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January 31, 1985
RBG- 20045
File Nos. G9.5,
G9.19.2

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Denton:

River Bend Station-Unit 1
Docket No. 50-458

Gulf States Utilities Company (GSU) provides the enclosed response addressing the River Bend Station (RBS) Safety Evaluation Report (SER) Confirmatory Item No. (5) - Effects of Annulus Pressurization. The attached information will be provided in a future amendment to FSAR Sections 3.9B for the Nuclear Steam Supply System scope and 3.9A for the Balance of Plant scope. This completes GSU's response to Question 210.92.

Sincerely,

William J. Reed
for J. E. Booker
Manager-Engineering,
Nuclear Fuels & Licensing
River Bend Nuclear Group

erg
JEB/RJK/kt

Attachments

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QUESTION 210.92 (3.9)

Using the guidance of NUREG-0609, provide the methodology used and the results of the annulus pressurization (AP) analysis (asymmetric LOCA loads) for the reactor system and affected components including the following:

1) reactor pressure vessel and supports,

2) core supports and other reactor internals,

3) control rod drives,

4) ECCS piping attached to the reactor coolant system,

5) primary coolant piping, and

6) piping supports for affected piping system.

The results of the above analysis should specifically address the effects of the combined loadings due to annulus pressurization and an SSE.

RESPONSE

11 The reactor asymmetric loads analysis is due to be completed in the third quarter of 1984 and will be documented in a self-contained appendix to Section 3.9.

The following is a ~~brief~~ description of the methodology used in the reactor asymmetric loads analysis.

1. Pressure-Time Histories

   The pressure time histories in the annulus region between the RPV and shield wall are generated from a feedwater line break and a recirculation line break. ~~The RELAP code using nodalized mass and energy balance is used in this analysis.~~ These analyses are described in Section 6.2.1.2.

2. Concentrated Force-Time Histories

   The forcing function of jet impingement on the shield wall is obtained from the break flow transient caused by a feedwater line break and a recirculation line break. Forcing functions of jet reaction on RPV, jet impingement on RPV, and pipe whip restraint load on restraint anchors are obtained from the feedwater line break, the recirculation line break, and main steam line break.

3. Integrated Dynamic Analysis

   Beam and shell models are used to integrate pressure-time histories and concentrated force-time histories in determining the effects on the shield wall pedestal, vessel support, core support and internals, and control rod drives. These dynamic analyses yield displacements, forces, stresses and moments.

4. Attached Piping Analysis

   Acceleration time history from the integrated dynamic analysis is used to generate response spectra for the stress analysis of the attached piping. This analysis covers ECCS lines, primary coolant piping, and associated pipe supports.

5. Load Combination for Vessel and Piping

   Asymmetric LOCA loads in combination with SSE by the SRSS methodology are treated as a faulted condition for evaluation against the ASME Code and functional capability requirements. This is described in Table 3.9B-2 (for NSSS components)

For attached ECCS piping, the ARS that is generated for the annulus pressurization (AP) case is used in the pipe stress analysis in the same manner as it is used for the seismic SSE case, i.e. considered as faulted condition with the critical damping values of 2% and 3% according to NRC regulatory guide 1.61, and with the combination of modes and spatial components according to NRC regulatory guide 1.92.

The results of the pipe stress analysis due to AP are combined by the SRSS method with those due to SSE and flow transients and are used in the evaluation of equation 9 with respect to both the ASME code allowables and functional capability requirements.

Pipe loads exerted on the ECCS pipe supports as a result of annulus pressurization and combined with SSE by the SRSS method, under the faulted condition.

Piping analysis methods and load combinations are discussed in Section 3.9A. Stress results for the annulus pressurization case are shown in Tables 1 thru 5 for ECCS piping and in Tables 6 thru 10 for ECCS piping supports.

FSAR

TABLE 3.9A-16
RHS LPCI SYSTEM
STRESS PROBLEM AX-71B

NODE	PRIMARY STRESS (PSI)	ALLOWABLE (PSI) 3Sm
5	31115	55356
6	17583	55356
7	17152	55356
10	14788	55356
11	11974	55356
12	18127	55356
15	18648	55356
16	30685	55356
161	30064	55356
17	17627	55356
18	17217	55356
22	13594	60000
23	21473	60000
25	12646	60000
26	18100	60000
27	17764	60000
30	11565	60000
31	13085	60000
32	11956	60000
35	23719	60000
37	25917	60000
40	12604	60000
41	13360	60000
42	13458	60000
45	17387	60000
47	13594	60000
50	11580	60000
51	14120	60000
52	31617	60000
55	25297	60000
551	14083	60000
56	12028	60000
57	13620	60000
60	25810	60000
62	29143	60000
63	14887	60000
64	13163	60000
640	11807	60000
641	10677	60000
65	10999	60000
66	10243	60000
660	9927	60000
67	10741	60000
68	10437	60000
69	12991	60000

NOTE:

1. STRESSES WERE CALCULATED PER ASME SECTION III, SUB ARTICLES NB-3652 (EQUATION 9) AND NB-3656.

TABLE 3.9A-16 (cont'd.)
RHS LPCI SYSTEM
STRESS PROBLEM AX-71B

NODE	PRIMARY STRESS (PSI)	ALLOWABLE (PSI) 3Sm
70	12392	60000
72	17889	60000
75	24558	60000
76	15214	60000
77	24174	60000
80	22034	60000
82	15399	60000
85	17376	60000

See Figure 3.9A-13

FSAR

TABLE 3.9A-17
RHS LPCI SYSTEM
STRESS PROBLEM AX-71C

NODE	PRIMARY STRESS (PSI)	ALLOWABLE (PSI) 3Sm
5	30600	55356
6	20244	55356
7	14809	55356
12	16265	55356
13	29375	55356
14	2131	55356
15	18419	55356
17	18575	55356
22	14126	60000
300	21112	60000
23	11893	60000
25	21910	60000
27	22062	60000
28	13771	60000
30	14054	60000
31	14036	60000
32	13408	60000
35	27651	60000
37	27432	60000
40	12747	60000
42	21062	60000
43	26169	60000
45	13325	60000
46	14637	60000
461	12034	60000
463	11385	60000
47	11777	60000
470	11584	60000
48	11557	60000
49	11258	60000
50	13593	60000
54	13255	60000
55	27209	60000
57	24592	60000
60	12041	60000
62	27133	60000
65	25558	60000
67	11893	60000
70	11334	60000

NOTE:

1. STRESSES WERE CALCULATED PER ASME SECTION III, SUB ARTICLES NB-3652 (EQUATION 9) AND NB-3656.

See Figure 3.9A-14

FSAR

TABLE 3.9A-18
RHS LPCI SYSTEM
STRESS PROBLEM [illegible]X-71D

NODE	PRIMARY STRESS (PSI)	ALLOWABLE (PSI) 3Sm
5	20169	55356
6	13069	55356
8	11285	55356
10	14682	55356
15	16333	55356
30	17124	55356
35	37478	55356
37	16525	55356
38	16385	55356
40	16414	55356
50	13591	60000
52	25640	60000
55	12582	60000
57	11872	60000
60	27826	60000
62	22535	60000
65	10282	60000
70	13709	60000
75	11004	60000
80	23657	60000
82	18489	60000
84	6529	60000
85	19764	60000
87	24898	60000
90	13374	60000
500	13347	60000

NOTE:

1. STRESSES WERE CALCULATED PER ASME SECTION III, SUB ARTICLES NB-3652 (EQUATION 9) AND NB-3656.

See Figure 3.9A-15

FSAR

TABLE 3.9A-19
CSL SYSTEM
STRESS PROBLEM AX-78A

NODE	PRIMARY STRESS (PSI)	ALLOWABLE (PSI) 3Sm
5	13667	55356
7	21984	55356
10	16890	55356
15	13640	55356
17	13325	55356
20	13565	55356
35	15733	55356
37	16532	55356
38	16583	55356
40	16634	55356
50	15604	60000
51	15337	60000
52	15025	60000
55	21022	60000
60	18930	60000
62	12902	60000
65	19509	60000
70	18515	60000
72	13334	60000
75	13181	60000
78	14348	60000
80	30497	60000
85	28464	60000
90	10864	60000
92	10992	60000
95	23056	60000
100	22388	60000

NOTE:

1. STRESSES WERE CALCULATED PER ASME SECTION III, SUB ARTICLES NB-3652 (EQUATION 9) AND NB-3656.

See Figure 3.9A-16

FSAR
TABLE 3.9A-20
CSH SYSTEM
STRESS PROBLEM AX-83A

NODE	PRIMARY STRESS (PSI)	ALLOWABLE (PSI) 3Sm
5	15124	55356
10	22447	55356
2011	14502	55356
20	28992	55356
22	2685	55356
25	15407	55356
35	16565	55356
40	16839	55356
42	16705	55356
45	16462	55356
55	14992	60000
58	14168	60000
60	11566	60000
65	19795	60000
70	19348	60000
71	11313	60000
72	12548	60000
75	20177	60000
80	21032	60000
82	12081	60000
85	13703	60000
88	13543	60000
90	24090	60000
95	26575	60000
97	13191	60000
100	13953	60000
105	15183	60000

NOTE:

1. STRESSES WERE CALCULATED PER ASME SECTION III, SUB ARTICLES NB-3652 (EQUATION 9) AND NB-3656.

See Figure 3.9A-17

TABLE 3.9A-21
RHS LCPI SYSTEM
PIPE SUPPORT LOADS FOR STRESS PROBLEM AX-71B

NODE POINT	SUPPORT FUNCTION	SUPPORT MARK NO.	LOAD Fx(lbs)	 Fy(lbs)	 Fz(lbs)
15	SPRING	1RHS*PSSH3070A1	0	0	0
17	SNUBBER	1RHS*PSSP3071A1	0	-9650	0
25	STRUT	1RHS*PSST3072A1	+11984	0	+14719
310	SNUBBER	1RHS*PSSP3073A1	4774	-14262	4774
32	SNUBBER	1RHS*PSSP3074A1	4709	0	+9616
40	SPRING	1RHS*PSSH3075A1	0	0	0
42	STRUT	1RHS*PSST3076A1	-15673	0	0
47	RESTRAINT	1RHS*PSR3077A1	0	-11500	0
50	SNUBBER	1RHS*PSSP3078A1	-16974	0	0
510	SNUBBER	1RHS*PSSP3079A1	0	-8929	-8929
551	SNUBBER	1RHS*PSSP3164A1	-15268	0	-15268
57	STRUT	1RHS*PSST3080A1	0	-13915	0
630	SNUBBER	1RHS*PSSP3158A1	-22894	-4450	0
65	SNUBBER	1RHS*PSSP3159A1	0	-3522	-13145
67	RESTRAINT	1RHS*PSR3160A1	0	-11812	0
70	RESTRAINT	1RHS*PSR3081A1	0	-11710	-13625
82	RESTRAINT	1RHS*PSR3082A1	0	-13113	0

NOTE: (1) Loads are in the global coordinates system.
(2) Loads shown above are SRSS (Annulus Pressurization , SSE, Fluid Transient.)

TABLE 3.9A-22
RHS LCPI SYSTEM
PIPE SUPPORT LOADS FOR STRESS PROBLEM AX-71C

NODE	SUPPORT	SUPPORT		LOAD	
POINT	FUNCTION	MARK NO.	Fx(lbs)	Fy(lbs)	Fz(lbs)
15	SPRING HANGER	1RHS*PSSH3088A1	0	0	0
23	STRUT	1RHS*PSST3089A1	13069	-1613	-12995
30	SNUBBER	1RHS*PSSP3090A1	-14163	0	0
310	SNUBBER	1RHS*PSSP3091A1	-643	-8490	372
40	SPRING HANGER	1RHS*PSSH3092A1	0	0	0
44	SNUBBER	1RHS*PSSP3161A1	0	-8575	-14269
460	SNUBBER	1RHS*PSSP3162A1	-2387	10540	0
47	SNUBBER	1RHS*PSSP3094A1	0	-12405	-3618
48	STRUT	1RHS*PSST3095A1	0	0	-11764
49	SPRING HANGER	1RHS*PSSH3093A1	0	0	0
54	RESTRAINT	1RHS*PSR3097A1	0	0	-19678
60	SPRING HANGER	1RHS*PSSH3096A1	0	0	0
67	RESTRAINT	1RHS*PSR3098A1	0	-7536	0

NOTE: (1) Loads are in the global coordinates system.
(2) Loads shown above are SRSS (Annulus Pressurization, SSE, Fluid Transient.)

TABLE 3.9A-23
RHS LCPI SYSTEM
PIPE SUPPORT LOADS FOR STRESS PROBLEM AX-71D

NODE POINT	SUPPORT FUNCTION	SUPPORT MARK NO.	LOAD		
			Fx(lbs)	Fy(lbs)	Fz(lbs)
37	SNUBBER	1RHS*PSSP3066A1	-311.	12853	311.
38	SPRING	1RHS*PSSH3067A1	0.0	-14.	0.0
55	SPRING	1RHS*PSSH3068A1	0.0	-63.	0.0
57	RESTRAINT	1RHS*PSR3065A1	-11942.	0.0	11942.
84	SNUBBER	1RHS*PSSP3139A1	2486.	-14834	1943.
90	STRUT	1RHS*PSST3061A1	-9075.	0.0	11514.

NOTE: (1) Loads are in the global coordinates system.
(2) Loads shown above are SRSS (Annulus Pressurization, SSE, Fluid Transient.)

TABLE 3.9A-24
RHS LCPI SYSTEM
PIPE SUPPORT LOADS FOR STRESS PROBLEM AX-78A

NODE POINT	SUPPORT FUNCTION	SUPPORT MARK NO.	LOAD Fx(lbs)	Fy(lbs)	Fz(lbs)
17	SNUBBER	1CSL*PSSP3000A1	0.	-354B	0.
37	SPRING	1CSL*PSSH3001A1	0.	-82.	0.
62	SNUBBER	1CSL*PSSP3002A1	-16991.	0.	0.
72	SNUBBER	1CSL*PSSP3003A1	0.	-8651.	0.
78	SPRING	1CSL*PSSH3004A1	0.	-83.	0.
90	SNUBBER	1CSL*PSSP3005A1	-6001.	956.	-7854.

NOTE: (1) Loads are in the global coordinates system.
(2) Loads shown above are SRSS (Annulus Pressurization, SSE, Fluid Transient.)

TABLE 3.9A-25
CSH LCPI SYSTEM
PIPE SUPPORT LOADS FOR STRESS PROBLEM AX-83A

NODE	SUPPORT	SUPPORT		LOAD	
POINT	FUNCTION	MARK NO.	Fx(lbs)	Fy(lbs)	Fz(lbs)
22	SNUBBER	1CSH*PSSP3001A1	0	-4149	0
40	SPRING HANGER	1CSH*PSSH3002A1	0	0	0
72	STRUT	1CSH*PSST3003A1	19911	0	-2122
82	SNUBBER	1CSH*PSSP3004A1	0	-10880	-2412
85	SPRING HANGER	1CSH*PSSH3005A1	0	0	0
88	STRUT	1CSH*PSSM3006A1	0	0	-16132

NOTE: (1) Loads are in the global coordinates system.
(2) Loads shown above are SRSS (Annulus Pressurization, SSE, Fluid Transient.)

