WCAO-88147-1
Final Report, Rev. 1

FINAL REPORT OF SEP TOPIC III-1

QUALITY GROUP CLASSIFICATION OF COMPONENTS AND SYSTEMS

FOR

SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

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May 1989

WCAO 88147-01
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OF
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OF
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FOR
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

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May 1989

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1.0 INTRODUCTION

The Systematic Evaluation Program was initiated in February 1977 by the U.S. Nuclear Regulatory Commission to review the designs of older operating nuclear reactor plants to reconfirm and document their safety. San Onofre Nuclear Generating Station, Unit 1, (SONGS 1), operated by Southern California Edison (SCE) Company is one of ten plants reviewed under Phase II of this program. The review provides (1) an assessment of how these plants compare with current licensing safety requirements relating to selected issues, (2) a basis for deciding on how these differences should be resolved in an integrated plant review, and (3) a documented evaluation of plant safety.

SEP plants were generally designed and constructed in the 1950's to the late 1960's. The plants were designed to generally recognized codes, standards and criteria in effect at that time; however, the codes, standards and criteria have been periodically revised. Therefore, the SEP plants may have been designed and constructed to codes, standards and criteria no longer in effect or acceptable to the NRC.

The purpose of SEP Topic III-1, classification of structures, systems and components is to review the classification of structures, systems and components of as-built plants compared to the current classification (Reference 1) required for seismic and quality groups in the codes, standards and criteria. Since the review of seismic classification is addressed in other SEP topics as stated in Section 1.2 below, this topic is limited to the evaluation of quality group classifications. The NRC review of this topic is documented in References 2, 3 and 4 and it is the purpose of this report to fulfill the NRC's request of Reference 4 as described below.

1.1 General Review Scope

10CFR50 (GDC 1), as implemented by Regulatory Guide 1.26, requires, in part, that structures, systems, and components important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. The codes used for the design, fabrication, erection, and testing of SONGS 1 were compared with the ASME B&PV Code, Section III, 1977 Edition through Summer 1978 Addenda.

The development of the American Society of Mechanical Engineers "Boiler and Pressure Vessel Code" (ASME Code) has been a process evolving from earlier ASME Code, American National Standards Institute, and other standards, and manufacturer's requirements. In general, the materials of construction used in earlier designs provide comparable levels of safety.

The NRC in its topic evaluation identified several systems and components for which SONGS 1 was unable to provide information to justify a conclusion that the quality standards imposed during plant fabrication and construction meet the quality standards required for new facilities.

Reference 2 stated the NRC's position that SCE should complete the evaluations described below. As an alternative, since much of the requested information may not exist, the NRC allowed that SCE may evaluate the safety significance of the components and systems in question and show that they are either adequately monitored by a formal inspection program or are of no consequence on the basis of risk or safety function.

1.1.1 Radiography Requirements

ASME Code, Section III, requires that Categories A, B, and C weld joints be radiographed. Furthermore, ASME Code, Section III, 1977 Edition through Summer 1978 Addenda, requires that weld joints for Class 1 and 2 piping, pumps, and valves be radiographed. Because information was not available during the topic review, the NRC concluded that the SCE should verify that (1) the control rod drive housing, (2) Class 2 and 3 vessels for which Code Case 1273N was not invoked and having welded joint thicknesses less than 1½ in., and (3) Class 1 and 2 piping and valves designed only to American Standards Association (ASA) B31.1, have been radiographed or subsequently volumetrically inspected. If neither has been done, SCE should perform a volumetric inspection. Section 3.0 of this report addresses SONGS 1 compliance with regard to radiography requirements.

1.1.2 Pressure Vessels

The NRC requested that SCE demonstrate compliance with current fatigue analysis requirements for all Class 1 vessels. Section 4.0 of this report provides the results of fatigue evaluation for SONGS 1 Class 1 pressure vessels.

1.1.3 Fracture Toughness

ASME Code, Section III, imposes minimum fracture toughness requirements on carbon steel components. For 55 of the 112 SONGS 1 components reviewed, the information was not sufficient for the NRC to complete this review. Accordingly, SCE was requested to perform an evaluation of those items that are not exempt from current fracture toughness requirements to determine if toughness of the material is sufficient to ensure component integrity and, if it is not, evaluate the consequences and demonstrate acceptability or replace the components. Section 5.0 of this report evaluates SONGS 1 compliance with ASME Code, Section III fracture toughness requirements.

1.1.4 Piping

The current Class 1 piping design requirements are given in ASME Code, Section III, NB-3600. The NRC requested that calculations similar to those presented in Examples 1 and 2 in Section 4.2, Appendix A, of TER C5257-433 (enclosure to the SER forwarded by Reference 3) applicable to SONGS 1 design parameters, be performed on a sampling basis to assess the impact on the usage factor of gross discontinuities in Class 1 piping systems for a medium and large number of cyclic loads. Section 6.0 of this report provides the results of fatigue evaluations for SONGS 1 piping.

1.1.5 Valves

Current ASME Code, Section III, design requirements regarding body shapes and Service Level C stress limits for Class 1 valves and pressure-temperature ratings for Class 2 and 3 valves are different from those used when the plant was designed. Sufficient information was not available for the NRC to assess the valves in the above-stated areas. Accordingly, SCE was requested to verify, on a sampling basis, that Class 1 valve stress limits meet current criteria for body shape and Service Level C conditions and that the pressure-temperature ratings of Class 2 and 3 valves are comparable to current standards. If current criteria are not met, SCE should take appropriate corrective action (analysis or upgrading). Section 7.0 of this report provides the results of evaluations performed for Class 1, and Class 2 and 3 valves at SONGS 1.

1.1.6 Pumps

The NRC topic evaluation concluded that codes, code classes, editions, code cases, and design calculations should be provided for eight groups of the pumps in SONGS 1. Proof of compliance with current fatigue analysis requirements for current Class 1 pumps (the reactor coolant pumps) is to be established. Accordingly, SCE was requested to evaluate the design standards used for the other pumps in relation to current design standards and determine whether adequate safety margins exist. Section 8.0 of this report provides the results of evaluation performed for the identified pumps at SONGS 1.

1.1.7 Storage Tanks

Compressive stress requirements for atmospheric tanks and tensile stress requirements for 0- to 15-psig storage tanks designed to ASME Code, Section VIII (1962), or American Petroleum Institute (API) 650, differ from those of Section III, Class 2 and 3, of the current ASME Code. Sufficient information was not available during the NRC topic review for the assessment of the significance of these changes for the tanks designed to earlier ASME Code editions or other code editions. Accordingly, SCE was requested to evaluate the margins of safety for (1) atmospheric storage tanks, which should be checked to determine if they meet current compressive stress requirements; (2) 0- to 15-psig tanks, which should be checked to determine if they meet current tensile allowable values for biaxial stress field conditions; and (3) tanks designed to API-650. Section 9.0 of this report provides the results of the evaluations performed for SONGS 1 storage tanks.

1.2 Related Safety Topics

The scope of review for this topic was limited by the NRC to avoid duplication of effort since some aspects of the review are performed in related topics. As stated previously, the seismic aspect of this topic has been deleted. The quality aspect for the reactor vessel and steam generator (PWRs only) and the quality assurance have been deleted. The related safety topics, that cover the aspects deleted in Topic III-1, and the subject matter covered in the topics are identified below.

III-6	Seismic Design Considerations
III-7.B	Design Codes, Design Criteria, Load Combinations, and Reactor Cavity Design Criteria
V-6	Reactor Vessel Integrity
V-8	Steam Generator Integrity
XVII	Operational Quality Assurance Program

1.3 Summary Conclusion

The information provided in this report generally demonstrates SONGS 1 compliance with current codes and standards. Where adequate compliance could not be demonstrated or sufficient data were not available to support a conclusion of adequate compliance, assurance of component or system adequacy is obtained by periodic testing and inspection of the equipment.

2.0 SAFETY FUNCTION REVIEW

2.1 Scope

The purpose of this review is to verify the basis for the scope of SONGS 1 systems and components to which certain pressure boundary design considerations identified during the review of SEP Topic III-1 apply. These considerations include code allowable stresses, fracture toughness requirements and radiography requirements. They are to be applied to the systems and components "to assure they are of the quality level commensurate with their safety functions" (Reference 2).

2.2 Methodology

The approach consisted of the following steps:

(1) The NRC list of components identified in Table 4-1 was verified against:

- SONGS 1 P&IDs
- SONGS 1 UFSAR (Reference 5)
- SONGS 1 Q-List (Appendix 3.2A of Reference 5)

(2) Review of this list to determine if any scope reduction could be achieved based upon system function arguments.

(3) Identification of suspect components based upon review of the SONGS 1 ISI and IST programs.

2.3 Safety Function Review Criteria

The safety functions used in the review are those that have a relationship to the prevention or mitigation of SONGS 1 design basis accidents. Specific safety functions applicable to transient prevention and mitigation may be found in NRC Regulatory Guide 1.26 (Reference 1) which was one of the NRC's bases for definition of SEP Topic III-1 (Reference 4, page 2). These safety functions and systems are as follows:

- Reactor coolant pressure boundary
- Emergency core cooling
- Postaccident containment heat removal
- Postaccident fission product removal

- Extensions of the reactor coolant pressure boundary that are not provided with adequate isolation capability

- Portions of the main steam and feedwater systems to the outermost containment isolation valves

- Steam generator heat removal (auxiliary feedwater)

- Service and cooling water heat removal to support above functions.

The use of more restrictive, previously licensed shutdown scenario selection criteria would further reduce the scope, but as noted throughout this report, sufficient data was available for the piping and components, so as not to require such an effort. Further, it should be noted that, while the scope of the safety function review includes those components generally necessary to bring SONGS 1 to cold shutdown condition, it should not be construed to supercede any previously licensed shutdown scenarios applicable to SONGS 1.

2.4 Results/Conclusions

Application of the methodology described above results in defining the scope of review as documented in Table 2-1. The result was to both remove some of the systems (the condensate and spent fuel pit support systems) from the evaluation and to confirm the remaining scope as presented in the NRC's letter of April 23, 1984 (Reference 4). In the evaluation presented in the following Sections of this report safety function based justification for exclusion is presented on a case-by-case basis.

TABLE 2-1
Classification of Systems and Components
San Onofre Nuclear Generating Station, Unit 1

Item No.	Component Description	Type	Tag Nos.	System	ASME III Class
1	Component Cooling Water Heat Exchangers	Pressure Vessel	E-20A, B	ACS	3
2	Component Cooling Water Pumps	Pumps	G-15A, B, C	ACS	3
3	Component Cooling Water Surge Tank	Pressure Vessel	C-17	ACS	3
4	Piping to Reactor Coolant Pump Oil Coolers and Thermal Barriers	Piping		ACS	3
5	Piping to Shield Cooling Coils	Piping		ACS	3
6	Piping to Charging Pumps Oil Coolers	Piping		ACS	3
7	Charging Pump Oil Coolers	Pumps		ACS	3
8	Piping up to and including Isolation Valves Up and Downstream of Excess Letdown Heat Exchanger	Piping		ACS	3
9	Piping to Shell Side of Sample Heat Exchangers	Piping		ACS	3
10	Piping to Shell Side of Seal Water Heat Exchanger	Piping		ACS	3
11	Piping from Shell Side of RHR Heat Exchangers to RHR Pumps	Piping		ACS	3
12	Piping to Shell Side of Spent Fuel Pit Heat Exchanger	Piping		ACS	3

TABLE 2-1
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San Onofre Nuclear Generating Station, Unit 1

Item No.	Component Description	Type	Tag Nos.	System	ASME III Class
13	Piping to Shell Side Recirculation HX	Piping		ACS	3
14	Piping to Gas Stripper Condenser	Piping		ACS	3
15	Valves MOV-720A & B, TCV-601A & B, Located Downstream of Component Cool Water Heat Exchanger	Valves	MOV-720AB TCV-601AB	ACS	3
16	CCW System Valves	Valves	See Att. 1	ACS	See Att. 1
17	Auxiliary Feedwater Pumps	Pump	G-10, S, W	AFS	2
18	Piping Downstream of Last Automatic Valves to the Steam Generators	Piping		AFS	2
19	Other Auxiliary Feedwater Piping	Piping		AFS	3
20	Auxiliary Feedwater Valves	Valves	See Att. 2	AFS	See Att. 2
21	Auxiliary Feedwater Storage Tank	Storage Tank	D-2A	AFS	3
22	Auxiliary Pressurizer Spray Piping Downstream of Valve CV-305	Piping		APSS	1
23	Pressurizer Spray and Surge Lines	Piping		APSS	1
24	Auxiliary Spray From CVCS Piping to Valve CV-305	Piping		APSS	2
25	Valve	Valves	CV-305	APSS	1
26	Hydrazine Tank	Pressure Vessel	D-200	CAS	2

TABLE 2-1
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San Onofre Nuclear Generating Station, Unit 1

Item No.	Component Description	Type	Tag Nos.	System	ASME III Class
27	Spray Additive Pumps	Pumps	G-200A, B	CAS	2
28	Piping Including Recirculation Lines and Test Lines	Piping		CAS	2
29	Valves on Recirculation Lines and Test Lines	Valves	SHA-317, 318, 322	CAS	2
30	Control Valves for Containment Isolation	Valve	See Att. 3	CPS	See Att. 3
31	Control Rod Drive Mechanism	Pressure Vessel		CRDS	1
32	Refueling Water Pumps	Pumps	G-27N, S	CSSS	2
33	Piping from Refueling Water Storage Tank to Refueling Water Pumps	Piping		CSSS	2
34	Piping and Downstream of Refueling Water Pumps	Piping		CSSS	2
35	All Valves Downstream of Refueling Water Pumps	Valves	See Att. 4	CSSS	See Att. 4
36	Regenerative Heat Exchanger Tube Side	Pressure Vessel	E-13	CVCS	2
37	Regenerative Heat Exchanger Shell Side	Pressure Vessel	E-13	CVCS	3
38	Excess Letdown Heat Exchanger Tube Side	Pressure Vessel	E-33	CVCS	1
39	Excess Letdown Heat Exchanger Shell Side	Pressure Vessel	E-33	CVCS	3
40	Seal Water Heat Exchanger Tube Side	Pressure Vessel	E-34	CVCS	2

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Item No.	Component Description	Type	Tag Nos.	System	ASME III Class
41	Seal Water Heat Exchanger Shell Side	Pressure Vessel	E-34	CVCS	3
42	Seal Water Filter	Pressure Vessel	C-40	CVCS	2
43	Regenerative HX Outlet Control Valves	Valves	CV-202, 203, 204	CVCS	1
44	Seal Water Supply Filters	Pressure Vessel	C-952A, B, C	CVCS	2
45	Piping (Loop B), Letdown Line via Excess Letdown HX to Valve HCV-1117	Piping		CVCS	1
46	CVCS Piping	Piping		CVCS	1
47	Excess Letdown Hx Outlet Control Valve	Valves	HCV-1117	CVCS	1
48	CVCS Valves	Valves	CV-304, 305 VCC-002, 003	CVCS	1
49	Piping (Loop A), Letdown Line via Regenerative HX to Valves CV-202,-203, -204	Piping		CVCS	1
50	CVCS Charging Pumps	Pumps	G-8A, B	CVCS	2
51	CVCS Piping	Piping		CVCS	2
52	CVCS Valves	Valves	See Att. 5	CVCS	See Att. 5
53	Piping Downstream of Valves to Residiual Heat Removal Line Interface	Piping		CVCS	2
54	Piping Downstream of RHR HX through Valve TCV-1105 via RC Filter to Vol Ctl Tank	Piping		CVCS	2

TABLE 2-1
Classification of Systems and Components
San Onofre Nuclear Generating Station, Unit 1

Item No.	Component Description	Type	Tag Nos.	System	ASME III Class
55	Piping from VCT to Charging Pumps	Piping		CVCS	2
56	Salt Water Cooling Pumps	Pumps	G-13A, B	CWS	3
57	Salt Water Supply Piping to Component Cooling Heat Exchangers	Piping		CWS	3
58	Salt Water Supply Valves on Piping to Component Cooling Heat Exchangers	Valves	See Att. 6	CWS	See Att. 6
59	DG Air Intake Filters	Pressure Vessel	C-908, 909, 924, 925	DGCAS	3
60	DG Air Intake Silencers	Pressure Vessel	C-911, 912, 926, 927	DGCAS	3
61	DGSAS Piping	Piping		DGCAS	3
62	DG Cooling Water Heat Exchanger	Pressure vessel	E-5	DGCWS	3
63	DG Cooling Water Expansion Tank	Pressure Vessel	D-27	DGCWS	3
64	DG Cooling Water Pump (Engine Driven)	Pumps	G-16	DGCWS	3
65	DG Cooling Water Piping	Piping		DGCWS	3
66	DG Cooling Water Valves	Valves		DGCWS	3
67	Diesel Fuel Oil Storage Tank	Pressure Vessel	D-23	DGFSSS	3
68	Diesel Fuel Oil Transfer Pumps	Pumps	G-74A, B	DGFSSS	3

TABLE 2-1
Classification of Systems and Components
San Onofre Nuclear Generating Station, Unit 1

Item No.	Component Description	Type	Tag Nos.	System	ASME III Class
69	DG Fuel Oil Filters	Pressure Vessel	C-21A,B	DGFSSS	3
70	DG Fuel Oil Day Tank	Pressure Vessel	D-14	DGFSSS	3
71	Piping from Fuel Oil Storage Tank to Fuel Oil Day Tank	Piping		DGFSSS	3
72	DG Fuel Oil Pumps	Pump	G-42,76	DGFSSS	3
73	DG Fuel Oil Piping from Day Tank to Diesel Fuel Storage Tank	Piping		DGFSSS	3
74	Valves on Piping Fuel Oil Storage Tank to Day Tank	Valves		DGFSSS	3
75	Valves on Piping from Day Tank to Diesel Fuel Storage Tank	Valves		DGFSSS	3
76	DG Lube Oil Cooler Shell Side	Pressure Vessel	E-10	DGLOS	3
77	DG Duplex Lube Oil Filters	Pressure Vessel	C-24A, B, C-26A, B	DGLOS	3
78	DG Lube Oil Strainer	Pressure Vessel	C-27,28	DGLOS	3
79	DG Lube Oil Pump (Engine Driven and Standby Motor)	Pumps	G-67, 68, 69, 70	DGLOS	3
80	DG Lube Oil Piping	Piping		DGLOS	3
81	DG Lube Oil Valves	Valves		DGLOS	3
82	DG Starting Air Storage Tanks	Pressure Vessel	C-13A,B	DGSAS	3

TABLE 2-1
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Item No.	Component Description	Type	Tag Nos.	System	ASME III Class
83	DGSAS Piping	Piping		DGSAS	3
84	DGSAS Valves	Valves		DGSAS	3
85	Piping Downstream of Valves FCV-456, 457 and 458	Piping		FWS	2
86	Feedwater System Valves	Valves	See Att. 7	FWS	See Att. 7
87	Piping Between Valves HV 852A,B, and HV-854A,B	Piping		FWS	2
88	Feedwater Pumps	Pumps	G-3A, B	FWS	2
89	Main Steam Safety Valves	Valves	RV1 through RV10	MSS	2
90	Steam Dump Valves	Valves	CV-76, 77, 78, 79	MSS	2
91	Piping from Steam Generators to Main Stop Valves	Piping		MSS	2
92	Piping from Main Steam Line Including 3"-600-129	Piping		MSS	2
93	Piping from 3"-600-129 to Auxiliary Feedwater Pump Turbine	Piping		MSS	2
94	Main Stop Valves	Valves	PV-1650, 1651	MSS	2
95	Valves on Piping to Auxiliary Feedwater Pump Turbine	Valves	See Att. 8	MSS	See Att. 8
96	Pressurizer	Pressure Vessel		RCS	1

TABLE 2-1
Classification of Systems and Components
San Onofre Nuclear Generating Station, Unit 1

Item No.	Component Description	Type	Tag Nos.	System	ASME III Class
97	Reactor Coolant Pumps	Pumps	G-2A, B, C	RCS	1
98	RCS Piping	Piping		RCS	1
99	Pressurizer Safety Valves	Valves	RV-532,533	RCS	1
100	Pressurizer Relief Valves	Valves	CV-530, 531, 545, 546	RCS	1
101	Piping fm Reactor Coolnt Loops B & C & Press Samp incl FIV w/in Sampling Room	Piping		RCSS	2
102	Valves from Reactor Coolnt Loops B & C & Pressurizer Sample up to and incl ing FIV w/i SR	Valves	See Att. 9	RCSS	See Att. 9
103	RHR Heat Exchangers Tube Side	Pressure Vessel	E-21A, B	RHRS	2
104	RHR Heat Exchangers Shell Side	Pressure Vessel	E-21A, B	RHRS	3
105	Residual Heat Removal Pumps	Pumps	G-14A,14B	RHRS	2
106	Residual Heat Removal Piping Upstream of Valve MOV-814 and Downstream Valve MOV-833	Piping		RHRS	1
107	Other RHR Piping	Piping		RHRS	2
108	Residual Heat Removal Valves MOV-822A, B, HCV-602	Valves	MOV-822A, B HCV-602	RHRS	2
109	Valves MOV-813, 814, 833, 834	Valves	MOV-813, 814, 833, 834	RHRS	1

TABLE 2-1
Classification of Systems and Components
San Onofre Nuclear Generating Station, Unit 1

Item No.	Component Description	Type	Tag Nos.	System	ASME III Class
110	Piping including Interfaces at Ion Exchanger Primary Plant & Refueling Water Storage Tank	Piping		SFCS	3
111	Valves at Ion Exchanger Primary Plant & Refueling Water Storage Tank	Valves		SFCS	3
112	Refueling Water Storage Tank	Storage Tank	D-1	SIS	2
113	Safety Injection Pumps	Pumps	G-50A,50B	SIS	2
114	Recirculation Pumps	Pumps	G-45A,45B	SIS	2
115	Recirculation Heat Exchanger Tube Side	Pressure Vessel	E-11	SIS	2
116	Recirculation Heat Exchanger Shell Side	Pressure Vessel	E-11	SIS	3
117	Recirculation Heat Exchanger Valves	Valves	See Att. 10	SIS	See Att. 10
118	Recirculation Heat Exchanger Piping	Piping		SIS	2

ATTACHMENT 1 TO TABLE 2-1

Component Description	Tag Nos.	ASME III Class
CCWS Valves	CCW-305	3
	CCW-309	3
	CCW-303	3
	CCW-307	3
	CCW-302	3
	CCW-306	3
	CCW-314	3
	CCW-316	3
	CCW-315	3
	CCW-319	3
	CCW-317	3
	CCW-321	3
	CCW-313	3
	CCW-373	3
	CCW-311	3
	CCW-371	3
	CCW-310	3
	CCW-370	3
	CCW-322	3
	CCW-326	3
	CCW-336	3
	CCW-332	3
	CCW-323	3
	CCW-327	3
	CCW-333	3
	CCW-337	3
	CCW-325	3
	CCW-329	3
	CCW-335	3
	CCW-339	3
	CCW-349	3
	CCW-350	3
	CCW-352	3
	CCW-353	3
	CCW-354	3
	CCW-347	3
	CCW-346	3
	CCW-340	3
	CCW-343	3
	CCW-330	3
	CCW-344	3
	CCW-331	3
	CCW-345	3
	CCW-358	3
	CCW-360	3

ATTACHMENT 1 TO TABLE 2-1 (Continued)

Component Description	Tag Nos.	ASME III Class
CCWS Valves	CCW-361	3
	CCW-359	3
	MOV-720A	3
	MOV-720B	3
	CCW-387	3
	CCW-380	3
	CCW-381	3
	CCW-383	3
	CCW-384	3
	CCW-388	3
	CCW-398	3
	CCW-399	3
	RV-755C	3
	CCW-400	3
	CCW-401	3
	CCW-402	3
	CCW-403	3
	CCW-389	3
	CCW-505	3
	CV-737B	3
	CCW-390	3
	CCW-394	3
	CCW-395	3
	CCW-396	3
	CV-737A	3
	CCW-391	3
	CCW-375	3
	CCW-377	3
	CCW-301	3
	CCW-378	3
	CCW-504	3
	CCW-379	3
	RCV-505	3
	CCW-355	3
	CCW-356	3
	CCW-365	3
	CCW-366	3
	CCW-404	3
	RV-775E	3
	CCW-405	3
	CCW-406	3
	CCW-410	3
	CCW-409	3
	CCW-408	3
	CCW-407	3

ATTACHMENT 1 TO TABLE 2-1 (Continued)

