
Cation Cond. @25°C	<0.5 μmhO/cm	1/day	NA	>2 μmho/cm
Dissolved O_2	≤1 μg/ℓ	1/day	NA	NA
Ammonia	≤1 mg/ℓ	1/day	NA	NA
Sodium	<1 μg/ℓ	Continuous 1/week	NA	NA
Silica	<10 μg/ℓ	1/day	NA	NA
Copper	<1 μg/ℓ	3/week	NA	NA
Iron	<2 μg/ℓ	3/week	NA	NA

6.0 PROCEDURE (continued)

6.3 Acceptance Criteria (continued)

6.3.8 Auxiliary Feedwater

Chemical limits to be the same as for the high pressure feedwater heater outlet (6.3.5) when this system is in service.

6.3.9 Turbine Plant Cooling Water

PARAMETER	NORMAL LIMITS	ANALYSIS FREQUENCY	TRANSIENT LIMIT	IMMEDIATE SHUTDOWN
pH @25°C	8.3-10.5	1/week	NA	NA
K_2CrO_4	300-600 mg/ℓ (as CrO_4=)	1/week	NA	NA
Total Hardness	≤1 mg/ℓ	1/week	NA	NA

6.3.10 Chilled Water Systems (Containments, Auxiliary Building, Emergency Loops A and B)

pH @25°C	8.2-10.5	1/week during recirculation	NA	NA
K_2CrO_4	300-600 mg/ℓ (as CrO_4=)	1/week during recirculation	NA	NA
Total Hardness	≤1 mg/ℓ (as CrO_4=)	1/week during recirculation	NA	NA

6.3.11 Aux. Blr. Deaerator Outlet

pH @25°C	8.8-9.2	1/day	NA	NA
Conductivity @25°C	≤5 μmho/cm	1/day	NA	NA

6.0 PROCEDURE (continued)

6.3 Acceptance Criteria (continued)

6.3.11 Aux. Blr. Deaerator Outlet (continued)

PARAMETER	NORMAL LIMITS	ANALYSIS FREQUENCY	TRANSIENT LIMIT	IMMEDIATE SHUTDOWN
Dissolved O_2	≤5 μmho/cm	1/day	NA	NA
Ammonia	≤1 mg/ℓ	1/day	NA	NA
Hydrazine	10-50 μg/ℓ	1/day	NA	NA
Gross Activity	(Not yet available)	3/week	NA	NA

6.3.12 Auxiliary Boiler

pH @25°C	8.8-9.2	1/day	NA	NA
Conductivity @25°C	≤5 μmho/cm	1/day	NA	NA
Dissolved O_2	≤5 μg/ℓ	1/day	NA	NA
Ammonia	≤1 mg/ℓ	1/day	NA	NA
Hydrazine	10-50 μg/ℓ	1/day	NA	NA

6.3.13 Make-Up Demineralizer Effluent

pH @25°C	5.5-7.0	1/day	NA	NA
Conductivity @25°C	<1 μmho/cm	1/day	≤2 μmho/cm	NA
Chloride	<50 μg/ℓ	1/day	NA	NA
Fluoride	<10 μg/ℓ	1/day	NA	NA
Silica	<10 μg/ℓ	1/day	NA	NA
Suspended Solids	<1 mg/ℓ	1/day	NA	NA

6.0 PROCEDURE (continued)

6.3 Acceptance Criteria (continued)

	PARAMETER	NORMAL LIMITS	ANALYSIS FREQUENCY	TRANSIENT LIMIT	IMMEDIATE SHUTDOWN
6.3.14	Diesel Generator Cooling Water Systems				
	pH @25°C	8.3-10.5	1/week during recir.	NA	NA
	Total Hardness as $CaCo_3$	≤1 mg/ℓ	1/week during recir.	NA	NA
	K_2CrO_4	300-600 mg/ℓ (as CrO_4=)	1/week during recir.	NA	NA
6.3.15	Main Circulating Water				
	Chlorine	0.1-1.0 mg/ℓ	1/week	NA	NA
6.3.16	Turbine Plan Cooling Water Heat Exchanger				
	Chlorine	0.1-1.0 mg/ℓ	1/week	NA	NA

7.0 RECORDS

7.1 Results of all secondary system analyses shall be recorded on the appropriate SO(2/3)-1042 series forms and shall be transmitted to EDM on a monthly frequency. These data shall be filed as follows by EDM:

Steam Generators CN05-AX5 (SO2/3)
Turbine Plant, Daily CN05-AX2 (SO2/3)
Turbine Plant, Weekly CN05-AX3 (SO2/3)

7.2 The cognizant Chemical Radiation Protection Foreman shall review all daily and weekly analyses data sheets for completeness and for in-limits conditions prior to transfer to EDM.

8.0 ATTACHMENTS

8.1 None

H. E. MORGAN
SUPERINTENDENT UNITS 2 AND 3

APPROVED:

J. M. CURRAN
PLANT MANAGER

AJP/ap

SECONDARY SYSTEM LOCAL AND CENTRAL SAMPLE POINTS

1.0 OBJECTIVE

1.1 Function and Purpose

The function of the turbine plant sampling system is to deliver, on a continuous basis, turbine cycle fluids to the turbine plant laboratory for analysis of pH, conductivity, dissolved oxygen, ammonia, hydrazine, and sodium; and for the detection of condenser and steam generator tube leaks. The system provides signals for the automatic control of chemical injection and alarms for abnormal conditions. The system is also provided with local sample points for the purpose of identifying corrosion areas. The turbine plant sampling system, then, provides a means for sampling the following subsystems:

Steam generator blowdown samples
Main steam samples
Condensate pump discharge sample
First point heater discharge sample
Local condensate hotwell sample system
Local feedwater heater samples
Local feedwater heater drains samples
Local ancilliary systems samples

1.2 General Description

All continuous samples, except the condenser hotwell and turbidity analyzer sample, flow through sample nozzles from the sampling point to a pressure reduction rack (2/3 L-231) located on elevation 30.0 ft. outside and juxtaposed to the west control building wall. Samples flow from this rack to a sample rack (2/3 L-27) located inside the turbine plant laboratory. The steam generator blowdown, main steam, and feedwater samples also flow through rough sample coolers located close to the points of sample origin. The rough coolers reduce the sample temperatures to 57°C (135°F) or less. Sample pressures are reduced by restriction orifices on the pressure reduction rack (2/3 L-231). The sample pressures at the entry to sample rack (2/3 L-27) are controlled to approximately 450kPa (50 lb/in^2 gauge) by means of

1.0 OBJECTIVE (continued)

1.2 General Description (continued)

backpressure regulators. The regulators also serve to bypass a portion of the total sample flow that is not required by the analyzers. This allows a larger total flow to be used, thus reducing the sample delay time. All the bypassed fluids, except that of the steam generator blowdown samples, flow into the sample drains system. The bypassed portion of the steam generator blowdown samples flows into waste drains.

At the sample rack, the samples are cooled by an isothermal bath to 25°C (77°F) and then flow to individual analyzers through rotameters with needle valves. The desired flow through the analyzers is obtained by adjusting the needle valves. The steam generator blowdown samples flow into waste drains after they have been analyzed. All other samples are returned to the "sample drain system" except the portion that has passed through the sodium, dissolved oxygen, and hydrazine analyzers where chemicals are added during the analysis. This portion of the samples is routed into the waste drains system.

Sample streams flowing out of the isothermal bath are also run to a grab sample station (2/3 L-245), located above the south sample sink in the turbine plant laboratory.

The grab sample station consists of a rotameter with a needle valve and a three-way manual valve for each sample line. The samples flow continuously through the rotameters to the three-way valves, where they can be diverted to the sample drains system or to the sample sink. In this way, fresh samples are always available at this location.

The condenser hotwell samples are pumped to the hotwell sample racks 2L-31 (Unit 2) and 3L-31 (Unit 3) located on the east side of each main condenser, on elevation 7.0 ft. The samples flow through continuous analyzers on the rack and then back to the condenser.

1.0 OBJECTIVE (continued)

1.3 Sample and Analyzer Location

The following is a list of the various samples that are available throughout the turbine plant system.