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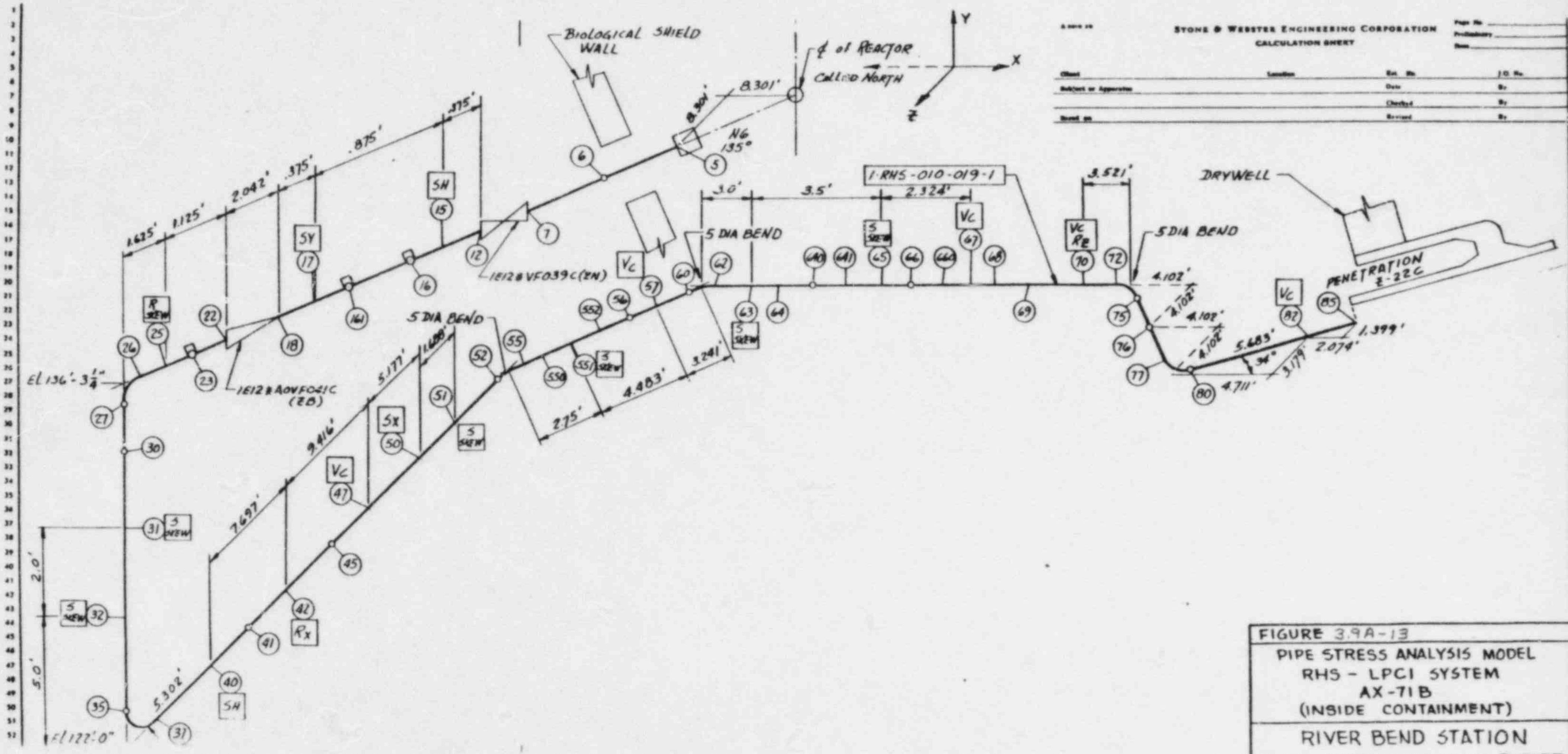

FIGURE 3.9A-13
PIPE STRESS ANALYSIS MODEL
RHS - LPCI SYSTEM
AX-71B
(INSIDE CONTAINMENT)

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STONE & WEBSTER ENGINEERING CORPORATION
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Page No. ____
Preliminary ____
Final ____

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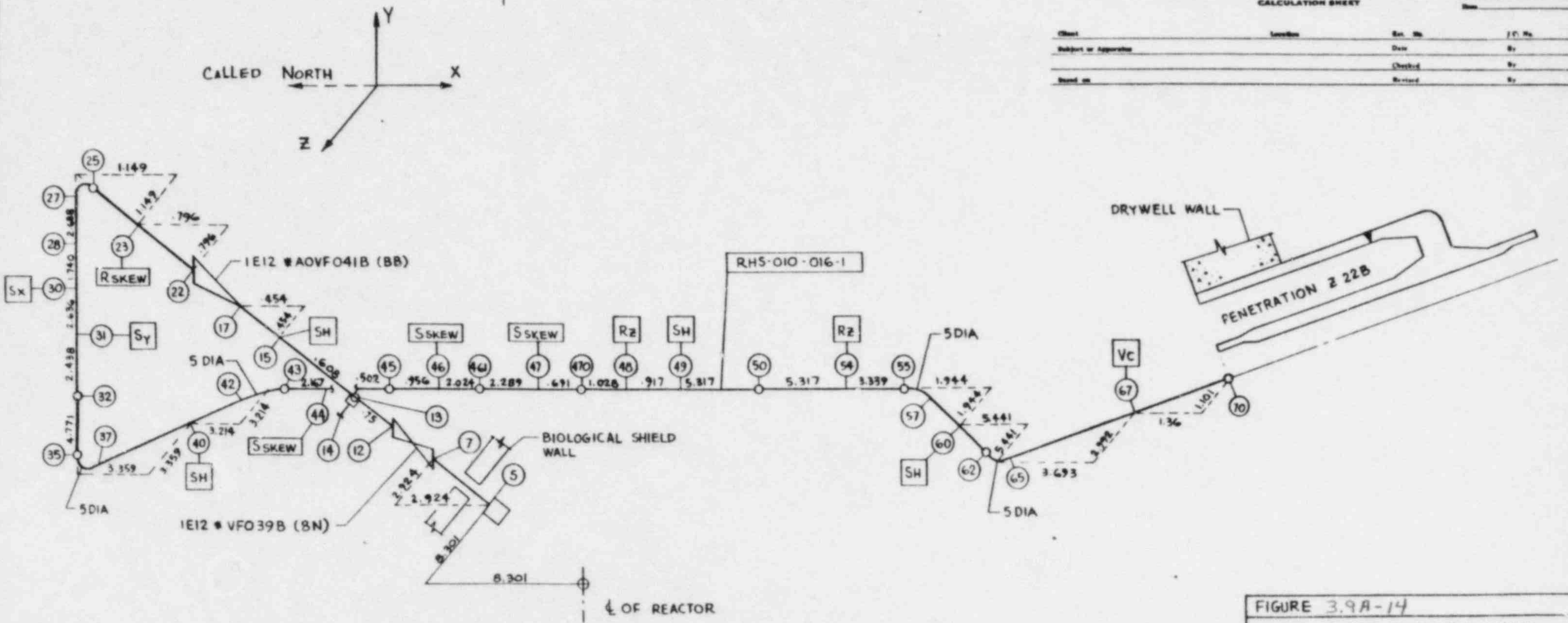

FIGURE 3.9A-14

PIPE STRESS ANALYSIS MODEL
RHS-LPCI SYSTEM
AX-71C
(INSIDE CONTAINMENT)

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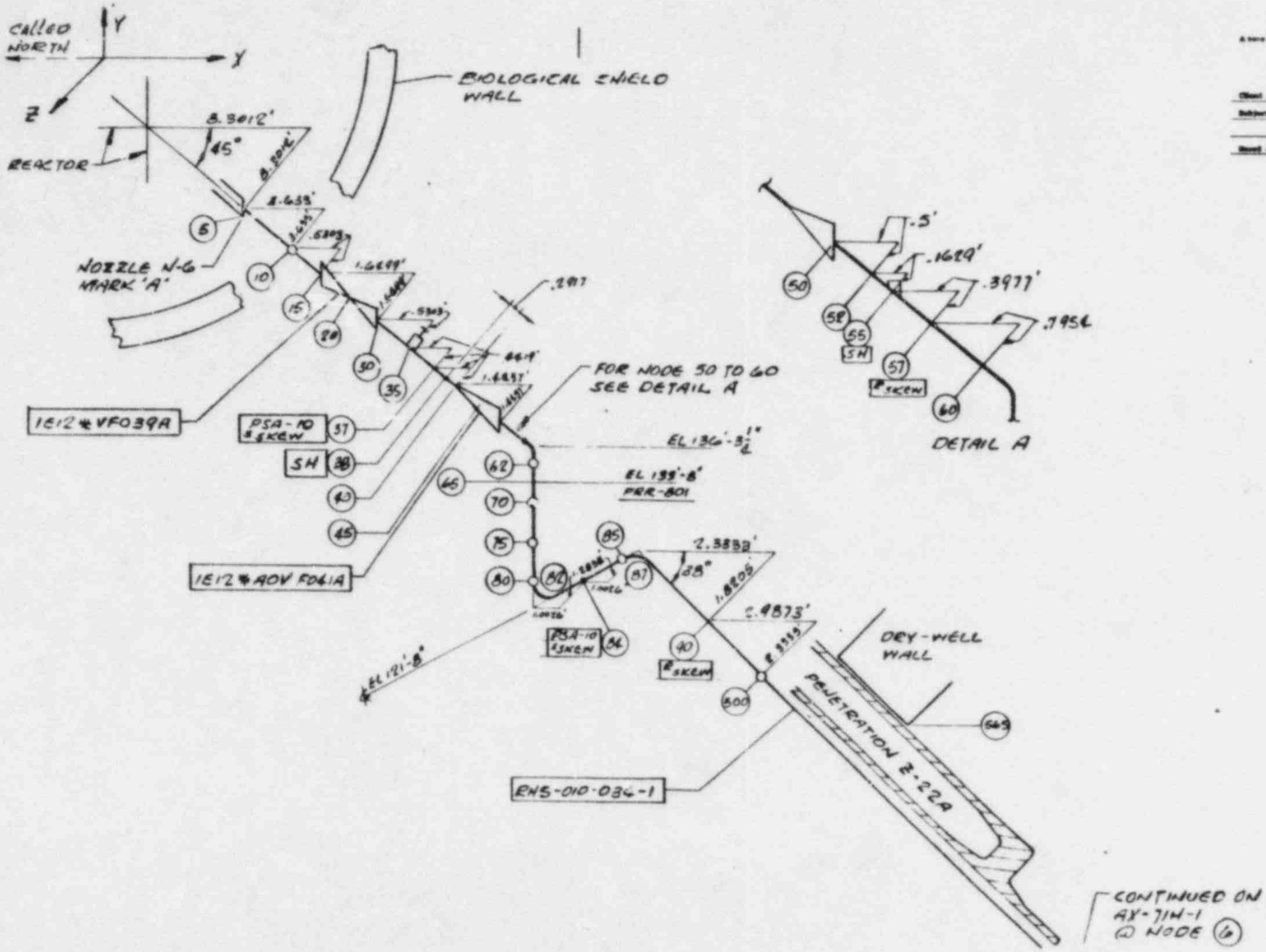

FIGURE 39A-15

PIPE STRESS ANALYSIS MODEL
RHS-LPCI SYSTEM
AX-71D
(INSIDE CONTAINMENT)

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Page No. ______
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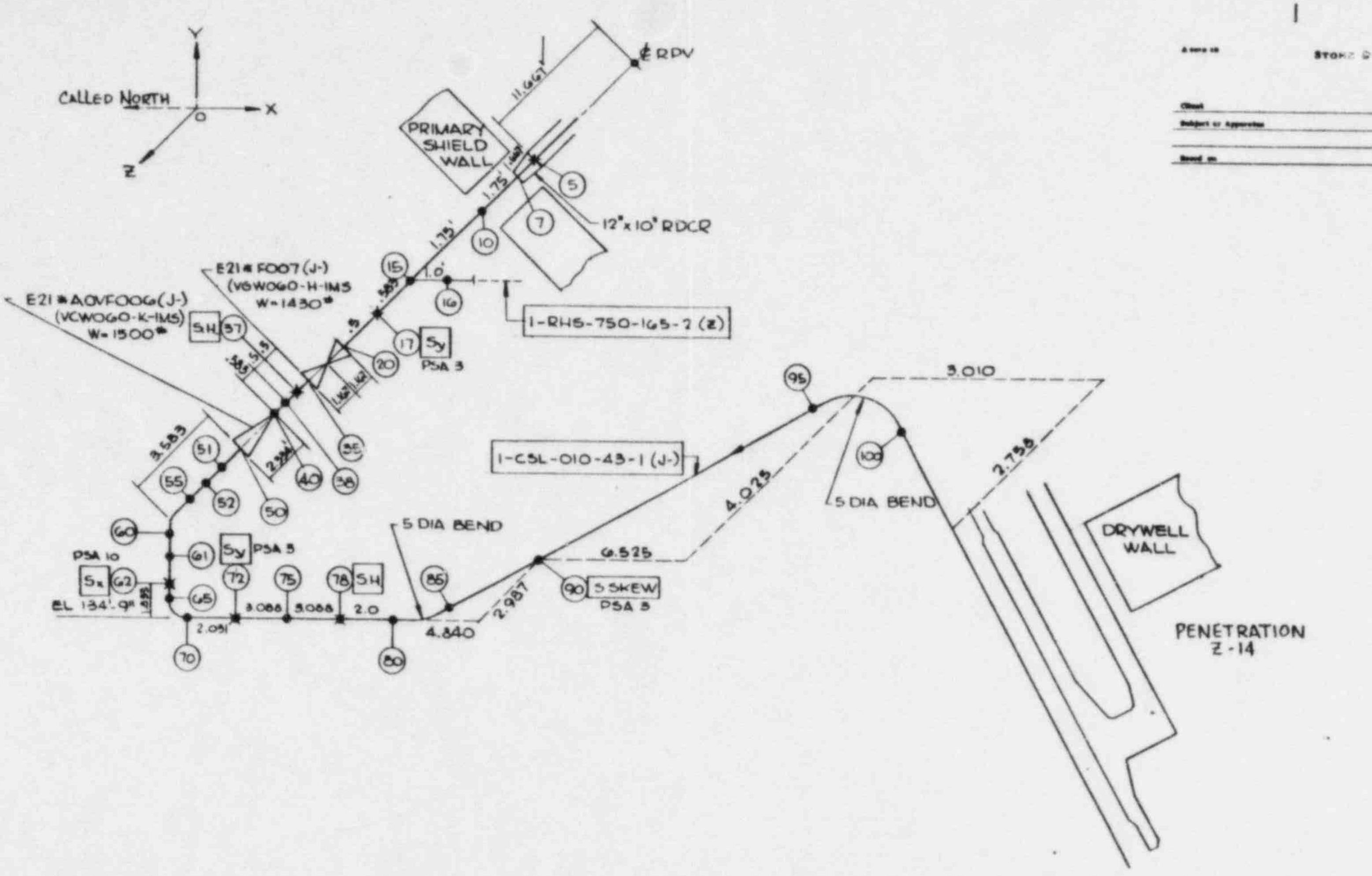

FIGURE 3.9A-16
PIPE STRESS ANALYSIS MODEL
CSL SYSTEM
AX-78A
(INSIDE CONTAINMENT)