Component Description	Tag Nos.	ASME III Class
CCWS Valves	CCW-411	3
	CCW-422	3
	CCW-421	3
	CCW-424	3
	CCW-423	3
	CCW-412	3
	CCW-413	3
	CCW-414	3
	CCW-494	3
	CCW-415	3
	CCW-416	3
	CCW-417	3
	CCW-420	3
	CCW-496	3
	CCW-418	3
	CCW-419	3
	RV-775F	3
	CCW-495	3
	CCW-425	3
	CCW-497	3
	CCW-442	3
	CCW-432	3
	PSV-M-109	3
	CCW-440	3
	CCW-441	3
	CCW-439	3
	CCW-430	3
	CCW-438	3
	CCW-431	3
	CCW-437	3
	CCW-429	3
	CCW-436	3
	CCW-427	3
	CCW-434	3
	CCW-426	3
	CCW-433	3
	CCW-428	3
	CCW-435	3
	TCV-601B	3
	CCW-459	3
	CCW-460	3
	RV-775B	3
	RV-775A	3
	TCV-601A	3
	CCW-461	3

ATTACHMENT 1 TO TABLE 2-1 (Continued)

Component Description	Tag Nos.	ASME III Class
CCWS Valves	CCW-463	3
	CCW-462	3
	CCW-498	3
	CCW-499	3
	CCW-464	3
	CCW-465	3
	CCW-491	3
	CCW-469	3
	CCW-470	3
	CCW-471	3
	CCW-472	3
	CCW-473	3
	CCW-474	3
	CCW-475	3
	RV-775D	3
	CCW-477	3
	CCW-476	3
	CCW-478	3
	CCW-479	3
	CCW-480	3
	RV-775G	3
	CCW-481	3
	CCW-482	3
	CCW-483	3
	CCW-484	3
	CCW-485	3
	RV-775I	3
	CCW-486	3
	CCW-487	3
	CCW-488	3
	CCW-489	3
	CCW-490	3
	RV-775H	3
	CCW-492	3
	CCW-447	3
	CCW-449	3
	CCW-448	3
	CCW-079	3
	CCW-080	3
	CCW-081	3
	CCW-078	3
	CCW-059	3
	CCW-062	3
	CCW-058	3
	CCW-069	3

ATTACHMENT 1 TO TABLE 2-1 (Continued)

Component Description	Tag Nos.	ASME III Class
CCWS Valves	CCW-057	3
	CCW-068	3
	CCW-056	3
	CCW-067	3
	CCW-055	3
	CCW-066	3
	CCW-054	3
	CCW-065	3
	CCW-053	3
	CCW-064	3
	CCW-052	3
	CCW-063	3
	CCW-051	3
	CCW-061	3
	CCW-050	3
	CCW-060	3
	CCW-445	3
	CCW-446	3
	CCW-048	3
	CCW-042	3
	CCW-072	3
	CCW-443	3
	CCW-444	3
	CCW-049	3
	CCW-087	3
	CCW-041	3
	CCW-044	3
	CCW-043	3
	CCW-046	3
	CCW-047	3
	CCW-040	3
	CCW-045	3
	CCW-071	3
	CCW-073	3
	CCW-450	3
	CCW-451	3
	CCW-452	3
	CCW-083	3
	CCW-077	3
	CCW-075	3
	CCW-085	3
	CCW-076	3
	CCW-453	3
	CCW-001	3
	CCW-003	3

ATTACHMENT 1 TO TABLE 2-1 (Continued)

Component Description	Tag Nos.	ASME III Class
CCWS Valves	CCW-454	3
	CCW-047	3
	CCW-005	3
	CCW-025	3
	CCW-011	3
	CCW-035	3
	CCW-033	3
	CCW-009	3
	CCW-028	3
	CCW-030	3
	CCW-032	3
	CCW-017	3
	CCW-013	3
	CCW-015	3
	CCW-021	3
	CCW-019	3
	RV-721A	3
	CV-722A	3
	CCW-457	3
	CCW-458	3
	CCW-082	3
	CCW-086	3
	CCW-084	3
	CCW-088	3
	CCW-090	3
	CCW-092	3
	CCW-040	3
	CCW-038	3
	CCW-024	3
	CCW-096	3
	CCW-094	3
	CCW-100	3
	CCW-098	3
	CV-722B	3
	RV-721B	3
	CCW-455	3
	CCW-002	3
	CCW-006	3
	CCW-010	3
	CCW-456	3
	CCW-008	3
	CCW-004	3
	CCW-012	3
	CCW-026	3
	CCW-029	3

ATTACHMENT 1 TO TABLE 2-1 (Continued)

Component Description	Tag Nos.	ASME III Class
CCWS Valves	CCW-016	3
	CCW-014	3
	CCW-020	3
	CCW-018	3
	CV-722C	3
	RV-721C	3

ATTACHMENT 2 TO TABLE 2-1

Component Description	Tag Nos.	ASME III Class
AFW Valves	AFW-503	3
	AFW-469	3
	AFW-507	3
	AFW-350	3
	AFW-434	3
	AFW-302	3
	AFW-442	3
	AFW-440	3
	AFW-304	3
	MOV-1202	3
	AFW-331	3
	AFW-340	3
	AFW-338	3
	AFW-339	3
	AFW-337	3
	AFW-336	3
	AFW-477	3
	AFW-475	3
	AFW-506	3
	AFW-504	3
	AFW-468	3
	AFW-301	3
	AFW-433	3
	AFW-349	3
	AFW-426	3
	AFW-374	3
	AFW-303	3
	AFW-346	3
	AFW-345	3
	CV-3213	3
	AFW-320	3
	AFW-318	3
	AFW-316	3
	AFW-314	3
	AFW-317	3
	AFW-313	3
	AFW-312	3
	AFW-308	3
	AFW-362	3
	AFW-324	3
	AFW-386	3
	AFW-388	3
	AFW-382	3
	AFW-384	3
	AFW-306	3

ATTACHMENT 2 TO TABLE 2-1 (Continued)

Component Description	Tag Nos.	ASME III Class
AFW Valves	AFW-310	3
	AFW-393	3
	AFW-394	3
	FCV-3301	3
	FCV-2301	3
	AFW-322	3
	AFW-396	3
	AFW-326	3
	AFW-398	3
	AFW-397	3
	AFW-409	3
	AFW-399	3
	AFW-305	3
	AFW-309	3
	FCV-2300	3
	AFW-445	3
	AFW-321	3
	AFW-447	3
	AFW-325	3
	AFW-482	3
	AFW-466	3
	AFW-465	3
	AFW-464	3
	AFW-401	3
	AFW-385	3
	AFW-381	3
	AFW-373	3
	AFW-387	3
	AFW-391	3
	AFW-363	3
	AFW-369	3
	AFW-395	3
	AFW-389	3
	AFW-403	3
	FV-3110	3
	AFW-491	3
	AFW-492	3
	AFW-490	3
	AFW-488	3
	AFW-341	3
	AFW-472	3
	AFW-348	3
	AFW-305	3
	AFW-309	3
	AFW-410	3

ATTACHMENT 2 TO TABLE 2-1 (Continued)

Component Description	Tag Nos.	ASME III Class
AFW Valves	AFW-379	3
	AFW-380	3
	FCV-3300	3
	AFW-328	3
	AFW-370	3
	RV-3206	3
	PSV-3200	3
	AFW-463	3
	AFW-467	3
	AFW-481	3
	AFW-480	3
	AFW-505	3
	AFW-415	3
	AFW-501	3
	AFW-502	3
	AFW-460	3
	AFW-496	3
	AFW-495	3
	AFW-479	3
	AFW-485	3
	AFW-383	3
	AFW-371	3
	AFW-411	3
	AFW-407	3
	AFW-441	3
	AFW-443	3
	AFW-437	3
	AFW-439	3
	AFW-487	3
	MOV-1204	3
	AFW-342	3
	AFW-489	3

ATTACHMENT 3 TO TABLE 2-1

Component Description	Tag Nos.	ASME III Class
Containment Isolation Valves	POV-10	2
	CVS-313	2
	CVS-314	2
	CVS-316	2
	CVS-317	2
	CVS-320	2
	CVS-322	2
	CVS-325	2
	CVS-328	2
	POV-9	2
	CVS-301	2
	CV-10	2
	CVS-333	2
	SV-1212-8	2
	SV-1212-9	2
	CVS-335	2
	CV-527	2
	CV-535	2
	GNI-595	2
	CV-536	2
	CV-107	2
	RLC-520	2
	CV-106	2
	CV-105	2
	RLC-522	2
	CV-104	2
	CV-103	2
	RLC-525	2
	CV-102	2
	MSS-362	2
	MSS-364	2
	MSS-372	2
	MSS-370	2
	MSS-374	2
	MSS-366	2
	MSS-368	2
	MSS-426	2
	MSS-360	2
	MSS-380	2
	PV-1650	2
	MSS-358	2
	MSS-378	2
	MSS-376	2
	MSS-386	2
	MSS-382	2

ATTACHMENT 3 TO TABLE 2-1 (Continued)

Component Description	Tag Nos.	ASME III Class
Containment Isolation Valves	MSS-384	2
	MSS-411	2
	MSS-413	2
	MSS-407	2
	MSS-409	2
	MSS-405	2
	MSS-401	2
	MSS-403	2
	PV-1651	2
	MSS-361	2
	MSS-339	2
	MSS-341	2
	CV-145	2
	MSS-351	2
	MOV-14	2
	CV-128	2
	MOV-16	2
	CV-130	2
	MOV-15	2
	CV-129	2
	MOV-17	2
	CV-131	2
	SCF-359	2
	SCF-358	2
	SCF-398	2
	CV-516	2
	CV-515	2
	CV-534	2
	CV-533	2
	CV-537	2
	SDW-418	2
	CV-115	2
	GNI-362	2
	GNI-336	2
	GNI-388	2
	GNI-391	2
	GNI-392	2
	RV-86	2
	SV-2004	2
	CV-532	2
	GNI-732	2
	GNI-736	2
	GNI-001	2
	GNI-102	2
	SV-3004	2

ATTACHMENT 3 TO TABLE 2-1 (Continued)

Component Description	Tag Nos.	ASME III Class
Containment Isolation Valves	SV-125A	2
	ISA-539	2
	ISA-540	2
	ISA-016	2
	ISA-955	2
	ISA-969	2
	ISA-001	2
	CV-147	2
	CV-146	2
	POV-9	2
	CVS-314	2
	CVS-316	2
	CVS-317	2
	CVS-320	2
	CVS-322	2
	CVS-325	2
	POV-10	2
	CVS-328	2
	CVS-333	2
	SV-1212-8	2
	CVS-335	2
	SV-1212-9	2
	SV-3303	2
	PAS-310	2
	PAS-004	2

ATTACHMENT 4 TO TABLE 2-1

Component Description	Tag Nos.	ASME III Class
Refueling Water Pump Valves	CRS-330	2
	CRS-304	2
	CRS-306	2
	CRS-322	2
	CRS-321	2
	CRS-361	2
	CRS-337	2
	CRS-338	2
	CRS-336	2
	CRS-339	2
	CRS-340	2
	CRS-341	2
	CRS-020	2
	MOV-880	2
	CV-517	2
	CV-518	2
	CRS-350	2
	CV-92	2
	CV-82	2
	CRS-042	2
	CRS-041	2
	CRS-044	2
	CV-114	2
	CRS-021	2
	CRS-305	2
	CRS-333	2
	CRS-307	2
	CRS-382	2
	RV-882	2
	CRS-348	2
	CRS-349	2
	CRS-346	2
	CRS-347	2
	CRS-353	2
	CRS-354	2
	CRS-039	2
	CRS-040	2
	CRS-045	2
	CRS-043	2
	CRS-385	2
	CRS-001	2
	CRS-344	2
	CRS-308	2
	CRS-391	2
	CRS-405	2

ATTACHMENT 4 TO TABLE 2-1 (Continued)

Component Description	Tag Nos.	ASME III Class
Refueling Water Pump Valves	CRS-403	2
	CRS-402	2
	CRS-302	2
	CRS-303	2
	CRS-331	2
	CRS-329	2
	CRS-332	2
	CRS-334	2
	CRS-328	2
	CRS-327	2
	CRS-319	2
	CRS-324	2
	CRS-325	2
	CRS-326	2
	CRS-323	2

ATTACHMENT 5 TO TABLE 2-1

Component Description	Tag Nos.	ASME III Class
CVCS Valves	VCC-374	2
	VCC-334	2
	VCC-376	2
	FCV-1112	2
	VCC-333	2
	RV-259	2
	VCC-319	2
	VCC-314	2
	VCC-315	2
	VCC-316	2
	VCC-317	2
	VCC-313	2
	VCC-318	2
	VCC-362	2
	MOV-1100B	2
	MOV-1100D	2
	VCC-326	2
	VCC-358	2
	FCV-5051	2
	CV-410	2
	VCC-356	2
	RV-289	2
	VCC-350	2
	VCC-351	2
	VCC-341	2
	CV-291	2
	VCC-347	2
	CV-528	2
	VCC-324	2
	VCC-383	2
	VCC-354	2
	VCC-309	2
	VCC-323	2
	VCC-390	2
	VCC-304	2
	VCC-303	2
	VCC-332	2
	VCC-329	2
	VCC-306	2
	VCC-338	2
	VCC-308	2
	VCC-337	2
	VCC-307	2
	VCC-388	2
	VCC-335	2

ATTACHMENT 5 TO TABLE 2-1 (Continued)

Component Description	Tag Nos.	ASME III Class
CVCS Valves	VCC-320	2
	VCC-311	2
	VCC-301	2
	VCC-302	3
	VCC-322	3
	VCC-321	3
	CV-406B	3
	LDS-001	1
	CV-1112	1
	LDS-005	1
	LDS-006	1
	LDS-004	1
	CV-287	1
	LDS-002	1
	CV-212	1
	CV-213	1
	CV-214	1
	LDS-010	2
	HCV-1117	2
	CV-288	2
	CV-412	2
	CV-413	2
	LDS-011	2
	LDS-003	2
	LDS-020	2
	LDS-021	2
	LDS-022	2
	CV-525	2
	VCC-330	2
	VCC-331	2
	VCC-305	2
	VCC-373	2
	VCC-001	2
	CV-304	2
	CV-305	2
	VCC-002	2
	VCC-003	2
	MOV-1100C	2
	VCC-310	2
	VCC-395	2
	VCC-389	2
	VCC-336	2
	VCC-385	2
	VCC-312	2
	VCC-403	2

ATTACHMENT 5 TO TABLE 2-1 (Continued)

Component Description	Tag Nos.	ASME III Class
CVCS Valves	VCC-345	2
	VCC-346	2
	VCC-359	2
	VCC-352	2
	VCC-353	2
	VCC-342	2
	VCC-343	2
	VCC-344	2
	VCC-349	2
	VCC-357	2
	CV-411	2
	VCC-371	2
	VCC-373	2
	VCC-368	2
	VCC-367	2
	VCC-366	2
	VCC-363	2
	SV-225	2
	VCC-365	2
	RV-226	2

ATTACHMENT 6 TO TABLE 2-1

Component Description	Tag Nos.	ASME III Class
SWS Valves to CCW Hx	SWC-383	3
	SWC-315	3
	SWC-379	3
	SWC-337	3
	SWC-335	3
	SWC-381	3
	SWC-357	3
	SWC-361	3
	SWC-301	3
	SWC-367	3
	SWC-382	3
	SWC-314	3
	SWC-380	3
	SWC-334	3
	SWC-336	3
	SWC-356	3
	SWC-360	3
	SWC-300	3
	SWC-302	3
	SWC-366	3
	SWC-368	3
	SWC-363	3
	SWC-362	3
	SWC-363	3
	SWC-364	3
	SWC-369	3
	SWC-365	3
	SWC-320	3
	SWC-321	3
	SWC-324	3
	SWC-325	3
	SWC-328	3
	SWC-329	3
	SWC-332	3
	SWC-333	3
	RV-58	3
	RV-59	3
	SWC-303	3
	SWC-304	3
	SWC-317	3
	SWC-305	3
	SWC-308	3

ATTACHMENT 7 TO TABLE 2-1

Component Description	Tag Nos.	ASME III Class
Feedwater System Valves	HV-854A	2
	FWS-564	2
	FWS-436	2
	FWS-438	2
	FWS-472	2
	CV-38	2
	FWS-474	2
	FWS-568	2
	FWS-470	2
	FWS-468	2
	HV-852A	2
	CV-875A	2
	HV-854B	2
	FWS-439	2
	HV-852B	2
	FWS-575	2
	CV-875B	2
	FWS-473	2
	FWS-475	2
	CV-37	2
	FWS-432	2
	FWS-415	2
	FWS-382	2
	FWS-408	2
	FWS-396	2
	FWS-368	2
	FWS-398	2
	FWS-417	2
	FWS-378	2
	FWS-376	2
	FWS-428	2
	FWS-352	2
	FWS-384	2
	FWS-342	2
	FWS-446	2
	FWS-346	2
	FWS-377	2
	FWS-423	2
	FWS-379	2
	FWS-339	2
	FWS-343	2
	FWS-369	2
	FWS-425	2
	FWS-345	2
	FWS-508	2

ATTACHMENT 7 TO TABLE 2-1 (Continued)

Component Description	Tag Nos.	ASME III Class
Feedwater System Valves	FWS-535	2
	FWS-565	2
	FWS-443	2
	FWS-445	2
	FWS-469	2
	FWS-543	2
	FWS-507	2
	FWS-544	2
	FWS-554	2
	FWS-337	2
	FWS-389	2
	FWS-371	2
	FWS-341	2
	FWS-367	2
	FWS-373	2
	FWS-351	2
	CV-456	2
	MOV-21	2
	FWS-349	2
	FWS-421	2
	FWS-357	2
	FWS-355	2
	CV-142	2
	FWS-340	2
	FWS-386	2
	FWS-388	2
	FWS-344	2
	FWS-366	2
	CV-457	2
	FWS-348	2
	FWS-350	2
	MOV-20	2
	FWS-376	2
	FWS-422	2
	FWS-358	2
	FWS-360	2
	CV-144	2
	FWS-426	2
	FWS-410	2
	FWS-412	2
	FWS-394	2
	FWS-365	2
	CV-458	2
	FWS-400	2
	FWS-402	2

ATTACHMENT 7 TO TABLE 2-1 (Continued)

Component Description	Tag Nos.	ASME III Class
Feedwater System Valves	MOV-22	2
	FWS-430	2
	FWS-363	2
	FWS-361	2
	CV-143	2
	FWS-007	2
	FWS-009	2
	FWS-006	2
	FWS-008	2
	FWS-012	2
	FWS-014	2

ATTACHMENT 8 TO TABLE 2-1

Component Description	Tag Nos.	ASME III Class
AFW Pump Turbine Valves	MSS-333	2
	AFW-408	2
	AFW-375	2
	CV-113	2
	AFW-405	2
	AFW-419	2
	AFW-354	2
	SV-3200	2
	AFW-353	2
	AFW-356	2
	CV-3201	2
	AFW-357	2
	AFW-358	2
	AFW-359	2
	SV-3214	2
	AFW-364	2
	AFW-361	2
	SV-3211	2
	AFW-355	2

ATTACHMENT 9 TO TABLE 2-1

Component Description	Tag Nos.	ASME III Class
RCS Sample Valves	CV-992	2
	RSS-301	2
	RSS-331	2
	SV-3302	2
	RSS-315	2
	RSS-345	2
	RSS-001	2
	RSS-002	2
	CV-951	2
	RSS-004	2
	RSS-005	2
	CV-953	2
	RSS-010	2
	RSS-011	2
	CV-956	2
	RSS-007	2
	RSS-008	2
	CV-955	2
	RSS-013	2
	RSS-014	2
	CV-962	2
	RSS-310	2
	CV-957	2
	RSS-015	2
	RSS-016	2
	CV-948	2
	CV-949	2

ATTACHMENT 10 TO TABLE 2-1

Component Description	Tag Nos.	ASME III Class
SIS Valves	SIS-304	2
	SIS-310	2
	SIS-303	2
	SIS-309	2
	MOV-883	2
	CRS-301	2
	CRS-360	2
	CRS-311	2
	SIS-302	2
	SIS-301	2
	SIS-305	2
	SIS-306	2
	SIS-307	2
	SIS-308	2
	SIS-312	2
	SIS-114	2
	SIS-311	2
	SIS-313	2
	SIS-318	2
	SIS-330	2
	SIS-315	2
	SIS-317	2
	HV-853A	2
	HV-853B	2
	SIS-321	2
	SIS-322	2
	SIS-319	2
	SIS-320	2
	SIS-323	2
	SIS-324	2
	SIS-325	2
	SIS-326	2
	SIS-327	2
	SIS-328	2
	SIS-333	2
	SIS-335	2
	SIS-334	2
	SIS-336	2
	SV-3900	2
	SV-2900	2
	SIS-337	2
	SIS-338	2
	SIS-340	2
	SIS-341	2
	SIS-342	2

ATTACHMENT 10 TO TABLE 2-1 (Continued)

Component Description	Tag Nos.	ASME III Class
SIS Valves	SIS-343	2
	SIS-344	2
	SIS-349	2
	SIS-355	2
	SIS-339	2
	SIS-361	2
	SIS-363	2
	SIS-365	2
	SIS-369	2
	SIS-363	2
	SIS-370	2
	SV-702A	2
	SV-702C	2
	SV-702B	2
	SIS-006	2
	CRS-017	2
	FV-3078	2
	FV-2077	2
	CRS-016	2
	CRS-009	2
	CRS-007	2
	MOV-866B	2
	MOV-866A	2
	CRS-003	2
	CRS-015	2
	CRS-013	2
	CRS-001	2
	CRS-027	2
	CRS-031	2
	CRS-008	2
	CRS-006	2
	CRS-004	2
	CRS-014	2
	CRS-012	2
	CRS-002	2
	CRS-317	2
	CRS-358	2
	CRS-318	2
	CRS-425	2
	CRS-316	2
	CRS-426	2
	SIS-012	2
	SV-702D	2
	SIS-001	2
	SIS-008	2

ATTACHMENT 10 TO TABLE 2-1 (Continued)

Component Description	Tag Nos.	ASME III Class
SIS Valves	SIS-002	2
	SIS-390	2
	SIS-388	2
	RV-868	2
	SIS-386	2
	SIS-385	2
	MOV-850C	1
	MOV-850B	1
	MOV-850A	1
	SIS-003	1
	SIS-010	1
	SIS-004	1
	MOV-358	1
	MOV-353	1
	MOV-356	1

3.0 RADIOGRAPHY REQUIREMENTS REVIEW

SEP Topic III-1 notes that radiographic inspection requirements existing in current design codes for vessels, piping, pumps and valves were not included in many of the codes used during the design and construction of SONGS 1. Consequently an evaluation of the following components and areas is required to verify if radiography was done and to what extent it was performed.

1. Control Rod Drive Mechanism (CRDM) Housing,

2. Class 2 & 3 vessels designed without code case 1273N invoked and having welds < 1-1/2 in. thick,

3. Class 1 & 2 piping and valves designed only to ASA (ANSI) B31.1, and

4. Class 1 & 2 pumps.

The scope for the radiography evaluation as defined above in items 1 through 4 is not affected by the Functional Safety Review discussed in Section 2.0.

3.1 Radiography Requirements

SEP Topic III-1 has specified the ASME B&PV Code, Section III, 1977 Edition including Addenda through summer 1978 (Reference 6) for the evaluation of SONGS 1 components with respect to radiography. The ASME B&PV code presents these requirements in articles NB-5000, NC-5000, and ND-5000. Additional radiography requirements which may be applicable are given in paragraphs NB-2500, NC-2500, and ND-2500. The applicable requirements are presented in the following paragraphs for the respective class of equipment and component type or grouping.

3.1.1 ASME Class 1 Vessels (Subsection NB-5000)

(1) Category A Vessel Welds require 100% radiography.

   a) Longitudinal shell welds
   b) Head circumferential welds
   c) Orange peel section welds in vessel head

(2) Category B Vessel Welds require 100% radiography.

   a) Circumferential vessel welds
   b) Nozzle circumferential welds

(3) Category C Vessel Welds require 100% radiography.

   a) Vessel to flange welds
   b) Nozzle to flange welds

(4) Category D Vessel Welds require 100% radiography.

   a) Full penetration nozzle to Vessel Welds

3.1.2 ASME Class 2 Vessels (Subsection NC-5000)

(1) Category A Vessel Welds in material > 3/16-inch thick require 100% radiography.

(2) Category B Vessel Welds in material > 3/16-inch thick require 100% radiography.