1.3.1 Turbine Plant Laboratory (Elevation 30.0 ft.)

.1 Laboratory Sink Grab Samples, Units 2/3

North Steam Generator Blowdown (E-088)
South Steam Generator Blowdown (E-089)
North Steam Generator Main Steam (E-088)
South Steam Generator Main Steam (E-089)
Combined First Point Heater Outlet (E-036/E-037)
Combined Condensate Pump Discharge

.2 Laboratory Analyzer Samples, Units 2/3

Analysis Performed

Sample	pH	Cat. Cond.	Cond.	N_2H_4	O_2	Na^+	Radiation Leak Det.
N Stm. Gen. BD	X	X					X
S Stm. Gen. BD	X	X					X
N Main Stm.			X				
S Main Stm.			X				
Comb.1st Pt.Htr.	X	X	X	X	X	X	
Comb.Cond.Pp.Dis.	X	X	X		X	X	

1.3.2 Local Analyzer Samples

.1 Unit 2

.1.1 Condenser Hotwell Sample System (Elevation 7.0 ft.)

Northeast Condenser -- Cation conductivity and Sodium (Na^+) Analyzers
Northwest Condenser -- Cation conductivity and Sodium (Na^+) Analyzers
Southeast Condenser -- Cation conductivity and Sodium (Na^+) Analyzers
Southwest Condenser -- Cation conductivity and Sodium (Na^+) Analyzers

1.0 OBJECTIVE (continued)

1.3.2 Local Analyzer Samples (continued)

.1.2 Condensate/Feedwater System

Combined Condensate Pump Discharge (Elevation 30.0 ft.) -- Turbidity Analyzer
Combined 1st Point Heater Discharge (Elevation 30.0 ft.) -- Turbidity Analyzer

.2 Unit 3

(To be added at a future date.)

1.3.3 Local Samples

.1 Unit 2

Sample Point	El.,ft.	Location
N Stm Gen (E-088), 2AP6756	30	Pipe Penetration Rm, Penetrtn 17
S Stm Gen (E-089) 2AP6750	30	Pipe Penetration Rm, Penetrtn 44
N Main Stm (E-088), 2A6745	43	NE of Air Eject HEPA filter
S Main Stm (E-089), 2A6744	43	NE of Air Eject HEPA filter
E Reheat Main Stm Drain TK, (T-101) 2AN6764	34	Between N & S 1st Pt Htrs
W Reheat Main Stm Drain TK, (T-098) 2AN6767	34	Between N & S 1st Pt Htrs
E Reheat Bled Stm Drain TK, (T-099) 2AN6763	34	N-side of N 2nd Pt Htr
W Reheat Bled Stm Drain TK, (T-097) 2AN6766	34	S-side of S 2nd Pt Htr
E Reheat Moist Sep Drn TK, (T-100) 2AN6762	34	N-side of N 2nd Pt Htr
W Reheat Moist Sep Drn TK, (T-096) 2AN6765	34	S-side of S 2nd Pt Htr

1.0 OBJECTIVE (continued)

1.3.3 Local Samples (continued)

.1 Unit 2 (continued)

Sample Point	El.,ft.	Location
NE Hot Well Quadrant 2PI6703B	7	W-side of N condenser
NW Hot Well Quadrant 2PI6702B	7	W-side of N condenser
SE Hot Well Quadrant 2PI6701B	7	W-side of S condenser
SW Hot Well Quadrant 2PI6700B	7	W-side of S condenser
Comb Cond Pp Disch, 2AN6706 or 2AN6791	30	SW of Stm Gen BD Flash TK
Turbidity Analyzer Effluent Comb Cond Pp Disch, 2AN6789, 2AE6789	30	SW of Stm Gen BD Flash TK under stairs
Comb Inlet to 6th Pt Htrs, (AE & GSC Disch), 2AN6710	7	Directly below Air Eject
N 6th Pt Htr Out (E-046), 2AN6714	43	N of E-end N 6th Pt Htr on N concrete turbine pedestal
C 6th Pt Htr Out (E-047), 2AN6715	43	E-end C 6th Pt Htr
S 6th Pt Htr Out (E-048), 2AN6716	43	S of E-end S 6th Pt Htr on S concrete turbine pedestal
N 5th Pt Htr Out (E-044), 2AN6723	43	E-end of N 5th Pt Htr
S 5th Pt Htr Out (E-045), 2AN6721	43	E of E-end S 5th Pt Htr

1.0 OBJECTIVE (continued)

1.3.3 Local Samples (continued)

.1 Unit 2 (continued)

Sample Point	El.,ft.	Location
N 4th Pt Htr Out (E-042), 2AN6727	56	NE-end of N 4th Pt Htr
S 4th Pt Htr Out (E-043), 2AN6725	56	SE-end of S 4th Pt Htr
N 3rd Pt Htr Out (E-040), 2AN6730	34	NE-end of N 3rd Pt Htr
S 3rd Pt Htr Out (E-041), 2AN6731	34	SE-end of S 3rd Pt Htr
N 2nd Pt Htr Out (E-038), 2AN6733	34	N-side of N 2nd Pt Htr
S 2nd Pt Htr Out (E-039), 2AN6732	34	S-side of S 2nd Pt Htr
Comb FW to Stm Gens, 2AN6738A	43	S-end of Air Eject HEPA filter
Turbidity Analyzer Effluent Comb FW to Stm Gens, 2AN6738, 2AE 6772	30	SW of Stm Gen BD Flash Tank under stairs
N 1st Pt Htr Out (E-037), 2AN6738B	43	S-end of Air Eject HEPA filter
S 1st Pt Htr Out (E-036), 2AN6738C	43	S-end of Air Eject HEPA filter
N 1st Pt Htr Drips, 2AN6737	43	Between N & S 1st Pt Htrs
S 1st Pt Htr Drips, 2AN6736	43	Between N & S 1st Pt Htrs

1.0 OBJECTIVE (continued)

1.3.3 Local Samples (continued)

.1 Unit 2 (continued)

Sample Point	El.,ft.	Location
N 2nd Pt Htr Drips, 2AN6733	34	N-side of N 2nd Pt Htr
S 2nd Pt Htr Drips, 2AN6732	34	S-side of S 2nd Pt Htr
E 3rd Pt Htr Drain Tk (T-094), 2AN6729	7	SW of S Htr drain Tk pump
W 3rd Pt Htr Drain Tk (T-095), 2AN6728	7	SW of S Htr drain Tk pump
N 4th Pt Htr Drips, 2AN6724	43	W of W-end N 5th Pt Htr
S 4th Pt Htr Drips, 2AN6726	43	W-end of S 5th Pt Htr between S 5th & S 6th Pt Htrs
N 5th Pt Htr Drips, 2AN6722	30	E-end C 6th Pt Htr on E wall of N-center concrete turbine pedestal
S 5th Pt Htr Drips, 2AN6720	30	NW of Air Eject
N 6th Pt Htr Drips, 2AN6713	30	E-end C 6th Pt Htr on E wall of N-center concrete turbine pedestal
C 6th Pt Htr Drips, 2AN6712	30	E-end C 6th Pt Htr on E wall of S-center concrete turbine pedestal
S 6th Pt Htr Drips, 2AN6711	30	NW of Air Eject
Air Ejector Drips, After Cond		(To be added at a future date.)