RIVER BEND STATION
FINAL SAFETY ANALYSIS REPORT

STONE & WEBSTER ENGINEERING CORPORATION
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Page No.
Preliminary
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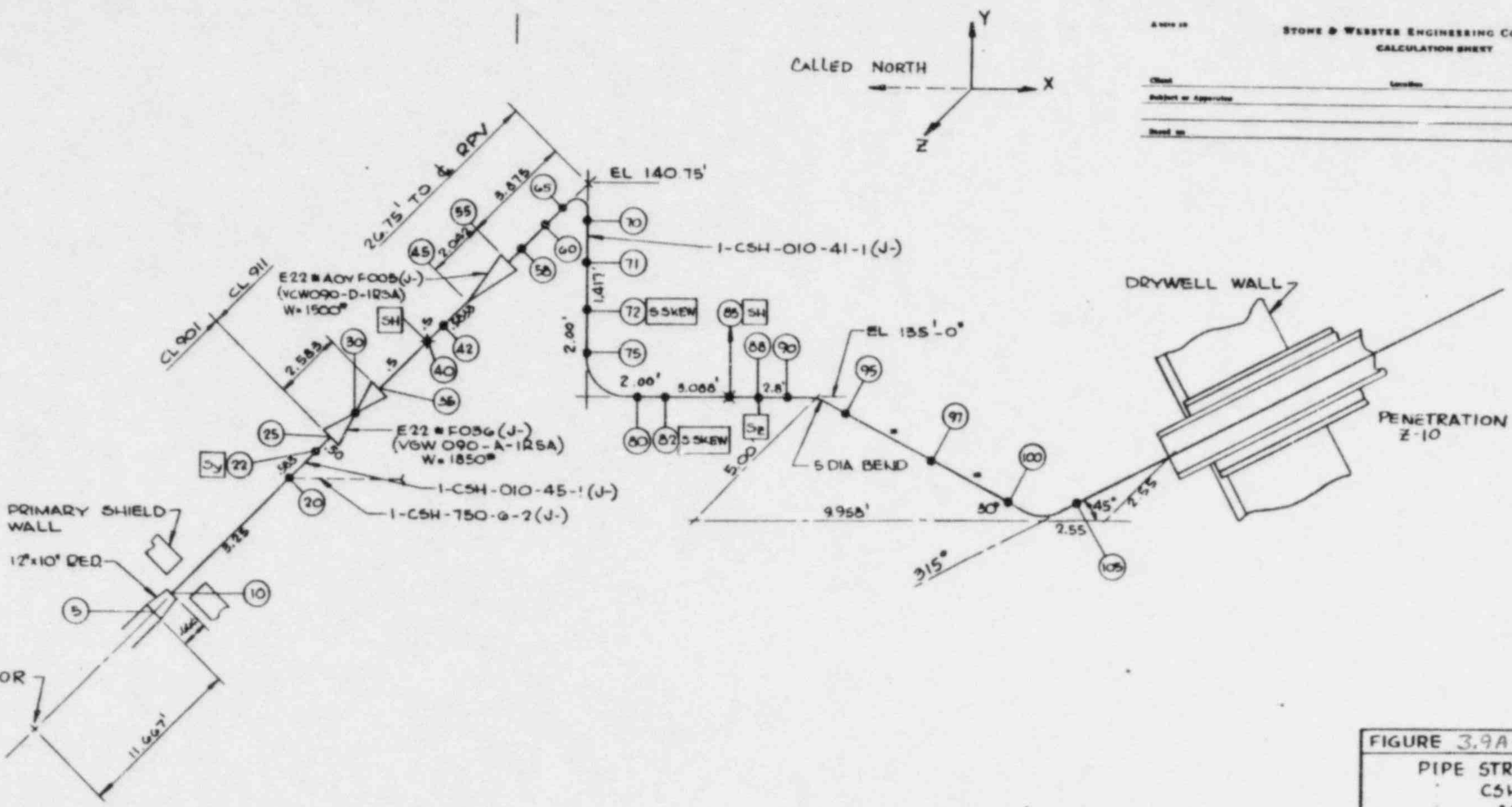

FIGURE 3.9A-17
PIPE STRESS ANALYSIS MODEL
CSH SYSTEM
AX-83A
(INSIDE CONTAINMENT)

RIVER BEND STATION
FINAL SAFETY ANALYSIS REPORT

3.9B MECHANICAL SYSTEMS AND COMPONENTS (GE SCOPE OF SUPPLY)

3.9.1B Special Topics For Mechanical Components

3.9.1.1B Design Transients

This section describes the transients which are used in the design of major NSSS ASME Section III, Code Class 1 and Class 2 components. The number of cycles or events for each transient is included. These transients are included in the design specifications and/or stress reports for components. Transients or combinations of transients are classified with respect to the component operating condition categories identified as "normal," "upset," "emergency," "faulted," or "testing" in the ASME Section III Subsection NCA as applicable (The first four conditions correspond to service levels A,B,C, and D, respectively).

3.9.1.1.1B CRD Transients

The normal and test service load cycles used for the design and fatigue analysis for the 40-yr life of the Control Rod Drive (CRD) are as follows:

	Transient	Category	Cycles
1.	Reactor startup/shutdown	normal/upset	120
2.	Vessel pressure tests	normal/upset	130
3.	Vessel overpressure	normal/upset	10
4.	Scram tests	normal/upset	140
5.	Startup scrams	normal/upset	160
6.	Operational scrams	normal/upset	300
7.	Jog cycles	normal/upset	30,000
8.	Shim/drive cycles	normal/upset	1,000

In addition to the above transients, the following transients have been considered in the design and fatigue analysis of the CRD.

3.9.1.1.7B Reactor Assembly Transients

The reactor pressure vessel assembly includes the reactor pressure vessel, support skirt, and shroud support, ~~and shroud plate.~~ including leg, cylinder and plate. The cycles listed in Table 3.9B-1 were specified in the reactor assembly design and fatigue analysis.

3.9.1.1.8B Main Steam Isolation Valve Transients

The main steam isolation valves are designed for the following service conditions and thermal cycles:

Transient	Category	Cycles
1. Startup and shutdown		
a. Heating cycle @ 100°F/hr	normal/upset	300
b. Cooling cycle @ 100°F/hr	normal/upset	300
c. ±29°F between 70°F and 552°F	normal/upset	600
d. ±50°F step change between 70°F and 552°F	normal/upset	200
2. Loss of feedwater pump/MSLIV closure		
a. 552°F to 573°F in 3 sec (ΔT = 21°F heating)	normal/upset	10
b. 573°F to 525°F in 9 min (ΔT = 48°F cooling)	normal/upset	10
c. 525°F to 573°F in 6 min (ΔT = 48°F heating)	normal/upset	10
d. 573°F to 485°F in 7 min (ΔT = 88°F cooling)	normal/upset	10
e. 485°F to 573°F in 8 min (ΔT = 88°F heating)	normal/upset	10
f. 573°F to 485°F in 7 min (ΔT = 88°F cooling)	normal/upset	10
3. Single relief valve blowdown		
a. 552°F to 375°F in 10 min (ΔT = 177°F cooling)	normal/upset	8
4. Reactor overpressure with delayed scram		
a. 552°F to 586°F in 2 sec (ΔT = 34°F heating)	emergency	1
b. 586°F to 561°F in 30 sec (ΔT = 25°F heating)	emergency	1
5. Automatic and blowdown (ADS)		
a. 552°F to 375°F in 3.3 min (ΔT = 177°F cooling)	emergency	1

3.9.1.1.12B Recirculation Gate Valve Transients

The following transients are considered in the design of the recirculation gate valves:

Transient	Cycles
1. 70°F-575°F-70°F of 100°F/hr	300
2. ±29°F between limits of 70°F and 575°F, instantaneous	600
3. ±50°F between limits of 70°F and 575°F, instantaneous	200
4. 552°F to 375°F, in 10 min	8
5. 552°F to 281°F, in 22.3 min	1
6. 100°F to 552°F, in 15 sec	1
7. 110% of design pressure at 575°F	1
8. 1300 psi at 100°F installed hydrostatic test	130
9. ~~1570~~ 1670 psi at 100°F installed hydrostatic test	3

3.9.1.2B Computer Programs Used in Analysis

The following sections discuss computer programs used in the analysis of specific components. (Computer programs were not used in the analysis of all components, thus, not all components are listed.)

Subsections 3.9.1.2.1B through 3.9.1.2.5B, 3.9.1.3.3B, and 3.9.1.4.3B reference computer programs utilized by GE and vendors for analyzing NSSS components. These NSSS programs can be divided into two categories:

GE Programs

The verification of the following GE programs has been performed in accordance with the requirements of 10CFR50, Appendix B. Evidence of the verificaion of input, output, and methodology is documented in GE Design Record Files. 7

a. SPECA
b. SNAP
c. CREEP-PLAST
d. ANSYS
e. SAP4
f. ANSI7
g. NOZAR
h. RVFOR
i. TSFOR
j. PDA
k. EZPYP
l LION
m. WTNOZ
n. WBHFN
o. CRDSS01

3.9.1.2.2B Piping

The computer programs used in the analysis of NSSS piping systems within GE's scope of supply are identified and their use summarized in the following paragraphs.

INSERT →

3.9.1.2.2.1B ~~Structural~~ Piping Analysis ~~Program/SAP 4~~ /PISYS

SAP is a general Structural Analysis Program for static and dynamic analysis of linear elastic complex structures. The finite element displacement method is used to solve the displacements and compute the stresses of each element of the structure. The structure can be composed of unlimited numbers of three-dimensional truss, beam, plate, shell, solid, plate strain-plane stress, brick, thick shell, or spring, axi-symmetric elements. The program can treat thermal and various forms of mechanical loading as well as internal element loading. The dynamic analysis includes mode superposition, time-history, and response-spectrum analyses. Earthquake types of loading as well as time varying pressure can be treated. The program is very versatile and efficient in solving large and complex structural systems. The output contains displacements of each nodal point as well as stresses at the surface of each element.

3.9.1.2.2.2B Component Analysis/ANSI 7

The ANSI 7 Computer Program determines stress and accumulative usage factors in accordance with NB-3600 of ASME Code, Section III. The program was written to perform stress analysis in accordance with the ASME sample problem, and has been verified by reproducing the results of the sample problem analysis.

3.9.1.2.2.3B Area Reinforcement/NOZAR

The computer program NOZAR (Nozzle Area Reinforcement Program) performs an analysis of the required reinforcement area for openings. The calculations performed by NOZAR are in accordance with the rules of the ASME Code, Section III.

3.9.1.2.2.~~4~~3B Dynamic Forcing Functions

3.9.1.2.2.~~4~~3.1B Relief Valve Discharge Pipe Forces Computer Program/RVFOR

The relief valve discharge pipe connects the relief valve to the suppression pool. When the valve is opened, the transient fluid flow causes time dependent forces to develop

INSERT

Page 3.9B-17

PISYS is a computer code specialized for piping load calculations. It utilizes selected stiffness matrices representing standard piping components, which are assembled to form a finite element model of a piping system. The technique relies on dividing the pipe model into several discrete substructures, called pipe elements, which are connected to each other via nodes called pipe joints. It is through these joints that the model interacts with the environment and loading of the structure becomes possible. PISYS is based on the linear classical elasticity in which the resultant deformation and stresses are proportional to the loading and the superposition of loading is valid.

PISYS has a full range of static and dynamic analysis options which include: distributed weight, thermal expansion, differential support motion modal extraction, response spectra, and time history analysis by modal or direct integration. The PISYS program has been benchmarked against five Nuclear Regulatory Commission piping models for the option of response spectrum analysis and the results are documented in Reference 7.

analysis were also determined during actual testing of prototype control rod drives.

3.9.1.4B Considerations for the Evaluation of Faulted Conditions

Seismic Category I equipment is evaluated for the faulted loading conditions. ~~In all cases, actual stresses are within the allowable limits.~~ The following paragraphs in Subsection 3.9.1.4B show examples of the treatment of faulted conditions for the major components on a component-by-component basis. Additional discussion of faulted analysis is found in Section 3.9.3B, Section 3.9.5B, and Table 3.9B-2.

Sections 3.9.2.2B and 3.7B discuss the treatment of dynamic loads resulting from the postulated SSE. Section 3.9.2.5B discusses the dynamic analysis of loads on NSSS equipment resulting from blowdown. Deformations under faulted conditions have been evaluated in critical areas and no cases are identified where design limits, such as clearance limits, are exceeded.

3.9.1.4.1B Control Rod Drives System Components

3.9.1.4.1.1B Control Rod Drives

The major control rod drive components that have been analyzed for the faulted conditions are: ring flange, main flange, and indicator tube. The maximum stresses for these components and for various plant operating conditions including the faulted condition are given in Table 3.9B-2u.

3.9.1.4.1.2B Hydraulic Control Unit

The Hydraulic Control Unit (HCU) is ~~was~~ analyzed for the seismic ~~SSE faulted condition.~~ and hydraulic load conditions. Subsection 3.9.2.2.2.4B describes the methods of this analysis.

The analysis of the HCU under faulted condition loads establishes the structural integrity of the system.

3.9.1.4.2B Standard Reactor Internal Components

3.9.1.4.2.1B CR Guide Tube

The maximum calculated stress on the CR guide tube occurs in the base during the faulted condition ~~an SSE and is 19,654 psi.~~ The "faulted" limit is the lesser of 2.4 S_m / or 0.7 S_u at the design temperature per ASME Code, Section III, Table I-1.2 and F 1322-1; S_u = 57,500 psi and S_m = 16,000 psi @ 575°F.

where Sm is 16,000psi at 575°F. The analysis and the results for various plant operating conditions are summerized in Table 3.9B-2x.

3.9.1.4.2.2B Incore Housing

The maximum calculated stress on the incore housing occurs at the outer surface of the vessel penetration during ~~an SSE and is 21143 psi~~ the faulted condition. The "faulted" limit is the lesser of 2.4 S_m or 0.7 S_u ~~at the design temperature per ASME Code, Section III F1323.1(b); S_u = 80,000 psi and S_m = 23,300 psi at 575°F~~. Stresses are summarized in Table 3.9B-2y.

3.9.1.4.2.3B Jet Pump

The dynamic analysis of the jet pump under faulted load conditions shows that the maximum stress occurs at the jet pump riser brace.

The elastic analysis for the jet pump faulted conditions shows that the maximum stress is due to impulse loading of the diffuser during a pipe rupture and blowdown and is no greater than 12,000 psi. The maximum allowable for this condition per ASME Code, Section III, Subsection NG, is 3 S_m ~~or 60,000~~ psi. At all other sections of the pump by addition of all stresses in each direction the maximum stress is approximately 2,500 psi for the faulted condition.

Stresses are summarized in Table 3.9B-2v.

3.9.1.4.2.4B LPCI Coupling

The location of the highest primary stress ($P_m + P_b$) is at the strut to shroud attachment weld. The smallest margin at the weld is from the faulted condition ~~of NL+ΔPA+JR+AP/F+SSE~~, resulting from a large line break plus SSE. ~~The calculated stress is __*__.~~ The allowable stress is ~~35,658 psi, or~~ 2.4 x 1.5 x 0.7 S_m. A weld quality factor of 0.7 is included as required by ASME Code, Section III, Table NG-3352-1. The analysis and results are summarized in Table 3.9B-2w.

3.9.1.4.2.5B Orificed Fuel Support

See Subsection 3.9.1.3.2B, "Orificed Fuel Support, Vertical and Horizontal Load Tests."

3.9.1.4.2.6B CRD Housing

The CRD housing is analyzed for the faulted condition. The SSE and hydrodynamic loads are considered. Table 3.9B-2u shows that the maximum calculated stresses are bounded by the allowables.

The SSE is classified as a faulted condition; however, in the CRD housing analysis the SSE event has been treated as an emergency condition. The maximum stress on the CRD housing during an SSE is 14,727 psi. The maximum design stress limit for this event is 1.2 S_m =20,000 psi, and the ultimate strength of the material is 57,500 psi.

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* Information to be provided upon completion of new loads program

INSERT →

Table 3.9B-2v shows the load combinations, analytical methods, and allowable and calculated stress values for the highly stressed areas of the control rod drive housing.

3.9.1.4.3B Reactor Pressure Vessel Assembly

The reactor pressure vessel assembly includes the reactor pressure vessel and shroud support.

For faulted conditions the reactor vessel was evaluated using elastic analysis. For the reactor, ultimate strength allowable values were not used since the emergency allowable stress limits of ASME Section III were used for the faulted condition. For the shroud support, an elastic analysis was performed, except for the support legs, for primary membrane stress, and for a compressive loading case where buckling was evaluated. For this analysis the Creep-Plast computer program was used which is described in Subsection 4.1.4.1.10.