(3) Category C Vessel Welds in material > 3/16-inch thick require 100% radiography.

(4) Category D full penetration nozzle to vessel welds require 100% radiography.

(5) Atmospheric Storage tank welds which require 100% radiography.

   a) Sidewall joints, vertical and horizontal
   b) Nozzle butt welds

(6) Welds in Storage tanks for 0 - 15 psi service which require 100% radiography.

   a) Sidewall joints, vertical and horizontal
   b) Roof joints
   c) Full penetration butt joints in nozzles
   d) Roof to sidewall if design permits

3.1.3 ASME Class 3 Vessels (Subsection ND-5000)

(1) Category A Vessel Welds requiring radiography.

   a) Welds in carbon steel (P-1) materials that are > 1-1/4 inches thick require 100% radiography
   b) Welds in stainless steel (P-8) materials that are > 1-1/2 inches thick require 100% radiography
   c) Welds in materials not requiring 100% radiography require spot radiography
   d) Butt welds in nozzles or chambers > ten inches diameter or >1-1/4 inches thickness attached to vessel sections or heads require 100% radiography

(2) Category B Vessel Welds requiring radiography.

a) Welds in P-1 materials > 1-1/4 inches thick require 100% radiography
b) Welds in P-8 materials > 1-1/2 inches thick require 100% radiography
c) Welds in materials not requiring 100% radiography require spot radiography
d) Butt welds in nozzles and chambers > 10 inches diameter or 1-1/8 inches thick attached to vessel heads or sections require 100% radiography

(3) Category C vessel welds requiring radiography

a) Welds in P-1 materials > 1-1/4 inches thick require 100% radiography
b) Welds in P-8 materials > 1-1/2 inches thick require 100% radiography
c) Welds in materials not requiring 100% radiography require spot radiography
d) Butt welds in nozzles and chambers > 10 inches diameter or 1-1/8 inches thick attached to vessel heads or sections require 100% radiography

(4) Category D vessel welds requiring radiography

a) Full penetration butt welds when a joint efficiency of 1.0 is used requires 100% radiography
b) Full penetration butt welds in nozzles and chambers require 100% radiography
c) Welds in materials not requiring 100% radiography require spot radiography

(5) Atmospheric storage tank welds which require radiography

a) Side wall joints in P-1 material > 1-1/4 inches thick require 100% radiography
b) Side wall joint in P-8 material > 1-1/2 inches thick require 100% radiography
c) Full penetration welds not requiring 100% radiography require spot radiography

(6) Welds in storage tanks for 0-15 psi service which require radiography

a) Sidewall joints in P-1 materials > 1-1/4 inches thick require 100% radiography
b) Sidewall joints in P-8 materials > 1-1/2 inches thick require 100% radiography

c) Roof joints and side wall to roof joints in P-1 materials > 1-1/4 inches thick require 100% radiography
d) Roof joints and side wall to roof joints in P-8 materials > 1-1/2 inches thick require 100% radiography
e) Full penetration welds not requiring radiography require spot radiography

3.1.4 ASME Class 1 Piping, Pumps, and Valves (Subsection NB-5000)

(1) Longitudinal weld joints require 100% radiography

(2) Circumferential weld joints require 100% radiography

(3) Nozzles, branches, and piping connections attached by full penetration welds require 100% radiography

(4) Weld repair to pump and valve castings during manufacture require 100% radiography per the material section NB-2579.4 whenever the repair depth is ≥ 3/8 inch or 10% of section thickness. P-1 and P-8 materials for pumps and valves with nominal piping size ≤ 2 inches are exempted from this examination.

3.1.5 ASME Class 2 Piping, Pumps, and Valves (Subsection NC-5000)

(1) Longitudinal weld joints require 100% radiography

(2) Circumferential weld joints require 100% radiography

(3) Nozzles, branches, and connections attached by full penetration welds where the nominal pipe size is > 4 inches require 100% radiography

(4) Weld repair to pump and valve castings during manufacture require 100% radiography per the material section NC-2579-4 whenever the repair depth is ≥ 3/8 inch or 10% of section thickness.

a) P-1 and P-8 materials for pumps and valves with nominal pipe size ≤ 2 inches are exempted from this examination
b) P-1 and P-8 material for pumps and valves with nominal pipe size > 2 inches up to and including 4 inches are exempted from examination when a quality factor of 0.70 is applied to the pressure rating of the valve and to the allowable stress values used in the design of the pump.

3.2 Method of Evaluation

When available, the purchase documentation of the involved components was reviewed to determine whether radiography was specified.

For information about the circumferential weld examinations performed during the original plant construction and installation, the contractor prepared plant specific specifications (Form 84's) were reviewed.

Plant specific documents such as the following were reviewed to obtain information on volumetric examinations performed: equipment drawings, valve lists, IST/ISI program description and piping design and material specification.

3.3 Results/Conclusions

Table 3-1 provides the results of the radiography requirements review, a summary of which is provided below.

The components considered in this evaluation are normally in use when the reactor system is operating. Any leakage would be discovered by the operating personnel and the appropriate corrective action taken.

3.3.1 CRDM Housing

The Control Rod Drive Mechanism (CRDM) Housing Welds were initially radiographed as required by the Westinghouse equipment specification (Reference 7). The flange to nozzle welds are also covered under the Inservice Inspection Program (ISI) with periodic ultrasonic examinations. The nozzle to closure head welds are visually examined under the Inservice Inspection Program. The CRDM Housings, therefore, meet the criteria set forth in Section 3.0 of this report.

3.3.2 Vessels

When a component is constructed to the ASME Code Section VIII and code cases are involved and the Section VIII or "U" stamp is applied, the general philosophy is that all of the applicable requirements of design, fabrication, and inspection in the Code and Code Cases have been either met or exceeded.

Of the Class 2 and 3 vessels listed in Section II of Table 3-1, only the refueling water storage tank, the recirculation heat exchanger, the component cooling water heat exchanger, the component cooling water surge tank, and the hydrazine tank are required in the mitigation of a major loss-of-coolant accident (coolant pipe break $\geq$ 2 inches nominal pipe size). The other listed Class 2 and 3 vessels are utilized during normal operation and shutdown of the reactor plant.

The refueling water storage tank was radiographed in accordance with the requirements of the API-650 code which required only spot radiography of the circumferential and longitudinal full penetration welds (horizontal and vertical welds).

The heat exchangers listed in Section II of Table 3-1 were constructed to the ASME Code Section VIII. They were radiographically inspected accordingly and were code stamped. The vendor drawing for the component cooling water heat exchanger specifically calls for radiography of the shell longitudinal seams. This drawing identifies the ASME Section VIII code and that Code Case 1270N was invoked.

The specification for the residual heat removal heat exchangers invoked code case 1270N and required radiography per the ASME Section VIII Code with code stamping of the vessel. In addition, the specification specifically required radiography of the full penetration welds of shell, heads and nozzles. Also the shell to head, shell to flange, inlet nozzle (6") to shell and outlet nozzle (6") to shell welds are ultrasonically examined periodically under the Inservice Inspection Program.

The seal water heat exchanger was also fabricated to the ASME Section VIII Code with Code Case 1270N invoked and the completed vessel code stamped. The excess letdown heat exchanger and the regenerative heat exchanger were both fabricated to the ASME Section VIII Code and both code cases 1270N and 1273N were invoked by the specification and drawing. Both vessels were code stamped. In addition, the regenerative heat exchanger circumferential welds and longitudinal seam welds (if any) are ultrasonically examined periodically under the Inservice Inspection Program.

The extent of radiography, if any, for the remaining vessels, reactor coolant pump seal water filter, seal supply filter, vapor seal head tank, recirculation heat exchanger, and the hydrogen tank, listed in Table 3-1, has not been found in the data files searched. However, based on the other information found, the long operating history of the facility and the results of the ISI program requirements to date, such as ultrasonic examination, visual inspection, liquid penetrant examination, and magnetic particle examination, the Class 2 and 3 vessels are considered to be adequate for performing their intended service during the life of the operating plant.

All of the Class 2 and 3 vessels listed in Table 3-1 are considered adequate for performing their intended service during the life of the operating plant.

3.3.3 Pumps

Upon review of the purchase specifications for the Class 2 and 3 pumps listed in Section III of Table 3-1, it was determined that a volumetric examination of the pump bowl or casing was not required. However, it was found that ten of the eleven Class 2 and 3 pumps listed in Table 3-1 are visually examined periodically under the Inservice Testing (IST) Program for Pumps. Any abnormalities such as casing leaks would be discovered and the appropriate corrective action taken.

The CVCS test pump, because of size limitations, is exempted per the code from a volumetric examination. In addition the CVCS test pump is not required to operate during either the normal shutdown of the reactor plant or during the mitigation of an accident such as a loss-of-coolant accident (LOCA).

Of the pumps listed in Table 3-1, the reactor coolant pumps, the residual heat removal pumps and the CVCS test pump are not required to achieve shutdown in mitigation of a major LOCA event (coolant pipe break of $\geq$2 inches NPS). The pumps are installed in pairs or in triplicate such that the single failure of any single unit does not impair the system safety function. Accordingly, they do not need to be examined under this evaluation.

The saltwater cooling pumps, the component cooling water pumps, and the auxiliary feedwater pumps are Class 3 pumps. Even though they are evaluated in Table 3-1, the NRC did not request consideration of the Class 3 pumps. Accordingly, they did not need to be examined under this evaluation.

The reactor coolant pump bowl or casing was assembled with three circumferential welds. Records indicating that radiography was performed were not located. These three welds are given a periodic ultrasonic examination under the Inservice Inspection Program.

With the facts of coverage in the IST Program, coverage in the ISI Program, and the pump redundancy factor, the conclusion drawn is that the installed pumps listed in Table 3-1 are suitable for their intended service during the life of the facility.

3.3.4 Piping

The Class 1 and 2 piping at SONGS 1 generally meets the intent of the inspection requirements of the comparison code specified by Reference 4. According to the piping installation records, more radiography was performed than was required by the ANSI (ASA) B31.1 Code, 1955 Edition.

Generally all piping of nominal pipe size (NPS) 2 inches and less is either socketwelded or screwed together at assembly. Neither type of joint provides a good radiograph so therefore they are visually examined; the socketweld joints are also visually examined with the aid of liquid penetrant materials.

The piping welds have been examined or exempted by one or more of the following means as recorded in documentation of record and/or ongoing ISI programs.

1. 100% radiographic examination performed during original installation,

2. 10% radiographic examination performed during original installation,

3. 100% liquid penetrant examination performed during original installation,

4. 100% ultrasonic and or radiographic examination performed under the SONGS 1 Inservice Inspection Program.

5. Nominal pipe size of 2 inches or less exempted per code from a volumetric examination.

Plant specific documentation indicates that system modifications met the ASME III Code requirements in effect at the time of the modification.

Class 1 and 2 piping welds in systems required to mitigate an accident such as a loss-of-coolant (LOCA) are given a periodic ultrasonic examination under the Inservice Inspection Program. For example, the circumferential piping welds in the safety injection system and the containment sphere spray system are examined periodically under the ISI Program.

The conclusion drawn is that the piping as installed is acceptable for service under the conditions imposed during operation of the facility.

3.3.5 Valves

The Class 1 and 2 valves at SONGS 1 generally meet the intent of the inspection requirements of the comparison code specified by the NRC in Reference 4.

The valves of nominal pipe size of 2 inches and less in diameter were exempted per code from a volumetric examination.

Generally the valves furnished by Westinghouse Electric Corporation were radiographed in accordance with the equipment specification requirement.

Most of the valves listed in the Table 3-1 under Section V are periodically tested as a part of the Inservice Testing Program. The visual examination and inservice test for some valves such as check valves involve disassembly of the valve and a visual inspection of the valve internals prior to reassembly.

It is concluded from the information noted in Table 3-1, Section V, that these valves are suitable for the service intended. Even though a number of the valve bodies were not radiographed, nearly all of the valves listed in Table 3-1 are covered in the Inservice Testing Program. The Inservice Testing Program also covers a number of small valves which, per the code, were exempt from a volumetric or radiographic examination. For example, this is noticed in Item 28 of Table 3-1 which lists a number of containment sphere penetration isolation valves.

Only a sampling of the total number of valves was evaluated. The sample considered came from various systems and includes containment sphere isolation valves, isolation valves in the purge system and isolation valves in the sampling system as well as RCS boundary valves, RHR system valves, CVCS system valves, SI system valves, feedwater and auxiliary feedwater system valves and main steam system valves. The sample included control valves as well as manual valves including check valves, butterfly valves, globe valves and gate valves.

TABLE 3-1

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
I. Control Rod Drive Mechanism Housing	4	1	CS	x		Radiography required per specification; also visually examined under the ISI program; weld also given UT.
II. Class 2 and 3 Vessels						
1. Refueling Water Storage Tank CRS-D-1	N.A.(3)	2	CS	x		Spot radiography required per API 650 code and note 5 of Pittsburg-Des Moines Steel Co. drawing.
2. Component Cooling Water Heat Exchanger CCW-E-20A CCW-E-20B	N.A.	3	CS	x		Per ASME Section VIII and Code Case 1270N; code inspected and stamped; per BASCO, Inc. Drawing B-1-12242-3. Specifically noted on drawing was radiography of the shell longitudinal seam weld.
3. Reactor Coolant Pump Seal Water Filter	N.A					
RCP-C-42(N)		2	SS		x	Radiographic examination of welds as a specification requirement was not found.
RCP-C-42(S)		2	SS		x	
4. Seal Supply Filter	N.A.					
RCP-C-952A		2	SS		x	Radiographic examination of welds as a specification requirement was not found.
RCP-C-952B		2	SS		x	
RCP-C-952C		2	SS		x	

(1) NPS = Nominal Pipe Size
(2) CS = Carbon Steel; SS = Stainless Steel; CI - Cast Iron
(3) N.A. = Not Applicable
(4) UT = Ultrasonic Test; MT = Magnetic Particle Test
(5) RT = Radiography Test; PT = Liquid Penetrant Test

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
5. Vapor Seal Head Tank	N.A.					
RCP-D-9A		2	SS	x		Radiographic examination of welds as a specification requirement was not found.
RCP-D-9B		2	SS	x		
RCP-D-9C		2	SS	x		
6. Pressurizer Relief Tank						
PZR-C-16	N.A.	3	CS	x		Constructed to ASME VIII Code, Code Case 1270N, secondary vessel, paragraph UW-2 and State of California Unfired Pressure Vessel Safety Orders. Also certified for use with Lethal substances. Code stamped; all welded nozzle attachments liquid penetrant examined; head to shell, shell to shell, and shell longitudinal seam welds were radiographed.
7. Recirculation Heat Exchanger						
CRS-E-11	N.A.	2/3	SS	x		100% radiographic examination of welds.
8. Hydrazine Tank (N_2 H_4)						
SHA-D-200	N.A.	2	SS		x	Radiographic examination of welds as a specification requirement was not found.
9. Excess Letdown Heat Exchanger						
LDS-E-33	N.A.	1/3	SS CS	x		Radiography performed per the ASME Section VIII Code and Code Cases 1270N and 1273N. Vessel is code stamped to ASME VIII.

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
10. Regenerative Heat Exchanger						
LDS-E-13	N.A.	2/1	SS SS	x		Radiography performed per the ASME Section VIII Code and Code Cases 1270N and 1273N. Vessel is code stamped to ASME VIII. Circumferential welds and shell seam welds, if any, are ultrasonically examined per the Inservice Inspection Program.
11. Residual Heat Exchanger						
RHR-E-21A	N.A.	2/3	SS CS	x		Radiographed all full penetration welds, shell, heads, nozzles. PT or MT for welds not requiring radiography per ASME VIII and Code Case 1270N. Code stamp was required. The shell to head, shell to flange, inlet nozzle (6") to vessel, and outlet nozzle (6") to shell welds are ultrasonically examined under the Inservice Inspection Program.
RHR-E-21B	N.A.	2/3	SS CS	x		
12. Volume Control Tank						
VCC-C-15	N.A.	2	SS	x		100% radiography of main vessel butt welds and manway neck butt weld. ASME 1962, Section VIII Lethal and Code Case 1270N, secondary vessel; code stamped.

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
13. Seal Water Heat Exchanger						
VCC-E-34	N.A.	2/3	SS CS	x		Radiography performed per the ASME VIII Code and Code Case 1270N. Vessel is code stamped to ASME VIII.
14. Seal Water Return Filter						
VCC-C-40	N.A.	2	SS		x	Vessel constructed per ASME VIII Code 1962. Radiography was not specifically identified on the drawing. Specification required liquid penetrant examination of all pressure retaining welds.
15. Auxiliary Feedwater Storage Tank						
AFW-D-2A	N.A.	3	SS	x		ASME B&PV, Section III, Class 3 subsection ND, 1977 Edition, with Addenda through Summer 1978 was specified. No code stamp. Radiography per the code.
16. Component Cooling Water Surge Tank						
CCW-C-17	N.A	3	CS		x	Constructed to ASME VIII Code, Code Case 1270N, secondary vessel and the State of California Unfired Pressure Vessel Safety Orders. Code stamped. Root and final weld passes of all welds were liquid penetrant examined. All welds and nozzle attachments were examined by magnetic particle methods. No

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
						radiography or volumetric examination imposed by the specification.
17. Spent Fuel Pit Filter						
SFP-C-849	N.A.	3	SS	x		100% RT for full penetration welds: head to flange, shell to flange, head to shell, shell longitudinal seam. Constructed per ASME VIII, Code 1962 and Code Case 1271N. Specification required liquid penetrant examination of all pressure retaining welds.
18. Reactor Coolant Filter						
LDS-C-28	N.A.	2	SS	x		100% RT for full penetration welds: head to flange, shell to flange, head to shell, shell longitudinal seam. Constructed per ASME VIII Code, 1962. Specification required liquid penetrant examination of all pressure retaining welds.
19. Spent Resin Return Filter						
RLC-C-29	N.A.	-	CS		x	Vessel constructed per ASME VIII Code, 1965. Radiography of full penetration welds not specifically confirmed.
20. Boric Acid Supply Filter						
BAS-C-41	N.A.	3	SS		x	Radiography of full penetration welds not specifically confirmed. Specification required liquid penetrant examination of all pressure retaining welds.

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
21. Diesel Fuel Oil Storage Tank						
DFS-D-23	N.A.	3	CS	x		Radiography performed per the requirements of the ASME B&PV Section III Code, Article ND-5000 1974 Edition plus appropriate Addenda. In addition back sides of welds visually examined and repaired where necessary. Code N stamp required.
DFS-D-24	N.A	3	CS	x		

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
III. ASME Class 1 and 2 Pumps						
1. CVCS Test Pump 2x2 VCC-G-42	N.A.	2	SS	x		Pump casting or forging of NPS 2 inches and less exempted from radiography. The purchase specification did not require a volumetric examination of the pump body or casing.
2. Reactor Coolant Pumps						
RCS-G-2A	N.A.	1	SS	x		Pump bowls were radiographed and inspected for material flaws per Westinghouse specification. The pump welds are volumetrically examined periodically by ultrasonic methods under the Inservice Inspection Program.
RCS-G-2B	N.A.	1	SS	x		
RCS-G-2C	N.A.	1	SS	x		
3. Safety Injection Pumps						
SIS-G-50A	N.A.	2	SS		x	The purchase specification did not require a volumetric examination of the pump body or casing. The pumps tested periodically under the Inservice Testing Program and the observations are recorded in the permanent record file.
SIS-G-50B	N.A.	2	SS		x	

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
4. Feedwater Pumps						
FWS-G-3A	N.A.	2	SS		x	The purchase specification did not require a volumetric examination of the pump body or casing. The pumps are tested periodically under the Inservice Testing Program and the observations are recorded in the permanent record file.
FWS-G-3B	N.A.	2	SS		x	
5. Refueling Water Pumps						
CRS-G-27S	N.A.	2	*		x	*Specified material not found; Radiographic examination of welds, and casings as a specification requirement was not found.
CRS-G-27N	N.A.	2	*		x	
6. Recirculation Pumps						
CRS-G-45A	N.A.	2	CS		x	The purchase specification did not require a volumetric examination of the pump body or casing. The pumps are tested periodically under the Inservice Testing Program and the observations are recorded in the permanent record file. A subsequent specification in 1982 replaced these pumps. The specified code was ASME B&PV Section III 1977 Edition including all Addenda through Summer 1979, subsection NC. Radiography of cast pump body as per the Code Article-2000. In addition all welds required visual examination using liquid penetrant materials.
CRS-G-45B	N.A.	2	CS		x	

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
7. Spray Additive Pumps						
SHA-G-200A	N.A.	2	SS		x	Pump NPS ≤2 inches exempted per code; however, pumps were ordered to the ASME Section III, Class 2 Code including the summer 1975 addenda. Nondestructive examinations as required per the code. The pumps are tested periodically under the Inservice Testing Program and the observations are recorded in the permanent record file.
SHA-G-200B	N.A.	2	SS		x	
8. Residual Heat Removal Pumps						
RHR-G-14A(E)	N.A.	2	SS		x	Standards of hydraulic institute with ASME Section VIII Code for pressure parts only. All stainless steel pressure containing parts were liquid penetrant examined; all welding including repair welding required radiography per the specification and referred to paragraph UW-51. No volumetric examination of pump casing per specification. The pumps are tested periodically under the Inservice Testing Program and the observations are recorded in the permanent record file.
RHR-G-14B(W)	N.A.	2	SS		x	

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
9. CVCS Charging Pumps						
VCC-G-8A	N.A.	2	SS	x		Volumetric examination of pump casings and shafts by ultrasonic methods was required by Westinghouse specification. Stainless steel surfaces also examined by liquid penetrant methods.
VCC G-8B	N.A.	2	SS	x		The pumps are tested periodically under the Inservice Testing Program and the observations are recorded in the permanent record file.
10. Auxiliary Feedwater Pumps						
AFW-G-10S	N.A.	3	CI		x	The purchase specification did not require a volumetric examination of the pump body or casing.
AFW-G-10W	N.A.	3	CI		x	The pumps are tested periodically under the Inservice Testing Program and the observations are recorded in the permanent record file.
AFW-G-10	N.A.	3	CI		x	
11. Component Cooling Water Pumps						
CCW-G-15A	N.A.	3	CI		x	The purchase specification did not require a volumetric examination of the pump body or casing.
CCW-G-15B	N.A.	3	CI		x	The pumps are tested periodically under the Inservice Testing Program and the observations are recorded in the permanent record file.
CCW-G-15C	N.A.	3	CI		x	

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
12. Saltwater Cooling Pumps						
SWC-G-13A	N.A.	3	SS		x	The purchase specification did not require a volumetric examination of the pump body or casing.
SWC-G-13B	N.A.	3	SS		x	The pumps are tested periodically under the Inservice Testing Program and the observations are recorded in the permanent record file.IV.Class 1 and 2 Piping
IV. Class 1 and 2 Piping						
Chemical and Volume Control System						
1. Letdown piping from RCS Loop A to LDS-CV-202, -203, -204						
Line RCS-5008						
LDS-2071						
LDS-2067	2	1	SS		x	Socket welds (SW) are not full penetration welds and do not give meaningful radiographs and thus are exempted per code; 100% PT was performed; these socket welds are given a 100% PT surface examination under the ISI program.
LDS-2068	2	1	SS		x	
	2	1	SS		x	
	2	1	SS		x	

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
2. Excess letdown piping from RCS Loop B to valve LDS-HCV-1117						
Line RCS-5016	2	1	SS		x	Socket welds are exempted per code because a meaningful radiograph cannot be obtained; 100% PT was performed.
RCS-5014	3/4	1	SS		x	
LDS-5014	3/4	1	SS		x	
LDS-2073	1	1	SS		x	
3. Letdown piping from LDS-CV-202, -203, -204 to the RHR Interface						
Line LDS-2067	2	2	SS		x	Socket welds are exempted per code; 100% PT was performed.
LDS-2071	2	2	SS		x	
LDS-2068	2	2	SS		x	
4. Letdown piping from RHR Interface to volume control tank, VCC-C-15						
Line LDS-3006	2	2	SS		x	Socket welds exempted per code; 100% PT performed. 10% RT performed on circumferential welds during original construction installation.
LDS-3006	3	2	SS	x		
LDS-2043	3	2	SS	x		
LDS-2036	3	2	SS	x		
5. Letdown piping from VCC-C-15 to charging and test pumps						
Line VCC-2000	4	2	SS	x		100% RT performed on circumferential welds during original construction installation.
VCC-2001	3	2	SS	x		
VCC-2000	3	2	SS	x		
VCC-2028	2	2	SS		x	Socket welds exempted per code, 100% PT performed.