1.0 OBJECTIVE (continued)

1.3.3 Local Samples (continued)

.1 Unit 2 (continued)

Sample Point	El.,ft.	Location
Turbidity Analyzer Effluent BD System Comb Filter Out (F-450 & F-451) 2AP3704, 2AE3704	7	E of Units 2/3 Chem Feed Area
N BD Demin (T-144) 2AP3734	7	Between N & S BD Demins on N Demin eff line
S BD Demin (T-145) 2AP3740	7	Between N & S BD Demins on S Demin eff line
BD Demin Sys H_2SO_4 soln dilution, 2APC702	7	E of BD Demins
BD Demin Sys NaOH soln dilution, 2APC703	7	E of BD Demins
Condensate Storage Tank (T-120) 2AP (Later)	29	N of Storage Tank Area on Cond Transf Pp Disch
Condensate Storage Tank (T-121), 2AP (Later)	29	(To be added at a future date.)
NE Cond Circ Wtr In, Cl_2 2AN5151	7	N cond inlet pedestal, E side of NE inlet conduit
NW Cond Circ Wtr In, Cl_2 2AN5155	7	N cond inlet pedestal, W side of NW inlet conduit
SE Cond Circ Wtr In, Cl_2 2AN5153	7	S cond inlet pedestal, E side of SE inlet conduit
SW Cond Circ Wtr In, Cl_2 2AN5157	7	S cond inlet pedestal, W side of SW inlet conduit
NE Cond Circ Wtr Out, Cl_2 2AN5104	7	Center of Main Cond, EE outlet conduit, SW side

1.0 OBJECTIVE (continued)

1.3.3 Local Samples (continued)

.1 Unit 2 (continued)

Sample Point	El.,ft.	Location
NW Cond Circ Wtr Out Cl_2 2AN5105	7	Center of Main Cond, WW outlet conduit, SE side
SE Cond Circ Wtr Out, Cl_2 2AN5106	7	Center of Main Cond, Center E outlet conduit, SW side
SW Cond Circ Wtr Out, Cl_2 2AN5107	7	Center of Main Cond, Center W outlet conduit, SE side
Comb Circ Wtr Out, Cl_2 (use Portable Sample Pump)	29	Unit 2 outfall gate
Turb Plt Cool Wtr Ht Xchgr Out, Cl_2, 2AP6610	9	E end of S heat Xchgr
Component Cool Wtr Ht Xchgr Out, Cl_2, 2AP5293	-7	Main Circ Pp basement, SW of W Circ Pp (P-118)
Turbine Plt Cool Wtr Sys 2PI6941 and 2PI6953	29	Disch of W and E Cool Wtr Circ Pps.
Turbine Plt Cool Wtr Sys Surge Tk, 2AP6942	29	S side of Surge Tank
Component Cool Wtr, Non-Critical Loop, 2AP6285	30	SW end of Pipe Penetration Room
Component Cool Wtr, "A" Loop, 2AP6283	8	N of Comp Cool Wtr Ht Xchgrs, Rm 022
Component Cool Wtr, "B" Loop, 2AP6287	8	N of Comp Cool Wtr Ht Xchgrs, Rm 024
Component Cool Wtr, A and/or B Loops, 2PI6315, 2PI6321 & 2PI6325	-5	Rooms 008, 007 and 006, respectively

1.0 OBJECTIVE (continued)

1.3.3 Local Samples (continued)

.1 Unit 2 (continued)

Sample Point	El.,ft.	Location
Stator Cooling Water	45	(To be added at a future date.)

.2 Unit 3

(To be added at a future date.)

.3 Common Systems, Units 2/3

Sample Point	El.,ft.	Location
Service Wtr to MU Demin	29	N side of A-Cat unit up stream of regulator
MU Demin Cat effluent (A, B & C) 2/3 AP E505A, B & C	29	S side of each Cat unit, respectively
MU Demin An effluent (A, B & C) 2/3 AP E518A, B & C	29	N side of each An unit, respectively
MU Demin Comb An effluent 2/3 PI E526	29	E side of A-An unit
MU Demin MB effluent (A & B) 2/3 AP E534 A&B	29	N side of each MB unit, respectively
MU Demin MB Comb effluent 2/3 PI E546	29	W side of B-MB unit
MU Demin bulk conc H_2SO_4 2/3 AP (Later)	29	(To be added at a future date.)
MU Demin bulk 50% NaOH 2/3 AP (Later)	29	(To be added at a future date.)
MU Demin, dilute H_2SO_4 2/3 AP (Later)	29	S side of W sump

1.0 OBJECTIVE (continued)

1.3.3 Local Samples (continued)

.3 Common Systems, Units 2/3

Sample Point	El., ft.	Location
MU Demin, dilute NaOH 2/3AP (Later)	29	W side of hot water tank
SG Blow Down Systems bulk conc H_2SO_4 (T-194)	29	(To be added at a future date.)
SG Blow Down Systems bulk 50% NaOH (T-195)	29	(To be added at a future date.)
Chlorination System, bulk Sodium Hypochlorite (T-139)	29	(To be added at a future date.)
Chilled Wtr Sys, Normal 2/3 PI 9551 and 2/3 PI9554	9	W side Aux Bldg, Rm 116 (P-158 and 159)
Chilled Wtr Sys, Emerg "A" Loop 2/3 PI9873	9	W side Aux Bldg, Rm 115 (P-162)
Chilled Wtr Sys, Emerg "B" Loop 2/3 PI9893	9	W side Aux Bldg, Rm 117 (P-160)
Chemical Feed Sys, bulk Ammonia Storage (T-119)	29	(To be added at a future date.)
Aux Boiler Wtr BD (B-001) 2/3 AP4813	29	N side of Aux boiler
Aux Blr Deaerator Out (T-018) 2/3 AP4864	29	W end of Deaerating heater
Oily Waste Float Sep, Influent 2/3 AP5264	29	NW corner of separator unit
Oily Waste Float Sep, effluent 2/3 AP5205	29	NW corner of separator unit
Turbine Plt Sample Drain Tk 2/3 PI6748	9	SW corner of Room 107

2.0 REFERENCE

2.1 Station Manual System Descriptions, San Onofre Nuclear Generating Station: Units 2 and 3, Southern California Edison Company, San Diego Gas and Electric Company; Volume 2, Section 62 "Turbine Plant Sampling System"; December 1977.

2.2 SONGS Units 2/3 Chemical and Radiation Protection Procedures series SO23-III and SO23-VII, respectively.

3.0 PREREQUISITES

3.1 Equipment and Reagents

3.1.1 The equipment and reagents will be those which are described in the applicable Chemical or Radiation Protection Procedures -- series SO23-III and SO23-VII, respectively.

4.0 PRECAUTIONS AND LIMITATIONS

4.1 Wear face and eye protection equipment when sampling local pressurized systems. Be sure (1) that continuously running laboratory sink samples are diverted to the sample drain tank when not required for analysis sampling and (2) that local samples are properly secured after samples have been obtained.

4.2 Check the applicable radiation and contamination survey information before performing your job. Use the survey information to assist in maintaining your exposure ALARA.

5.0 CHECK-OFF LISTS

5.1 See applicable Chemical (series SO23-III) or Radiation Protection (series SO23-VII) procedures.

6.0 PROCEDURE

6.1 Laboratory sink sample flows should be adjusted to a flow rate of 500 ml per minute at a nominal temperature of 25°C.

6.2 Local sample flows should be adjusted to maintain sample temperature at 25 ± 5°C -- this usually results in a sample flow of approximately 500 ml per minute. However, some difficulty may be encountered in regulating sample temperature to less than 30°C for those local sample points located between the combined condensate pump discharge and the 6th point heater outlet.

7.0 RECORDS

7.1 See applicable Chemical (series SO23-III) or Radiation Protection (series SO23-VII) procedures.

8.0 ATTACHMENTS

8.1 None

H E Morgan
H. E. MORGAN
SUPERINTENDENT UNITS 2 AND 3

APPROVED:

JM Curran/slew
J. M. CURRAN
PLANT MANAGER

AJP/ap

SECONDARY SYSTEM OUTAGE PROTECTION

1.0 OBJECTIVE

1.1 Purpose

The purpose of this Chemical Procedure is to outline methods to be utilized to minimize corrosion of the various secondary plant subsystems during periods of startup, shutdown and outage. It is essential that this procedure be stringently complied with in order to maintain operating integrity of all system components.

1.2 Background

The most common form of corrosion encountered in the steam generator and feedwater/condensate system results from oxygen attack in the presence of water. During secondary plant operation, continual dearation and continuous feed of a chemical oxygen scavenger will effectively eliminate oxygen from the system. However, during outages, the techniques required to prevent corrosion must often be modified. Outage protection as described in this Chemical Procedure consists of applying the proper safeguards to minimize such corrosion.

2.0 REFERENCES

2.1 S-E-2, "Operation, Maintenance and Chemical Control of Heat Exchange Equipment."

2.2 S-E-3, "Outage Protection."

2.3 S023-III-2.3, "Secondary System Chemical Limits and Sampling Frequencies."

2.4 ANSI N45.2.1, "Cleaning of Fluid Systems and Associated Components During Construction Phase of Nuclear Power Plants;" American National Standards Institute, Feb. 1973.