3.9.1.4.4B Core Support Structure

The evaluations for faulted conditions for the core support structure are described in Section 3.9.5B.

3.9.1.4.5B Main Steam Isolation, Recirculation Gate and Safety/Relief Valves

Tables 3.9B-2g, 3.9B-2h, and 3.9B-2j provides a summary of the method of analyses of the safety/relief, main steam isolation, and recirculation gate valve, respectively.

Standard design rules, as defined in ASME III, are utilized in the analysis of pressure boundary components of Seismic Category I valves. Conventional, elastic stress analysis is used to evaluate components not defined in the ASME Code. The code allowable stresses are applied to determine acceptability of structure under applicable loading conditions including faulted condition.

3.9.1.4.6B Recirculation System Flow Control Valve

The recirculation system flow control valve is analyzed for faulted conditions using the elastic analysis ~~methods~~ criteria from the ASME Code, Section III. The results are summarized in Table 3.9B-2f.

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page 3.9B-26

3.9.1.4.3B Reactor Pressure Vessel Assembly

The RPV assembly includes the RPV, support skirt, and shroud support. For faulted condition, the RPV was evaluated using an elastic analysis. The support skirt and shroud support were also evaluated with an elastic analysis; the compressive buckling load was accounted for. The analysis and results are summarized in Table 3.9B-2a.

3.9.1.4.4B Core Support Structure

The core support structures are evaluated for the faulted load condition on the basis of the seismic and other dynamic events described in Section 3.7B and 3.9.5, respectively. The calculated stresses and the allowables are summarized in Table 3.9B-2b for various plant operating conditions.

3.9.1.4.7B Main Steam and Recirculation Piping

For main steam and recirculation system piping, elastic analysis methods are used for evaluating faulted loading conditions. The equivalent allowable stresses using elastic techniques are obtained from ASME Code, Section III, Appendix F, "Rules for Evaluation of Faulted Conditions," and these are above elastic limits. Additional information on the main steam and recirculation piping is in Tables 3.9B-2d and 3.9B-2e.

3.9.1.4.8B Nuclear Steam Supply System Pumps, Heat Exchanger, and Turbine

The recirculation (Table 3.9B-2i), ECCS (Table 3.9B-2n), RCIC (Table 3.9B-2r), and SLC pumps (Table 3.9B-2l), RHR heat exchangers (Table 3.9B-2b) and RCIC turbine (Table 3.9B-2q) have been analyzed for the faulted loading conditions identified in Section 3.9.1.1B. In all cases, stresses were within the elastic limits. The analytical methods, stress limits, and allowable stresses are discussed in Sections 3.9.2.2B and 3.9.3.1B.

3.9.1.4.9B Control Rod Drive Housing Supports

Examples of the calculated stresses and the allowable stress limits for faulted conditions for the control rod drive housing supports are shown in Table 3.9B-2z. 9

3.9.1.4.10B Fuel Storage Racks

Examples of the calculated stresses, and stress limits for the faulted conditions for the new fuel storage racks, fuel preparation machine, refueling platform and fuel transfer tube ~~and the containment fuel storage racks~~ are shown in Table 3.9B-2s.

3.9.1.4.11B Fuel Assembly (including Channels)

GE BWR fuel channel design bases, analytical methods and evaluation results, including those applicable to the faulted conditions, are contained in References 4 and 5. The acceleration profiles are summarized in Table 3.9B-2aa.

3.9.1.4.12B Reactor Refueling & Servicing Equipment

Refueling and servicing equipment which are important to safety are classified as essential components per 9
the requirements of 10CFR50, Appendix A. This equipment and other equipment whose failure would degrade an essential component is defined in Section 9.1 and is classified as Seismic Category I. 9
These components are subjected to an elastic dynamic finite element analysis to generate loadings. This analysis

for seismic and 60Hz for hydrodynamic loads

utilizes appropriate seismic floor response spectra and combines loads at frequencies up to 33 Hz in three directions. Imposed stresses are generated and combined for normal, upset, and faulted conditions. Stresses are compared, depending on the specific safety class of the equipment, to Industrial Codes, ASME, ANSI or Industrial Standards, AISC, allowables.

3.9.2B Dynamic Testing and Analysis

3.9.2.1B Piping Vibration, Thermal Expansion, and Dynamic Effects

The test program is divided into three phases: piping vibration, thermal expansion, and dynamic effects.

3.9.2.1.1B Piping Vibration

3.9.2.1.1.1B Preoperational Vibration Testing of Recirculation Piping

The purpose of the preoperational vibration test phase is to verify that operating vibrations in the recirculation piping are within acceptable limits. This phase of the test uses visual observation to supplement remote measurements. If, during steady state operation, visual observation indicates that vibration is significant, measurements are made with a hand held vibrograph. Visual observations, manual and remote measurements are made during the following steady-state conditions:

1. Recirculation pumps minimum flow
2. Recirculation pumps at 50% of rated flow
3. Recirculation pumps at 75% of rated flow
4. Recirculation pumps at 100% of rated flow.

1 Section 3.9.2.1A further discusses preoperational vibration testing, including measurement locations and visual inspection points.

3.9.2.1.1.2B Startup Vibration Testing of Main Steam and Recirculation Piping

The purpose of this phase of the program is to verify that the main steam and recirculation piping vibration are within acceptable limits. Because of limited access due to high

3.9.2.2B Seismic Qualification of Safety-Related Mechanical Equipment

This subsection describes the criteria for seismic qualification of safety-related mechanical equipment and the qualification testing and/or analysis applicable to this plant for all of the major components on a component-by-component basis. In some cases, a module or assembly consisting of mechanical and electrical equipment is qualified as a unit, for example, ECCS pumps. These modules are generally discussed in this paragraph rather than in Sections 3.10B and 3.11. Seismic qualification testing is also discussed in Section 3.9.3.2B. Electrical supporting equipment such as control consoles, cabinets, and panels which are part of the NSSS are discussed in Section 3.10B.

3.9.2.2.1B Tests and Analysis Criteria and Methods

The ability of equipment to perform its Seismic Category I function during and after an earthquake is demonstrated by tests and/or analysis. Selection of testing, analysis, or a combination of the two is determined by the type, size, shape, and complexity of the equipment being considered. When practical, the Seismic Category I operations are performed simultaneously with vibratory testing. Where this is not practical, the operation and/or loads are simulated by mathematical analysis and applied in addition to physical tests.

Equipment which is large, simple, and/or consumes large amounts of power is usually qualified by analysis or static bend test to show that the loads, stresses, and deflections are less than the allowable maximum. Analysis and/or static bend testing is also used to show that there are no natural frequencies below 33 Hz. If a natural frequency lower than 33 Hz is discovered, dynamic tests may be conducted and, in conjunction with mathematical analysis, used to verify operability and structural integrity at the required seismic input conditions.

When the equipment is qualified by dynamic test, the response spectrum or time history of the attachment point is used in determining input motion.

Natural frequency may be determined by running a continuous sweep frequency search using a sinusoidal steady state input of low magnitude. Seismic conditions are simulated by testing using random vibration input or single frequency input (within equipment capability) at frequencies through

or 60Hz if the equipment is affected by hydrodynamic loads.

or 60Hz if the equipment is affected by hydrodynamic loads.

33 Hz√ Whichever method is used, the input motion during testing envelopes the actual input motion expected during earthquake conditions.

The equipment being dynamically tested is mounted on a fixture which simulates the intended service mounting and causes no dynamic coupling to the equipment.

Equipment having an extended structure, such as a valve operator, is analyzed by applying static equivalent seismic SSE loads at the center of gravity of the extended structure. In cases where the equipment structural complexity makes mathematical analysis impractical, a static bend test is used to determine spring constant and operational capability at maximum equivalent seismic load conditions.

3.9.2.2.1.1B Random Vibration Input

When random vibration input is used, the actual input motion envelopes the appropriate floor input motion at the individual modes. However, single frequency input such as sine waves can be used provided one of the following conditions is met:

1. The characteristics of the required input motion are dominated by one frequency.
2. The anticipated response of the equipment is adequately represented by one mode.
3. The input has sufficient intensity and duration to excite all modes to the required magnitude, such that the testing response spectra envelope the corresponding response spectra of the individual modes.

3.9.2.2.1.2B Application of Input Motion

When dynamic tests are performed, the input motion is applied to one vertical and one horizontal axis simultaneously. However, if the equipment response along the vertical direction is not sensitive to the vibratory motion along the horizontal direction, and vice versa, then the input motion is applied to one direction at at time. In the case of single frequency input, the time phasing of the inputs in the vertical and horizontal directions are such that a purely rectilinear resultant input is avoided.

3.9.2.2.1.3B Fixture Design

The fixture design simulates the actual service mounting and cause no dynamic coupling to the equipment.

3.9.2.2.1.4B Prototype Testing

Equipment testing is conducted on prototypes of the equipment installed in this plant.

3.9.2.2.2B Seismic Qualification of Specific NSSS Mechanical Components

The following sections discuss the testing or analytical qualification of NSSS equipment. Seismic qualification is also described in Sections 3.9.1.4B, 3.9.3.1B, and 3.9.3.2B.

3.9.2.2.2.1B Jet Pumps

A static analysis of the jet pumps was performed assuming 3.0g horizontal acceleration and 1.5g vertical. The stresses resulting from the analysis were below the design allowables. Static analysis with an appropriate amplification factor was used in lieu of dynamic analysis since the jet pump is a simple component with a natural frequency of slightly less than 33 Hz.

3.9.2.2.2.2B CRD and CRD Housing

The seismic qualification of the CRD housing (with enclosed CRD) for OBE and SSE was done analytically, and the stress results of their analysis established the structural integrity of these components. Preliminary dynamic tests have been conducted to verify the operability of the Control Rod Drive during a seismic event. A simulated test, imposing a static bow in the fuel channels, was performed with the CRD functioning satisfactorily.

3.9.2.2.2.3B Core Support (Fuel Support and CR Guide Tube)

No dynamic testing of the CR Guide Tube has been conducted; however, a detailed analysis imposing dynamic effects due to seismic events has shown that the maximum stresses developed during these events are much lower than the maximum allowed for the component material.

3.9.2.2.2.4B Hydraulic Control Unit (HCU)

The HCU was analyzed for the SSE faulted condition, using the method of "Sum of Absolute Values of the Modal Loads."

A dynamic anlysis of the jet pump assembly was performed. All stresses were below the ASME Code Section III, Subsection NG allowables(Subsection NG is used as an analysis guide for this non-code component).

The maximum stress on the HCU frame was calculated to be below the maximum allowable for the SSE faulted condition. These stresses were obtained by assuming that the HCUs are braced together back-to-back on the "H" beams at the top and bottom of the HCU.

The dynamic analysis of the HCU under faulted condition loads establishes the structural integrity of the HCU.

3.9.2.2.2.5B Fuel Channels Assembly(Including Channels)

assembly

GE BWR fuel channel design bases, analytical methods, and evaluation results, including seismic considerations, are contained in References 4 and 5.

and hydrodynamic

3.9.2.2.2.6B Recirculation Pump and Motor Assembly

The recirculation pump, including its appurtenances and supports, individually and as an assembly, is designed to withstand the seismic forces of 4.5g horizontal and 3.0g vertical as follows:

1. The flooded pump motor assembly is analyzed as a free body supported by constant support hangers from the brackets on the motor mounting member, with hydraulic snubbers attached to brackets on the pump case and the top of the motor frame. Natural frequencies are greater than 33 Hz, as determined by analysis; therefore, an equivalent static load method of seismic analysis is used.

2. Primary stresses due to horizontal and vertical seismic forces are considered to act simultaneously and therefore added algebraically. Horizontal and vertical seismic forces are applied to mass centers, and equilibrium reactions are determined for motor and pump brackets.

3. Load, shear, and moment diagrams were constructed to scale, using live loads, dead loads, and calculated snubber reactions. Combined bending, tension, and shear stresses were determined for each major motor flange bolting and pump case.

4. The maximum combined tensile stress in the cover bolting was calculated including tensile stress from design pressure.

in ~~two~~ three directions, one vertical and two horizontal, and calculated using the square root of the sum of the squares method. The pump mass, support system, and accessory piping have been shown, by analysis, to have a natural frequency greater than 33 Hz or 60Hz for equipment affected by hydrodynamic loads.

The RCIC pump assembly has been analytically qualified by static analysis for seismic loading as well as the design operating loads of pressure, temperature, and external piping loads. The results of this analysis confirm that the stresses are substantially less than 90 percent of the allowable.

3.9.2.2.2.9B RCIC Turbine Assembly

The RCIC turbine has been seismically qualified via a combination of static analysis and dynamic testing. The turbine assembly consists of rigid masses, wherein static analysis has been utilized, interconnected with control levers and electronic control systems, necessitating final qualification via dynamic testing. Static loading analysis has been employed to verify the structural integrity of the turbine assembly and the adequacy of bolting under operating and seismic loading conditions. The complete turbine assembly has been seismically qualified via dynamic testing, in accordance with IEEE 344, 1975. The qualification test program included demonstration of startup and shutdown capabilities, as well as no load operability during seismic loading conditions.

1. Requirements

    The specification for seismic qualification of the RCIC turbine and its accessories states that they shall be capable of withstanding the specified seismic accelerations at all frequencies within the range of 0.25 Hz to 33 Hz. Proper performance may be demonstrated by tests, analysis, or a combination of both. If all natural frequencies of the turbine, the component parts, and the accessories are greater than 33 Hz (as defined by test and/or analysis), a static load analysis may be performed. The seismic forces of each component or assembly are obtained by concentrating its mass at the center of mass of the component or assembly and multiplying by the seismic acceleration (earthquake coefficient). The magnitude of the earthquake coefficients is 1.5 g - both horizontal and vertical. If component parts and/or accessories have natural frequencies below 33 Hz,

or 60Hz for equipment affected by hydrodynamic loads.

Regulatory Guide 1.48 through the incorporation of the alternate approach cited in Table 3.9B-4.

Regulatory Guide 1.48 delineates acceptable design limits and appropriate combinations of loadings associated with normal operation, postulated accidents, and specified seismic events for the design of the Seismic Category I fluid system components. Compliance with this guide is shown in Table 3.9B-4.

3.9.3.1.2B Reactor Pressure Vessel Assembly

The reactor vessel assembly consists of the reactor pressure vessel and shroud support.

The reactor pressure vessel and shroud support are constructed in accordance with Section III of the ASME Code. The shroud support consists of the shroud support plate and the shroud support cylinder and its legs. The reactor pressure vessel is an ASME Class I component. Complete stress reports on these components have been prepared in accordance with ASME requirements. Table 3.9B-2a summarizes the loading combinations for each category of plant conditions. The stress analysis performed on the reactor vessel, including the faulted conditions, was completed using elastic methods. The shroud support was also evaluated using elastic conditions, except as noted in Subsection 3.9.1.4.3B. Load combinations and stress analyses for other reactor internals are discussed in Subsection 3.9.5B.

3.9.3.1.3B Main Steam Piping

The main steam piping discussed in this paragraph includes that piping extending from the reactor pressure vessel to the outboard main steam isolation valve. This piping is designed in accordance with the ASME Code, Section III, Subsection NB-3600. The load combinations and stress criteria are shown in Table 3.9B-2d.

The rules contained in Appendix F of ASME Section III are used in evaluating faulted loading conditions, independently of all other design and operating conditions. Stresses calculated on an elastic basis are evaluated in accordance with F-1360.

The shroud support was constructed to the requirements of the April 1973 draft of Subsection NG.

3.9.5.1.1.7B Control Rod Guide Tubes

The control rod guide tubes, located inside the vessel, extend from the top of the control rod drive housings up through holes in the core plate.