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
6. Auxiliary Pressurizer Spray Piping from Line VCC-2081-2" to VCC-CV-305 to Line PZR-5011-4"						
Line VCC-2080	2	1	SS		x	Socket welds exempted per code, 100% PT performed. Welds are 100% PT examined under the ISI program.
Safety Injection System						
7. Piping from Refueling Water Storage Tank to Safety Injection System Pumps						
Line CRS-6000	16	2	SS	x		100% RT performed on circumferential welds during original construction installation.
SIS-6000	16	2	SS	x		
CRS-6001	16	2	SS	x		
SIS-6001	16	2	SS	x		
8. Piping from Pumps to Feedwater System Interface						
Line SIS-6002	16	2	SS	x		UT examination of welds under ISI program from valves SIS-HV-853A and -853B to the FWS interface. 100% RT performed on circumferential welds during original construction installation.
SIS-6003	16	2	SS	x		

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
9. Piping from FWS Interface to Safety Injection System						
Line FWS-6004	14	2	SS	x		UT examination of welds under ISI program. 100% RT performed on circumferential welds during original construction installation.
SIS-6004	14	2	SS	x		
FWS-6005	14	2	SS	x		
SIS-6005	14	2	SS	x		
10. Piping to the RCS Loops A, B and C						
Line SIS-6006	6	1&2	SS	x		UT examination of welds under ISI program. 100% RT performed on circumferential welds during original construction installation.
SIS-6007	6	1&2	SS	x		
SIS-6008	6	1&2	SS	x		
11. Other Lines						
Line SIS-12984	2	2	SS		x	Socket welds exempted per code;
SIS-8013	2	2	SS		x	100% PT performed.
SIS-6014	3	2	SS	x		100% RT performed.
SIS-6011	2	2	SS		x	Socket welds exempted per code;
SIS-6012	2	2	SS		x	100% PT performed.
Residual Heat Removal System						
12. Piping Upstream of Valve RHR-MOV-814 and downstream of valve RHR-MOV-833						
Line RCS-5000	8	1	SS	x		UT examination of welds under ISI program. 100% RT performed on circumferential welds during original construction installation.
RHR-3001	6	1	SS	x		

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
13. Other RHR System Piping						
Line RHR-5000	8	2	SS	x		UT examination of welds under ISI program. 100% RT performed on circumferential welds during original construction installation.
RHR-5038	6	2	SS	x		
RHR-3016	6	2	SS	x		
RHR-3015	6	2	SS	x		
RHR-3019	6	2	SS	x		
RHR-3000	6	2	SS	x		
RHR-3001	6	2	SS	x		
RHR-3003	4	2	SS	x		
Containment Sphere Spray System						
14. Piping from Refueling Water Storage Tank to Refueling Water Pumps						
Line CRS-729	8	2	SS	x		100% RT performed on circumferential welds during original construction installation.
15. Piping Downstream of Refueling Water Pumps						
Line CRS-10375	6	2	SS	x		UT examination of welds under ISI program.
CRS-739	6	2	SS	x		
CRS-891	2	2	SS		+	
CRS-10371	6	2	SS	x		+Socket weld joints exempted per code. 100% RT Performed on circumferential welds during original construction installation.
CRS-10379	6	2	SS	x		
CRS-734	6	2	SS	x		
CRS-765	4	2	SS	x		
CRS-8020	6	2	SS	x		

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	No	REMARKS(4,5)
Chemical Addition System (N_2H_4)						
16. Piping Upstream and Downstream of Pumps including Recirculation Piping						
Line SHA-1156	1	2	SS		x	2-inch and under socket welded
SHA-1157	1	2	SS		x	installation exempted per code;
SHA-1158	1	2	SS		x	100% PT performed.
SHA-1151	3/4	2	SS		x	
SHA-1152	3/4	2	SS		x	
SHA-1150	3/4	2	SS		x	
SHA-1153	3/4	2	SS		x	
SHA-1154	3/4	2	SS		x	
SHA-1161	3/4	2	SS		x	
SHA-1162	3/4	2	SS		x	
SHA-1163	3/4	2	SS		x	
SHA-1164	3/4	2	SS		x	
SHA-1155	3/4	2	SS		x	
SHA-1159	1	2	SS		x	
SHA-1160	3/4	2	SS		x	
Containment Purge System Piping for Containment Isolation						
17. Piping for Penetration						
	24	2	CS	x		100% RT performed on
Lines CVS-13290	24	2	CS	x		circumferential welds during
CVS-13291						original construction installation.

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
Auxiliary Feedwater System						
18. Piping to Steam Generators						
Line AFW-381A						
AFW-381B	3	2	CS	x		100% RT performed on circumferential welds during original construction installation.
AFW-381C	3	2	CS	x		
AFW-14101	3	2	CS	x		
	3	2	CS	x		
19. Other AFW System Piping Upstream of Valves AFW-FCV-3300, -3301, -2300, -2301						
Line AFW-381A	3	2	CS	x		100% RT performed on circumferential welds during original construction installation.
AFW-381A	4	2	CS	x		
AFW-381B	3	2	CS	x		
AFW-381C	3	2	CS	x		
AFW-397A	3	2	CS	x		
AFW-397B	3	2	CS	x		
AFW-397C	3	2	CS	x		
AFW-397A	4	2	CS	x		
AFW-17039	3	2	CS	x		
AFW-17040	3	2	CS	x		
AFW-17038	4	2	CS	x		
AFW-8111	4	2	CS	x		
AFW-8110	4	2	CS	x		
AFW-8111	6	2	CS	x		
AFW-17035	6	2	CS	x		
AFW-8110	6	2	CS	x		

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
Feedwater System						
20. Piping Inside and Outside Containment Downstream of Valves FWS-FCV-456, -457, -458 and FWS-CV-142, -143, -144						
Line FWS-393	10	2	CS	x		100% RT performed on circumferential welds during original construction installation.
FWS-14104	4	2	CS	x		
FWS-14114	4	2	CS	x		
FWS-392	10	2	CS	x		
FWS-391	10	2	CS	x		
FWS-1409	4	2	CS	x		
21. Piping from Valves FWS-854A and -854B to Valves FWS-852A and -852B						
Line FWS-318	14	2	CS	x		UT examination of welds under ISI program. 100% RT performed on circumferential welds during original construction installation.
FWS-320	12	2	CS	x		
FWS-317	16	2	CS	x		
FWS-319	12	2	CS	x		

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
Main Steam System						
22. Piping from Steam Generators to Main Steam Stop Valves						
Line MSS-3	20	2	CS	x		UT or RT examination of welds under ISI program. 100% RT performed on circumferential welds during original construction installation.
MSS-4	20	2	CS	x		
MSS-5	20	2	CS	x		
MSS-6	24	2	CS	x		
MSS-7	24	2	CS	x		
MSS-50	24	2	CS	x		
MSS-51	24	2	CS	x		
MSS-1	24	2	CS	x		
MSS-2	24	2	CS	x		
MSS-14	20	2	CS	x		
23. Piping from Main Steam Lines						
Line MSS-18	10	2	CS	x		UT examination of welds under ISI program. 100% RT performed on circumferential welds during original construction installation.
MSS-15	8	2	CS	x		
MSS-1316	8	2	CS	x		
MSS-17	6	2	CS	x		
MSS-18	6	2	CS	x		
MSS-20	6	2	CS	x		
MSS-9	3	2	CS	x		
MSS-1317	3	2	CS	x		
MSS-69	3	2	CS	x		
24. Piping to Auxiliary Feedwater Pump Turbine						
Line MSS-69	3	2	CS	x		100% RT performed on circumferential welds during original construction installation.

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
Reactor Coolant Sampling System						
25. Piping from RCS to the Outside Containment Isolation Valves						
Line PZR-5029	3/4	1	SS		x	Piping and tubing 2-inch and less NPS exempted from volumetric examination. 100% visual examination performed.
PZR-5029	3/8	1	SS		x	
PZR-5029	3/8	2	SS		x	
PZR-5032	3/4	1	SS		x	
PZR-5032	3/8	1	SS		x	
PZR-5032	3/8	2	SS		x	
RCS-5004	3/4	1	SS		x	
RCS-5004	3/8	1	SS		x	
RCS-5004	3/8	2	SS		x	
RCS-5026	3/4	1	SS		x	
RCS-5026	3/8	1	SS		x	
RCS-5026	3/8	2	SS		x	
RHR-3008	3/4	1	SS		x	
RHR-3008	3/8	1	SS		x	
RHR-3008	3/8	2	SS		x	
PZR-5052	3/4	1	SS		x	
PZR-5052	3/8	1	SS		x	
PZR-5052	3/8	2	SS		x	
Containment Spray and Recirculation System						
26. Piping from Recirculation Pumps						
Line CRS-6018	6	2	SS	x		100% RT examination noted for circumferential welds; socket welds and fillet welds exempted per code.
CRS-6019	6	2	SS	x		
CRS-6019	4	2	SS	x		
CRS-6018	4	2	SS	x		
CRS-737	8	2	SS	x		
CRS-728	8	2	SS	x		
CRS-6015	4	2	SS	x		

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	No	REMARKS(4,5)
V. Class 1 and 2 Valves						
Chemical and Volume Control System						
1. Letdown Piping from RCS Loop A to Valves LDS-CV-202, -203, -204						
LDS-LCV-1112	2	1	SS		(1)	(1) Valves of nominal pipe size ≤ 2 inches are exempted from a volumetric examination.
LDS-CV-202	2	1	SS		(1,2)	(2) These valves are tested under the inservice testing program.
LDS-CV-203	2	1	SS		(1,2)	
LDS-CV-204	2	1	SS		(1,2)	
2. Excess Letdown Piping from RCS Loop B to Valve LDS-HCV-1117						
LDS-CV-287	3/4	1	SS		(1)	(1) Valves of nominal pipe size ≤ 2 inches are exempted from a volumetric examination.
LDS-HCV-1117	1	1	SS		(1)	
3. Letdown Piping from LDS-CV-202, -203, -204 to RHR Interface						
No Valves						

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
4. Letdown Piping from RHR Interface to Volume Control Tank						
LDS-CV-525	2	2	SS	(1,2)		(1) Valves of nominal pipe size ≤ 2 inches are exempted from a volumetric examination.
LDS-CV-526	2	2	SS	(1,2)		(2) These valves are tested under the Inservice Testing Program.
LDS-PCV-1105	2	2	SS	(1)		(5) No RT, but liquid penetrant examination of all accessible surfaces.
LDS-TCV-1105	3	2	SS	(5)		
LDS-LCV-1100A	3	2	SS	(5)		
5. Volume Control Tank to Charging Pump Suction						
No Valves						
6. Auxiliary Pressurizer Spray Piping						
VCC-CV-305	2	1	SS	(1,2)		(1) Valves of nominal pipe size ≤ 2 inches are exempted from a volumetric examination. (2) These valves are tested under the Inservice Testing Program.
Safety Injection System						
7. Piping from RWST to SIS Pump Suction						
SIS-301	16	2	SS	(5)		(5) No RT, but PT performed on all accessible surfaces.
SIS-302	16	2	SS	(5)		

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
8. Piping from SIS Pumps to FW System Interface						
SIS-HV-853A	16	2	SS	(2,4)		(2) These valves are tested under the Inservice Testing Program.
SIS-HV-853B	16	2	SS	(2,4)		(4) 100% RT was performed on the original valve bodies.
9. Piping from FW System Interface to SI System						
SIS-HV-851A	14	2	SS	(2,4)		(2) These valves are tested under the Inservice Testing Program.
SIS-HV-851B	14	2	SS	(2,4)		
SIS-303	12	2	SS	(2,4)		
SIS-304	12	2	SS	(2,4)		(4) 100% RT was performed on the original valve bodies.
10. Piping to RCS Loops A, B and C						
SIS-MOV-850A	6	1	SS	(2,4)		(2) These valves are tested under the Inservice Testing Program.
SIS-MOV-850B	6	1	SS	(2,4)		
SIS-MOV-850C	6	1	SS	(2,4)		
SIS-003	6	1	SS	(2,4)		(4) 100% RT was performed on the original valve bodies.
SIS-004	6	1	SS	(2,4)		
SIS-010	6	1	SS	(2,4)		
11. Other Line Valves						
No Valves						

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	No	REMARKS(4,5)
Residual Heat Removal System						
12. Piping Upstream of Valve RHR-MOV-813 and Downstream of Valve RHR-MOV-834						
No valves						
13. Other RHR System Piping						
RHR-MOV-813	8	1	SS	(2,4)		(2) These valves are tested under the Inservice Testing Program.
RHR-MOV-814	8	1	SS	(2,4)		
RHR-MOV-833	6	1	SS	(2,4)		
RHR-MOV-834	6	1	SS	(2,4)		(4) 100% Radiographic inspection and acceptance in accordance with ASA-B31.1 code case N-10.
RHR-MOV-822A	6	2	SS	(2,4)		
RHR-MOV-822B	6	2	SS	(2,4)		
RHR-HCV-602	6	2	SS	(2,4)		
RHR-014	6	2	SS	(2,4)		
RHR-013	6	2	SS	(2,4)		
RHR-002	6	2	SS	(4)		
RHR-003	6	2	SS	(4)		
RHR-015	6	2	SS	(4)		
RHR-016	6	2	SS	(4)		
RHR-025	6	2	SS	(4)		
RHR-026	6	2	SS	(4)		
RHR-027	6	2	SS	(4)		
RHR-029	6	2	SS	(4)		

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
Containment Sphere Spray System						
14. Piping from RWST to Refueling Water Pump Suction						
CRS-MOV-883	8	2	SS		(2,5)	(2) These valves are tested under the Inservice Testing Program.
CRS-301	8	2	SS		(2,5)	(5) Radiography or volumetric examination as a specification requirement was not found.
15. Piping Downstream of Refueling Water Pumps						
CRS-304	6	2	SS		(2,5)	(1) Valves of nominal pipe size ≤2 inches are exempted from a volumetric examination.
CRS-305	6	2	SS		(2,5)	
CRS-CV-517	6	2	SS		(2,5)	
CRS-MOV-880	4	2	SS		(2,5)	
CRS-020	2	2	SS		(1,2)	(2) These valves are tested under the Inservice Testing Program.
CRS-CV-82	6	2	SS		(2,5)	
CRS-CV-92	4	2	SS		(2,5)	
CRS-CV-114	6	2	SS		(2,5)	(5) Radiography or volumetric examination as a specification requirement was not found.
CRS-CV-518	6	2	SS		(2,5)	

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes No	REMARKS(4,5)
Chemical Addition System (N_2H_4)					
16. Piping Upstream and Downstream of Pumps including Recirculation Piping					
SHA-305	3/4	2	SS	(1,2)	(1) Valves of nominal pipe size ≤2 inches are exempted from a volumetric examination.
SHA-306	3/4	2	SS	(1,2)	
SHA-SV-600	3/4	2	SS	(1,2)	(2) These valves are tested under the Inservice Testing Program.
SHA-SV-601	3/4	2	SS	(1,2)	
Containment Purge System Piping for Containment Isolation					
17. Piping for Penetrations					
CVS-POV-9	24	2	CS	(2,5)	(1) Valves of nominal pipe size ≤2 inches are exempted from a volumetric examination.
CVS-301	24	2	CS	(2,5)	
CVS-POV-10	24	2	CS	(2,5)	
CVS-313	24	2	CS	(2,5)	
CVS-CV-10	6	2	CS	(2,5)	(2) These valves are tested under the Inservice Testing Program.
CVS-SV-212-8	1	2	SS	(1,2)	
CVS-SV-212-9	1	2	SS	(1,2)	
CVS-CV-40	2	2	CS	(1,2)	(5) Radiography or volumetric examination as a specification requirement was not found.
CVS-CV-116	6	2	CS	(2,5)	

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes No	REMARKS(4,5)
Auxiliary Feedwater System					
18. Piping to Steam Generators					
No valves					
19. Other AFW System Piping Upstream of Valves AFW-FCV-3300, -3301, -2300, -2301					
AFW-321					
AFW-322	3	2	SS	(2,5)	(2) These valves are tested under the Inservice Testing Program.
AFW-324	3	2	SS	(2,5)	
AFW-FCV-3300	3	2	SS	(2,5)	
AFW-FCV-3301	3	2	CS	(2,5)	(5) Radiography or volumetric examination as a specification requirement was not found.
AFW-FCV-2300	3	2	CS	(2,5)	
AFW-FCV-2301	3	2	CS	(2,5)	
AFW-CV-3213	3	2	CS	(2,5)	
AFW-MOV-1202	3	2	CS	(2,5)	
AFW-FV-3110	3	2	CS	(2,5)	
AFW-303	3	2	CS	(2,5)	
AFW-304	3	2	CS	(2,5)	
AFW-309	3	2	CS	(2,5)	
AFW-310	3	2	SS	(2,5)	
AFW-312	3	2	SS	(2,5)	
AFW-317	3	2	SS	(2,5)	
AFW-318	3	2	SS	(2,5)	
AFW-384	3	2	CS	(2,5)	
AFW-387	3	2	CS	(2,5)	
AFW-388	3	2	CS	(2,5)	
AFW-399	3	2	CS	(2,5)	
AFW-403	3	2	CS	(2,5)	
	3	2	CS	(2,5)	

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS[1]	ASME III	Material Type [2]	Radiography specified Yes	Radiography specified No	REMARKS[4,5]
Feedwater System						
20. Piping Inside and Outside Containment Downstream of Valves FWS-FCV-456, -457, -458, and FWS-CV-142, -143, -144						
FWS-006	10	2	CS		(2,5)	(2) These valves are tested under the Inservice Testing Program.
FWS-007	10	2	CS		(2,5)	
FWS-012	10	2	CS		(2,5)	
FWS-345	10	2	CS		(2,5)	(5) Radiography or volumetric examination as a specification requirement was not found.
FWS-379	4	2	CS		(2,5)	
FWS-346	10	2	CS		(2,5)	
FWS-378	4	2	CS		(2,5)	
FWS-398	10	2	CS		(2,5)	
FWS-417	4	2	CS		(2,5)	
FWS-438	12	2	CS		(2,5)	
FWS-439	12	2	CS		(2,5)	

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes No
21. Other Feedwater Piping Upstream of Isolation Valves				
FWS-CV-143	4	2	CS	(2,4)
FWS-FCV-458	8	2	CS	(2,5)
FWS-CV-144	4	2	CS	(2,4)
FWS-FCV-457	8	2	CS	(2,5)
FWS-CV-142	4	2	CS	(2,4)
FWS-FCV-456	8	2	CS	(2,5)
FWS-CV-36	3	2	CS	(2,4)
FWS-CV-37	3	2	CS	(2,4)
FWS-HV-852A	12	2	CS	(2,4)
FWS-HV-852B	12	2	CS	(2,4)
FWS-HV-854A	14	2	CS	(2,4)
FWS-HV-854B	14	2	CS	(2,4)
FWS-CV-100	2	2	CS	(1,2)
FWS-CV-100A	2	2	CS	(1,2)
FWS-CV-100B	3	2	CS	(2,4)
FWS-MOV-20	10	2	CS	(2,5)
FWS-MOV-21	10	2	CS	(2,5)
FWS-MOV-22	10	2	CS	(2,5)

REMARKS(4,5)

(1) Valves of nominal pipe size ≤2 inches are exempted from volumetric examination.

(2) These valves are tested under the Inservice Testing Program.

(4) Per Westinghouse specification, E-676044, these valve bodies were subjected to 100% RT examination.

(5) Radiography or volumetric examination as a specification requirement was not found.

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	Radiography specified No	REMARKS(4,5)
Main Steam System						
22. Piping from Steam Generators to Main Steam Stop Valves						
MSS-PV-1650	24	2	CS	(2,5)		(2) These valves are tested under the Inservice Testing Program.
MSS-PV-1651	24	2	CS	(2,5)		
MSS-RV-1	6	2	CS	(2,5)		
MSS-RV-2	6	2	CS	(2,5)		(4) Per Westinghouse specification, E-676044, these valve bodies were subjected to 100% RT examination.
MSS-RV-3	6	2	CS	(2,5)		
MSS-RV-4	6	2	CS	(2,5)		
MSS-RV-5	6	2	CS	(2,5)		
MSS-RV-6	6	2	CS	(2,5)		
MSS-RV-7	6	2	CS	(2,5)		(5) Radiography or volumetric examination as a specification requirement was not found.
MSS-RV-8	6	2	CS	(2,5)		
MSS-RV-9	6	2	CS	(2,5)		
MSS-RV-10	6	2	CS	(2,5)		
MSS-CV-76	4	2	CS	(2,4)		
MSS-CV-77	4	2	CS	(2,4)		
MSS-CV-78	4	2	CS	(2,4)		
MSS-CV-79	4	2	CS	(2,4)		
MSS-CV-3	4	2	CS	(4)		
MSS-CV-4	4	2	CS	(4)		

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	No	REMARKS(4,5)
23. Piping from Main Steam Lines						
THP-MOV-14	6	2	CS	(5)		(1) Valves of nominal pipe size ≤2 inches are exempted from a volumetric examination.
THP-CV-126	6	2	CS	(4)		
THP-MOV-16	6	2	CS	(5)		
THP-CV-124	6	2	CS	(4)		
THP-CV-128	1	2	CS	(1)		(4) 100% radiographic inspection and acceptance in accordance with ASA B31.1 code case N-10.
THP-CV-130	1	2	CS	(1)		
MSS-CV-96	3	2	CS	(4)		
THP-MOV-15	6	2	CS	(5)		
THP-CV-127	6	2	CS	(4)		(5) Radiography or volumetric examination as a specification requirement was not found.
THP-CV-129	1	2	CS	(1)		
THP-MOV-17	6	2	CS	(5)		
THP-CV-125	6	2	CS	(4)		
THP-CV-131	1	2	CS	(1)		
MSS-333	3	2	CS	(5)		
24. Piping to Auxiliary Feedwater Pump Turbine						
MSS-333	3	2	CS	(5)		(2) These valves are tested under the Inservice Testing Program.
AFW-CV-113	3	2	CS	(2,5)		
AFW-CV-3201	3	2	CS	(2,5)		
AFW-SV-3200	1/2	2	CS	(2,5)		(5) Radiography or volumetric examination as a specification requirement was not found.
AFW-SV-3214	1/2	2	SS	(2,5)		
AFW-SV-3211	1/2	2	SS	(2,5)		
AFW-RV-3206	4	2	CS	(5)		

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes No	REMARKS(4,5)
Reactor Coolant Sampling System					
25. Piping from RCS up to the Outside Containment Isolation Valves					
RSS-CV-951	3/8	2	SS	(1,2)	(1) Valves of nominal pipe size $\leq$2 inches are exempted from a volumetric examination.
RSS-CV-992	3/8	2	SS	(1,2)	
RSS-CV-953	3/8	2	SS	(1,2)	
RSS-CV-956	3/8	2	SS	(1,2)	
RSS-CV-955	3/8	2	SS	(1,2)	(2) These valves are tested under the Inservice Testing Program.
RSS-SV-3302	3/8	2	SS	(1,2)	
RSS-CV-962	3/8	2	SS	(1,2)	
RSS-CV-957	3/8	2	SS	(1,2)	
RSS-CV-948	3/8	2	SS	(1,2)	
RSS-CV-949	3/8	2	SS	(1,2)	
Containment Spray and Recirculation System					
26. Piping from Recirculation Pumps					
CRS-MOV-866A	4	2	SS	(2,5)	(2) These valves are tested under the Inservice Testing Program.
CRS-MOV-866B	4	2	SS	(2,5)	
VCC-MOV-1100B	4	2	SS	(2,5)	
VCC-MOV-1100D	4	2	SS	(2,5)	(4) 100% RT was performed on the original valve bodies.
VCC-FCV-5051	3	2	SS	(2,5)	
CRS-008	6	2	CS	(4)	
CRS-009	6	2	CS	(4)	(5) Radiography or volumetric examination as a specification requirement was not found.

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	No	REMARKS(4,5)
Pressurizer Safety Valves						
27.Safety Valves						
PZR-RV-532	3	1	SS	(2,3,4)		(1) Valves of nominal pipe size ≤2 inches are exempted from a volumetric examination.
PZR-RV-533	3	1	SS	(2,3,4)		
PZR-CV-530	2	1	SS	(1,2)		
PZR-CV-531	2	1	SS	(1,2)		
PZR-CV-545	2	1	SS	(1,2)		(2) These valves are tested under the Inservice Testing Program.
PZR-CV-546	2	1	SS	(1,2)		
						(3) Original valves replaced; valves nondestructively examined per code paragraph N320.
						(4) 100% RT was performed on the original valve bodies.