2.5 "Chemistry Manual CENPD-28," Nuclear Power Systems, Combustion Engineering, Inc., Inc., Winsor, CT 06095; Revision No. 3, Jan. 1978.

3.0 PREREQUISITES

3.1 Equipment and Reagents

The equipment and reagents required for this procedure are specified in the following analytical procedures:

3.0 PREREQUISITES (continued)

3.1 Equipment and Reagents (continued)

3.1.1 SO23-III-2.1 "Spectrophotometric Determination of Ammonia with Nessler's Reagent".

3.1.2 SO23-III-2.2 "Determination of Dissolved Oxygen by Indigo Carmine".

3.1.3 SO23-III-2.9 "Conductivity and Cation Conductivity".

3.1.4 SO23-III-2.17 "Determination of Hydrazine with p-Dimethylaminobenzaldehyde".

3.1.5 SO23-III-2.18 "Titrametric Determination of High Concentrations of Hydrazine".

3.1.6 SO23-III-2.27 "pH by Potentiometric Determination".

3.1.7 SO23-III-2.43 "Suspended Solids".

3.2 Treatment Chemicals

3.2.1 Ammonium hydroxide NH_4OH -- pH control

3.2.2 Hydrazine, N_2H_4 -- oxygen scavenger

4.0 PRECAUTIONS AND LIMITATIONS

4.1 Check the applicable radiation and contamination survey information before performing your job. Use the survey information to assist in maintaining your exposure ALARA.

5.0 CHECK-OFF LISTS

5.1 Startup - Log all startup chemistry data on SO(2/3)-1042-12, "Unit Start-Up Sheet".

5.2 Shutdown - Log all shutdown chemistry data on SO(2/3)-1042-8, "Daily Turbine Plant Summary Sheet".

5.3 Outage Protection - Log all physical and chemical outage protection measures on the "Daily Turbine Plant Summary Sheet" on the day of shutdown and on the "Unit Start-Up Sheet".

6.0 PROCEDURE

6.1 Method

6.1.1 Startup Protection

In preparation for unit startup, two or more condensate pumps are used to circulate treated (N_2H_4 and NH_3) demineralized water (at 7500 gpm) from the four main condenser hot well quadrants through the feedwater trains, and back to the main condenser. The purpose of this operation is to remove loosely adherent ferric oxide (Fe_2O_3) that may have accumulated during the unit outage period.

The condensate pumps are then shutdown, the condensate/feedwater system is drained, and then refilled with treated demineralized water. It is at this stage that startup protection chemicals limits will have an influence on the progress of the unit startup.

Following the pre-startup flush, dump and refill, circulation of the condensate/feedwater system is reestablished at 7500 gpm; hydrazine and ammonia feeds are initiated; gland sealing steam from the auxiliary boiler is valved to the main turbine seals and to the seals of both feedwater pump turbines; vacuum is established on the main condenser; and steam (from aux. blr.) is admitted to the shell side of the 4th point heaters to bring the condensate/feedwater system to a temperature of 180°F. The purpose of these operations is to purge the system of dissolved oxygen, convert ferric oxide (Fe_2O_3) to magnetite (Fe_3O_4) and to stabilize the system pH.

To aid in system cleanup, a side stream flow of 1250 gpm is passed through the blowdown ion-exchanger to remove Fe_3O_4 and other contaminants before returning the processed effluent to the main condenser hotwells.

Coincidental with the cleanup of the condensate/feedwater system, the steam generators are filled, and their volumes maintained, with treated (N_2H_4 and NH_3) demineralized water by way of the auxiliary feedwater system.

Upon completion of unit startup, the entire system should be operating within normal chemical limits referenced in Procedure SO23-III-2.3.

6.0 PROCEDURE (continued)

6.1.1 Startup Protection (continued)

.1 Hotwells

Prior to system startup each hotwell quarter shall be sampled and analyzed for pH, conductivity, chloride and suspended solids to determine if the water therein is acceptable for circulation through the feedwater heater trains.

All hotwells which do not meet feedwater specifications (see 6.2.1) shall be pumped down to minimum level -- overboarding the water to the circulating water outfall -- and refilled with demineralized water from the secondary plant condensate storage tank.

.2 Feedwater Systems

Each feedwater train shall be analyzed for dissolved oxygen hydrazine, pH, conductivity (specific and cation) and suspended solids. The concentration of hydrazine in the feedwater system shall be maintained at a concentration ratio of 4:1 (N_2H_4 to O_2) in order to inhibit the corrosive effects of oxygen and to assure a reducing environment for the conversion of ferric oxide to magnetite.

The feedwater system shall not be allowed to feed the steam generators until the water meets the startup specifications for both systems. (See 6.2.1)

.3 Steam Generators

Each steam generator shall be sampled and analyzed for dissolved oxygen, hydrazine, pH, conductivity, suspended solids and chloride. Blowdown through the blowdown ion exchangers should be initiated as required to clean up the system.

6.0 PROCEDURE (continued)

6.1.2 Shutdown Protection

.1 Feedwater System

Increase hydrazine feed to maximum as soon as shutdown operations commence. Hydrazine should be maintained at a concentration 1.5 times (or greater) the dissolved oxygen concentration.

6.1.3 Outage Protection

The type and extent of outage protection to be utilized for a given outage will depend upon the duration of that outage, the type of maintenance to be performed during the outage and the requirements for unit availability.

Outage conditions exist whenever the steam generators are at a temperature less than 227°F and/or 5 lb/in^2 gauge, while the pressure of the system is in the process of being reduced. Outage conditions are defined for two situations -- wet storage and dry storage; and for two durations -- short and extended. Short duration is defined as four days or less; and extended duration is defined as greater than four days, up to two months. For outages greater than two months, dry storage is the only method of outage protection that should be utilized.

Outage protection for systems ancilliary to the major components of the secondary system are given in 6.2.4.

.1 Wet Storage - Short Duration ($t_{outage} \leq 4$ days)

Wet storage methods should be applied during short term outages or whenever unit availability must be maintained.

Vacuum shall be maintained on the main condenser and on the shell side of the 5th and 6th point heaters. The main circulating water pumps must be operating.

Pegging steam shall be maintained on the shell side of the 1st through 4th point heaters and on the steam generators.

6.0 PROCEDURE (continued)

6.1.3.1 (continued)

Wet storage outage conditions shall be monitored no less than twice weekly; and samples taken from the hotwells shall be analyzed for pH, conductivity and chloride, and those taken from the feedwater and steam generators for pH, conductivity, dissolved oxygen and hydrazine. Normal operating limits shall be maintained for wet storage outage protection of short duration. System should be circulated for 30 minutes prior to sampling -- if at all possible.

.2 Wet Storage - Extended Duration (4 days $< t_{outage} <$ 2 months)

If vacuum cannot be maintained on main condenser and on the shell side of the 5th and 6th point heaters, then these systems must be drained while still hot ($\geq$90°F). Also, if the main circulating water pumps are shutdown, the water boxes should be drained.

If steam pegging protection is not available, then a nitrogen overpressure of 5 psig shall be applied to the steam generators; and the shell sides of the 1st through 4th point heaters shall be flooded with demineralized water treated with 200 ppm hydrazine. These protective measures should be done prior to breaking vacuum on the main condenser and prior to the attainment of ambient temperature.

Wet storage outages of extended duration shall be monitored at least twice weekly; and samples taken from the steam generators and feedwater heaters shell side shall be analyzed for pH, conductivity and hydrazine; and checked for nitrogen overpressure, pH, hydrazine and nitrogen overpressure within these systems should be maintained at 10.0 ±0.2, 200 ±50 ppm N_2H_4, and $\geq$5.0 psig N_2. respectively. Prior to sampling, the system should be circulated for 30 minutes -- if at all possible.

.3 Dry Storage (t_{outage} > 2 months)

Hotwells should be drained while above ambient temperature (~92°F) and access panels opened to allow thorough drying of internal condenser surfaces.

6.0 PROCEDURE (continued)

6.1.3.3 (continued)

Feedwater heaters tube side and shell side should be drained while above ambient temperature (6th, 5th and 4th @ >220°F; and 1st @ 240°F).