Each tube is designed as the guide for a control rod and as the vertical support for a four-lobed orificed fuel support piece and the four fuel assemblies surrounding the control rod. The bottom of the guide tube is supported by the control rod drive housing, which in turn transmits the weight of the guide tube, fuel support, and fuel assemblies to the reactor vessel bottom head. A thermal sleeve is inserted into the control rod drive housing from below and is rotated to lock the control rod guide tube in place. A key is inserted into a locking slot in the bottom of the control rod drive housing to hold the thermal sleeve in position.

3.9.5.1.1.8B Jet Pump Assemblies

The jet pump assemblies are not core support structures but are discussed here to describe coolant flow paths in the vessel. The jet pump assemblies are located in two semicircular groups in the downcomer annulus between the core shroud and the reactor vessel wall. The design and performance of the jet pump is covered in detail in References 1 and 2. Each stainless steel jet pump consists of driving nozzles, suction inlet, throat or mixing section, and diffuser (see Fig. 3.9B-10). The driving nozzle, suction inlet, and throat are joined together as a removable unit, and the diffuser is permanently installed. High pressure water from the recirculation pumps is supplied to each pair of jet pumps through a riser pipe welded to the recirculation inlet nozzle thermal sleeve. A riser brace ~~consists of cantilever beams welded to a riser pipe and to pads on the reactor vessel wall~~. which provides lateral support for the riser pipe assembly, is welded to the riser pipe and to pads on the reactor vessel wall. The inlet mixer assembly ~~nozzle entry section~~ is connected to the riser by a metal-to-metal, spherical-to-conical seal joint. Firm contact is maintained by a holddown clamp. The ~~throat section~~ inlet mixer is supported laterally by a bracket attached to the riser. There is a slip-fit joint between the throat and diffuser. The diffuser is a gradual conical section changing to a straight cylindrical section at the lower end.

7 Gulf State Utilities has reduced the preload on the beams from 30 to 25 kips in accordance with General Electric recommendations. This increases the expected life of these beams without cracking from 19 to 40 years. Inservice

The driving nozzles, suction inlet, and throat comprise the inlet mixer assembly which is removable as a unit. The diffuser is welded to the shroud support ledge.

again as it enters the center of the semicircular sparger, which is routed halfway around the inside of the top guide cylinder. The two spargers are supported by brackets designed to accommodate thermal expansion. The line routing and supports are designed to accommodate differential movement between the top guide and vessel. The other core spray line is identical except that it enters the opposite side of the vessel and the spargers are at a slightly different elevation inside the top guide cylinder. The correct spray distribution pattern is provided by a combination of distribution nozzles pointed radially inward and downward from the spargers. (See Section 6.3, Emergency Core Cooling System.)

3.9.5.1.1.12B Vent and ~~Vessel~~ Head Spray Nozzle

This component is not a core support structure. It is included here to describe a safety class feature in the reactor pressure vessel. When reactor coolant is returned to the reactor vessel, part of the flow can be diverted to a spray nozzle in the reactor head. This spray maintains saturated conditions in the reactor vessel head volume by condensing steam being generated by the hot reactor vessel walls and internals. The spray also decreases thermal stratification in the reactor vessel coolant. This ensures that the water level in the reactor vessel can rise. The higher water level provides conduction cooling to more of the mass of metal of the reactor vessel and, therefore, helps to maintain the cooldown rate. The vessel head spray nozzle is mounted to a short length of pipe and a flange, which is bolted to a mating flange on the reactor vessel head nozzle. (See Section 5.4.7, Residual Heat Removal System.) The vent and head spray assembly is bolted to a mating flange on the reactor vessel head nozzel. External piping is connected to the assembly by means of standard flanges.

3.9.5.1.1.13B Differential Pressure and Liquid Control Line

This component is not a core support structure or safety class component. It is discussed here to describe the coolant paths in the reactor vessel. The differential pressure and liquid control lines enter the vessel through two bottom head penetrations and serves a dual function within the reactor vessel - to sense the differential pressure across the core support plate (described in Section 5.4, Component and Subsystem Design) and to provide a path for the injection of the liquid control solution into the coolant stream. One line terminates near the lower shroud with a perforated length below the core support plate. It is used to sense the pressure below the core support plate during normal operation and to inject liquid control solution if required. This location facilitates

The vent and head spray assembly performs a dual function of providing a vent for the non-condensable gases in the vessel head, and providing a spray nozzel for the injection of cooling water into the upper areas of the vessel.

3.9B References 1

1. Design and Performance of G.E. BWR Jet Pumps. General Electric Company, Atomic Power Equipment Department, APED-5460, July 1968.

2. Moen, H.H. Testing of Improved Jet Pumps for the BWR/6 Nuclear System. General Electric Company, Atomic Power Equipment Department, NEDO-10602, June 1972.

3. Analytical Model for Loss-of-Coolant Analysis in Accordance with 10CFR50, Appendix K. Proprietary Document, General Electric Company, NEDE-20566.

4. BWR Fuel Channel Mechanical Design and Deflection. NEDE-21354-P, September 1976.

5. BWR/6 Fuel Assembly Evaluation of Combined Safe Shutdown Earthquake (SSE) and Loss-of-Coolant Accident (LOCA) Loadings. NEDE-21175-P, November 1976. and NEDE-21175-3-P, July 1982.

6. Boiling Water Reactor Feedwater Nozzle/Sparger Final Report, NEDO-21821, March, 1978. 7

7. PISYS Analysis of NRC Problem, NEDO-24210, August 1979.

TABLE 3.9B-1

PLANT EVENTS

Normal, Upset, and Testing Conditions	No. of Cycles	
1. Bolt up(1)	123	
2. Design hydrostatic test	40	
a. Leak checks at 400 psig prior to power operation, 3 cycles/startup		
3. Startup (100°F/hr heatup rate)(2)	~~117~~ 120	
4. Daily reduction to 75% power(1)	10,000	
5. Weekly reduction 50% power(1)	2,000	
6. Control rod pattern change(1)	400	
7. Loss of feedwater heaters (80 cycles total)	80	
8. 50% safe shutdown earthquake event at rated operating conditions	10/50(4)	7
9. Scram:		
a. Turbine generator trip, feedwater on, isolation valves stay open	40	
b. Other scrams	140	
c. Loss of feedwater pumps, isolation valves closed	10	
d. Turbine bypass, single safety or relief valve blowdown	8	
10. Reduction to 0% power, hot standby, shutdown (100°F/hr cooldown rate)(2)	111	
11. Unbolt	123	

TABLE 3.9B-2 INDEX

LOADING COMBINATIONS, STRESS LIMITS, AND ALLOWABLE STRESSES

a. Reactor Pressure Vessel and Shroud Support Assembly

b. Reactor Vessel Internals and Associated Equipment

c. Reactor Water Cleanup Heat Exchangers

d. Main Steam Piping (Class 1)

e. Recirculation Piping System

f. Recirculation Flow Control Valve

g. Main Steam Safety/Relief Valves

h. Main Steam Isolation Valves

i. Recirculation Pump

j. Reactor Recirculation System Gate Valves

k. Safety/Relief Valve Discharge Piping (To First Anchor)

l. Standby Liquid Control Pump

m. Standby Liquid Control Tank

n. ECCS pumps

o. Residual Heat Removal Heat Exchanger

p. Reactor Water Cleanup System Pump

q. RCIC Turbine

r. RCIC Pump

s. New Fuel and Containment Fuel Storage Racks and Refueling Equipment

t. Control Rod Drive

u. Control Rod Drive Housing

v. Jet Pumps

w. LPCI Coupling

RBS FSAR TABLE 3.9B-2 INDEX (cont'd.)

x. Control Rod Guide Tube

y. Incore Housing

z. Reactor Vessel Support Equipment (CRD Housing Support)

aa. Fuel Assembly (Including Channel)

TABLE 3.9B-2

INTRODUCTION

Table 3.9B-2 provides the design loading combinations and acceptance criteria for all NSSS ASME Code Class equipment reported in Tables 3.9B-2a through 3.9B-2z. These tables list the major safety-related mechanical components in the plant on a component-by-component basis. For each component, the loading conditions, stress criteria, calculated stresses, and the allowable stresses are also summarized. The format in these tables is not consistent since the analytical method and depth of detail, necessary to demonstrate the safety aspects of various components, differ. References throughout Section 3.9B to Table 3.9B-2 should be construed to include Tables 3.9B-2a through 3.9B-2z unless an individual table is specified. 2

TABLE 3.9B-2

DESIGN LOADING COMBINATIONS AND ACCEPTANCE CRITERIA FOR NSSS-SUPPLIED ASME CODE CLASS 1, 2, and 3 PIPING AND COMPONENTS

Load Case	N	SRV_X(1)	SRV_{ADS}	OBE	SSE	SBA/IBA(2)	DBA	ASME Code Service Limits
1	X	X						B
2	X	X		X				B
3	X	X			X			D(3)
4	X		X			X (SBA only)		C(3)
5	X		X	X		X		D(3)
6	X		X		X	X		D(3)
7	X				X		X	D(3)
8	X							A
9	X			X				B

NOTES:
1. SRV_{ALL} or SRV_1 - whichever is controlling is used.
2. SBA or IBA, whichever is greater, except Case 4.
3. All ASME Code Class 1, 2, and 3 piping systems that are required to function for safe shutdown under the postulated events are designed to meet the requirements of the NRC memorandum, Evaluation of Topical Report-Piping Functional Capability Criteria, dated July 17, 1980.

KEY TO LOAD DEFINITIONS:

N = Normal load consists of pressure, dead weight, and thermal loads.
OBE = Operating basis earthquake loads.
SSE = Loads due to vibratory motion from safe shutdown earthquake loads.
SRV_1 = SRV discharge induced loads from one valve's subsequent actuation.
SRV = The loads induced by actuation of all SRVs which activate within milliseconds of each other during the postulated small or intermediate-size pipe rupture.
SRV_{ALL}= The loads induced by the actuation of SRVs associated with the automatic depressurization system which actuate within milliseconds of each other during the postulated small or intermediate-size pipe rupture.
DBA_{ADS}= Design basis accident is the sudden break of the main steam or recirculation lines (largest postulated breaks). DBA-related loads include main vent clearing and pool swell, chugging, condensation oscillation, and annulus pressurization.
SBA = Small break accident.
IBA = Intermediate break accident.

TABLE 3.9B-2a

REACTOR PRESSURE VESSEL AND SHROUD SUPPORT ASSEMBLY

(i) VESSEL SUPPORT SKIRT

ASME B&PV CODE SEC. III PRIMARY STRESS LIMIT CRITERIA	LOADING	PRIMARY STRESS TYPE	ALLOWABLE STRESS (psi)	MAXIMUM CALCULATED STRESS (psi)
MATERIAL: 5A-533, Gr. B., Class 1				
A. NORMAL & UPSET CONDITION:				
$P_m \le S_m$ S_m = 26,700 psi @ 575°F	Normal & Upset Condition Loads: 1. Normal Loads	PRIMARY MEMBRANE	26,700	<18,680
$P_L + P_b \le 1.5\ S_m$ S_m = 26,700 psi @ 575°F	2. Pressure 3. OBE 4. SRV	PRIMARY MEMBRANE PLUS BENDING	40,050	<39,920
B. EMERGENCY CONDITION:				
$P_m \le S_y$ S_y = 42,800 psi @ 528°F	Emergency Condition Loads: 1. Normal Loads	PRIMARY MEMBRANE	42,800	<25,200
$P_L + P_b \le 1.5\ S_y$ S_y = 42,800 @ 528°F (See Note 1)	2. Pressure 3. SRV (ADS) 4. Chugging	PRIMARY MEMBRANE PLUS BENDING	64,300	<53,280
C. FAULTED CONDITION:				
$P_m \le S_y$ (2) S_y = 42,800 psi @ 528°F	Faulted Condition Loads: 1. Normal Loads	PRIMARY MEMBRANE	42,800(2)	<25,200
$P_L + P_b \le 1.5\ S_y$ (3) S_y = 42,800 @ 528°F (See Note 1)	2. Pressure 3. Jet Reaction 4. Scram 5. SSE	PRIMARY MEMBRANE PLUS BENDING	64,300(2)	<53,280

D. MAXIMUM CUMULATIVE USAGE FACTOR: 0.4905 AT RPV Bottom Head

NOTES:
1. Value of S_m or S_y is shown depending upon the controlling criteria (e.g., 1.8 S_m or 1.5 S_y for B)
2. Using emergency allowables for conservatism.

TABLE 3.9B-2a (cont'd.)
REACTOR PRESSURE VESSEL AND SHROUD SUPPORT ASSEMBLY
(ii) SHROUD SUPPORT

ASME B&PV CODE SEC. III PRIMARY STRESS LIMIT CRITERIA	LOADING	PRIMARY STRESS TYPE	ALLOWABLE STRESS (psi)	MAXIMUM CALCULATED STRESS (psi)
MATERIAL: SB-168 Inconel				
A. NORMAL & UPSET CONDITION:				
$P_m \le 0.9\ S_m$ $S_m = 23{,}300$ psi @ 575°F	Normal & Upset Condition Loads: 1. Normal Loads	PRIMARY MEMBRANE	20,970	<15,500
$P_L + P_b \le (1.5)\ (0.9)\ S_m$ $S_m = 23{,}300$ psi @ 575°F	2. Pressure 3. OBE 4. SRV	PRIMARY MEMBRANE PLUS BENDING	31,450	<16,800
B. EMERGENCY CONDITION:				
$P_m \le 0.9\ S_m$ $S_m = 23{,}300$ psi @ 575°F	Emergency Condition Loads: 1. Normal Loads	PRIMARY MEMBRANE	20,970 (2)	<15,500
$P_L + P_b \le (1.5)(0.9)\ S_m$ $S_m = 23{,}300$ @ 575°F (See Note 1)	2. Pressure 3. SRV (ADS) 4. Chugging	PRIMARY MEMBRANE PLUS BENDING	31,450 (2)	<16,800
C. FAULTED CONDITION:				
$P_m \le (0.7)(0.9) S_y$ $S_y = 74{,}000$ psi @ 575°F	Faulted Condition Loads: 1. Normal Loads	PRIMARY MEMBRANE	46,600	30,400
$P_L + P_b \le (1.5)(0.9) S_y$ $S_y = 74{,}000$ psi @ 575°F (See Note 1)	2. Pressure 3. Jet Reaction 4. Vent Clearing 5. SSE	PRIMARY MEMBRANE PLUS BENDING	69,900	47,100

D. MAXIMUM CUMULATIVE USAGE FACTOR: 0.406 AT Top surface of shroud support plate

NOTES: 1. Value of S_m or S_y is shown depending upon the controlling criteria (e.g., 1.8 S_m or 1.5 S_y for B)

2. Using emergency allowables for conservatism

TABLE 3.9B-2a (cont'd.)
REACTOR PRESSURE VESSEL AND SHROUD SUPPORT ASSEMBLY
(iii) RPV FEEDWATER NOZZLE

ASME B&PV CODE SEC. III PRIMARY STRESS LIMIT CRITERIA	LOADING	PRIMARY STRESS TYPE	ALLOWABLE STRESS (psi)	MAXIMUM CALCULATED STRESS (psi)
MATERIAL: SA 508 Cl.1 Safe End				
A. NORMAL & UPSET CONDITION:				
$P_m \le 17,700$ S_m = 17,700 psi @ 575°F	Normal & Upset Condition Loads: 1. Normal Loads	PRIMARY MEMBRANE	17,700	16,220
$P_L + P_b \le 1.5 S_m$ S_m = 17,700 psi @ 575°F	2. Pressure 3. OBE 4. SRV	PRIMARY MEMBRANE PLUS BENDING	26,550	22,930
B. EMERGENCY CONDITION:				
$P_m \le S_y$ S_y = 25,900 psi @ 594°F	Emergency Condition Loads: 1. Normal Loads	PRIMARY MEMBRANE	25,900	21,420
$P_L + P_b \le 1.5 S_y$ S_y = 25,900 @ 594°F (See Note 1)	2. Pressure (upset) 3. Chugging 4. SRV	PRIMARY MEMBRANE PLUS BENDING	38,900	22,400
C. FAULTED CONDITION:				
$P_m \le 2.4 S_m$ S_m = 17,700 psi @ 575°F	Faulted Condition Loads: 1. Normal Loads	PRIMARY MEMBRANE	42,480	23,210
$P_L + P_b \le 1.5 S_y$ S_y = 25,900 @ 594°F (See Note 1)	2. Pressure (accident) 3. Chugging 4. SRV 5. SSE	PRIMARY MEMBRANE PLUS BENDING	38,900	33,740
D. MAXIMUM CUMULATIVE USAGE FACTOR:	0.950	AT	Safe End	