TABLE 3-1 (Continued)

RADIOGRAPHY REVIEW

ITEM	SIZE inches NPS(1)	ASME III	Material Type (2)	Radiography specified Yes	No	REMARKS(4,5)
Containment Isolation System						
28. Containment Penetration Isolation Valves						
VCC-CV-304	2	1	SS		(1,2)	(1) Valves of nominal pipe size ≤2 inches are exempted from a volumetric examination.
VCC-CV-305	2	1	SS		(1,2)	
VCC-FCV-1112	2	2	SS		(1,2)	
RLC-CV-104	2	2	SS		(1,2)	
RLC-CV-102	1-1/2	2	SS		(1,2)	(2) These valves are tested under the Inservice Testing Program.
RLC-CV-103	1-1/2	2	SS		(1,2)	
RLV-CV-105	2	2	SS		(1,2)	
RLC-CV-106	2	2	SS		(1,2)	
RLC-CV-107	2	2	SS		(1,2)	
GNI-CV-535	1	2	SS		(1,2)	
GNI-CV-536	1	2	SS		(1,2)	
SHA-SV-600	3/4	2	SS		(1,2)	
SHA-SV-601	3/4	2	SS		(1,2)	
RCP-FCV-1115A	2	1	SS		(1,2)	
RCP-FCV-1115B	2	1	SS		(1,2)	
RCP-FCV-1115C	2	1	SS		(1,2)	
RCP-FCV-1115D	2	1	SS		(1,2)	
RCP-FCV-1115E	2	1	SS		(1,2)	
RCP-FCV-1115F	2	1	SS		(1,2)	
RCP-005	2	1	SS		(1,2)	
RCP-006	2	1	SS		(1,2)	
RCP-104	2	1	SS		(1,2)	
SDW-CV-115	2	2	SS		(1,2)	
SDW-CV-537	2	2	SS		(1,2)	
VCC-FCV-1112	2	2	SS		(1,2)	
VCC-CV-304	2	1	SS		(1,2)	

4.0 PRESSURE VESSELS

SEP Topic III-1 requires demonstration of compliance with ASME Code (Reference 6) fatigue analysis requirements for all Class 1 pressure vessels. Pressure vessels requiring fatigue exemption evaluations are as follows:

- Reactor Coolant Pumps (although this is not a pressure vessel the approach for fatigue analysis exemption is identical)
- Pressurizer
- Control Rod Drive Mechanism (CRDM) Housing
- Excess Letdown Heat Exchanger (tube side)

4.1 Methodology

The methodology involves the evaluation of fatigue analysis exemption criteria as provided by the ASME Code. (Reference 6)

4.2 Fatigue Exemption Criteria

The fatigue exemption criteria cited in the ASME Code (Reference 6) are five basic conditions which must all be met for the pressure vessel in question to be exempt from fatigue evaluation. The parameters relevant to the five exemption criteria below are evaluated for each pressure vessel in Section 4.3. The criteria are as follows:

4.2.1 Normal Service Pressure Fluctuations:

$$(\Delta P)_{NS} \leq \frac{S_a(N_f)\, P_{DESIGN}}{3S_m}$$

where:

$(\Delta P)_{NS}$ = The specified full range of pressure fluctuations during normal service.

N_f = Number of significant pressure fluctuations

$S_a(N_f)$ = Alternating stress, from ASME Appendix I fatigue curves, corresponding to N_f.

S_m = Allowable stress intensity at the service temperature

P_{DESIGN} = Design Pressure.

4.2.2 Atmospheric to Service Pressure Cycles

$$N_A \leq N(3S_m)$$

where:

N_A = Maximum number of atmospheric to service pressure cycles.

$N(3S_m)$ = Number of cycles corresponding to an alternating stress level S_a=$3S_m$ in the fatigue curves.

4.2.3 Thermal Gradients

$$(\Delta T)_i \leq \frac{S_a(N_i)}{2E\alpha} \quad ; \quad (i=1,2)$$

where:

i = 1 = Startup and shutdown condition
2 = Normal service condition

$(\Delta T)_i$ = Temperature difference between two adjacent points located on the pressure vessel shell meridians within the distance given by $2\sqrt{Rt}$ for condition "i".

R = Mean radius between the two meridional points

t = Mean shell thickness between the two meridional points

N_1 = Number of start-ups and shut-downs

N_2 = Number of "significant" temperature difference fluctuations during normal service

$S_a(N_i)$ = Alternating stress, from fatigue curves, corresponding to N_i (i=1,2)

E = Modulus of elasticity at T_{MEAN}

α = Instantaneous coefficient of thermal expansion

T_{MEAN} = Mean temperature between the two meridional points

Note that the definition of (ΔT) is associated with the attenuation length $2\sqrt{RT}$, thus characterizing a spacial temperature gradient.

4.2.4 Temperature Difference Between Dissimilar Materials

$$\Delta T_{12} \leq \frac{S_a(N_2)}{2(E_1\alpha_1 - E_2\alpha_2)}$$

where:

ΔT_{12} = Total algebraic range of temperature fluctuations experienced by the component during normal operation.

E_1, E_2 = Moduli of elasticity at the mean temperature of the different materials of construction.

α_1, α_2 = Instantaneous coefficients of thermal expansion at the mean temperature of the different materials of construction.

$S_a(N_2)$ = Alternating stress, from fatigue curves, corresponding to N_2, the number of "significant" temperature fluctuations.

4.2.5 Mechanical Load Fluctuations

$$S_{MF} < S_a\,(N_{MF})$$

where:

S_{MF} = Stresses due to mechanical load (excluding pressure) fluctuations. e.g. piping loads on nozzles.

N_{MF} = Number of expected load fluctuations.

$S_a(N_{MF})$= Alternating stress, from fatigue curves, corresponding to N_{MF}.

4.3 Fatigue Exemption Assessment

This section contains the fatigue exemption requirement evaluations for the following pressure vessels:

- Reactor Coolant Pump (RCP)
- Pressurizer
- Control Rod Drive Mechanism (CRDM) Housing
- Excess Letdown Heat Exchanger (Tube Side) E-33

The evaluation of all the relevant parameters is performed for each individual pressure vessel in Sections 4.3.1 through 4.3.4 and summarized in Tables 4-1 and 4-2. The exemption criteria are tested in each case and documented in Table 4-3.

4.3.1 Reactor Coolant Pumps (RCP)

The relevant structural and material properties of the RCP are shown in Table 4-1. The thermal loading parameters shown in Table 4-2 for the RCP correspond to inflow and average reactor coolant temperatures of 553°F and 573°F, respectively. The pressure and mechanical loading parameters for the RCP are also shown in Table 4-2 where:

- According to Section 5.2.1.3.5 of the SONGS 1 Updated FSAR, (Reference 5) the average reactor coolant pressure varies by $\pm$ 50 psi - i.e., the whole primary loop experiences this fluctuation. Hence, ΔP = 100 psi. Note that this is approximately 5% of the operating pressure.

- For the purposes of evaluating $S_a(N_f)$ for exemption criterion (1), N_f is taken as 10^6, representing the endurance limit.

- $N_A = 2(150) = 300$ = total number of heatups and cooldowns per Section 5.2.1.3.1 of the SONGS 1 Updated FSAR.

- The number of mechanical load fluctuations, N_{MF}, is conservatively assumed to be 500,000.

Furthermore, the stresses due to mechanical loading are conservatively assumed to be at the allowable limit, i.e., $S_{MF} = 1.5S_m$

4.3.2 Pressurizer

The operational characteristics of the pressurizer are taken from the SONGS 1 Updated FSAR (Reference 5). The design and operating temperatures of the pressurizer are 680°F and 642°F, respectively.

Design transients common to the reactor coolant system (RCS), and specific to the pressurizer vessel are given in Table 5.2-2 of Reference 4 and are reproduced in Table 4-4 of this report.

From items I(1), and II(c) of Table 4-4, the following load cases are inferred:

(1) Normal Operation

In- and out- surges take place in the pressurizer under the following conditions:

$\Delta T_{SURGE} = \pm$ 60°F 600 gal/min flow, an infinite number of times.

Hence, $(\Delta T)_2$ = 60°F over $2\sqrt{RT}$ = 30.5 inches.

This is a conservative estimate since it is based on the assumption that the metal temperature change that occurs during these surges is instantaneous.

(2) Start-up/Shut-down

These conditions are given in items II(a) and (b) of Table 4-4, where normal start-ups and shutdowns are considered to correspond to the 150 number of occurrences, as specified in Section 5.2.1.3.1 of Reference 4.

The most severe thermal transient is expected to occur in the upper region of the pressurizer where the spray nozzles are located. The differential temperature expected here is 320°F according to Table 4-4.

Thus, it can conservatively be assumed that:

$(\Delta T)_1 \simeq 300°F$ over $2\sqrt{RT} = 30.5$ inches

The temperature range experienced by the base metal and cladding is $\Delta T_{12} = 120°F$.

For the pressure and mechanical loading parameters for the pressurizer, see Table 4-2. The discussion for the RCP's in Section 4.3.1 also applies to the pressurizer except that $N_{MF} = 10^6$, very conservatively.

4.3.3 Control Rod Drive Mechanism (CRDM) Housing

The structural and operational characteristics of the CRDM housing are summarized in Table 4-1. By virtue of its operational requirements the thermal environment experienced by the CRDM Housing is similar to that of the reactor vessel.

The temperature of the reactor coolant varies with power as shown in Figure 4-1. Thus, the service temperature is 575°F, the average reactor coolant temperature at 100% power.

(1) Normal Operation

This load case will be constructed out of the temperature-power curve given in Figure 4-1.

Using Figure 4-1, the largest temperature gradient possible along the length of the cylinder under normal operation is obtained as:

$$(\Delta T)_2 = T_1 - T_2 = 597 - 553$$
$$= 44°F \text{ over } 2\sqrt{Rt} = 3 \text{ inches length}$$

(2) Startup/Shut-down

The gradient obtained for normal operation is not expected to be exceeded for cool-down and heat-up cycles and therefore $(\Delta T)_1 = 44°F$ over 3 inches length.

For the pressure and mechanical loading parameters for the CRDM housing, see Table 4-2. The discussion for the RCP's in Section 4.3.1 also applies to the CRDM housing except that very conservatively N_{MF} = 100,000 (instead of the much more conservative N_{MF} = 500,000 for the RCP's).

4.3.4 Excess Letdown Heat Exchanger (E-33) - Tube Side

The basic configuration of the heat exchanger is depicted from the Exchanger specification sheet and the heat exchanger vendor drawing. The structural, operational and thermal loading parameters of the excess letdown heat exchanger are summarized in Table 4-1.

For the pressure and mechanical loading parameters for the CRDM housing, see Table 4-2. The discussion for the RCP's in Section 4.3.1 also applies to the excess letdown heat exchanger.

4.3.5 Fatigue Exemption Assessment Results

The parameters required to test the fatigue exemption criteria defined in Section 4.2 are evaluated as shown in Table 4-3.

The evaluations are performed using the parameters developed in Sections 4.3.1 through 4.3.4. The criteria are tested via the ratios indicated by the arrows (→) shown in Table 4-3. A ratio not exceeding 1.0 indicates the satisfaction of the exemption criterion in question (see Section 4.2).

4.4 Conclusions

Ratios preceded by arrows (→), and appearing as less than 1.0 in Table 4-3 indicate that all of the fatigue evaluation exemption criteria are satisfied for the RCP, excess letdown heat exchanger E-33, and the CRDM housing.

The pressurizer fails to meet the exemption criteria. However, it should be recalled that the two exemption criteria that cannot be satisfied, namely the "thermal gradients," and the "mechanical load fluctuations" exemption criteria, have been calculated using conservative assumptions.

The "thermal gradients" exemption criterion is not satisfied because of the conservative assumption of $\Delta T_2 = 60°F$, an assumption that has to be made in the absence of a thermal transient analysis. (See Section 4.3.2).

The "mechanical load fluctuations" exemption criterion is not satisfied because of the conservative assumption of 10^6 mechanical load cycles at an allowable limit of $1.5S_M = 40$ ksi. If, however, the actual number and level of mechanical load fluctuations is assumed as 100,000 and 18 ksi, respectively, the ratio associated with the "mechanical load fluctuations" exemption criterion will be reduced to just below 1.0.

Cygna's past experience indicates that by performance of detailed finite element fatigue analyses on similar Westinghouse pressurizers, cumulative usage factors have been shown to be below 1.0. Furthermore, the fact that the pressurizer is periodically inspected as part of the SONGS 1 In-Service Inspection Program can be relied on to demonstrate compliance with fatigue requirements of the ASME Code. The In-Service Inspection Program has been relied on in lieu of a fatigue exemption evaluation by other plants subject to SEP Topic III-1 evaluation.

TABLE 4-1

STRUCTURAL AND MATERIAL PROPERTIES

	RCP	Pressurizer	CRDM Housing	Letdown HX E-33
• Structural Parameters:				
R (in)	48	42.7	$\simeq 5$	.568
t (in)	7	5.4375	$\simeq .5$	.179
$2\sqrt{Rt}$ (in)	37	30.5	$\simeq 3.2$	.64
• Temperatures				
T_{MEAN} (°F)	563	642	575	553
$T_{SERVICE}$ (°F)	573	642	575	553
T_1 (°F)	T_{MEAN}	642	T_{MEAN}	T_{MEAN}
T_2 (°F)	N/A	642	N/A	N/A
• Material Properties				
Material 1 Specs.	316 Stainless Steel	A-302 Gr.B Alloy Steel	304 Stainless Steel	A-312 Tp 304 Stainless Steel
Material 2 Specs.	N/A	Austenitic S.S. Cladding	N/A	N/A
E_1 (ksi) @ T_1	25.8×10^3	26×10^3	25.6×10^3	25.8×10^3
α_1 (in/in °F) @ T_1	10.4×10^{-6}	8.54×10^{-6}	10.3×10^{-6}	10.2×10^{-6}
E_2 (ksi) @ T_2	N/A	25.1×10^3	N/A	N/A
α_2 (in/in °F) @ T_2	N/A	10.6×10^{-6}	N/A	N/A
$2E_1\alpha_1$ (ksi/°F)	.536	.444	.527	.526
$2E_2\alpha_2$ (ksi/°F)	N/A	.532	N/A	N/A
$(S_m)_1$ (ksi) @ $T_{SERVICE}$	17.3	26.7	18	18.3
$(S_m)_2$ (ksi) @ $T_{SERVICE}$	N/A	20.5	N/A	N/A

TABLE 4-2

LOADING CONDITIONS/PARAMETERS

	RCP	Pressurizer	CRDM Housing	Letdown HX E-33
• Pressure Loading:				
P_{OPER} (psig)	2085	2085	2085	2050
P_{DESIGN} (psig)	2485	2485	2485	2500
ΔP_{NS} (psi)	100	100	100	100
N_f (cycles)	10^6	10^6	10^6	10^6
N_A (cycles)	300	300	300	300
N_1 (cycles)	300	300	300	300
• Thermal Loading:				
$(\Delta T)_1$ (°F)	20	300	44	1
$(\Delta T)_2$ (°F)	20	60	44	1
ΔT_{12} (°F)	N/A	120	N/A	N/A
N_1 (cycles)	300	300	300	300
N_2 (cycles)	10^6	10^6	10^6	10^6
• Mechanical Loading:				
$S_{MF} = 1.5 S_m$ (ksi)	26	max {40,31}	27	27.5
N_{MF} (cycles)	5×10^5	10^6	10^5	5×10^5

TABLE 4-3

FATIGUE EXEMPTION CRITERIA EVALUATION

	RCP	Pressurizer	CRDM Housing	Letdown HX E-33
(1) Pressure Fluctuations				
$S_a(N_f)$ (ksi)	25	12	25	25
$3S_m$ (ksi)	42	80	54	55
$\Delta P^* = S_a(N_f)\, P_{DESIGN}/3S_m$ (psi)	1195	373	1150	1140
→ $\Delta P_{NS}/\Delta P^*$	.084	.27	.087	.088
(2) Atmospheric to Service Pressure Cycles				
$N_A^* = N(3S_m)$	18,000	1,500	11,000	11,000
→ N_A/N_A^*	.017	.20	.027	.027
(3) Thermal Gradients:				
$S_a(N_1)$ (ksi)	150	140	150	150
$S_a(N_2)$ (ksi)	25	12	25	25
$\Delta T_1^* = S_a(N_1)/2E\alpha$ (°F)	280	315	285	284
$\Delta T_2^* = S_a(N_2)/2E\alpha$ (°F)	47	27	47	47
→ $\Delta T_1/\Delta T_1^*$	.071	.95	.15	.004
→ $\Delta T_2/\Delta T_2^*$	.43	2.2	.94	.02
(4) Dissimilar Materials:				
$\Delta E\alpha = \lvert E_1\alpha_1 - E_2\alpha_2\rvert$ (ksi/°F)	N/A	.088	N/A	N/A
$\Delta T_{12}^* = S_a(N_2)/2\Delta E\alpha$ (°F)	N/A	136	N/A	N/A
→ $\Delta T_{12}/\Delta T_{12}^*$	N/A	.88	N/A	N/A
(5) Mechanical Load Fluctuations:				
$S^*_{MF} = S_a(N_{MF})$ (ksi)	28	12	35	28
→ S_{MF}/S^*_{MF}	.93	3.3	.77	.98

Table 4-4

Transient Conditions and Frequency of Occurrence Considered in Design of the Reactor Coolant System and Components

(Taken from Table 5.2-2 in SONGS 1 UFSAR)

I. Design Transients Common to All the RC System and Components

Design Transient	Annual Frequency	Total Occurrences
(a) Plant heatup at 100°F/h	5	150
(b) Plant cooldown at 100°F/h	5	150
(c) Plant loading at 3%/min	250	7500
(d) Plant unloading at 3%/min	250	7500
(e) Step-load increase of 10% (below 90% power)	50	1500
(f) Step-load decrease of 10% (from full power)	50	1500
(g) Step-load reduction of 50% (from full power, 395 MWE)	5	150
(h) Reactor scram from full power	10	300
(i) Loss-of-coolant flow followed by natural circulation	Twice	60
(j) Sudden cooling of the hot leg due to power loss and reversal of flow in the affected loop	Twice	60
(k) Accidental step load reduction to auxiliary load-steam dump fails to operate - reactor scrams upon pressurizer high water level	Twice	60
(l) Temperature and pressure fluctuations less than 6°F and 100 psi about the steady-state set point	NA	Infinite

Table 4-4 (cont'd)

II. Design Transients Specific to the Pressurizer Vessel

(a) Cooldown of vessel contents at 200°F/h, Annual Frequency 5; Total Occurrences 150

(b) Spray system transients and conditions

Condition	Spray Flow, gal/min	Differential Temperature, °F	System Pressure, psig	Number of Occurrences
Plant heatup	1	320	210	150
Plant heatup	200	150	210-2050	750
Loading and unloading	360	150	2100	25,700
Plant cooldown	200	150	210-2050	750
Plant cooldown	360	320	210	150

(c) Pressurizer surge nozzle (insurges and outsurges)

Condition	Flowrate, gal/min	Differential Temperature, °F	Number of Occurrences
Insurges (cooling)	600	-100	7,500
	8,600	-60	60
	2,100	-60	150
	600	-60	Infinite

Table 4-4 (cont'd)

Condition	Flowrate gal/min	Differential Temperature, °F	Number of Occurrences
Outsurges (heating)	8,600	+60	60
	21,00	+60	150
	600	+60	Infinite

III. Design Transients Specific to the RHR System

(a) RHR loop return nozzle,

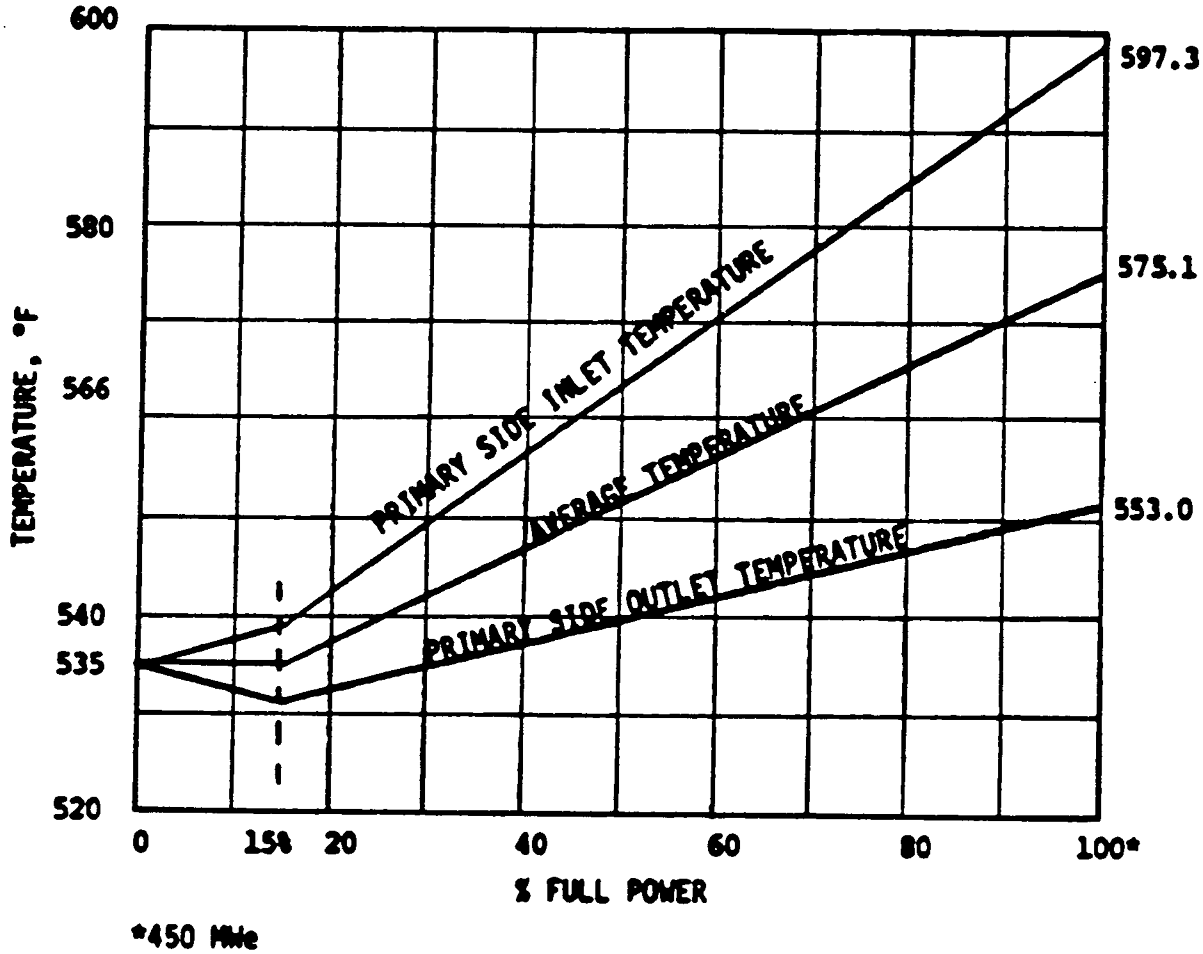
Water inlet temperature at nozzle	70°F
Reactor coolant piping temperature	350°F
Number of occurrences	150

(b) RHR heat exchanger,

Tubeside fluid temperature increase,	60°F to 271°F
Tubeside flow rate, gal/min	1800
Shellside temperature	60°F
Number of occurrences	1

Figure 4-1

Reactor Coolant Temperature-Power Relationship



5.0 FRACTURE TOUGHNESS EVALUATION

SEP Topic III-1 required fracture toughness evaluations for particular components. Accordingly, the system components listed in Table 5-1 of Reference 4 were evaluated with respect to the developed fracture toughness criteria presented below. The data presented in this section completes the blank spaces in Table 5-1 of Reference 4.

5.1 Fracture Toughness Criteria

SEP Topic III-1 has specified the ASME B&PV Code, Section III, 1977 Edition including Addenda through Summer 1978 for the evaluation of SONGS 1 components with respect to fracture toughness of the material. The ASME B&PV Code presents these requirements and acceptance criteria in paragraphs NB.-, NC-, and ND-2300 for Class 1, 2, and 3 components, respectively. The requirements and acceptance criteria are discussed in the following paragraphs for the respective classes of equipment.

5.1.1 ASME Class 1 (Subsection NB)

5.1.1.1 Pressure retaining material and material welded thereto shall be impact tested. The following material is exempted from Class 1 impact testing.

(1) Material with a nominal section thickness of 5/8 inch (16mm) and less where the thickness is taken as defined below.