In addition heater shell sides should be drained under a nitrogen overpressure atmosphere of 5.0 psig.

Steam generators must be drained hot -- beginning at 240°F -- under a nitrogen overpressure atmosphere.

Monitor and record, at least once per week, the nitrogen pressure on all heat exchange equipment under nitrogen atmosphere protection. Make adjustments as required to maintain N_2 at $\geq$5.0 psig.

6.2 Limits

6.2.1 Startup Protection

	HOTWELLS	FEEDWATER	STEAM GENS.	STEAM GEN AUX. FDWTR	AUX. BLR.	DEAERATOR
pH @25°C	9.0±0.2	9.0±0.2	9.0±0.5	9.0±0.2	9.0±0.5	9.0±0.2
Conductivity (Specific) @25°C	<10μmho/cm	<10μmho/cm	<15μmho/cm	<10μmho/cm	<10μmho/cm	<10μmho/cm
Conductivity (cation) @25°C	<1.5μmho/cm	<1.5μmho/cm	NA	NA	NA	NA
Chloride	≤0.1 ppm	NA	≤0.1 ppm	NA	<1.0 ppm	NA
Suspended Solids	<10 ppm	<10 ppm	<10 ppm	<10 ppm	<10 ppm	<10 ppm
Dissolved Oxygen	< ppb	<10 ppb	<10 ppb	<10 ppb	<10 ppb	<10 ppb
Hydrazine	NA	$4xO_2$ ppb	NA	$4xO_2$ ppb	NA	$4xO_2$ ppb

6.0 PROCEDURE (continued)

6.2.2 Shutdown Protection

	FEEDWATER	STEAM GENS.	AUX.BLR.	AUX. BLR. DEAERATOR
pH @25°C	9.0 ± 0.2	9.0 ± 0.5	9.0 ± 0.5	9.0 ± 0.2
Hydrazine	$2XO_2$ ppb	$2XO_2$ ppb	$2XO_2$ ppb	$2XO_2$ ppb

Shutdown limits for the auxiliary feedwater (to steam generators) system are the same as the startup limits in 6.2.1.

6.2.3 Outage Protection

.1 Wet Storage - Short Duration ($t_{out} \leq$ 4d)

Vacuum on main condenser; steam pegging on shell side of feedwater heaters and on steam generators:

	HOTWELLS	FEEDWATER HEATERS	STEAM GENERATORS	AUX.BLR.	AUX. BLR. DEAERATOR
pH @25°C	9.0±0.2	9.0±0.2	9.0±0.5	9.0±0.5	9.0±0.2
Conductivity (Specific) @25°C	<10μmho/cm	<10μmho/cm	<15μmho/cm	<15μmho/cm	<10μmho/cm
Chloride	<0.15 ppm	NA	<0.15 ppm	<1.0 ppm	NA
Dissolved Oxygen	<100 ppb	<10 ppb	<10 ppb	<10 ppb	<10 ppb
Hydrazine	NA	$\geq 2 \times O_2$	$\geq 2 \times O_2$	$\geq 2 \times O_2$	$\geq 2 \times O_2$

.2 Wet Storage - Extended Duration (4d $< t_{out} <$ 2 mo)

No vacuum on main condenser, hotwells drained; N_2 overpressure on shell side of feedwater heaters and on steam generators.

6.0 PROCEDURE (continued)

6.2.3.2 (continued)

	FEEDWATER HEATERS TUBE SIDE	FEEDWATER HEATERS SHELL SIDE	STEAM GENERATORS	AUX.BLR.	AUX. BLR. DEAERATOR
pH @25°C	10.0±0.2	10.0±0.2	10.0±0.2	10.0±0.2	9.0±0.2
Hydrazine	200 ±50 ppm	200 ±50 ppm	200 ±50 ppm	200 ±50 ppm	100 ±50 ppm
Dissolved Oxygen	<100 ppb	NA	<100 ppb	<100 ppb	<100 ppb

.3 Dry Storage - Extended Duration (t_{out} >2 mo)

All systems drained under following condition:

	HOTWELLS	FEEDWATER HEATERS TUBE SIDE	FEEDWATER HEATERS SHELL SIDE	STEAM GENERATORS	AUX.BLR.	AUX. BLR. DEARATOR
pH @25°C	9.0±0.2	9.0±0.2	9.0±0.2	9.3±0.3	9.3±0.3	9.0±0.2
Hydrazine	NA	>4xO_2 ppb	NA	>4xO_2 ppb	>4xO_2 ppb	>4xO_2 ppb
Temp. °F	~90	(Between 90 & 240)		~240	90 - 240	~240
N_2 overpress. (1.0-5.0 psig)	NO	NO	YES	YES	NO	NO

6.2.4 Outage Protection - Ancilliary Systems

SYSTEM DESIGNATION	SYSTEM	INTERNAL CLEAN. CLASS*	TENTATIVE FLUSH METHOD**	OUTAGE PROTECTION PRE-STARTUP	OUTAGE PROTECTION POST STARTUP
	MAIN POWER CYCLE				
ADA/AEA	Condensate/Feedwater Sys.	C/D	PF	(See	6.2.3)
ALA	Auxiliary Feedwater	C	PF	1	2
AQA	Condensate & FW Chemical Feed	C	PF	1	3

6.0 PROCEDURE (continued)

6.2.4 (continued)

SYSTEM DESIGNATION	SYSTEM	INTERNAL CLEAN. CLASS*	TENTATIVE FLUSH METHOD**	OUTAGE PROTECTION PRE-STARTUP	OUTAGE PROTECTION POST STARTUP
APA	Condensate Transfer & Storage	C	WC/PF	2	2
CGA	Condenser Air Removal	D	SF	1	NONE
ANA	Demineralized Wtr. M.U & Transf.	B	PF	2	2
AFA	Feedwater Heaters Extractions	C	WC/PF	1	NONE
ABA-B	Main Steam	C	WC	1	NONE
ACA	Main Turbine	C	WC	1	NONE
ACA	Main Turbine L.P. Exhaust Spray	C	PF	1	NONE
BMA	Steam Gen. Blowdown Processing	C/D	SF	1	NONE
RCA	Turbine Plant Sampling	C/D	PF	1	NONE
	TURBINE-GNERATOR CONTROLS				
CAA	Steam Seals	C	PS	1	NONE
CBA	Main Turbine & Gen. Lube Oil	C	PF	1/3	3
CCA	Generator H_2 & CO_2	C	PB	1/3	3
CDA	Hydrogen Seal Oil	C	PF	1/3	3
CFA	Lube Oil Storage, Transf. & Purif.	C	PF	1/3	3
CHA	Main Turbine Controls	C	PF	1/3	3

6.0 PROCEDURE (continued)

6.2.4 (continued)

SYSTEM DESIGNATION	SYSTEM	INTERNAL CLEAN. CLASS*	TENTATIVE FLUSH METHOD**	OUTAGE PROTECTION PRE-STARTUP	POST STARTUP
CEA	Stator Water Cooling	C	PF	1/2	2
	CIRCULATING WATER				
DAA	Main Circ. Water	D	HC	1/3	NONE
DCA	Traveling Screens & Fish Handlg.	D	PF	1/3	3/4
DDA	Chlorine Injection	D	HC/SF	1/3	NONE
DEA	Amertap	D	HC/SF	1/3	NONE
	COOLING & CHILLED WATER				
EBA	Turbine Plant Cooling Wtr.	D	PF	2/***	2
EPA	Salt Water Cooling	D	HC	1/3	NONE
GBA/GJA/GND	Chilled Water (Normal and emergency, all systems)	D	PF	2/***	2
	AUXILIARY STEAM				
FAA	Auxiliary Boiler	C	CC	(See	6.2.3)
FBA	Auxiliary Steam	C	PS/SF	1	NONE
FCA-B	Auxiliary Turbines	C	SF	1	NONE
	ANCILLIARY SERVICES				
KAA	Compressed Air (Service)	D	PB	1/3	3
KBA	Critical Compressed Air (Instr.)	C	PB	1/3	3
KDA	Domestic Water	D	PF	1/3	3

6.0 PROCEDURE (continued)

6.2.4 (continued)