NOTES: 1. Value of S_m or S_y is shown depending upon the controlling criteria (e.g., 1.8 S_m or 1.5 S_y for B)

TABLE 3.9B-2a (cont'd.)
REACTOR PRESSURE VESSEL AND SHROUD SUPPORT ASSEMBLY
(iv) CRD PENETRATION

ASME B&PV CODE SEC. III PRIMARY STRESS LIMIT CRITERIA	LOADING	PRIMARY STRESS TYPE	ALLOWABLE STRESS (psi)	MAXIMUM CALCULATED STRESS (psi)
MATERIAL: SB-167 Inconel				
A. NORMAL & UPSET CONDITION:				
$P_m \le S_m$	Normal & Upset Condition Loads:	PRIMARY MEMBRANE	20,000	<8,490
S_m = 20,000 psi @ 575°F	1. Normal Loads			
$P_L + P_b \le 1.5\ S_m$	2. Pressure 3. OBE 4. SRV	PRIMARY MEMBRANE PLUS BENDING	30,000	<15,200
S_m = 20,000 psi @ 575°F				
B. EMERGENCY CONDITION:				
$P_m \le S_y$	Emergency Condition Loads:	PRIMARY MEMBRANE	24,100	<10,750
S_y = 24,100 psi @ 575°F	1. Normal Loads			
$P_L + P_b \le 1.5\ S_y$	2. Pressure (upset) 3. Chugging 4. SRV (ADS)	PRIMARY MEMBRANE PLUS BENDING	36,150	<20,100
S_y = 24,100 @ 575°F (See Note 1)				
C. FAULTED CONDITION:				
$P_m \le 2.4\ S_m$	Faulted Condition Loads:	PRIMARY MEMBRANE	48,000	<10,750
S_m = 20,000 psi @ 575°F	1. Normal Loads			
$P_L + P_b \le 3.6\ S_m$	2. Pressure (accident) 3. Jet Reaction 4. Scram 5. SSE	PRIMARY MEMBRANE PLUS BENDING	72,000	<20,100
S_m = 20,000 @ 575°F (See Note 1)				

D. MAXIMUM CUMULATIVE USAGE FACTOR: 0.485 AT on O.D. below weld

NOTES: 1. Value of S_m or S_y is shown depending upon the controlling criteria (e.g., 1.8 S_m or 1.5 S_y for B)

TABLE 3.9B-2b
REACTOR INTERNALS & ASSOCIATED EQUIPMENT
(i) GRID - HIGHEST STRESSED BEAM

ASME B&PV CODE SEC. III PRIMARY STRESS LIMIT CRITERIA	LOADING	PRIMARY STRESS TYPE	ALLOWABLE STRESS (psi)	MAXIMUM CALCULATED STRESS (psi)
MATERIAL: 304L				
A. NORMAL & UPSET CONDITION:				
$P_m \le S_m$	Normal & Upset	PRIMARY MEMBRANE	14,300	5,547
	Condition Loads:			
S_m = 14,300 psi @ 550^{o}F	1. Normal Loads			
	2. Upset pressure	PRIMARY MEMBRANE PLUS BENDING	21,450	16,244
$P_L + P_b \le 1.5\ S_m$	3. OBE			
	4. SRV			
S_m = 14,300 psi @ 550^{o}F				
B. EMERGENCY CONDITION:				
$P_m \le 1.5\ S_m$	Emergency	PRIMARY MEMBRANE	21,450	< 5,547
	Condition Loads:			
S_m = 14,300 psi @ 550^{o}F	1. Normal Loads			
	2. Upset Pressure	PRIMARY MEMBRANE PLUS BENDING	32,175	<16,244
$P_L + P_b \le 2.25\ S_m$	3. Chugging			
	4. SRV (ADS)			
S_m = 14,300 @ 550^{o}F (See Note 1)				
C. FAULTED CONDITION:				
$P_m \le 2.4\ S_m$	Faulted	PRIMARY MEMBRANE	34,320	16,571
	Condition Loads:			
S_m = 14,300 psi @ 550^{o}F	1. Normal Loads			
	2. Accident Pressure	PRIMARY MEMBRANE PLUS BENDING	51,480	51,012
$P_L + P_b \le 3.6\ S_m$	3. Chugging			
	4. SSE			
S_m = 14,300 @ 550^{o}F (See Note 1)	5. SRV (ADS)			
D. MAXIMUM CUMULATIVE USAGE FACTOR:	0.2	AT	Shroud flange	

NOTES: 1. Value of S_m or S_y is shown depending upon the controlling criteria (e.g., 1.8 S_m or 1.5 S_y for B)

TABLE 3.9B-2b (cont'd.)
REACTOR INTERNALS & ASSOCIATED EQUIPMENT
(ii) CORE PLATE (LIGAMENT IN TOP PLATE)

ASME B&PV CODE SEC. III PRIMARY STRESS LIMIT CRITERIA	LOADING	PRIMARY STRESS TYPE	ALLOWABLE STRESS (psi)	MAXIMUM CALCULATED STRESS (psi)
MATERIAL: 304L				
A. NORMAL & UPSET CONDITION:				
$P_m \le S_m$	Normal & Upset	PRIMARY MEMBRANE	14,300	7,816
	Condition Loads:			
S_m = 14,300 psi @ 550°F	1. Normal Loads			
	2. Upset pressure	PRIMARY MEMBRANE	21,450	15,950
$P_L + P_b \le 1.5\ S_m$	3. OBE	PLUS BENDING		
	4. SRV			
S_m = 14,300 psi @ 550°F				
B. EMERGENCY CONDITION:				
$P_m \le 1.5\ S_m$	Emergency	PRIMARY MEMBRANE	21,450	<7,816
	Condition Loads:			
S_m = 14,300 psi @ 550°F	1. Normal Loads			
	2. Pressure (upset)	PRIMARY MEMBRANE	32,175	< 15,950
$P_L + P_b \le 2.25\ S_m$	3. Chugging	PLUS BENDING		
	4. SRV (ADS)			
S_m = 14,300 @ 550°F (See Note 1)				
C. FAULTED CONDITION:				
$P_m \le 2.4\ S_m$	Faulted	PRIMARY MEMBRANE	34,320	29,611
	Condition Loads:			
S_m = 14,300 psi @ 550°F	1. Normal Loads			
	2. Accident Pressure	PRIMARY MEMBRANE	51,480	41,053
$P_L + P_b \le 3.6\ S_m$	3. Jet Reaction	PLUS BENDING		
	4. Vent Clearing			
S_m = 14,300 @ 550°F (See Note 1)	5. SSE			

D. MAXIMUM CUMULATIVE USAGE FACTOR: 0.5868 AT Stiffener beam

NOTES: 1. Value of S_m or S_y is shown depending upon the controlling criteria (e.g., 1.8 S_m or 1.5 S_y for B)

TABLE 3.9B-2b (cont'd.)
REACTOR INTERNALS & ASSOCIATED EQUIPMENT
(iii) VENT & HEAD SPRAY NOZZLE

ASME B&PV CODE SEC. III PRIMARY STRESS LIMIT CRITERIA	LOADING	PRIMARY STRESS TYPE	ALLOWABLE STRESS (psi)	MAXIMUM CALCULATED STRESS (psi)
MATERIAL: SA-350 LF-2				
A. NORMAL & UPSET CONDITION:				
$P + Q_m \leq 3.0\ S_m$ S_m = 18,100 psi @ 550°F	Normal & Upset Condition Loads: 1. Normal Loads 2. Upset pressure 3. OBE 4. SRV	PRIMARY MEMBRANE PLUS BENDING PLUS SECONDARY MEMBRANE	54,300	49,200
B. EMERGENCY CONDITION:				
$P_L + P_b \leq 1.8\ S_m$ S_m = 18,100 @ 550°F (See Note 1)	Emergency Condition Loads: 1. Normal Loads 2. Upset Pressure 3. Chugging 4. SRV	PRIMARY MEMBRANE PLUS BENDING	32,600	26,900
C. FAULTED CONDITION:				
$P_L + P_b \leq 1.5\ (.7\ S_u)$ S_u = 70,000 @ 550°F (See Note 1)	Faulted Condition Loads: 1. Normal Loads 2. Pressure (accident) 3. Annulus pressurization 4. SSE 5. Jet reaction	PRIMARY MEMBRANE PLUS BENDING	73,500	42,400

NOTES: 1. Value of S_m or S_y is shown depending upon the controlling criteria (e.g., 1.8 S_m or 1.5 S_y for B)

TABLE 3.9B-2d

ASME CODE CLASS 1 MAIN STEAM PIPING AND PIPE MOUNTED EQUIPMENT - HIGHEST STRESS SUMMARY

PIPING STRESS

Acceptance Criteria	Limiting Stress Type	Calculated Stress(1) or Usage Factor	Allowable Limits	Ratio Actual/ Allowable	Loading	Identification of Locations of Highest Stress Points - NODG Point Numbers
ASME B&PV Code Section III, NB-3600						
Design Condition: Eq. 9 ≤ 1.5 S_m	Primary	11,428	26,550	0.43	1. Pressure 2. Weight 3. OBE	Main Steam Line D Guide 101
Service Levels A & B (Normal & Upset) Condition: EQ. 12 ≤ 3.0 S_m	Secondary	42,134	53,100	0.79		Main Steam Line A Elbow (Nozzle)
Service Levels A & B (Normal & Upset) Condition: Eq. 13 ≤ 3.0 S_m	Primary Plus Secondary (Except Thermal Expansion)	32,374	54,600	0.59		Main Steam Line C SRV Sweepolet (First)
Service Levels A & B (Normal and Upset) Conditions: Cumulative Usage Factor	N.A.	0.06	1.0	0.06		Flow element

TABLE 3.9B-2d (cont'd.)

ASME CODE CLASS 1 MAIN STEAM PIPING AND PIPE MOUNTED EQUIPMENT - HIGHEST STRESS SUMMARY

PIPING STRESS

Acceptance Criteria	Limiting Stress Type	Calculated Stress[(1)] or Usage Factor	Allowable Limits	Ratio Actual/ Allowable	Loading	Identification of Locations of Highest Stress Points - NODG Point Numbers
Service Level B (Upset) Condition: Eq. 9 ≤ 1.8 S_m & 1.5 S_y	Primary	14,924	31,860	0.47	1. Pressure 2. Weight 3. OBE 4. SRV	Main Steam Line C Guide G101
Service Level C (Emergency Condition: Eq. 9 ≤ 2.25 S_m & 1.8 S_y	Primary	16,560	40,950	0.40	1. Pressure 2. Weight 3. Chugging 4. SRV (ADS)	Main Steam Line C SRV Sweepolet (Fourth)
Service Level D (Faulted) Condition: Eq. 9 ≤ 3.0 S_m	Primary	18,799	54,600	0.34	1. Pressure 2. Weight 3. SSE 4. Annulus Pressurization	Main Steam Line D SRV Sweepolet (Third)

TABLE 3.9B-2d (Continued)

ASME CODE CLASS 1 MAIN STEAM PIPING AND PIPE MOUNTED EQUIPMENT - HIGHEST STRESS SUMMARY

EQUIPMENT LOADING

Component/ Load Type	Highest Calculated Load	Allowable Load	Ratio Calculated/ Allowable	Loading	Identification of Equipment with Highest Loads
Service Level A & B	22,353 psi	120,000 psi	0.186	1. Pressure 2. Weight 3. OBE 4. SRV	Main Steam Line C Snubber S106
Service Level C & D	50,564 psi	180,000 psi	0.281	1. Pressure 2. Weight 3. Annulus Pressurization 4. SSE	Main Steam Line C Snubber S106
Bonnet/Moment	514,611in-lbs	1,469,900in-lbs	0.3501	1. Pressure 2. Weight 3. Thermal Expansion 4. Annulus Pressurization 5. SSE	Main Steam Line A MSIV
Flange/Moment	427,536in-lbs	1,699,950in-lbs	0.2515	1. Pressure 2. Weight 3. Thermal Expansion 4. Annulus Pressurization 5. SSE	Main Steam Line C SRV inlet

TABLE 3.9B-2d (Continued)

ASME CODE CLASS 1 MAIN STEAM PIPING AND PIPE MOUNTED EQUIPMENT - HIGHEST STRESS SUMMARY

SRV ACCELERATION

Component/ Load Type	Highest Calculated Load	Allowable Load	Ratio Calculated/ Allowable	Loading	Identification of Equipment with Highest Loads
Horizontal Acceleration	4.197g	9.0g	0.4664	1. Pressure 2. Weight 3. SSE 4. Chugging 5. SRV	Main Steam Line A SRV
Vertical Acceleration	2.351	10.0g	0.2351	1. Pressure 2. Weight 3. Annulus Pressurization 4. SSE	Main Steam Line A SRV

Notes: 1. Appropriate loading combinations of Table 3.9B-2 were considered and the calculated stresses are reported for the governing loading combinations.

TABLE 3.9B-2e
ASME CODE CLASS 1 MAIN STEAM PIPING AND PIPE MOUNTED EQUIPMENT - HIGHEST STRESS SUMMARY
PIPING STRESS

Acceptance Criteria	Limiting Stress Type	Calculated Stress[1] or Usage Factor	Allowable Limits	Ratio Actual/ Allowable	Loading	Identification of Locations of Highest Stress Points - NODE Point Numbers
ASME B&PV Code Section III, NB-3600						
Design Condition:						
Eq. 9 $\leq 1.5\ S_m$	Primary	13,000 psi	25,875 psi	0.502	1. Pressure 2. Weight 3. OBE	(Suction Line) Hanger Lugs Loop B
Service Levels A & B (Normal & Upset) Condition:						
Eq. 12 $\leq 3.0\ S_m$	Secondary	21,152 psi	51,750 psi	0.409		(Suction Line) Elbow Loop B
Service Levels A & B (Normal & Upset) Condition: Eq. 13 $\leq 3.0\ S_m$	Primary Plus Secondary (Except Thermal Expansion)	35,187 psi	51,750 psi	0.68		Pump Outlet Loop B
Service Levels A & B (Normal and Upset) Condition:						
Cumulative Usage Factor	N.A.	0.013	1.0	0.013		RHR Tee Loop B
Service Level B (Upset) Condition:					1. Pressure 2. Weight 3. OBE 4. SRV	(Suction Line) Hanger Lugs
Eq. 9 $\leq 1.8\ S_m$ & $1.5\ S_y$	Primary	14,009 psi	29,400 psi	0.476		

TABLE 3.9B-2e (cont'd.)