(a) For pumps, valves and fittings use the largest nominal pipe wall thickness of the connecting pipes.

(b) For vessel and tanks, use the nominal thickness of the shell or head, as applicable.

(c) For nozzles or parts welded to vessels, use the lesser of the vessel shell thickness to which the item is welded or the maximum radial thickness of the item exclusive of integral shell buttwelding projections.

(d) For flat heads, tubesheets, or flanges, use the maximum shell thickness associated with the buttwelding hub.

(e) For integral fittings used to attach process piping to the containment vessel or a containment vessel nozzle, use the larger nominal thickness of the pipe connections.

(2) Bolting, including studs, nuts, and bolts, with a nominal size of 1 inch (25 mm) and less.

(3) Bars with a nominal cross-sectional area of 1 sq. in. (645 mm^2) and less.

(4) All thickness of material for pipe, tube, fittings, pumps, and valves with a nominal pipe size 6 inches diameter and smaller.

(5) Material for pumps, valves and fittings with all pipe connections of 5/8 inch (16 mm) nominal wall thickness and less.

(6) Austenitic, stainless steels.

(7) Nonferrous material.

5.1.1.2 Impact tests are not required for the martensitic high allow chromium (Series 400) steels and precipitation-hardening steels listed in Appendix I of the ASME B&PV Code, Section III. For nominal wall thickness greater than 2-1/2 inches (64 mm), the impact valves shall be 40 mils lateral expansion for the Charpy V-notch tests required under code paragraph NB-2332.

5.1.1.3 Impact test acceptance criteria.

(1) Material for Vessels.

(a) At a temperature $\geq$ the nil-ductility transition temperature plus 60°F, the material shall exhibit at least 35 mils lateral expansion and not less than 50 ft lbs absorbed energy.

(2) Material for piping, pumps and valves, excluding bolting material.

(a) For pressure retaining material up to and including 2-1/2 inches nominal wall thickness for piping and for pumps, valves and fittings with pipe connection of 2-1/2 inches or less nominal wall thickness.

Nominal Wall Thickness, in	Mils Lateral Expansion
over 5/8 to 3/4 inclusive	20
over 3/4 to 1-1/2 inclusive	25
over 1 1/2 to 2 1/2 inclusive	40

(b) For pressure retaining material with nominal wall thickness over 2-1/2 inches for piping and for pumps, valves and fittings with piping connections of wall thickness greater than 2-1/2 inches, the material shall exhibit at least 35 mils lateral expansion and not less than 50 ft lbs absorbed energy.

(3) Material for Bolting

For bolting material including studs, nuts, and bolts, the Charpy v-notch values shall meet the following values.

Nominal Diameter, inches	Mils Laterial Expansion	Foot-lbs Absorbed Energy
over 1 to 4 inclusive	25	No requirements
over 4	25	45

5.1.2 ASME Class 2 (Subsection NC)

5.1.2.1 Refer to 5.1.1.1 above except for the items listed below.

(1) Materials for components for which the lowest service temperature exceeds 150°F. The lowest service temperature is the minimum temperature of the fluid retained by the component or alternatively the calculated volumetric average metal temperature expected during normal operation whenever the pressure within the component exceeds 20% of the preoperational system hydrostatic test pressure.

(2) The materials listed below for which the listed nil-ductility transition temperature is lower than the lowest service temperature by an amount greater than the value of "A" from the ASME B&PV figure NC-2311(a)-1.

Material	Material Condition	Nil -ductility Transition Temperature °F
SA 537 Class 1	N	-30
SA 516 Class 70	Q & T	-10
SA 516 Grade 70	N	0
SA 508 Class 1	Q & T	+10
SA 533 Grade B	Q & T	+10
SA 299 - made to fine grain practice	N	+20
SA 216 Grades WCB, WCC	Q & T	+30
SA 36 (Plate)	HR	+40
SA 508 Class 2	Q & T	+40

* N - Normalized
Q & T - Quenched and tempered
HR - Hot rolled

5.1.2.2 The design specification shall state the lowest service temperature for the component.

5.1.2.3 Impact tests are not required for the martensitic high alloy chromium (Series 400) steels and precipitation-hardening steels listed in Appendix I of Section III of the ASME B&PV Code. For nominal wall thicknesses greater than 2-1/2 inches (64 mm), the impact values shall be 40 mils lateral expansion for the Charpy v-notch tests required under Code paragraph NC-2331.

5.1.2.4 Impact test acceptance criteria.

(1) For pressure retaining material other than bolting with a nominal wall thickness of 2-1/2 inches (64 mm) and less for vessels, tanks, piping and material for pumps, valves, and fittings with piping connections of nominal wall thickness 2-1/2 inches and less.

Nominal Diameter, inches	Mils Lateral Expansion	Foot-lbs Absorbed Energy
over 5/8 to 3/4 inclusive	20	
over 3/4 to 1½ inclusive	25	
over 1½ to 2½ inclusive	40	
over 4	25	45

(2) For pressure retaining material other than bolting with a nominal wall thickness exceeding 2-1/2 inches (64 mm) for vessels, tanks, piping, and tubes and materials for pumps, valves, and fittings with any pipe connection having a nominal wall thickness greater than 2-1/2 inches, the nil-ductility transition temperatures plus the value of A determined by figure NC-2311(a)-1 shall be $\leq$ the lowest service temperature (as previously defined).

(3) For bolting material, including studs, nuts, and bolts, the Charpy v-notch valves shall meet the following values.

Nominal Diameter, in.	Mils Laterial Expansion	Foot lbs Absorbed Energy
over 1 thru 4	25	no requirement
over 4	25	45

5.1.3 ASME Class 3 (Subsection ND)

5.1.3.1 Refer to 5.1.1.1 above except for the items listed below.

(1) Materials for components for which the lowest service temperature exceeds 100°F. The lowest service temperature is the minimum temperature of the fluid retained by the component or alternatively the calculated volumetric average metal temperature expected during normal operation whenever the pressure within the components exceeds 20% of the preoperational system hydrostatic test pressure.

(2) The materials listed below in the thicknesses shown and for lowest service temperature equal to or more than the temperature given below.

		Lowest Service Temperature for Thickness Shown			
Material	Condition*	3/4 inch	1 inch	1-1/2 inch	2-1/2 inch
SA 516 Grade 70	N	-30F	-20F	0F	0F
SA 537 Class 1	N	-40	-30	-30	-30
SA 516 Grade 70	Q & T	-10	-10	-10	-10
SA 508 Class 1	Q & T	+10	+10	+10	+10
SA 508 Class 2	Q & T	+40	+40	+40	+40
SA 533 Gr B Class 1	Q & T	+10	+10	+10	+10
SA 216 Grades WCB, WCC	Q & T	+30	+30	+30	+30
SA 299 Fine Grain practice	N	+20	+20	+20	+20

* N - Normalized
Q&T - Quenched and tempered

5.1.3.2 Impact tests are not required for the martensitic high alloy chromium (Series 400) steels and precipitation hardening steels listed in Appendix I Section III of the ASME B&PV Code. For nominal wall thicknesses greater than 2-1/2 inches the impact values shall be 40 mils lateral expansion for the Charpy v-notch tests required under code paragraph ND-2311.

5.1.3.3 Impact test acceptance criteria.

(1) Pressure retaining material other than bolting for vessels, tanks, piping, pumps, valves and fittings shall exhibit the values given below at a temperature less than or equal to the lowest service temperature.

Nominal Wall Thickness (Inches)	Ft-lbs Energy Absorbed					
	40F or below		40F to 55F		55F to 105F	
	avg. of 3	lowest 1 of 3	avg. of 3	lowest 1 of 3	avg. of 3	lowest 1 of 3
Over 5/8 to 3/4 inclusive	13	10	15	10	20	15
Over 3/4 to 1 inclusive	15	10	20	15	25	20
Over 1 to 1½ inclusive	20	15	25	20	30	25
Over 1½ to 2½ inclusive	25	20	35	30	40	35
Over 2½	30	25	40	35	45	40

(2) For bolting material including studs, nuts, and bolts, the Charpy v-notch values shall meet the following values.

Nominal Diameter, in.	Mils Laterial Expansion	Foot lbs Absorbed Energy
over 1 thru 4	15	30
over 4	20	35

5.1.4 Material Samples

These fracture toughness evaluations are to be performed on material samples from the following sources.

(a) Base material
(b) Weld metal
(c) The base material, heat affected zone and weld metal from the weld procedure qualification tests.

5.2 Method of Evaluation

The base material of the components in question was determined by reviewing plant specific design documents. In some cases, this determination eliminated components from further consideration. If further consideration was required, the material thickness was determined and evaluated against the requirements in the appropriate section of 5.1 of this report. Additional evaluations were performed based on the lowest service temperature of the system or component as defined by the ASME Code.

Plant specific documents such as the following were reviewed to obtain information on the base material, base material thickness, piping standard diameter and temperature conditions: equipment drawings, valve lists, IST/ISI program description, P&ID's and piping designs and material specifications.

5.3 Results/Conclusions

5.3.1 Results

The items identified as requiring additional information in Table 5-1 of Reference 3 are presented in Table 5-1 of this report using a similar format. The materials, the line size, the material thickness and the piping schedule are presented with the disposition of the requirement, including the reason for the exemption.

For those items where fracture toughness would normally be required, additional information is presented as a basis for material acceptance without requiring fracture toughness testing.

5.3.2 Conclusion

In summary, it was determined that all the incomplete items in Table 5-1 of Reference 3 as reported in Table 5-1 of this report were exempted from the fracture toughness requirements per the ASME Code, Paragraphs NB-2311, NC-2311, ND-2311.

Table 5-1
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
Reactor Coolant System				
1. Pressurizer safety valves RV-532 and RV-533 Line-PZR-5027-3"-BH2 Line-PZR-5030-3"-BH2	A	Valve body-SA 351-GR CF8M stainless steel; piping-A312 type 316 stainless steel	No	Austenitic stainless steel exempted per code, NB-2311; nominal pipe size 6" and less exempted per code, NB-2311.
2. Pressurizer relief valves CV-530, -531, -545, -546 Line-PZR-5034-2"-BH2 Line-PZR-5035-2"-BH2	A		No	Nominal pipe size 6" and less exempted per code, NB-2311.
3. Control rode drive mechanism	A	304 stainless steel	No	Austenitic stainless steel exempted per code, NB-2311.
Auxiliary Pressurizer Spray System				
4. Auxiliary pressurizer spray piping downstream of valve CV-305 Line-VCC-2080-2"-BH2 Line-PZR-5011-4"-BH2	A	Type 316 stainless steel; piping-A312 type 316 stainless steel	No	Austenitic stainless steel exempted per code, NB-2311; nominal pipe size 6" and less exempted per code, NB-2311.

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
5. Pressurizer spray and surge lines Line-RCS-5013-10"-BH2 Line-RCS-5011-3"-BH2 Line-RCS-5025-3"-BH2 Line-RCS-5011-4"-BH2	A	Piping-A312 type 316 stainless steel	No	Austenitic stainless steel exempted per code, NB-2311.
6. Auxiliary spray from CVCS piping to valve CV-305 Line-VCC-2002-2"-BH3	B	Piping-A312 type 304 stainless steel	No	Austenitic stainless steel exempted per code, NC-2311.
7. Valve CV-305 Line-VCC-2080-2"-BH2	A	Piping - A312 type 304 stainless steel	No	Nominal pipe size 6" and less exempted per code, NB-2311.
Chemical and Volume Control System (CVCS)				
8. Excess letdown heat exchanger-shell side 4½" O.D. Sch 40 piping	C	A-106 Grade B carbon steel	No	Nominal pipe size 6" and less exempted per code, ND-2311.
9. Seal water heat exchanger - shell side 14" Sch-20, 0.312" wall	C	A-285 Grade C carbon steel	No	Pipe wall thickness 0.625" or less exempted per code, ND-2311.

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
10. Valves Maximum line size is 4" diameter	A B	Piping-A312 type 316 or type 304 stainless steel	No	Austenitic stainless steel exempted per code, NB-2311 or NC-2311; nominal pipe size 6" and less exempted per code, NB-2311 or NC-2311.
Safety Injection System				
11. Refueling water storage tank Bottom course-0.329" plate Other 9 courses-0.250" plate	B	A-283 Grade C carbon steel, lined	No	Plate thickness 0.625" and less exempted per code, NC-2311.
12. Feedwater pumps G-3A and G-3B material thickness-1.45"	B	Hichrome-11% to 13% CR alloy-type 410 stainless steel	No	Martensitic high alloy chromium steels listed in appendix I of the code and ≤ 2½ inches material thickness are exempted per the code, NC-2311. In addition, the inlet and outlet flange circumferential welds are included in the ISI program. See also the discussion presented in Item A, at the end of the table.

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
13. Recirculation pumps G-45A and G-45B Outlet lines - CRS-6018-6"-HM2 CRS-6019-6"-HM2	B	Carbon steel Piping-SA312 type 304 stainless steel	No	Nominal pipe size 6" and less exempted per code, NC-2311.
14. Valves MOV-866A, -866B 4" valves Line-CRS-6019-6"-HM2 Line-CRS-6018-6"-HM2	B	Piping-SA312 type 304L	No	Nominal pipe size 6" and less exempted per code, NC-2311.

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
15. Piping	B			Austenitic stainless steel exempted per code, NC-2311; plate or piping wall thickness 0.625" and less exempted per code NC-2311; nominal pipe size 6" and less exempted per code-NC-2311.
Line				
SIS-6000-16"-HK (Sch 40)		A312 type 304	No	
SIS-6002-16"-HK (Sch 40)		Stainless steel	No	
FWS-318-14"-GG (Std) (0.375" wall)		A53 Grade B	No	
FWS-6004-14"-CL (0.58" wall)		A312 type 316	No	
SIS-6004-14"-CL (0.58" wall)		A312 type 316	No	
SIS-6006-6"-BH2 (Sch 80S)		Stainless steel	No	
CRS-6000-16"-HK (Sch 40S)		Stainless steel	No	
CRS-6019-6"-HM2 (Sch 40S)		Stainless steel	No	
CRS-737-8"-JN (Sch 40S)		Stainless steel	No	
CRS-738-8"-HP (Sch 10S)		Stainless steel	No	
CRS-6015-4"-HK (Sch 10S)		Stainless steel	No	
VCC-2000-4"-HK (Sch 10S)		Stainless steel	No	
VCC-2001-3"-HK (Sch 10S)		Stainless steel	No	
FWS-320-12"-EG (Sch 80) (0.688" wall)		A106 Grade B	No	See discussion presented in Item A, at the end of this Table.
FWS-319-12"-EG (Sch 80) (0.688" wall)		A106 Grade B	No	
Auxiliary Coolant System				
16. Component cooling water heat exchangers		ASTM-A285 Grade C carbon steel plate; tubes 90-10 copper-nickel	No	Plate thickness 0.625" and less exempted per code, ND-2311.
Tube side channel, ½" thick	C			
Shell side cylinder, ½" thick	C			

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
17. Component cooling water pumps CCW-G-15A CCW-G-15B CCW-G-15C 8" inlet, 6" outlet Lines CCW-3040-8"-HH1 CCW-3041-8"-HH2 CCW-2037-8"HH1 (Sch 40, 0.322" wall)	C	Cast iron	No	Nominal pipe size 6" and less exempted per code ND-2311; plate thickness and pipe wall thickness 0.625" and less exempted per code, ND-2311.
18. Component cooling water surge tank Shell thickness - 0.250"	C	ASTM-A285 Grade C carbon steel	No	Nominal plate thickness 0.625" and less exempted per code, ND-2311.
19. Piping up to and including isolation valves upstream and downstream of excess letdown heat exchanger	C	ASTM-A53, Grade A carbon steel		Nominal pipe size 6" and less exempted per code, ND-2311.
Upstream Line CCW-3066-3"-HH9 (Sch 40)			No	
Downstream Line CCW-3085-3"-HH9 (Sch 40)			No	

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
20. Piping to shell side of sample heat exchangers	C	ASTM-A53 Grade A carbon steel		Nominal pipe size 6" and less exempted per code, ND-2311.
Upstream				
Line-CCW-3065-1½"-HH9			No	
Downstream				
Line-CCW-3089-1½"-HH9			No	
Line-CCW-3089-2"-HH9			No	
21. Piping to shell side of sealwater heat exchanger	C	ASTM-A53 Grade A carbon steel		Nominal pipe size 6" and less exempted per code, ND-2311.
Upstream Line				
CCW-3038-4"-HH9 (Sch 40)			No	
Downstream Line				
CCW-3093-4"-HH9 (Sch 40)			No	

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
22. Piping from shell side of residual heat exchangers and RHR pumps	C	ASTM-A53 Grade A carbon steel		Nominal pipe size 6" and less exempted per code, ND-2311; nominal pipe wall thickness 0.625" and less exempted per code, NB-2311
heat exchangers: Upstream Line CCW-3064-8"-HH9 (Sch 40) (0.322" wall)			No	
Downstream Line CCW-3033-8"-HH9 (Sch 40) (0.322" wall)			No	
Pumps: Upstream Line-CCW-3007-2"-HH9			No	
Downstream Line-CCW-3009-2"-A			No	
23. Piping to shell side of spent fuel pit heat exchanger	C	ASTM-A53 Grade A carbon steel		Nominal pipe size 6" and less exempted per code, ND-2311.
Upstream Line CCW-3045-6"-HH9 (Sch 40) (0.280" wall)			No	
Downstream Line CCW-3046-6"-HH9 (Sch 40) (0.280" wall)			No	

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
24. Piping to shell side of recirculation heat exchanger	C	ASTM-A53 Grade A carbon steel		Nominal pipe size 6" and less exempted per code, ND-2311.
Upstream Line CCW-3103-6"-HH9 (Sch 40) (0.280" wall)			No	
Downstream Line CCW-3104-6"-HH9 (Sch 40) (0.280" wall)			No	
25. Piping to gas stripper condenser	C	ASTM-A53 Grade B carbon steel		Nominal pipe size 6" and less exempted per code, ND-2311.
Upstream Line-CCW-3091-2"-HH			No	
Downstream Line-CCW-3105-2"-HH			No	
26. Valves CCW-MOV-720A and B located downstream of component cooling water heat exchangers	C	Piping-ASTM-A53 Grade A carbon steel	No	Nominal pipe wall thickness 0.625" and less exempted per code, ND-2311
Line-CCW-3057-10"-HHP (Sch 40) (0.365" wall)			No	
Line-CCW-3056-10"-HHP (Sch 40) (0.365" wall)			No	
Valves CCS-TCV-601A and 601B located downstream of RHR heat exchangers				
Line-CCW-3029-8"-HH9 (Sch 40) (0.322" wall)			No	
Line-CCW-3033-9"-HH9 (Sch 40) (0.322" wall)			No	

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
Spent Fuel Cooling System				
27. Spent fuel pit heat exchanger-shell side per EQ-30, 3/8" plate thickness	C	Carbon steel	No	Nominal plate thickness 0.625" and less exempted per code, ND-2311.
Residual Heat Removal System				
28. Residual heat removal heat exchanger-Shell side - per EQ-15, 0.375" plate thickness	C	Carbon steel	No	Nominal plate thickness 0.625" and less exempted per code, ND-2311.
Circulating Water System				
29. Saltwater cooling pumps G-13A and G-13B Discharge piping Line-SWC-415-12"-KP (Sch 40) (0.375" wall) Line-SWC-416-12"-KP (Sch 40) (0.375" wall)	C	Pump body-SA351, Grade CF3/CF8 stainless steel; Piping-A53 Grade B carbon steel	No	Austenitic stainless steel exempted per code, ND-2311; nominal pipe wall thickness 0.625" and less exempted per code, ND-2311.

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
30. Saltwater supply piping and valves to component cooling water heat exchangers Line-SWC-415-12"-KP (Sch Std, 0.375" wall) Line-SWC-416-12"-KP (Sch Std, 0.375" wall) Line-SWC-412-12"-KP (Sch Std, 0.375" wall) Line-SWC-413-16"-KP (Sch Std, 0.375" wall)	C	ASTM-A53, Grade B carbon steel	 No No No No	Nominal pipe wall thickness 0.625" and less exempted per code, ND-2311.
Containment Sphere Spray System				
31. Refueling water pumps G-27N Inlet, 6" CRS-729-8"-JN Outlet, 4" CRS-734-6"-GM G-27S Inlet, 6" CRS-729-8"-JN Outlet, 4" CRS-10375-6"-GM	B	Piping-ASTM A312 type 304 stainless steel, Sch 40	No	Nominal pipe size 6" and less exempted per code, NC-2311.
32. Piping from refueling water storage tank to refueling water pumps Line-CRS-729-8"-JN (Sch 40)	B	ASTM-A-312 type 304 stainless steel	No	Austenitic stainless steel exempted per code, NC-2311.

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
33. Piping and valves downstream of refueling water pumps	B			Austenitic stainless steel exempted per code, NC-2311; nominal pipe size 6" and less exempted per code, NC-2311.
Line-CRS-734-6"-GM		ASTM-A312 type 304 stainless steel, Sch 40	No	
Line-CRS-734-6"-HM2			No	
Line-CRS-765-4"-HM2			No	
Line-CRS-734-6"-HH (0.280" wall)		ASTM-A53 Grade B carbon steel, Sch 40	No	
Line-CRS-765-4"-HH (0.237" wall)			No	
Chemical Addition System				
34. Hydrazine (N_2H_4) tank SHA-D-200	B	ASME-SA240 type 304 stainless steel	No	Austenitic stainless steel exempted per code, NC-2311.
35. Spray additive pumps G-200A and G-200B inlet lines/outlet lines SHA-1157-1"-HM2 SHA-1158-1"-HM2 SHA-1151-3/4"-GM SHA-1152-3/4"-GM	B	Piping ASTM A312 type 304 stainless steel	No	Austenitic stainless steel exempted per code, NC-2311; nominal pipe size 6" and less exempted per code, NC-2311.
36. Piping and valves including recirculation lines and test lines SHA-1150-3/4"-GM SHA-1163-3/4"-HM2 SHA-1155-3/4"-HM2 SHA-1159-1"-HM2	B	Piping A312 Type 304 stainless steel-3/4" to 1" nominal diameter	No	Austenitic stainless steel exempted per code, NC-2311; nominal pipe size 6" and less exempted per code, NC-2311.

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
Containment Purge System				
37. Air ducting and control valves for containment isolation Line-CVS-13290-24" Line-CVS-13291-24" Valve-CVS-POV-10 carbon steel Valve-CVS-POV-9 Note: These valves were replaced in 1985-86	B	Valve body-A352-Grade 60T, DISC 18-8 SS; shaft-316SS seat-rubber; new valves - ASTM-A216 Grade WCB body & SA-A516 Grade 70 body		See the discussion presented in Item C at the end of this Table.
Valve-CVS-CF10	B	6"-150# monoflange butterfly valve; ASTM-A352-6OT-LCB	No	Nominal pipe size 6" and less exempted per code, NC-2311. However, Charpy impact data was requested in bill of material.