SYSTEM DESIGNATION	SYSTEM	INTERNAL CLEAN. CLASS*	TENTATIVE FLUSH METHOD**	OUTAGE PROTECTION PRE-STARTUP	OUTAGE PROTECTION POST STARTUP
EAA	Service Water	D	PF	1/3	3
KCA	Fire Protection, Water	D	PF/PB	1/3	3
KCB	Fire Protection, Halon	D	PB	1/3	3
KCC	Fire Protection, CO_2	D	PB	1/3	3
KHA	Services Nitrogen, L.P.	B/C	PB	1/3	3
KLA	Service Hydrogen	B/C	PB	1/3	3
KJA-B	Standby Diesel Egn. Water	C	PF	1/3	3
KJA-B	Standby Diesel Eng. Air.	C	PB	1/3	3
	MISCELLANEOUS				
JAA	Aux. Boiler Fuel Oil	C	PF/PB	1/3	3
JEA	Standby Diesel Fuel Oil	C	PF/PB	1/3	3
	NON-RADIOACTIVE DRAINS				
LEA	Oily Waste	D	HC	1/3	NONE
LFA	All Turbine Plt., Gravity	D	DF	1/3	NONE
LFB	Diesel Bldg., Gravity	D	DF	1/3	NONE

6.0 PROCEDURE (continued)

6.2.4 (continued)

* INTERNAL CLEANNESS CLASS:

A, B, C and D: Reference 2.4, ANSI Standard N45.2.1-1973.

** TENTATIVE FLUSH METHOD:

CC Chemically Cleaned by Startup
DF Drains opened and flushed via master restoration procedure
HC Manually Cleaned Before Filling -- No Wiping
PB Gas Blown Procedure
PF Proof Flush Procedure
PS Steam Blown Procedure
SF Flushed or Blown as a Part of Startup Procedure
WC Manually Cleaned and Wiped

OUTAGE PROTECTION:

1. Lay up clean an dry (Ref. 2.4)

2. Use normal operating limits for outage protection control (Ref. 2.1 and 2.3).

3. Normal system fluid.

4. Wash screens with service water.

*** A Procedure Change Notice (PCN) may be required for outage protection of various in-service subsystems -- such as the Units 2/3 air compressor cooling loop -- prior to plant startup. These PCN's will be issued by the Units 2/3 Chemical/Radiation Protection Supervisor or Operations Supervisor, as required.

6.3 Acceptance Criteria

6.3.1 Commercial Operation

Secondary plant systems shall be protected during unit startup, shutdown, and during outage conditions in accordance with the chemical limits and layup techniques described in 6.1. Corrective action recommendations for out-of-limits conditions shall be made by the Chemical Radiation Protection Foreman and/or by the Chemical Radiation Protection Engineer.

6.0 PROCEDURE (continued)

6.3.2 Construction Phase Through Initial Startup

From a corrosion aspect, the final phase of construction, through hot functional testing, and the final stages of initial startup, are the most critical periods during the lieftime of any power plant. Therefore, the chemical control limits delineated by this document in 6.2 (in conjunction with the documents listed in 2.0 REFERENCES) shall be used as a guide for unit outage protection during this critical pre-commercial period.

7.0 RECORDS

7.1 Shutdown, startup and outage protection data shall be recorded on the appropriate data sheet(s) as specified in paragraph 5.0 CHECK-OFF LISTS.

7.2 All SO(2/3)-1042-8 and SO(2/3)-1042-12 data sheets shall be transferred to the EDM Center on a monthly basis and filed under the following encode numbers: CN05-AX2 (SO2/3) and CN05-AX startup (AA08-AX), respectively.

7.3 Copies of all data sheets should be made for retention in the secondary plant laboratory files prior to transfer to the EDM Center.

7.4 The cognizant Chemical Radiation Protection Foreman and/or Engineer shall review all data sheets as required prior to transfer to EDM.

8.0 ATTACHMENTS

8.1 None

H E Morgan
H. E. MORGAN
SUPERINTENDENT UNITS 2 AND 3

APPROVED:

J M Curran /
J. M. CURRAN
PLANT MANAGER

AJP/ap

40. Emergency Planning

Question 432.23

Identify radiological laboratories and their capabilities and expected response times.

Response

LFE Environmental Analysis Laboratories is located in Richmond, California.

LFE Environmental Analysis Laboratories has stated that in the event of an accident at the San Onofre Nuclear Generating Station, all of their resources could be directed towards assistance in offsite radioanalysis. Accordingly, response times for various analyses are dependent on transport time and physical analysis requirements. Some examples of analysis times from receipt at Oakland International Airport follow:

	Analysis	Results Available
23	TLD	Within 2 hrs
	Air samples	Within 5 hrs
	Water	Qualitative within 3 hrs Quantitative within 24 hrs
	Leafy Vegetation (Iodines)	Qualitative within 5 hrs Quantitative within 3 days

Transport time to Oakland International Airport can be assumed to be approximately 3 hours.

Reference

None.

Question 432.49

Provide decontamination capability for evacuated personnel.

Response

23 In the event that site personnel who have been evacuated are found to be contaminated, they will be returned to the site decontamination facilities for the unaffected plant; i.e., if Unit 2 or 3 has been affected, the Unit 1 decontamination facilities will be used.

Reference

None.

Question 432.58

Provide an index which covers any state and local plans, and a cross reference between your plan and each criteria in NUREG-0654.

Response

An index which covers state and local plans will be provided in the Emergency Plan for San Onofre, Units 2 and 3.

A cross reference between the Emergency Plan, San Onofre Nuclear Generating Station, Units 2 and 3 and the evaluation criteria of NUREG-0654 is presented in table 432.58-1. 23

Reference

Emergency Plan.

Table 432.58-1
CROSS-REFERENCE OF SONGS 2 & 3 EMERGENCY PLAN
TO NUREG-0654 (Sheet 1 of 7)

	NUREG-0654	SONGS 2 & 3 EP SECTION
Section A:	Assignment of Responsibility	
1a		3.0, 5.4, Table 5.3
1b		3.0, Table 5.3
1c		Fig. 5.4, Fig. 7.4
1d		5.2.1, Appendix B
1e		Table 5.3 item 3
2a		Not applicable to licensee
2b		Not applicable to licensee
3		Appendix A
4		3.0, 6.1
Section B:	Onsite Emergency Organization	
1		5.1, 5.2, Fig. 5.1, 5.2, Table 5.2
2		5.2.1, Appendix B
3		5.2.1, Appendix B
4		5.2.1, Appendix B
5		5.2.2 through 5.2.9, Table 5.2
6		Fig. 5.4, Table 5.3, Fig. 7.4
7		5.3.1, Fig. 5.3/5.4, Corporate Radiological Emergency Support Organization Manual
8		6.1.3.3
9		5.3.2, Appendix A

Table 432.58-1
CROSS-REFERENCE OF SONGS 2 & 3 EMERGENCY PLAN
TO NUREG-0654 (Sheet 2 of 7)

NUREG-0654	SONGS 2 & 3 EP SECTION
Section C: Emergency Response Support and Resources	
1	5.4.2.2, 6.1.4.3
2a	Not applicable to licensee
2b	3.3, 5.4, Fig. 5.4
3	5.3.2 (to be provided)
4	5.3.2 (to be provided)
Section D: Emergency Classification System	
1	4.1, Table 4.1/4.3* *instruments identified in emergency procedures
2	4.2, Table 4.3
3	Not applicable to licensee
4	Not applicable to licensee
Section E: Notification Methods and Procedures	
1	6.1, Table 4.4/5.4/6.1
2	6.1, Table 7.1
3	Emergency Procedures
4	Emergency Procedures
5	Not applicable to licensee
6	Admin--6.1 Phys--discussed under separate cover
7	Emergency Procedures

23

Table 432.58-1
CROSS-REFERENCE OF SONGS 2 & 3 EMERGENCY PLAN
TO NUREG-0654 (Sheet 3 of 7)