ASME CODE CLASS 1 MAIN STEAM PIPING AND PIPE MOUNTED EQUIPMENT - HIGHEST STRESS SUMMARY

PIPING STRESS

Acceptance Criteria	Limiting Stress Type	Calculated Stress(1) or Usage Factor	Allowable Limits	Ratio Actual/ Allowable	Loading	Identification of Locations of Highest Stress Points - NODE Point Numbers
Service Level C (Emergency) Condition:						
Eq. 9 $\leq 2.25\ S_m$ & $1.8\ S_y$	Primary	14,533 psi	35,280 psi	0.412	1. Pressure 2. Weight 3. SRV	(Suction Line) Hanger lugs Loop B
Service Level D (Faulted) Condition:						
Eq. 9 $\leq 3.0\ S_m$	Primary	14,421 psi	39,200 psi	0.368	1. Pressure 2. Weight 3. SSE 4. Annulus Pressurization	(Suction Line) Hanger Lugs Loop B

TABLE 3.9B-2e (Continued)

ASME CODE CLASS 1 MAIN STEAM PIPING AND PIPE MOUNTED EQUIPMENT - HIGHEST STRESS SUMMARY
EQUIPMENT LOADING

Component/ Load Type	Highest Calculated Load	Allowable Load	Ratio Calculated/ Allowable	Loading	Identification of Equipment with Highest Loads
Service Level A & B	14,091 psi	50,000 psi	0.282	1. Pressure 2. Weight 3. OBE 4. SRV	Recirc. Loop B Snubber - S363 (Discharge Line)
Service Level C & D	16,179 psi	74,900 psi	0.216	1. Pressure 2. Weight 3. Annulus Pressurization 4. SSE	Recirc. Loop B Snubber - S370 (Recirc. Pump)
Flange Moment	192,984in-lbs	1,925,000in-lbs	0.100	1. Pressure 2. Weight 3. Thermal Expansion 4. Annulus Pressurization 5. SSE	Recirc. Loop B Suction Gate Valve

TABLE 3.9B-2e (Continued)

ASME CODE CLASS 1 MAIN STEAM PIPING AND PIPE MOUNTED EQUIPMENT - HIGHEST STRESS SUMMARY

RECIRCULATION PUMP & MOTOR ACCELERATION

Component/ Load Type	Highest Calculated Load	Allowable Load	Ratio Calculated/ Allowable	Loading	Identification of Equipment with Highest Loads
Horizontal Acceleration	0.75g	4.5g	0.167	1. Pressure 2. Weight 3. SSE 4. Annulus Pressurization	Recirc. Loop B Recirc. Pump Motor CG
Vertical Acceleration	0.59g	3.0g	0.197	1. Pressure 2. Weight 3. SSE 4. Annulus Pressurization	Recirc. Loop B Recirc. Pump CG

Notes: 1. Appropriate loading combinations of Table 3.9B-2 were considered and the calculated stresses are reported for the governing loading combinations.

TABLE 3.9B-2f

RECIRCULATION FLOW CONTROL VALVE 20" SIZE (H.D.)

CODE: ASME SECTION III 1974 EDITION WITH S76 ADDENDA

Par No.	Component - Stress	Design Procedures	Allowable Limit	Calculated Or Actual Value	Ratio Calc/Allowed
1.0	Body, Bonnet, Cartridge, Covers				
1.1	Loads - Design Pressure	System Requirements		1675 psi	
	Loads - Design Temperature	System Requirements		575°F	
1.2	Body Pressure Rating	ASME Sec III, NB3545.1-2		984 psi	
1.3	Body Min. Wall Thickness	NB3541	$t_m \geq$ ~~2.234~~ 2.213 in.	t_m = 2.375 in	~~1.064~~ 1.073
1.4	Max. Primary Body Membrane Stress	NB3545.1	$P_m \leq 3\ S_m$(575°F) ≤17,380 psi	P_m = 8,860 psi	0.509
1.5	Max. Primary Plus Secondary Body Stress	NB3545.2	$S_n \leq 3\ S_m$ ≤52,140 psi	S_m = 21,340 psi	0.409
1.6	Bonnet Min. Wall Thickness	NB3541	t_m = 1.025 in	t_m = 3.50 in	3.41
1.7	Max. Bonnet Primary Stress	NB3545.1	$P_m \leq S_m$(575°F) ≤17,380 psi	P_m = 5,730 psi	0.329
1.8	Max. Primary Plus Secondary Bonnet Stress	NB3545.2	$S_m \leq 3S_m$ (575°F) ≤52,140 psi	S_n = 16,970 psi	0.325
1.9	Cyclic Requirements	NB3545.3	N_a>2000 cyc.	N_a = 10^6 cycl.	
1.10	Fatigue Analysis Usage Factor	NB3550	$I_t \leq 1.0$	I_t = .0018	
1.11	Body to Bonnet Flange Max. Stress	NB3647.1	S_m = 26,070 psi (1.5 x 17,380)	S_m = 19,260 psi	0.738
1.12	Body to Bonnet Studs - Area	NB3647.1	$A_b \geq 51.05$ in^2	A_b = 71.04 in^2	1.39
	Body to Bonnet Studs Primary Stud Stress		S_m = 27,000 psi	S_b = 19,380 psi	0.71
	Body to Bonnet Studs Maximum Stud Stress		$3S_m$ = 81,000 psi	S_b = 19,590 psi^2	0.24
1.13	Top Bonnet Cover - Thickness	NB3646 & Sec VIII-UG-34	$t_m \geq 4.28$ in	t_m = 4.75 in	1.109

TABLE 3.9B-2f (Cont)

Par No.	Component - Stress	Design Procedures	Allowable Limit	Calculated or Actual Value	Ratio Calc/Allowed
1.14	Top Bonnet Cover Studs - Area	NB3647.1	$A_b \geq 30.97$ in^2	$A_b = 32.82$ in^2	1.059
	Top Bonnet Primary Stud Stress		$S_m = 27{,}000$ psi	$S_b = 25{,}500$ psi	0.944
	Top Bonnet Maximum Stud Stress		$3S_m = 81{,}000$ psi	$S_b = 30{,}270$ psi	0.373
1.15	Bottom Cover Thickness	NB3646 & Sec VIII, UG-34	$t_m \geq 2.88$ in	$t_m = 4.00$ in	1.388
1.16	Bottom Cover Primary Stud Stress	NB3647.1	$S_m = 27{,}000$ psi	$S_b = 18{,}250$ psi	0.675
	Bottom Cover Maximum Stud Stress		$3S_m = 81{,}000$ psi	$S_b = 23{,}600$ psi	0.291
	Bottom Cover Studs Area		$A_b \geq 12.08$ in^2	$A_b = 17.90$ in^2	1.48
1.17	Actuator Cartridge - Thickness	NB3646 & Sec VIII UG-34	$t_m \geq 2.40$ in	$t_m =$ ~~4.00~~ 3.25 in	~~1.666~~ 1.354
1.18	Actuator Cartridge Studs - Area	NB3647.1	$A_b \geq 6.96$ in^2	$A_b = 17.9$ in^2	2.57
	Actuator Cartridge Primary Stud Stress		$S_m = 27{,}000$ psi	$S_b = 10{,}502$ psi	0.388
	Actuator Cartridge Maximum Stud Stress		$3S_m = 81{,}000$ psi	$S_b = 17{,}460$ psi	0.215

TABLE 3.9B-2h

MAIN STEAM ISOLATION VALVE DESIGN OF PRESSURE RETAINING PARTS-
ASME CODE SECTION III 1974 EDITION

Item Number	Component/Load Type/ Stress Type	Design Procedure	Allowable Value	Design/Calculated Value	Ratio [Calculated] / [Allowable]
1.0	Body and Bonnet				
1.1	Loads:				
	Design Pressure	GE System Specification	1,375 psi	1,375 psi	N/A
	Design Temperature	GE System Specification	586°F	586°F	N/A
	Pipe Reaction Loads				
1.2	Pressure Rating	Table NB 3542.1-2	P_R= 575 psi	P_R= 575 psi	N/A
1.3	Minimum Wall Thickness	Paragraph NB 3542	$t_m \geq$ 1.875 in (Actual)	t_m= 1.643 in	N/A
1.4	Primary Membrane Stress	Paragraph NB-3545.1 (500°F)	P_m= 19,400 psi	P_m = 11,317 psi	0.58
1.5	Secondary Stress Due To Pipe Reaction	Paragraph NB-3545.2 (b) (1)	P_{ed}, P_{eb}, and P_{et}	P_{ed} 6,281 psi	0.22
			≤1.55m (500°F)	P_{eb}=12,851 psi	0.44
			1.5 S_m= 29,100	P_{et}=12,121 psi	0.42
1.6	Primary Plus Secondary Stress Due to Internal Pressure	Paragraph NB-3545.2 (a) (1)		Q_p= 32,238 psi	
1.7	Thermal Secondary	Paragraph NB-3545.2(c)		Q_T= 1,347 psi	
1.8	Range of Primary Plus Secondary Stress at Crotch Region	Paragraph NB-3545.2	S_m= 58,200 psi	S_n= 39,213 psi	0.67
1.9	Body Shape Rule	Paragraph NB-3554			
	-Radius at Crotch	Paragraph NB-3554.1(a)	$r_2 \geq$0.563 in	r_2= 0.937 in	
	-Corner Radius	Paragraph NB-3554.1(b)	$r_4 \leq$0.937 in	r_4= 0.875 in	
	-Longitudinal Curvature	Paragraph NB-3544.6	>0.061 1/in	= 0.1251 in	
	-No Flat Walls	Paragraph NB-3544.7			
	-Minimum Wall at Weld Ends	Paragraph NB-3544.8	>1.587 in	= 1.444 in	

NEW LOAD STRESSES ARE LOWER THAN DESIGN STRESSES.

TABLE 3.9B-2i

RECIRCULATION PUMP CASE SUMMARY OF LOAD CLASSIFICATION HIGH STRESS LOCATIONS AND LIMIT CRITERIA

Loading Condition ASME Sec. III	Load Combination		Criteria (ASME Sec. III) NB-3220	Location	Highest Calc. Stress/ Usage Fact.	Allowable	Ratio Act./ All.
	Pressure	Mechanical Loads					
Design (NB-3112)	Design Pressure (1650 psig)	Pump Thrust Deadweight Nozzle Loads Gasket Seating Load	Fig. NB-3221-1 $P_m \le 1.0\ S_m$ $P_L + P_b \le 1.5\ S_m$	Suction Transition	27,250 psi/ 0.0008	1.5 S = 28,687 psi	.95
Design (NB-3441.3)	Design Pressure (1650 psig)	Pump Thrust Deadweight Nozzle Loads Gasket Seating Load OBE (conservatively included)	Special Stress Location $P_L + P_b \le 3.0\ S_m$	N/A	N/A psi	3.0 S = N/A psi	N/A
Normal (NB-3113.1) and Upset (NB-3113.2	Most Severe Normal/ Upset Pressure (1,313 psig)	Deadweight Nozzle Loads Thermal - Transient OBE Upset Only	Fig. NB-3222-1 $P_L+P_b+P_e+Q \le 3.0\ S_m$ $P_e \le 3.0\ S_m$ Elastic-Plastic Analysis NB-3228.3(1)	Casing Wall	57,222 psi/ 0.0038	3 S = 57,375 psi	.99
Emergency (NB-3113.3)	Most Severe Emergency Pressure (1,796 psig)	Deadweight Nozzle Loads Pump Thrust Gasket Seating Load	Fig. NB-3224-1 $P_m \le (1.2\ S_m \text{ or } S_y)$ $P_L \le (1.8\ S_m \text{ or } 1.5\ S_y)$ $P_L + P_b \le (1.8\ S_m \text{ or } 1.5\ S_y)$	Suction Nozzle	30404/ 0.002	1.8 S = 34,425 psi	.88
Faulted (NB-3113.4)	Most Severe Faulted Pressure (1,313 psig)	Deadweight Nozzle Loads SSE Pump Thrust Gasket Seating Load	Table F-1322.2-1 $P_m \le 2.4 S_m$ or $\ge 0.7\ S_u$ + $P_L \le 1.5(2.4\ S_m \text{ or } 0.7\ S_u)$ $P_L + P_b \le 1.5(2.4\ S_m \text{ or } 0.75\ S_u)$	Crotch	34,162 psi/ 0.0008	2.4 S = 73,500 psi	.46

NEW LOAD STRESSES ARE LOWER THAN DESIGN STRESSES.

TABLE 3.9B-2j

REACTOR RECIRCULATION SYSTEM GATE VALVE - SUCTION

Paragraph No.	Component/Load/Stress Type	Design Procedure	Allowable Limit	Design/ Calculated Value	Ratio Calculated/ Allowed
1.0	Body and Bonnet				
1.1	Loads: Design Pressure Design Temperature	 System Requirement System Requirement	 1,250 psi 575°F	 1,250 psi 575°F	 N/A N/A
1.2	Pressure Rating, psi	ASME Section III(1), Figure NB-3545.1-2	P_r= 734.96 psi	P_r= 734.96 psi	N/A
1.3	Minimum Wall Thickness, in	ASME Section III(1), Paragraph NB-3542	t_{min}=1.566 in	t_{min}=1.566 in	N/A
1.4	Primary Membrane Stress, psi	ASME Section III(1), Paragraph NB-3545.1	$P_m \leq S_m$(500°F) = 19,600 psi	P_m= 10,695 psi	0.54
1.5	Secondary Stress Due to Pipe Reaction	ASME Section III(1), Paragraph NB-3545.2 (b) (i)	P_e= Greatest Value of P_{ed} P_{eb} and P_{et} ≤ 1.5 S_m(500°F) (1.5) (19,600) = 29,400 psi	P_{ed}= 8,298 psi P_{eb}= 22,059 psi P_{et}= 21,211 psi P_e=P_{eb}= 22,059 psi	0.28 0.75 0.72 0.75
1.6	Primary Plus Secondary Stress Due to Internal Pressure	ASME Section III(1), Paragraph NB-3545.2 (a) (1)	See Paragraph 1.8	Q_P = 21,553 psi	0.36
1.7	Thermal Secondary Stress	ASME Section III(1), Paragraph NB-3545.2(c)	See Paragraph 1.8	Q_T = 3,514 psi	0.059
1.8	Range of Primary Plus Secondary Stress at Crotch Region	ASME Section III(1), Paragraph NB-3545.2	$S_n \leq 3\ S_m$(500°F) =3 (19,600) =58,800 psi	S_n= Q_P+P_e+2Q_T = 32,059	0.54
1.9	Cycle Requirements for Fatigue Analysis	ASME Section III(1), Paragraph NB-3545.3	N_a ≥2,000cycles ~~Cycles~~	N_a= 230,000cycles ~~Cycles~~	N/A
1.10	Usage Factor Requirements For Fatigue Analysis	ASME Section III(1), Paragraph NB-3550	$I_t \leq 1.0$	I_t = 0.0023	N/A

TABLE 3.9B-2j (Cont)

Paragraph No.	Component/Load/Stress Type	Design Procedure	Allowable Limit	Design/ Calculated Value	Ratio Calculated/ Allowed
2.0	Body to Bonnet Bolting				
2.1	Loads: Design Pressure and Temperature, Gasket Loads, Stem Operational Load, Seismic Load (SSE)				
2.2	Bolt Area	ASME Section III(1), Paragraph NB-3647.1	$A_b \geq 23.73$ in² $S_b = 28{,}675$ psi	$A_b = 28.1$ in² $S_b = 28{,}675$ psi	N/A N/A
2.3	Body Flange Stresses	ASME Section III(1), Paragraph NB-3647.1	---	---	---
2.3.1	Operating Condition		$S_h \leq 1.5\ S_m$(575°F) = 28,837 psi $S_r \leq 1.5\ S_m$(575°F) = 28,P37 psi $S_t \leq 1.5\ S_m$(575°F) = 28,837 psi	S_h = 17,368 ~~19,107~~ psi S_r = 19,372 ~~20,654~~ psi S_t = 1,109 ~~1,199~~ psi	0.61 ~~0.66~~ 0.67 ~~0.71~~ 0.04
2.3.2	Gasket Seating Condition	ASME Section III(1), Paragraph NB-3647.1	$S_h \leq 1.5\ S_m$(100°F) = 30,000 psi $S_r \leq 1.5\ S_m$(100°F) = 30,000 psi $S_t \leq 1.5\ S_m$(100°F) = 30,000 psi	S_h = 25,318 psi S_r = 29,385 psi S_t = 1,707 psi	0.84 0.98 0.05
2.4	Bonnet Flange Stresses	ASME Section III(1), Paragraph NB-3647.1	---	---	---
2.4.1	Operating Condition	ASME Section III(1), Paragraph NB-3647.1	$S_h \leq 1.5\ S_m$(575°F) = 28,837 psi $S_r \leq 1.5\ S_m$(575°F) = 28,837 psi $S_t \leq 1.5\ S_m$(575°F) = 28,837 psi	S_h = 17,368 ~~18,844~~ psi S_r = 15,230 ~~16,191~~ psi S_t = 2,004 ~~2,223~~ psi	0.60 ~~0.65~~ 0.53 ~~0.56~~ 0.07