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
Auxiliary Feedwater System				
38. Auxiliary feedwater pumps-electric driven	C*		No	Austenitic stainless steel exempted per code, ND-2311; Nominal pipe size 6" and less exempted per code, ND-2311.
AFW-G-10S: inlet/outlet				
Line-AFW-8111-4"-JN-3AC8		A312 type 304		
Line-AFW-397A-3"-EG-3AC8		A106 Grade B		
AFW-G-10W: inlet/outlet				
Line-AFW-17035-6"-JN		A312 type 304		
Line-AFW-17038-4"-EG		A106 Grade B		
39. Auxiliary feedwater pump-turbine driven	C*		No	Nominal pipe size 6" and less exempted per code, NC-2311.
AFW-G-10: inlet/outlet				
Line-AFW-8110-4"-EG-3AC8		A106 Grade B		
Line-AFW-381-3"-EG-3AC8				

* Per Appendix 3.2A of Reference 5

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
40. Piping from auxiliary feedwater pumps and including containment isolation valves to connections with feedwater system lines	C*	A-106		Nominal pipe size 6" and less exempted per code, ND-2311.
Line-AFW-381-3"-EG-3ACB			No	
Line-AFW-397-3"-EG-3ACB			No	
Line-AFW-17038-4"-EG			No	
Line-AFW-381A-4"-EG-3ACB			No	
Line-AFW-381A-3"-EG-3ACB			No	
Line-AFW-381C-3"-EG-3ACB			No	
Line-AFW-381B-3"-EG-3ACB			No	
Valve-AFW-FCV-2300			No	
Valve-AFW-FCV-3300			No	
Valve-AFW-FCV-3301			No	
Valve-AFW-FCV-2301			No	
Valve-AFW-324			No	
Valve-AFW-322			No	
Valve-AFW-321			No	

* Per Appendix 3.2A of Reference 5

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
Feedwater System				
41. Piping inside containment and outside up to and including valves FCV-456, FCV-457, FCV-458, CV-142, CV-143, CV-144	B	Piping-ASTM-A106 Grade B, Sch-60, 0.500" wall carbon steel		Nominal pipe wall thickness 0.625" and less exempted per code, NC-2311; nominal pipe size 6" and less exempted per code, NC-2311.
Line-FWS-391-10"-EG		Valve bodies chrome-moly steel	No	
Line-FWS-392-10"-EG			No	
Line-FWS-393-10"-EG			No	
Valve-FWS-FCV-456			No	
Valve-FWS-FCV-457			No	
Valve-FWS-FCV-458			No	
Valve-FWS-CV-142 (4")			No	
Valve-FWS-CV-143 (4")			No	
Valve-FWS-CV-144 (4")			No	
Line-FWS-14104-4"-EG			No	
Line-FWS-14109-4"-EG			No	
Line-FWS-14114-4"-EG			No	

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
42. Piping from valves HV-852A, B to	B	Piping-A106 Grade B, carbon		Piping wall thickness
HV-854A, B		steel		0.625" and less
Valve-FWS-HV-854A			No	exempted per code, NC-
Valve-FWS-HV-854B			No	2311; see discussion
Line-FWS-318-14"-GG		Sch-std, 0.375" wall	No	presented in Item A, at
Line-FWS-317-14"-GG		Sch-std, 0.375" wall	No	the end of this Table.
Valve-FWS-HV-852A		Valve body-A216	No	
Valve-FWS-HV-852B		Grade WCB	No	
Line-FWS-320-12"-EG		Sch 80, 0.688" wall	No	
Line-FWS-319-12"-EG		Sch 80, 0.688" wall	No	
43. Feedwater pumps	B	Pump casing-410 stainless steel-	No	Martensitic high alloy
FWS-G-3A: inlet/outlet		material thickness-1.45"; Piping-		chromium steels listed
FWS-G-3B: inlet/outlet		A106 Grade B		in appendix I of the
Inlet lines				code and ≤ 2½ inches
FWS-317-16"-GG (0.375" wall)				material thickness are
FWS-318-16"-GG (0.375" wall)				exempted per code-NC-
Outlet lines				2311. In addition, the
FWS-319-12"-EG (0.688" wall)				inlet and outlet
FWS-320-12"-EG (0.688" wall)				circumferential welds
				are included in the ISI
				program. See also the
				discussion presented in
				Item A, at the end of
				this table.

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
Main Steam System				
44. Main steam safety valves, RV-1 through RV-10 6" inlet x 10" outlet	B	Body material ASTM-A216 Grade WCB carbon steel	No	Nominal pipe size 6" and less exempted per code, NC-2311.
45. Main steam dump valves CV-76, CV-77, CV-78, CV-79 4" inlet, 4" outlet	B	ASTM-216, Grade WCB, carbon steel body material	No	Nominal pipe size 6" and less exempted per code, NC-2311.
46. Piping from steam generators to and including main steam stop valves	B	Piping-ASTM-A106, Grade B carbon steel, Sch 60		See the discussion presented in Item B, at the end of this table.
Line-MSS-3-20"-EG (0.812" wall)			No	
Line-MSS-4-20"-EG (0.812" wall)			No	
Line-MSS-5-20"-EG (0.812" wall)			No	
Line-MSS-6-24"-EG (0.969" wall)			No	
Line-MSS-7-24"-EG (0.969" wall)			No	
Line-MSS-50-24"-EG (0.969" wall)			No	
Line-MSS-51-24"-EG (0.969" wall)			No	
Line-MSS-1-24"-EG (0.969" wall)			No	
Line-MSS-2-24"-EG (0.969" wall)			No	
Line-MSS-14-20"-EG (0.812" wall)			No	
Valve-MSS-PV-1650			No	
Valve-MSS-PV-1651			No	

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
47. Piping and valves from main steam line	B	ASTM-A106 Grade B carbon steel		Nominal pipe size 6" and less exempted per code, NC-2311; nominal pipe wall thickness 0.625" and less exempted per code, NC-2311.
Line-MSS-18-10"-EG (0.500" wall)			No	
Line-MSS-15-8"-EG (0.322" wall)			No	
Line-MSS-1316-8"-HH (0.322" wall)			No	
Line-MSS-17-6"-EG (0.280" wall)			No	
Line-MSS-18-6"-EG (0.280" wall)			No	
Line-MSS-20-6"-EG (0.280" wall)			No	
Line-MSS-9-3"-EG			No	
Line-MSS-1317-3"-HH			No	
48. Piping from main steam line to auxiliary feedwater pump turbine drive	B	ASTM-A106 Grade B carbon steel		Nominal pipe size 6" and less exempted per code, NC-2311.
Line-MSS-69-3"-EG Sch 40 0.216" wall			No	
Line-AFW-69-3"-EG Sch 40 0.216" wall			No	
Condensate Storage System				
49. Condensate storage tank courses 1 through 5- 0.26" thick plate	C	ASTM-A238 Grade C carbon steel	No	Plate thickness $\leq$ 0.625" exempted per code, ND-2311.

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
50. Piping from condensate storage tank to suction of auxiliary feedwater pumps Line-AFW-380-4"-HP-4ACB Line-CND-396-4"-HP Line-CND-721-4"-HP Line-CND-17036-6"-HP Line-CND-721-10"-HP	C	Piping-ASTM-A312 type 304 stainless steel	No	Austenitic stainless steel exempted per code, ND-2311.
51. Auxiliary feedwater storage tank	C	SA240 type 304L stainless steel	No	Austenitic stainless steel exempted per code, ND-2311.

Table 5-1 (Continued)

Fracture Toughness Review

Resolution for Specific Items

Item A: The normal operating fluid temperature for the feedwater pumps and the piping downstream including the FWS valves HV-852A and B is approximately 327°F, the exit temperature of the 2nd point low pressure feedwater heater. According to paragraph NC-2311 of the reference code, the material is exempted from the fracture toughness requirements if the lowest service temperature exceeds 150°F. The lowest service temperature is defined as the minimum temperature of the fluid retained by the component during normal operation. Therefore, the feedwater pump, the discharge piping and the involved feedwater valves are exempted from the fracture toughness requirements.

In addition, the circumferential welds of piping to fittings, pipe to pipe, pipe to flange, pipe to valve, are examined ultrasonically under the inservice inspection program.

It is recognized that during accident conditions utilizing the safety injection system the fluid temperature will be between 40°F and 70°F. Such accident conditions are not likely during the operating life of the plant and as such are not considered further in this analysis.

Item B: The normal operating fluid temperature for the steam system piping and valves from the steam generators up to and including the main steam stop valves, MSS-PV-1650 and MSS-PV-1651, is approximately 500°F at the exit of the steam generators. According to paragraph NC-2311 of the reference code, the material is exempted from the fracture toughness requirements if the lowest service temperature exceeds 150°F. The lowest service temperature is defined as the minimum temperature of the fluid retained by the component during normal operation. Therefore, these steam lines and valves are exempted from the fracture toughness requirements.

In addition, the circumferential welds of the piping to fittings, pipe to pipe, pipe to flange, pipe to valve, pipe to nozzle are examined ultrasonically under the inservice inspection program.

Table 5-1 (Continued)

It is also recognized that during certain accident scenarios these steam lines will be filled with water whose temperature can be as low as 40 °F. The occurrence of such accident scenarios requiring use of the steam lines in this manner is not expected to occur but is considered a once-in-a-lifetime possibility over the operating life of the plant and as such are not considered further in this analysis.

Item C: The original valves installed in the SONGS 1 containment ventilation system, CVS-POV-9 and CVS-POV-10, were replaced with valves of the following body material:

(1) ASTM-A-216 Grade WCB cast steel rated at 150 psig and 200 °F

(2) ASME-SA-516 Grade 70 steel rated at 150 psig and 150 °F

Since extra strong 24-inch O.D. pipe has a nominal pipe wall thickness of 0.500", neither the piping nor the valves attached require impact testing.

It is therefore concluded that this piping and these valves in the containment ventilation system are exempt from the requirements of impact testing per the code, NC-2311.

6.0 CLASS 1 PIPING FATIGUE EVALUATION

6.1 Introduction

This section presents the SEP Topic III-1 fatigue assessment of the SONGS 1 piping systems listed below:

- Reactor coolant loop piping:
  - Reactor Coolant System (RCS) Loop A
  - RCS Loop B
  - RCS Loop C
  - Pressurizer surge line off Loop B.
    (Note: This line is being evaluated per NRC Bulletin 88-11.)
- Auxiliary pressurizer spray piping downstream of valve CV-305.
- Letdown line (Loop A) piping via regenerative heat exchanger to valves CV-202, 203, 204.
- Letdown line (Loop B) piping via the excess letdown heat exchanger to valve HCV-1117.

6.2 Transients

The relevant transients and loading conditions for the RCS piping have been obtained from Section 5.2.1.3 of the SONGS 1 updated FSAR (Reference 5) and are summarized in Table 6-1. Transients relevant to the pressurizer are given in Table 5.2-2 of Reference 5 (reproduced herein as Table 4-4). Thermal loading conditions for the letdown lines are deduced from the specifications sheets of heat exchangers E-13 and E-33. The temperature vs. power curves for the inlet/outlet conditions at the steam generator are shown in Figure 5.3-1 of Reference 5, and are reproduced herein as Figure 4-1. The relevant piping data are summarized in Table 6-2.

6.3 Analysis

On the basis of the data presented in Section 6.2, stresses are calculated for the load cases,i , for which the number of stress cycles, n_i, exceeds 500. Given that all the relevant piping here is austenitic stainless steel:

$$(S_P)_i = (K_1C_1)S_1 + K_2S_2 + S_3 + K_3S_4 + (K_3C_3)S_5$$

where:

$(S_P)_i$ = Peak stress intensity for the i^{th} service cycle
S_1 = $(.18\ S_u)\lambda_1$
S_2 = $(.82f\ S_u)\lambda_{2i}$
S_3 = $.380\,|\Delta T_2|$
S_4 = $.190\,|\Delta T_1|$

S_5	=	$E_{ab} \vert \alpha_a T_a - \alpha_b T_b \vert$
λ_1	=	$\Delta P/P_{DESIGN}$
ΔP	=	Service pressure range
P_{DESIGN}	=	Design pressure
λ_{2i}	=	$\vert(\Delta T)_i\vert (T_{op} - 70°F)$
$(\Delta T)_i$	=	Change in temperature for i^{th} service cycle
T_{op}	=	Maximum operating temperature
S_u	=	Ultimate tensile stress at room temperature
f	=	Stress reduction factor
ΔT_1	=	$.75(\Delta T)_i$
ΔT_2	=	$.25(\Delta T)_i$
E_{ab}	=	Elastic modulus
α_a, α_b	=	Coefficients of thermal expansion at gross structural discontinuity
K_1, K_2, K_3	=	Local stress indices
C_1, C_3	=	Secondary stress indices

6.3.1 Stress Cycles

In Table 6-1, stress cycles in excess of 500 cycles are identified by transient numbers 3, 4, and 6 for the RCS piping.

Thus,

$n_1 = 15{,}000$
$n_2 = 3{,}000$
$n_3 = \infty$, or 10^6

for these transients.

6.3.2 Loading Parameters

The $(\Delta T)_i$ values are determined as follows:

(1) RCS Piping:

$$(\Delta T)_i = \frac{(\Delta T)}{(\Delta\%FP)_{REACTOR}} \times \Delta(\%FP)_i$$

where: $\Delta(\%FP)_i$ = Change in % full power during stress cycle i

$\dfrac{\Delta T}{\Delta(\%FP)_{REACTOR}}$ = Slope of power curves given on Figure 4-1

The $\Delta T/\Delta(\%FP)_{REACTOR}$ values are 68.3°F/100%FP for the hot leg, and 26.0°F/100%FP for the cold and the cross-over legs.

(2) Letdown Piping:

Same as the RCS piping cross-over leg as described above.

(3) Auxiliary Pressurizer Spray Piping:

This piping is only operational during the last phase of cool-down. See section 5.5.5.2.1 of Reference 5. Based on Table 5.2-2 of Reference 5, a temperature fluctuation of 150 °F, occurring 750 times is considered to constitute the thermal loading.

The pressure loading ΔP is obtained from the normal operating fluctuations given in Reference 5:

$$\Delta P = 100 \text{ psi.}$$

For the surge line, and the unit loading/unloading in Table 6-3, ΔP is taken as 10% of P_{DESIGN} or 250 psi.

The thermal and pressure loading data and associated loading parameters are tabulated in Table 6-3.

6.3.3 Stress Indices

Stress indices for elbows and other discontinuities are obtained from Reference 6, and are tabulated in Table 6-4.

6.3.4 Gross Structural Discontinuities

Considering the junction of RCS piping at the reactor vessel nozzles, the maximum temperature difference is 44 °F which results in a stress contribution of S_5 of 11.8 ksi. Note that this value of S_5 is used throughout as typical and Reference 3 dismisses this term altogether by labelling it "atypical"; thus, the value is conservatively included in the present analysis.

6.3.5 Stress Evaluations

The parameters relevant to stress evaluations are tabulated in Table 6-5. In evaluating S_p, the gross discontinuity term S_5 is only used with the stress indices associated with the girth-butt weld discontinuity.

6.3.6 Usage Factors

The appropriate fatigue usage factors are evaluated as follows:

$$U = \sum_{i=1}^{3} u_i \quad , \; u_i = \frac{n_i}{N_i}$$

and are tabulated in Table 6-6. In the above equations, N_i is the maximum number of cycles permitted if $(S_{alt})_i = 0.5(S_p)_i$ were the only alternating stress intensity.

6.4 Conclusion

On the basis of the data tabulated in Table 6-6, the following conclusions are drawn:

1. The usage factors are negligible (U = .02) for the branch connection discontinuities.

2. The largest usage factors correspond to the surge line (U = .13), the letdown line (U = .15), and the auxiliary line (U = .10) for the gross structural discontinuity configuration. Note that the gross structural discontinuity term is considered in an extremely conservative manner.

3. The usage factors of .13, .15, and .10 associated with the surge, letdown and auxiliary pressurizer lines, respectively, are not significant. It is evident from Table 6-1 and the foregoing evaluation that the usage factors associated with low cycle fatigue will be much lower than these values.

TABLE 6-1

RCS PIPING TRANSIENTS

Transient No.	Service Cycle; i	Conditions	No. of cycles; n_i
1.	Heat-up ($T_{AMB} \rightarrow T_{NO\text{-}LOAD}$)	Rate <100°F/hr	150
2.	Cool-down ($T_{NO\ LOAD} \rightarrow T_{AMB}$)	Rate <100°F/hr	150
3.	Unit loading/unloading	Automatic control - continuous and uniform ramp power change between 15-100% full power	2 x 7500
4.	10% step increase/decrease	Automatic control - power between 15-100% full power	2 x 1500
5.	Large step decrease in load	50% full power decrease	150
6.	Steady-state fluctuation	$\Delta T < \pm 6°F$, $\Delta P < 100$ psi	∞
7.	Loss of load without immediate turbine or reactor trip	Most severe transient	60
8.	Loss of power with immediate turbine and reactor trip	Due to loss of outside electrical power	60
9.	Loss of flow	RCP trip	60
10.	Reactor trip from full power	Variety of reasons	300
11.	Inadvertent auxiliary spray	Shut-off letdown steam	10

TABLE 6-2

PIPING DATA

PIPING SYSTEM			ID	t		S_u[1]	T_o[2]	P_{DESIGN}
Piping	Designation	Function	(in)	(in)	Material	(ksi)	(°F)	(psig)
Reactor Coolant Loop	RCS-5007-27½"-BH2	Loop A Hot Leg	27.5	2.31	SA 376 Type 316 Austenitic Stainless Steel	70	597.3	2500
	RCS-5010-27½"-BH2	Loop A Cold Leg	27.5	2.31		70	553.0	2500
	RCS-5009-29"-BH2	Loop A Cross-over	29.0	2.43		70	553.0	2500
	RCS-5013-10"-BH2	Pressurizer Surge Line (Loop B)	8.5	1.125	A 312 Type 316 Austenitic Stainless Steel	70	597.3	2500
Loop A Letdown Line	RCS-5008-2"-BH2	Upstream of LDS-E-13 HX	1.687	.344		70	130	2500
	LDS-2071-2"-BH2	Downstream of LDS-E-13 X	1.687	.344		70	459	2500
Loop B Letdown Line	RCS-5014-3/4"-BH2	Letdown[3]						
Aux. Pzr. Spray	VCC-2080-2"-BH2	Aux. Pzr. Spray	1.687	.344		70	500	2500

[1] At 70°F, from Reference 6 - Appendix I - Table I-1.2.
[2] Maximum operating temperature.
[3] This is exempt from fatigue evaluation since the diameter is less than 1 inch.

TABLE 6-3

PRESSURE AND THERMAL LOADING PARAMETERS

Piping	Load i	Cycles n_i	ΔP (psi)	ΔT (°F)	ΔT_1 (°F)	ΔT_2 (°F)	λ_{2i}	λ_1
Hot Leg	1	15000	100	58.1	43.6	14.5	.110	.04
	2	3000	100	6.8	5.1	1.7	.013	.04
	3	10^6	100	12.0	9.0	3.0	.022	.04
Cold and Cross Over Legs	1	15000	100	22.1	16.6	5.5	.046	.04
	2	3000	100	2.6	2.0	.65	.005	.04
	3	10^6	100	12.0	9.0	3.0	.025	.04
Surge Line	1	7500	250	-100	-75.0	-25.0	.190	.10
	2	10^6	100	60.0	45.0	15.0	.114	.04
	3	10^6	100	12.0	9.0	3.0	.022	.04
Letdown Line Upstream of E-13	1	15000	100	22.1	16.6	5.5	.368	.04
	2	3000	100	2.6	2.0	0.7	.043	.04
	3	10^6	100	12.0	9.0	3.0	.200	.04
Letdown Line Downstream of E-13	1	15000	100	22.1	16.6	5.5	.057	.04
	2	3000	100	2.6	2.0	0.7	.007	.04
	3	10^6	100	12.0	9.0	3.0	.031	.04
Auxiliary Pressurizer Spray	1	750	100	150	112.5	37.5	.349	.04

TABLE 6-4

STRESS INDICES

	Girth* Butt Weld To Component	Elbow (Short Radius)	Branch* Connection	Butt Weld-Tees	Butt Weld-Reducers
K_1	1.2	1.0	2.2	4.0	1.2
C_1	1.1	1.25	1.5	1.5	<5
(K_1C_1)	1.32	1.25	3.3	6.0	6.0
K_2	2.5	1.0	2.0	1.0	2.5
K_3	1.7	1.0	1.7	1.0	1.0
C_3	1.0	1.0	1.8	1.0	1.0
(K_3C_3)	1.7	1.0	3.06	1.0	1.0

*Based on the above tabulated stress indices, the locations marked represent the worst conditions, in an overall sense, for the piping in question; and these locations are chosen for further consideration

TABLE 6-5
PEAK STRESSES

Piping	Load i	Cycles n_i	S_1 (ksi)	f	S_2 (ksi)	S_3 (ksi)	S_4 (ksi)	S_5[1] (ksi)	$(S_p)_i$ (ksi) Branch	Gross Discont.
Hot Leg	1	15000	.50	.8	5.1	5.5	8.3	11.8	31.5	53.1
	2	3000	.50	1.0	.75	.65	.97	11.8	5.4	24.9
	3	10^6	.50	.5	.63	1.14	1.71	11.8	7.0	26.3
Cold and Cross-over Legs	1	15000	.50	.8	2.1	2.1	3.2	11.8	13.4	33.5
	2	3000	.50	1.0	.29	.25	.38	11.8	3.1	22.3
	3	10^6	.50	.5	.72	1.14	1.71	11.8	7.1	26.6
Surge Line	1	7500	1.26	.9	9.8	9.5	14.3	11.8	55.1	80.0
	2	10^6	.50	.5	3.3	5.7	8.6	11.8	28.6	49.3
	3	10^6	.50	.5	.63	1.14	1.71	11.8	7.0	26.3
Letdown Line, Upstream of E-13	1	15000	.50	.8	16.9	2.1	3.2	11.8	43.0	70.5
	2	3000	.50	1.0	2.5	.25	.38	11.8	7.5	27.9
	3	10^6	.50	.5	5.7	1.14	1.71	11.8	17.1	39.0
Letdown Line, Downstream of E-13	1	15000	.50	.8	2.6	2.1	3.2	11.8	14.4	34.8
	2	3000	.50	1.0	.40	.25	.38	11.8	3.3	22.6
	3	10^6	.50	.5	.89	1.14	1.71	11.8	7.5	27.0
Auxiliary Przr. Spray	1	750	.50	1.0	20.0	14.1	21.5	11.8	92.3	121

[1] Applicable only to the gross structural discontinuity calculation.

TABLE 6-6
USAGE FACTORS

Piping	Load Cycle		Branch Connection				Gross Discontinuity			
	i	n_i	$(S_a)_i$ (ksi)	N_i	$u_i^* = \frac{n_i}{N_i}$	$U = \sum_i u_i$	$(S_a)_i$ (ksi)	N_i	$u_i^* = \frac{n_i}{N_i}$	$U = \sum_i u_i$
Hot Leg	1	15000	15.8	$>10^6$	.015		26.6	800,000	.019	
	2	3000	2.7	$>10^6$	.003		12.5	$>10^6$	.003	
	3	10^6	3.5	$>10^6$	--	.02	13.2	$>10^6$	--	.02
Cold and Cross-over Leg	1	15000	6.7	$>10^6$	.015		16.8	$>10^6$	.015	
	2	3000	1.6	$>10^6$	.003		11.2	$>10^6$	.003	
	3	10^6	3.6	$>10^6$	---	.02	13.3	$>10^6$	--	.02
Pressurizer Surge Line	1	7500	27.6	500,000	.015		40.0	60,000	.125	
	2	10^6	14.3	$>10^6$	--		24.7	$>10^6$	--	
	3	10^6	3.5	$>10^6$	--	.02	13.2	$>10^6$	--	.13
Letdown Line Upstream of E-13	1	15000	21.5	$>10^6$	.015		35.3	$>10^6$	.015	
	2	3000	3.8	$>10^6$	.003		14.0	$>10^6$	.003	
	3	10^6	8.6	$>10^6$	--	.02	19.5	$>10^6$	--	.15
Letdown Line Downstream of E-13	1	15000	7.2	$>10^6$	.015		17.4	$>10^6$	.015	
	2	3000	1.7	$>10^6$	.003		11.3	$>10^6$	.003	
	3	10^6	3.8	$>10^6$	--	.02	13.5	$>10^6$	--	.02
Auxiliary Pressurizer Spray	1	750	46	30,000	.025	.03	61	8000	.094	.10

*Based on Section NB-3653.5 of Reference 6, u_i; can be taken as zero if $N_i > 10^6$.

7.0 VALVES

SEP Topic III-1 requires the evaluation of Class 1 and Class 2 and 3 valves to stress limits and pressure-temperature ratings, respectively. The following sections respond to that request.

7.1 Class 1 Valves

7.1.1 Introduction

According to the Franklin Research Center (FRC) Technical Evaluation Report TER-C5257-433 (TER) (attached to Reference 3), page A-102, Class 1 valves should be evaluated on a case-by-case basis as follows:

1. Fracture Toughness Evaluation - Addressed in Section 5.0 of this report.

2. "Compare actual body shapes with body shape rules of Section NB-3544 of the ASME Code" (Reference 6). "If not significantly different, the valve would be considered adequate". The body shape rules are intended to limit the fatigue strength reduction factor associated with local structural discontinuities in critical regions to 2.0 or less.

7.1.2 Scope

The Class 1 valves in scope are listed by the NRC in Table 4.2(a) of Reference 4 as:

Pressurizer Safety Valves: RV-532 and 533

Pressurizer Relief Valves: CV-530, 531, 545, and 546

Pressurizer Spray Control Valves: PCV-430C and 430H

Air-Operated Valves: CV-202, 203, and 204

Residual Heat Removal Valves: MOV-813, 814, 833, and 834

Auxiliary Pressurizer Spray System Valves: CV-305, and CV-304

Air-Operated Valve: HCV-1117

In addition to the above valves identified by the NRC, CV-287, VCC-002 and 003 on the reactor coolant piping side of HCV-1117, CV-304 and CV-305, respectively, are also classified as Class 1 valves.