NUREG-0654		SONGS 2 & 3 EP SECTION
Section F:	Emergency Communications	
1a		6.1, Table 5.4/6.1/7.1/7.2, Fig. 7.4
1b		see above
1c		Table 5.4/7.1
1d		Table 5.4/7.1
1e		Table 7.1
1f		Table 5.4/7.1
2		To be provided
3		3.4, 8.1.2
Section G:	Public Education and Information	
1		8.4 (to be provided)
2		8.4 (to be provided)
3a		6.6 (to be provided)
3b		6.6 (to be provided)
4a		6.6 (to be provided)
4b		6.6 (to be provided)
4c		6.6 (to be provided)
5		6.6 (to be provided)
Section H:	Emergency Facilities and Equipment	
1		7.1.2, 7.1.3
2		5.4, 7.1.4
3		Not applicable to licensee
4		6.1, Table 4.2/4.4/6.1
5a		Table 7.3
5b		Table 4.3/7.4/7.7
5c		Table 7.5/4.3
5d		Table 7.6, Appendix D

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Table 432.58-1
CROSS-REFERENCE OF SONGS 2 & 3 EMERGENCY PLAN
TO NUREG-0654 (Sheet 4 of 7)

NUREG-0654	SONGS 2 & 3 EP SECTION
Section H: Emergency Facilities and Equipment (cont)	
6a	Table 7.3
6b	Table 7.4/7.7
6c	Table 7.7
7	Tables 7.3/7.4/7.7
8	Table 7.3
9	7.1.3, Appendix D
10	8.3
11	Appendix D, Tables 7.1-7.7
12	7.1.2.1
Section I: Accident Assessment	
1	Emergency Procedures
2	Table 4.3
3a	Emergency Procedures
3b	Emergency Procedures
4	Emergency Procedures
5	To be provided
6	Emergency Procedures
7	Table 5.1/7.3/7.4/7.7 Emergency Procedures
8	Emergency Procedures Table 4.2/4.4/5.1/6.1
9	Emergency Procedures
10	Emergency Procedures
11	Not applicable to licensee

23

Table 432.58-1
CROSS-REFERENCE OF SONGS 2 & 3 EMERGENCY PLAN
TO NUREG-0654 (Sheet 5 of 7)

NUREG-0654	SONGS 2 & 3 EP SECTION
Section J: Protective Response	
1	6.4.1, Table 4.2
2	6.4.1, 7.3.4, 7.3.5, Fig. 7.3
3	6.5.2
4	6.4.1
5	6.4.1
6	6.4.1
7	6.4.2.1 (to be provided)
9	Not applicable to licensee
10a	Appendix E
23 10b	Appendix E
10c	To be provided
10d-101	Not applicable to licensee
10m	6.4.2.1 (to be provided)
11	Not applicable to licensee
12	Not applicable to licensee
Section K: Radiological Exposure Control	
1	6.5.1, Table 6.2
2	Normal Radiation Protection Procedures, Table 6.2
3a/3b	Normal Radiation Protection Procedures
4	Not applicable to licensee
5a	Normal Radiation Protection Procedures
5b	6.5.2, Appendix D

Table 432.58-1
CROSS-REFERENCE OF SONGS 2 & 3 EMERGENCY PLAN
TO NUREG-0654 (Sheet 6 of 7)

	NUREG-0654	SONGS 2 & 3 EP SECTION
Section K:	Radiological Exposure Control (cont)	
6		Normal Radiation Protection Procedures
7		6.5.2, Appendix D
Section L:	Medical and Public Health Support	
1		6.5.3, 6.5.4, Appendix A
2		7.5, Table 8.1/5.2
3		Not applicable to licensee
4		6.5.3
Section M:	Recovery and Reentry Planning and Postaccident Operations	
1		9.1, 9.2, Emergency Procedures
2		9.2
3		Emergency Procedures
4		Emergency Procedures
Section N:	Exercises and Drills	
1a		8.1.2
1b		8.1.2
2		8.1.2
3		8.1.2
4		8.1.2
5		8.1.2

23

Table 432.58-1
CROSS-REFERENCE OF SONGS 2 & 3 EMERGENCY PLAN
TO NUREG-0654 (Sheet 7 of 7)

	NUREG-0654	SONGS 2 & 3 EP SECTION
Section O:	Radiological Emergency Response Training	
1a		8.1.1
1b		8.1.1
2		Training Procedures
3		Table 8.1
4		Table 8.1
5		Table 8.1
Section P:	Responsibility for the Planning Effort, etc.	
1		To be provided
2		8.1.3
3		8.1.3
4		8.2
5		8.2
6		2.0
7		Appendix C.
8		T of C
9		8.2
10		To be provided

43. SLB and FLB

Question

Explain the relationship of the San Onofre FSAR Steam Line Break Analysis and the Steam Line Break Analysis presented in CESSAR FSAR Appendix 15 C.

Response

Appendix 15C of CESSAR FSAR (Reference 1) provides a more detailed description of the steam line break mathematical model than is provided in subsection 15.1.3 of the San Onofre 2 & 3 FSAR. The mathematical model description in CESSAR Appendix 15C consists of a comprehensive summary of methods and descriptions previously provided as responses to NRC questions on San Onofre FSAR subsection 15.1.3 and, therefore, the CESSAR description is directly applicable to San Onofre.

Several notes follow which apply in reading CESSAR FSAR Appendix 15C as a description of San Onofre steam line break methods: (1) Replace the computer program name CESEC-II by CESEC, (2) The CESSAR steam generator design differs from San Onofre (CESSAR has two steam lines per steam generator, San Onofre has one steam line per steam generator; CESSAR includes integral flow restrictors in the steam generator outlet nozzles, San Onofre has flow restricting venturis in each steam line between the steam generator outlet nozzle and the containment penetration), (3) Refer to the responses to Questions 222.18 and 222.38 on subsection 15.1.3 for discussions of initial steam generator water inventory applicable to the San Onofre design.

References

1. CESSAR FSAR, Appendix 15C.

2. Responses to NRC Questions 222.18 and 222.38.

46. Fuel Building Ventilation System

SER OPEN ITEM NO. 46

Fuel Bldg. Ventil. System

SCE response to NRC question 312.44 described the addition of high throw air registers to the spent fuel pool HVAC discharge and also indicated that an analysis would be performed to verify adequate mixing.

In response to NRC concerns expressed during meetings held the week of December 15, 1980, SCE will perform the following tests on the Fuel Handling Building:

1. Air circulation and mixing test.

2. Fuel Handling Building positive pressure test.

The air circulation and mixing test will use qualitative criteria such as observation of streamers or smoke to verify adequate mixing. This test will be conducted on the Unit 3 Fuel Handling Bldg. and the test will be performed prior to storage of spent fuel in the Unit 2 spent fuel pool.

The fuel handling building positive pressure test will be performed to demostrate acceptable levels of exfiltration consistent with the assumptions of the fuel handling accident analysis. The acceptance criteria for this test will be based on the total measured leakage not exceeding 1300 scfm when the building is pressurized to approximately 0.1 inch of positive water pressure. This test will be performed on the Unit 3 Fuel Handling Building prior to storage of spent fuel in the Unit 2 spent fuel pool.

50. Snubber Inspection

Question 112.41

Due to a long history of problems dealing with inoperable and incorrectly installed snubbers, and due to the potential safety significance of failed snubbers in safety related systems and components, it is requested that maintenance records for snubbers be documented as follows:

a. Pre-service Examination

a pre-service examination should be made on all snubbers listed in tables 3.4-4a and 3.7-4b of Standard Technical Specifications 3/4.7.9. This examination should be made after snubber installation but not more than six months prior to initial system pre-operational testing, and should as a minimum verify the following:

(1) There are no visible signs of damage or impaired operability as a result of storage, handling, or installation.

(2) The snubber location, orientation, position setting, and configuration (attachments, extensions, etc.) are according to design drawings and specifications.

(3) Snubbers are not seized, frozen or jammed.

(4) Adequate swing clearance is provided to allow snubber movement.

(5) If applicable, fluid is to the recommended level and is not leaking from the snubber system.

(6) Structural connections such as pins, fasteners and other connecting hardware such as lock nuts, tabs, wire, cotter pins are installed correctly.

If the period between the initial pre-service examination and initial system pre-operational test exceeds six months due to unexpected situations, re-examination of items 1, 4, and 5 shall be performed. Snubbers which are installed incorrectly or otherwise fail to meet the above requirements must be repaired or replaced and re-examined in accordance with the above criteria.

b. Pre-Operational Testing

During pre-operational testing, snubber thermal movements for systems whose operating temperature exceeds 250° F should be verified as follows:

(a) During initial system heatup and cooldown, at specified temperature intervals for any system which attains operating temperature, verify the snubber expected thermal movement.

(b) For those system which do not attain operating temperature, verify via observation and/or calculation that the snubber will accommodate the projected thermal movement.

(c) Verify the snubber swing clearance at specified heatup and cooldown intervals. Any discrepencies or inconsistencies shall be evaluated for cause and corrected prior to proceeding to the next specified interval.

The above described operability program for snubbers should be included and documented by the pre-service inspection and pre-operational test programs.

The pre-service inspection must be a prerequisite for the pre-operational testing of snubber thermal motion. This test program should be specified in Chapter 14 of the FSAR.

Response

a. Pre-service Examination

A pre-service examination of each safety grade snubber is performed as part of the installation and acceptance procedures. Typically, the snubbers are the last pipe support item to be installed and inspected. This inspection will include but not necessarily be limited to the following:

(1) Snubbers are visually examined for signs of damage or impaired operability. Prior to installation, each snubber is fully stroked in both directions to verify operability. Any snubber showing signs of damage, binding or which makes unusual noises during stroking is either repaired or replaced.

23 (2) Snubber location, orientation, settings, and configuration are verified that they conform to the requirements of the design drawings and specifications.

(3) In addition to the operability examination described in (1) above, operability of spherical bearings is verified to assure freedom of movement.

(4) Adequate swing clearance is verified.

(5) Fluid level of hydraulic snubbers is verified upon installation and seals are inspected to verify no leakage is taking place.

(6) All structural connections are verified to be installed properly and in accordance with the design drawings and specifications. Thread or tube engagement lengths are verified on snubber extension kits.

Due to construction schedule requirements and unforeseen delays in plant start-up, the examinations described above may take place more than 6 months prior to pre-operational testing of the systems.

However, immediately prior to pre-operational testing of any safety grade system whose operating temperature exceeds 250F, the snubbers in that system will be visually inspected for signs of damage or impaired operability, adequate swing clearance will be reverified, and hydraulic snubbers will be checked for proper fluid level and any signs of leakage.

Any snubber assembly which is improperly or incorrectly installed or otherwise fails to meet the requirements of these examinations will be repaired or replaced and re-examined.

b. Pre-Operational Testing

Refer to FSAR paragraph 14.2.12.72, Thermal Expansion and Vibration Test, and paragraph 3.9.2.1, Pre-operational Vibration and Dynamic Effects Testing on Piping, also including the response to Question 112.5 for the "Piping Verification Program." 23

The above examinations and testing (pre-service and pre-operational) are fully documented. Pre-service examination findings are documented in accordance with the procedures outlined in SONGS 2&3 Field Construction and Quality Control Manual. Pre-operational examination results are documented in conformance with the requirements of the Startup and Test Program. All documentation will become a permanent part of the plant records.

Reference

See FSAR paragraphs 3.6, 3.9.2.1 and 14.2.12.72. Also refer to response to NRC Question 112.5. No change was made to the FSAR.

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55. Diesel Generator Reliability

Question 040.72

Operating experience at certain nuclear power plants which have two cycle turbocharged diesel engines manufactured by the Electromotive Division (EMD) of General Motors driving emergency generators have experienced a significant number of turbocharger mechanical gear drive failures. The failures have occurred as the result of running the emergency diesel generators at no load or light load conditions for extended periods. No load or light load operation could occur during periodic equipment testing or during accident conditions with availability of offsite power. When this equipment is operated under no load conditions insufficient exhaust gas volume is generated to operate the turbocharger. As a result the turbocharger is driven mechanically from a gear drive in order to supply enough combustion air to the engine to maintain rated speed. The turbocharger and mechanical drive gear normally supplied with these engines are not designed for standby service encountered in nuclear power plant application where the equipment may be called upon to operate at no load or light load condition and full rated speed for a prolonged period. The EMD equipment was originally designed for locomotive service where no load speeds for the engine and generator are much lower than full load speeds. The locomotive turbocharged diesel hardly ever runs at full speed except at full load. The EMD has strongly recommended to users of this diesel engine design against operation at no load or light load conditions at full rated speed for extended periods because of the short life expectancy of the turbocharger mechanical gear drive unit normally furnished. No load or light load operation also causes general deterioration in any diesel engine.

To cope with the severe service the equipment is normally subjected to and in the interest of reducing failures and increasing the availability of their equipment EMD has developed a heavy duty turbocharger drive gear unit that can replace existing equipment. This is available as a replacement kit, or engines can be ordered with the heavy duty turbocharger drive gear assembly.

To assure optimum availability of emergency diesel generators on demand, Applicant's who have on order or intend to order emergency generators driven by two cycle diesel engines manufactured by EMD should be provided with the heavy duty turbocharger mechanical drive gear assembly as recommended by EMD for the class of service encountered in nuclear power plants. Confirm your compliance with this requirement.

Response

The SONGS 2&3 diesel-generator units will operate only a few minutes each month in a no-load condition. Plant test procedures will require the diesel generator units be paralleled to the safeguard buses and loaded as quickly as possible (refer to response to Question 040.75). Similiar to emergency operating procedures, the test procedures will also limit the time of no-load operation, and require the operator to shut down the unit if the diesel generator operates more than 30 minutes in a no-load condition. 23

The engine manufacturer has recommended that the existing turbocharger mechanical drive gear assemblies be replaced after 200 cummulative hours of no-load operation or 1000 cummulative hours of operation under a combination of no-load and moderate load operation. These recommendations will be incorporated into the plant maintenance procedures for these units.

23 EMD of General Motors, the engine manufacturer, has under development a "heavy duty" mechanical drive gear assembly; however this assembly has not yet undergone sufficient testing to qualify it for nuclear service. Subsequent to successful qualification of this new heavy duty drive gear assembly, the existing assemblies on the SONGS 2&3 units will be replaced with the new design. This replacement will be made during the first refueling of each unit or as soon thereafter as the assemblies are available.

Reference

FSAR section 8.3. No FSAR changes were made.

Question 040.76

The availability on demand of an emergency diesel generator is dependent upon, among other things, the proper functioning of its controls and monitoring instrumentation. This equipment is generally panel mounted and in some instances the panels are mounted directly on the diesel generator skid. Major diesel engine damage has occurred at some operating plants from vibration induced wear on skid mounted control and monitoring instrumentation. This sensitive instrumentation is not made to withstand and function accurately for prolonged periods under continuous vibrational stresses normally encountered with internal combustion engines. Operation of sensitive instrumentation under this environment rapidly deteriorates calibration, accuracy and control signal output.

Therefore, except for sensors and other equipment that must be directly mounted on the engine or associated piping, the controls and monitoring instrumentation should be installed on a free standing floor mounted panel separate from the engine skids, and located on a vibration free floor area or equipped with vibration mounts.

Confirm your compliance with the above requirement or provide justification for noncompliance.

Response

To avoid the potential problem of diesel engine damage due to vibrationally induced instrument wear and/or setpoint drift, the engine and panel mounted instrumentation will be environmentally qualified for vibration service and the service life of the components specified.

In order to verify the validity of the parameters used in the environmental qualification program, the magnitude and frequency of vibration will be measured at key instrument locations (engine and panel) during pre-operational testing of the units. These actual measurements will be compared to those used in the environmental qualification program to verify the components have been qualified for the service. Subsequent to qualification of the instrumentation, function and setpoint will be periodically tested and recalibrated, as required, to assure their continued proper function.

23

Until the environmental qualification of these components is completed, an augmented inspection, test, and calibration program will be utilized. This program will require that all instrumentation be tested and calibrated before and after the preoperational testing of the diesel generator units. Subsequently, the instrumentation will be tested and recalibrated, as required, every 6 months or 12 hours of engine operation, whichever comes first.

Therefore it is felt that relocation of the skid mounted panel will not be necessary.

Reference

FSAR paragraph 8.3.1.1.4. No FSAR changes were made.