7.1.3 Evaluation

The valves in scope can be grouped according to their characteristics as shown in Table 7-1. The valve body sketches for these Class 1 valves do not have sufficient detailed dimensional information such as fillet radii, body internal contours, etc., and therefore the requirements of Section NB-3544 of Reference 6 cannot be checked numerically. Nevertheless, the Class 1 valves are considered adequate for the following reasons:

(1) All the Class 1 valves except HCV-1117 are included in the ISI and/or IST programs which require periodic operability testing and examination of pressure boundary integrity.

(2) Reference 3 requires that a determination of only the significant differences from the code requirements be made. A review of the Class 1 valve sketches reveals that:

- There are no sharp fillets at the intersections of surfaces of the pressure retaining boundary at the neck to body junction.
- Body internal contours are generally smooth in curvature.
- Flat sections are minimized.
- Body contours at welded ends are smooth and gradual.

More detail is not readily available; however, the above indicate that the body shapes of the Class 1 valves are not significantly different from the requirements of Section NB-3544 of Reference 6. Furthermore, historically, while body shape requirements have changed, the basic design of valve bodies have not radically changed, so that the probability of body shape irregularities is low. The body shape requirements have been an industry standard in ANSI B16.34 for many years but are also now incorporated into the ASME Section III Code.

The above body shape conformance observations hold for HCV-1117 as well as the other Class 1 valves that are also covered by the ISI and IST programs.

(3) Although the excess letdown control valve HCV-1117 is not covered by the ISI or IST programs, it's failure will not jeopardize safe plant operation since it is on a 3/4 inch line and the charging pumps are able make up the loss of coolant from a 3/4 inch line break (Reference 5).

Note that Table 4.2(a) of Reference 4 does not include valve CV-287 which is between reactor coolant piping and valve HCV-1117. Vendor drawings show that valves CV-287 and HCV-1117 are of the same size and model and by the same manufacturer: Black, Sivalls and Bryson (BS&B). Therefore, the above statements are true for both HCV-1117 and CV-287.

(4) Additional assurances are provided by system hydrostatic testing or system leakage testing conducted at start-up.

7.1.4 Conclusion

The Class 1 valves at SONGS 1 are adequate to meet the current (Reference 6) requirements regarding body shape rules based on:

- The ISI and IST programs in effect,
- The similarity of the body shapes compared with the body shapes defined in Section NB-3544 of Reference 6,
- Loop or hydrostatic testing or system leak tests at startup.

7.2 Class 2 and 3 Valve Evaluation

7.2.1 Introduction

This section describes the evaluation of Class 2 and 3 valves at SONGS 1.

The following sections describe the procedures used to select the sample group; the valves checked, their ratings, materials, design/operating temperatures, and pressures, and whether or not the valves meet the ANSI B16.34-1977 edition (Reference 8) rating requirements.

7.2.2 Evaluation

7.2.2.1 Selection of the Sample Group

The selection of the sample group was based on safety significance and data availability.

Groups of valves that belonged to all three of the following sets were chosen for evaluation in the present effort:

- Valves in Tables 4.2(b) and 4.2(c) of Reference 4.
- Valves in the In-Service Testing Program.
- Valves in the Seismic Reevaluation Program (Reference 9).

Using the above procedure, it was assured that the sample was limited to safety significant valves, and availability of dimensional, rating, material information was highly probable.

7.2.2.2 Determination of Valve Characteristics

The ratings, design/operating pressure and temperatures, and the materials of the Class 2 and 3 valves in scope were searched and are tabulated in Table 7-2.

7.2.2.3 Valve Acceptability

After compiling the data, the acceptability of the valves was determined. ANSI B16.34-1977 was used to determine the allowable normal service pressures at the temperature listed. Those valves for which the ANSI allowable pressures were higher than the design or operating pressures were deemed satisfactory. The results are presented in Table 7-2.

For two valves (appearing with Note (c) in Table 7-2) the allowable pressures are marginally exceeded by the service pressures;

however, those two valves are deemed adequate based on engineering judgement and years of successful service.

7.2.3 Conclusion

Out of a sample of 92 valves, 3 were cast iron, to which the referenced requirements are not applicable. This left 89 steel valves that were further evaluated. The further evaluation shows that all 89 valves meet ANSI B16.34-1977 rating requirements. Accordingly, based upon these results, the unsampled valves are similarly expected to meet ANSI B16.34-1977 requirements.

TABLE 7-1
CLASS 1 VALVES

Tag Nos.	Manufacturer	Model No.	In ISI(1)?	In SRP(2)?	In IST(3)?	Description
RV-532, 533	Crosby	HB86BPE	Yes	Yes	Yes	3"x6" Relief Valve
CV-530, 531	Anchor-Darling	DWG.10529	Yes	Yes	Yes	2" Globe/Air Operated
PCV-430C, 430H	BS&B	70-18-9DRTX	Yes	Yes	No	3" Globe/Air Operated
CV-545, 546, 202, 203, 204 304, 305	BS&B	70-18-9DRTX	Yes	Yes	Yes	2" Globe/Air Operated
MOV-813, 814	Crane	DWG. 33463	Yes	Yes	Yes	8" Gate/Motor Operated
MOV-833, 834	Crane	DWG. 33473	Yes	Yes	Yes	6" Gate/Motor Operated
HCV-1117 CV-287	BS&B	70-18-9DRTX	No	No Yes	No No	Air Operated 3/4" Globe/
VCC-002, 003	Rockwell Edwards	DWG. 3674	Yes	Yes	Yes	2" Check

Notes:

(1) ISI: In-Service Inspection Program.
(2) SRP: Seismic Reevaluation Program (Reference 9).
(3) IST: In-Service Testing Program.

TABLE 7-2
CLASS 2 AND 3 VALVES

Valve	Rating lbs	Pressure/Temperature (Operating) or Design psi/°F	Material	ANSI Allowable psi	Meets ANSI B16.34?
AFW-303	600	(1088/420)	A-216, Gr. WCB	1256	Yes
AFW-304	600	600/(490)	A-216, Gr. WCB	1207	Yes
AFW-309	1500	600/(420)	SS	2034[a]	Yes
AFW-310	1500	600/(420)	SS	2034[a]	Yes
AFW-312	1500	600/(420)	SS	2034[a]	Yes
AFW-317	1500	600/(490)	SS	1926[a]	Yes
AFW-318	1500	600/(490)	SS	1926[a]	Yes
AFW-320	1500	600/(490)	SS	1926[a]	Yes
AFW-321	1500	600/(420)	SS	2034[a]	Yes
AFW-322	1500	600/(420)	SS	2034[a]	Yes
AFW-324	1500	600/(420)	SS	2034[a]	Yes
AFW-339	600	50/105	A-105, Gr. II	1474	Yes
AFW-340	600	300/(490)	A-105, Gr. II	1207	Yes
CCW-322	150	150/500	CS	170	Yes
CCW-323	150	150/500	CS	170	Yes
CCW-325	150	150/500	CS	170	Yes
CRS-020	600	(500)/200	SA-182, Gr. F316	1240	Yes
CRS-301	150	(155)/200	A-351, Gr. CF8M	240	Yes
CRS-304	300	310/300	SA-182, Gr. F316	560	Yes
CRS-305	300	300/300	SA-182, Gr. F316	560	Yes
CRS-341	600	(500)/200	SA-182, Gr. F316	1240	Yes
CV-010	150	(50/270)	A-352, Gr. LCB	236	Yes
CV-036	600	(1350/260)	A-216, Gr. WCB	1329	Yes[c]
CV-037	600	(1350/260)	A-216, Gr. WCB	1329	Yes[c]
CV-076	1500	(985/545)	A-105, Gr. II	2878	Yes
CV-077	1500	(985/545)	A-105, Gr. II	2878	Yes

TABLE 7-2 (continued)
CLASS 2 AND 3 VALVES

Valve	Rating lbs	Pressure/Temperature (Operating) or Design psi/°F	Material	ANSI Allowable psi	Meets ANSI B16.34?
CV-078	1500	(985/545)	A-105, Gr. II	2878	Yes
CV-079	1500	(985/545)	A-105, Gr. II	2878	Yes
CV-113	600	(935/535)	A-216, Gr. WCB	1163	Yes
CV-114	150	(175/100)	316 SS	275	Yes
CV-3201	600	(600/490)	A-216, Gr. WCB	1207	Yes
CV-3213	600	(1088/420)	A-216, Gr. WCB	1256	Yes
CV-410	150[b]	150/400	SS	160[a]	Yes
CV-517	150	(175/100)	A-351, Gr. CF8M	275	Yes
CV-518	150	(175/100)	A-351, Gr. CF8M	275	Yes
CV-528	150	150/400	Steel	160[a]	Yes
CV-875A	1500	(900/120)	CS	3030[a]	Yes
CV-875B	1500	(900/120)	CS	3030[a]	Yes
CV-992	1500	(2085/640)	SA 182, Gr. F316	2227	Yes
CVS-313	150[b]	(50)/150	Steel	212[a]	Yes
FCV-1112	2500	(2700/130)	SS	4766[a]	Yes
FCV-2300	900	(1088/420)	A-216, Gr. WCB	1879	Yes
FCV-2301	900	600/(420)	A-216, Gr. WCB	1879	Yes
FCV-3301	900	600/(420)	A-216, Gr. WCB	1879	Yes
FWS-345	900	1264/450	A-216, Gr. WCB	1848	Yes
FWS-378	900	1264/450	A-216, Gr. WCB	1848	Yes
FWS-379	900	1264/450	A-216, Gr. WCB	1848	Yes
FWS-398	900	1264/450	A-216, Gr. WCB	1848	Yes

TABLE 7-2 (continued)
CLASS 2 AND 3 VALVES

Valve	Rating lbs	Pressure/Temperature (Operating) or Design psi/°F	Material	ANSI Allowable psi	Meets ANSI B16.34?
FWS-417	900	1264/450	A-216 Gr. WCB	1848	Yes
FWS-438	900	(1350/340)	A-216, Gr. WCB	1942	Yes
FWS-439	900	(1350/340)	A-216, Gr. WCB	1942	Yes
HCV-602	300	(500/140)	SS	562[a]	Yes
HV-852A	900	(1350/340)	CS	1570[a]	Yes
HV-852B	900	(1350/340)	CS	1570[a]	Yes
HV-854A	300	(360/340)	CS	525[a]	Yes
HV-854B	300	(360/340)	CS	525[a]	Yes
MOV-1100B	300	200/300	SS	455[a]	Yes
MOV-1100D	300	200/300	SS	455[a]	Yes
MOV-1202	600	(600/490)	A-216, Gr. WCB	1207	Yes
MOV-720A	150	(80/110)	CS	225[a]	Yes
MOV-720B	150	(80/110)	CS	225[a]	Yes
MOV-880	300	300/400	SS	415[a]	Yes
MOV-883	150	(155)/200	A-351, Gr. CF8M	240	Yes
POV-009	150	(50)/200	A-216, Gr. WCB	260	Yes
POV-010	150	(50)/150	SA-516, Gr. 70	273	Yes
RV-001	1500	1000/545	A-216, Gr. WCB	2878	Yes
RV-002	1500	1000/545	A-216, Gr. WCB	2878	Yes
RV-003	1500	1000/545	A-216, Gr. WCB	2878	Yes
RV-004	1500	1000/545	A-216, Gr. WCB	2878	Yes
RV-005	1500	1000/545	A-216, Gr. WCB	2878	Yes
RV-006	1500	1000/545	A-216, Gr. WCB	2878	Yes
RV-007	1500	1000/545	A-216, Gr. WCB	2878	Yes
RV-008	1500	1000/545	A-216, Gr. WCB	2878	Yes

TABLE 7-2 (continued)
CLASS 2 AND 3 VALVES

Valve	Rating lbs	Pressure/Temperature (Operating) or Design psi/°F	Material	ANSI Allowable psi	Meets ANSI B16.34?
RV-009	1500	1000/545	A-216, Gr. WCB	2878	Yes
RV-010	1500	1000/545	A-216, Gr. WCB	2878	Yes
RV-289	150[(b)]	(155/200)	SS	195[(a)]	Yes
SIS-303	150	150/400	304 SS	180	Yes
SIS-304	150	150/400	304 SS	180	Yes
SV-1212-8	600	150/300	SA 182, Gr. F316	1120	Yes
SV-1212-9	600	150/300	SA 182, Gr. F316	1120	Yes
SV-3200	600	600/(490)	A-105, Gr. II	1207	Yes
SV-3211	600	600/(490)	A-351, Gr. CF8	882	Yes
SV-3214	600	600/(490)	A-351, Gr. CF8	882	Yes
SWC-381	N/A	N/A	Cast Iron	N/A	N/A
SWC-382	N/A	N/A	Cast Iron	N/A	N/A
SWC-383	N/A	N/A	Cast Iron	N/A	N/A
TCV-601A	600	150/500	CS	975[(a)]	Yes
TCV-601B	600	150/500	CS	975[(a)]	Yes
VCC-301	150	(150/180)	304 SS	243	Yes
VCC-306	1500	(2700/130)	316 SS	3449	Yes
VCC-332	150	(155/200)	SS	195[(a)]	Yes
VCC-388	150	(155/200)	A-351, Gr. CF8 or CF8M	235[(a)]	Yes

Notes:

(a) Actual material specification number is unknown, but the lowest allowable for the worst material is used conservatively.

(b) Actual rating is unknown; the minimum ANSI rating is assumed.

(c) Allowable pressure is marginally exceeded, but the valve was qualified based on engineering judgement.

8.0 PUMPS

8.1 Introduction

[For fatigue analysis of Class 1 pumps (RCP's) see Section 4.0]

SEP Topic III-1 requires a review of pumps. Accordingly, the NRC Safety Evaluation Report (SER) (Reference 4) requires that information should be provided on the codes used for designing the eight pumps (pump groups) listed under "scope" below in order to determine if the manufacturer's standards meet the current (Reference 6) requirements.

The Franklin Research Center (FRC) technical evaluation report (TER) (enclosed with Reference 3), page A-97, contains the following elaboration:

> "Pumps furnished under the requirements of the Hydraulic Institute Standards were designed to satisfy functional requirements. Integrity of the pressure boundary was not covered by this standard. The design of the pump pressure boundary should be evaluated in accordance with the current requirements of NB\NC\ND-3400." (Reference 6)

Based on the above, demonstration of pressure boundary integrity of the pumps designed solely to manufacturer's standards is attempted and accomplished as described in Section 8.3, below. The pumps designed to manufacturer's standards, as well as some of their pertinent characteristics are listed in Table 8.1. Note that the use of the Hydraulic Institute Standards was the standard industry practice at the time.

8.2 Scope

According to Tables 4.2(a), (b), and (c) of Reference 4, the pumps in Table 8-1 are designed to manufacturer's standards and therefore constitute the scope.

8.3 Results

For the results of the analysis for the reactor coolant pumps, see Section 4.0.

The SEP Topic III-1 issues regarding SONGS-1 pumps designed to manufacturer's standards are resolved based on the following information. Notes (a) through (g) appearing below refer to the indices (a) through (g) appearing in the resolution column of Table 8-1. Note, further, that detailed dimensional information is not readily available, and therefore compliance with the requirements of Reference 6 cannot be demonstrated numerically.

(a) Pressure boundary integrity of casing and/or nozzle has been demonstrated by calculations performed previously.

(b) These pumps are tested regularly under the SONGS 1 IST procedure. The tests run on these pumps include speed, inlet pressure, differential pressure, flow rate, vibration, bearing temperature, and lube level, as applicable. These test results demonstrate acceptable pressure boundary integrity on a periodic basis.

(c) Due to presence of more than one pump performing the same function, there is redundancy, and single failure does not impair the safety function.

(d) These pumps are not needed to achieve shutdown or for mitigation of design basis accidents.

(e) These pumps were added to the plant during the Standby Power Addition Project around mid 1970's. As specified in the Q-List (Appendix 3.2A of Reference 5), these pumps have been supplied by the Diesel Generators No. 1 and 2 supplier in accordance with IEEE-387, and ASME VIII for the pressure retaining parts.

(f) The original equipment specification for these pumps requires the design should comply with the requirements of ASME VIII for pressure retaining parts.

(g) Auxiliary Feedwater Pump G-10W was designed and installed in 1986 in accordance with the ASME Code Section III, and therefore complies with current code requirements of Reference 6.

8.4 Conclusion

The information provided above is sufficient to resolve the pump related SEP Topic III-1 open issues.

TABLE 8-1

PUMPS DESIGNED TO MANUFACTURER'S STANDARDS

Pump(s)	Tag Nos.	ASME Code Class	In IST(1)?	In SRP(2)?	Resolution Indices (3)
Chemical and Volume Control Test Pump	G-42	2	No	Yes	(a), (d), (f)
Refueling Water Pumps	G-27N, G-27S	2	Yes	Yes	(a), (b), (c), (f)
Auxiliary Feedwater Pumps	G-10, G-10S, G-10W	3 3	Yes Yes	Yes No	(a), (b), (c) (b), (c), (g)
Component Cooling Pumps	G-15A, G-15B, G-15C	3	Yes	Yes	(a), (b), (c)
Spent Fuel Pit Pump	G-5	3	No	No	(d)
Salt Water Cooling Pumps	G-13A, G-13B	3	Yes	Yes	(a), (b), (c)
Diesel Generator Lube Oil Pumps	G-67, G-68, G-69, G-70	3	No	No	(c), (e)
Diesel Generator Cooling Water Pumps	G-16, G-18	3	No	No	(c), (e)

Notes:

(1) IST: In-Service Testing Program.
(2) SRP: Seismic Reevaluation Program (Reference 9).
(3) For resolution indices (a) through (g), see Section 8.3.

9.0 STORAGE TANKS

9.1 Scope

The NRC has classified the storage tanks at SONGS 1 according to the vapor pressure above the stored liquid. According to the NRC criteria, storage tanks in which the pressure exceeds 15 psig are considered to be pressure vessels.

The FRC and the NRC have identified only:

- the Refueling Water Storage Tank (RWST), and
- the Condensate Storage Tank which has since the review been replaced by the new Auxiliary Feed Water Storage Tank (AFWST)

as atmospheric or 0-15 psig storage tanks.

Based on the above discussion, the evaluation scope for the storage tanks consists of:

- the RWST, and
- the AFWST.

9.2 Evaluation

For the storage tanks, the NRC's concerns are as follows (Reference 4):

"(a) atmospheric storage tanks should be checked to determine if they meet current compressive stress requirements,

(b) 0 to 15 psig storage tanks should be checked to determine if they meet current tensile allowables for biaxial stress field conditions, and

(c) specifications and calculations on storage tanks designed to API-650 should be provided and checked to verify that they meet current standards."

9.2.1 Refueling Water Storage Tank

The RWST was originally designed in accordance with the API Specifications API-650, 1964 Edition. Since its original design, the RWST has been reanalyzed a number of times during the Seismic Reevaluation Program (Reference 9) by SCE, and by Lawrence Livermore National Laboratory for the NRC. (Reference 10)

For tanks designed to the API-650, the FRC has made the following specific observations (Reference 3):

(a) The past code permits an allowable tensile shell stress 21000 psi times E, the joint efficiency. This allowable may exceed the current 12600 psi allowable.

(b) The past code allows the use of A-7 plate material not currently listed as an acceptable material.

Note that the "current standards" referred to by the NRC and the FRC are the standards of the ASME Boiler and Pressure Vessel Code, 1977 Edition, with Addenda up to Summer 1978 (Reference 6).

In the evaluations summarized below, supplemental calculations have been performed to resolve the above listed NRC concerns.

(a) With regards to the NRC concern (a) above, SCE design calculations show that shell buckling has been evaluated using the rules of Code Case N-284. The code case allows use of increased allowables to reflect effects of internal pressure. This effect is quantified based of the procedures of the AWWA Standard for Welded Steel Water Storage Tanks (Reference 11). The buckling evaluation shows that RWST meets the requirements.

(b) With regards to the FRC concern (b) above, examination of the RWST as-built vendor drawing shows that A-7 material has not been used in the RWST and the shell material is A-283, Grade C.

(c) To address the NRC concerns (b) and (c), and the FRC concern that the tensile shell stress allowables of API-650 are no longer valid, the required shell thicknesses have been calculated in accordance with the requirements of paragraph NC-3800 of the ASME Code (Reference 6). The calculations take into the account the as-built material allowables and the joint efficiency, and show that the required shell thicknesses are available at the tank bottom as well as at the transition between the bottom and next higher courses.

9.2.2 Auxiliary Feed Water Storage Tank

The AFWST is a new tank (circa 1983) designed to current code requirements. Based on the vendor design calculations, the design code of record is determined to be the 1977 ASME III Code including Summer, 1978 Addenda, Subsection ND. The design also takes into account the buckling considerations of Subsection ND. This design basis constitutes the resolution.

9.3 Conclusions

Based on the results reported herein, storage tank issues are resolved.

10.0 REFERENCES

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

2. NUREG-0829, "Integrated Plant Safety Assessment, Systematic Evaluation Program, San Onofre Nuclear Generating Station, Unit 1, Southern California Edison Company, Docket No. 50-206, "Final Report", dated December 1986.

3. Letter, W. Paulson (NRC) to R. Dietch (SCE), "SEP Topic III-1, Quality Group Classification of Components and Systems", dated June 25, 1982.

4. Letter, D.M. Crutchfield (NRC) to K. Baskin (SCE), "SEP Topic III-1, Quality Group Classification of Components and Systems", dated April 23, 1984.

5. San Onofre Nuclear Generating Station, Unit 1 (SONGS 1) Updated Final Safety Analysis Report (UFSAR), December 1988.

6. ASME Boiler and Pressure Vessel Code, Section III, Division 1, 1977 Edition, with Addenda through Summer 1978.

7. Reactor Vessel Design Report, San Onofre Nuclear Generating Station, Unit 1, Westinghouse Electric Corporation, July 1965, Specification E-569259.

8. "Steel Valves", American National Standards Institute, ANSI B16.34, 1977.

9. "SONGS 1 LTS Seismic Scope Chart," Rev. G, dated June 2, 1986, enclosed with Letter, M.O. Medford (SCE) to G.E. Lear (NRC), "Scope of Seismic Reevaluation Program, SEP Topic III-6, Seismic Design Considerations," dated June 5, 1986.

10. "Structural Design Issues, Long Term Service Seismic Reevaluation, Southern California Edison Company, San Onofre Nuclear Generating Station, Unit 1", Lawrence Livermore Technical Evaluation Report UCID-20769, prepared for the Office of Nuclear Reactor Regulation, dated May 31, 1986.

11. "AWWA Standard for Welded Steel Tanks for Water Storage," ANSI/AWWA Standard D100-79, American Waterworks Association.

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
Containment Purge System				
37. Air ducting and control valves for containment isolation Line-CVS-13290-24" Line-CVS-13291-24" Valve-CVS-POV-10 carbon steel Valve-CVS-POV-9 Note: These valves were replaced in 1985-86	B	Valve body-A352-Grade 60T, DISC 18-8 SS; shaft-316SS seat-rubber; new valves - ASTM-A216 Grade WCB body & SA-A516 Grade 70 body		See the discussion presented in Item C at the end of this Table.
Valve-CVS-CF10	B	6"-150# monoflange butterfly valve; ASTM-A352-6OT-LCB	No	Nominal pipe size 6" and less exempted per code, NC-2311. However, Charpy impact data was requested in bill of material.

Table 5-1 (Continued)
FRACTURE TOUGHNESS REVIEW

ITEM	QUALITY GROUP	MATERIAL	IMPACT TEST REQ'D	REASON FOR EXEMPTION
Auxiliary Feedwater System				
38. Auxiliary feedwater pumps-electric driven	C*		No	Austenitic stainless steel exempted per code, ND-2311; Nominal pipe size 6" and less exempted per code, ND-2311.
AFW-G-10S: inlet/outlet				
Line-AFW-8111-4"-JN-3AC8		A312 type 304		
Line-AFW-397A-3"-EG-3AC8		A106 Grade B		
AFW-G-10W: inlet/outlet				
Line-AFW-17035-6"-JN		A312 type 304		
Line-AFW-17038-4"-EG		A106 Grade B		
39. Auxiliary feedwater pump-turbine driven	C*		No	Nominal pipe size 6" and less exempted per code, NC-2311.
AFW-G-10: inlet/outlet				
Line-AFW-8110-4"-EG-3AC8		A106 Grade B		
Line-AFW-381-3"-EG-3AC8				

* Per Appendix 3.2A of Reference 5