TABLE 3.9B-2j (Cont)

Paragraph No.	Component/Load/Stress Type	Design Procedure	Allowable Limit	Design/ Calculated Value	Ratio Calculated/ Allowed
5.0	<u>Yoke and Yoke Connections</u>				
5.1	Loads: Stem Operational Loads	Calculate Stresses in the Yoke and Yoke Connections to Acceptable Structural Analysis Methods	---	---	---
5.2	Tensile Stress in Yoke Leg Bolts	---	$S_{max} \leq S_m(100°F)$ = ~~35,000~~ 32,960 psi	S_{max} = ~~6,845~~ 3,659 psi	~~0.19~~ 0.12
5.3	Bending Stress of Yoke Legs	---	$S_b \leq 1.5\ S_m(185°F)$ = 33,165 psi	S_b = ~~14,807~~ 3,914 psi	~~0.44~~ 0.12

TABLE 3.9B-2j (Cont)

REACTOR RECIRCULATION SYSTEM GATE VALVE - DISCHARGE

Paragraph No.	Component/Load/Stress Type	Design Procedure	Allowable Limit	Design/ Calculated Value	Ratio Calculated/ Allowed
1.0	Body and Bonnet				
1.1	Loads:				
	Design Pressure	System Requirement	1,650 psi	~~N/A~~ 1650psi	N/A
	Design Temperature	System Requirement	575°F	~~N/A~~ 575°F	N/A
	Pipe Reaction	Not Specified	N/A	~~N/A~~	N/A
	Thermal Effects	Not Specified			
1.2	Pressure Rating, psi	ASME Section III(1) Figure NB-3545.1-2	P_r = 969.68 psi	P_r = psi	N/A
1.3	Mimimum Wall Thickness, in	ASME Section III(1) Paragraph NB-3542	t min. ~~(nominal)~~ = ~~2.0937~~ 2.077 in	t_m = 2.077 ~~m~~in. ~~in~~	N/A
1.4	Primary Membrane Stress, psi	ASME Section III(1) Paragraph NB-3545.1	$P_m \le S$ (500°F) = 19,600 psi	P_m = 11,870 psi	0.60
1.5	Secondary Stress Due to Pipe Reaction	ASME Section III(1), Paragraph NB-3545.2	P_e = Greatest	P_{ed} = 6,861 psi	0.23
			Value of P_{ed} P_{eb} and P_{et} $\le 1.5\ S_m$ (500°F) 1.5 (19,600) = 29,400 psi	P_{eb} = 15,342 psi P_{et} = 15,350 psi $P_e=P_{et}$ = 15,350 psi	0.52 0.52 0.52
1.6	Primary Plus Secondary Stress Due to Internal Pressure	ASME Section III(1), Paragraph NB-3545.2 (a)(1)	$S_n \le 3S_m$ (500°F) = 3 (19,600) = 58,800 psi	Q_p = 22,076 psi	0.37
1.7	Thermal Secondary Stress	ASME Section III(1), Paragraph NB-3545.2 (c)	See Paragraph 1.6	Q_t = 2,895 psi	0.05
1.8	Sum of Primary Plus Secondary Stress	ASME Section III(1), Paragraph NB-3545.2	See Paragraph 1.6	$S_h = Q_p + P_e + 2Q_t$ = 29,727 psi	0.50
1.9	Fatigue Requirements	ASME Section III(1), Paragraph NB-3545.3	$N_a \ge$ 2,000 Cycles	N_a = 10^6 Cycles	N/A

TABLE 3.9B-2j (Cont)

Paragraph No.	Component/Load/Stress Type	Design Procedure	Allowable Limit	Design/ Calculated Value	Ratio Calculated/ Allowed
1.10	Cyclic Rating	ASME Section III⁽¹⁾, Paragraph NB-3550	$I_t \le 1.0$	$I_t = 0.0012$	N/A
2.0	<u>Body to Bonnet Bolting</u>				
2.1	Loads: Design Pressure and Temperature, Gasket Loads, Stem Operational Load, Seismic Load (Design Basis Earthquake)	ASME Section III⁽¹⁾, Paragraph NB-3647.1	---	---	---
2.2	Bolt Area	ASME Section III⁽¹⁾, Paragraph NB-3647.1	$A_b \ge 34.87$ in² $S_b \le 28{,}675$ psi	$A_b = 40.32$ in² $S_b = 28{,}675$ psi	N/A N/A
2.3	<u>Body Flange Stresses</u>	ASME Section III⁽¹⁾, Paragraph NB-3647.1	---	---	---
2.3.1	Operating Conditions	ASME Section III⁽¹⁾, Paragraph NB-3647.1	$S_h \le 1.5\ S_m(575°F) = 28{,}837$ psi $S_r \le 1.5\ S_m(575°F) = 28{,}837$ psi $S_t \le 1.5\ S_m(575°F) = 28{,}837$ psi	S_h = 14,823 ~~16,363~~ psi S_r = 11,126 ~~12,060~~ psi S_t = 1,766 ~~1,897~~ psi	0.51 ~~0.57~~ 0.39 ~~0.42~~ 0.06
2.3.2	Gasket Seating Condition	ASME Section III⁽¹⁾, Paragraph NB-3647.1	$S_h \le 1.5\ S_m(100°F) = 30{,}000$ psi $S_r \le 1.5\ S_m(100°F) = 30{,}000$ psi $S_t \le 1.5\ S_m(100°F) = 30{,}000$ psi	$S_h = 21{,}963$ psi $S_r = 17{,}849$ psi $S_t = 2{,}809$ psi	0.73 0.59 0.09
2.4	<u>Bonnet Flange Stresses</u>				
2.4.1	Operating Condition	ASME Section III⁽¹⁾, Paragraph NB-3647.1	$S_h \le 1.5\ S_m(575°F) = 28{,}837$ psi $S_r \le 1.5\ S_m(575°F) = 28{,}837$ psi $S_t \le 1.5\ S_m(575°F) = 28{,}837$ psi	S_h = 16,412 ~~18,121~~ psi S_r = 10,596 ~~11,413~~ psi S_t = 2,826 ~~3,313~~ psi	0.57 ~~0.63~~ 0.37 ~~0.39~~ 0.10 ~~0.12~~

TABLE 3.9B-2j (Cont)

Paragraph No.	Component/Load/Stress Type	Design Procedure	Allowable Limit	Design/ Calculated Value	Ratio Calculated/ Allowed
5.0	Yoke and Yoke Connections				
5.1	Loads: Stem Operational Load	Calculate Stresses in the Yoke and Yoke Connections to Acceptable Structural Analysis Methods.	---	---	---
5.2	Tensile Stress in Yoke Leg Bolts	---	$S_{max} \le S_m (100°F)$ $= 35,000$ psi	S_{max} = 6,500psi ~~13,721~~ psi	0.20 ~~0.39~~
5.3	Bending Stress of Yoke Legs	---	$S_b \le 1.5S_m (185°F)$ $= 33,165$ psi	S_b = 5,772 ~~32,221~~ psi	0.17 ~~0.97~~

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(1)ASME Section III, 1971 Edition
(2)Valve differential pressure is 50 psig.

REPLACE WITH ATTACHED NEW TABLE

TABLE 3.9B-2n

ECCS PUMPS

The following is a summary of the design calculated stresses:

	Calculated Stress (psi)			
	RHR	LPCS	HPCS	Allowable (psi)
Pressure Boundary Parts				
Disch. Head Cover				
Disch. Head Shell				
Disch. Head Flange				
Disch. Head Bolts				
Suction Pipe				
Suction Flange				
Disch. Pipe				
Disch. Flange				
Suction Barrel Shell				
Suction Barrel Mtg. Flange				
Suction Barrel Mtg. Flange Bolts				
Dished Head				
Seal Flange				
Seal Flange Bolts				
Noz/Shell Intersection (Suct-Peak)				
Noz/Shell Intersection (Suct-avg)				
Noz/shell intersection (Disch-peak)				
Noz/Shell Intersection (Disch-Avg)				
Seal Piping				
Cyclone Separator Cover				
Cyclone Separator Bolts				
Heat Exchanger (Shell)				
Heat Exchanger Bolting				

NOTE: Information to be provided upon completion of new loads program.

TABLE 3.9B-2n
ECCS PUMPS
RESIDUAL HEAT REMOVAL PUMP

LOCATION	LOADING CONDITION	CRITERIA	CALCULATED STRESS (PSI) or ACTUAL THICKNESS (IN.)	ALLOWABLE STRESS (PSI) or MIN. THICKNESS (IN.)
Discharge Head Shell	FAULTED CONDITION Design Pressure Nozzle Loads Seismic Loads	ASME Boiler & Pressure Vessel Code, Section VIII, Division 1, Para. UG-27	5,289	17,500
Discharge Head Cover	Design Pressure	ASME Boiler & Pressure Vessel Code, Section VIII Division 1, Para. UG-34, UG-39, UG-40	8,274	17,500
Nozzle Shell Inter Section	FAULTED CONDITION Design Pressure Nozzle Loads Seismic Load	ASME Boiler & Pressure Vessel Code, Section VIII, Division 1, Para. UG-37	25,106 (Suction) (Discharge) 17,241	26,250
Discharge Pipe	FAULTED CONDITION Design Pressure Nozzle Loads	ASME Boiler & Pressure Vessel Code, Section VIII, Division 1, Para. UG-27	12,300	15,000
Discharge Head Bolting	FAULTED CONDITION	Bolting Loads & Stresses per "Rules for Bolted Flange Connections" ASME Section VIII, App. II	33,173	37,500
Motor Bolting	FAULTED CONDITION Seismic Load	Bolting Load & Stresses per "Rules for Bolted Flange Connections" ASME Section VIII, App. II	16,210	25,000

TABLE 3.9B-2n (cont'd.)
ECCS PUMPS
LOW PRESSURE CORE SPRAY PUMPS

LOCATION	LOADING CONDITION	CRITERIA	CALCULATED STRESS (PSI) or ACTUAL THICKNESS (IN.)	ALLOWABLE STRESS (PSI) or MIN. THICKNESS (IN.)
Discharge Head Shell	FAULTED CONDITION Design Pressure Nozzle Loads Seismic Loads	ASME Boiler & Pressure Vessel Code, Section VIII, Division 1, Para. UG-27	2,397 psi	17,500 psi
Discharge Head Cover	Design Pressure	ASME Boiler & Pressure Vessel Code, Section VIII Division 1, Para, UG-34, UG-39 & UG-40	7,578 psi	17,500 psi
Nozzle Shell Inter Section	FAULTED CONDITION Design Pressure Nozzle Loads Seismic Load	ASME Boiler & Pressure Vessel Code, Section VIII Division I, Para. UG-37	19,760 psi (Suction) (Discharge) 15,718 psi	21,000 psi 21,000 psi
Discharge Pipe	FAULTED CONDITION Design Pressure Nozzle Loads	ASME Boiler & Pressure Vessel Code, Section VIII Division 1, Para. UG-27	14,760 psi	15,000 psi
Discharge Head Bolting	FAULTED CONDITION Design Pressure Nozzle Loads Seismic Load	Bolting Loads & Stresses per "Rules for Bolted Flange Connections" ASME Section VIII, App. II	31,567 psi	37,500 psi
Motor Bolting	FAULTED CONDITION Seismic Load	Bolting Loads & Stresses per "Rules for Bolted Flange Connections" ASME Section VIII, App. II	22,881 psi	37,500 psi

TABLE 3.9B-2n (cont'd.)
ECCS PUMPS
HIGH PRESSURE CORE SPRAY PUMP

LOCATION	LOADING CONDITION	CRITERIA	CALCULATED STRESS (PSI) or ACTUAL THICKNESS (IN.)	ALLOWABLE STRESS (PSI) or MIN. THICKNESS (IN.)
Discharge Head Shell	FAULTED CONDITION Nozzle Loads Seismic Load	ASME Boiler & Pressure Vessel Code, Section VIII Division 1, Para. UG-27	2,332 psi	17,500 psi
Discharge Head Cover	Design Pressure	ASME Boiler & Pressure Vessel Code, Section VIII Division 1, Para. UG-34, UG-39 & UG-40	8,103 psi	17,500 psi
Nozzle Shell Inter Section	FAULTES CONDITION Design Pressure Nozzle Loads Seismic Load	ASME Boiler & Pressure Vessel Code, Section VIII, Division 1, Para. UG-37	14,878 psi (Suction) (Discharge) 15,440 psi	17,500 psi 17,500 psi
Discharge Pipe	FAULTED CONDITION Design Pressure Nozzle Loads	ASME Boiler & Pressure Vessel Code, Section VIII Division 1, Para. UG-27	8,915 psi	17,500 psi
Discharge Head Bolting	FAULTED CONDITION Design Pressure Nozzle Loads Seismic Load	Bolting Loads & Stresses per "Rules for Bolted Flange Connections" ASME Section VIII, App. II	33,855 psi	37,500 psi
Motor Bolting	FAULTED CONDITION Seismic Load	Bolting Loads & Stresses per "Rules for Bolted Flange Connections" ASME Section VIII, App. II	33,030 psi	37,500 psi

TABLE 3.9B-2o

RESIDUAL HEAT REMOVAL HEAT EXCHANGER

	Loading	Criteria	Allowable Stress or Min. Thickness Reqd.	Calculated Stress or Thickness
1.	Closure Bolting Loads: Normal and Upset Design pressure and temperature Design gasket load	Bolting loads and stresses calculated in accordance with "Rules for Bolted Flange Connections" ASME Section III, App XI		
	Bolting Stress Limit	a. Shell to tube sheet bolts	25,000 psi	23,526 psi
	Allowable Working Stress in accordance with ASME Section III	b. Channel cover bolts	25,000 psi	24,522 psi
2.	Wall Thickness	Shell Side ASME Section III, Class 2 and TEMA, Class C		
	Design pressure and temperature	Tube Side ASME Section III, Class 3 and TEMA, Class C		
	Stress Limit			
	ASME Section III	a. Shell	0.838 in	0.875 in
		b. Shell cover	0.827 in	0.870 in min
		c. Channel ~~ring~~	0.860 in	0.875 in
		d. Tubes	0.0515 in	0.054 BWG
		e. Channel cover	7.42 in	7.44 in
		f. Tube sheet	6.65 in	6.75 in

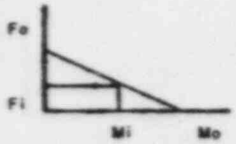
TABLE 3.9B-2o (Cont)

Loading	Criteria	Allowable Nozzle Forces and Moments (Forces in lb, Moment in ft lb)	Actual Nozzle Loads
3. Nozzle Loads	The maximum moments due to pipe reaction and the maximum forces shall not exceed the allowable limits.	(1) (1)	
Design Pressure and Temperature Dead Weight, Thermal Expansion, Safe Shutdown Earthquake	Primary Stress Smaller of 0.75 S_u or 2.4 Sm per ASME Section III allowable.		

NOTE: Information to be provided upon completion of new loads program.

(1) The following expression relates the allowable combination of forces and moments:

$$\left|\frac{Fi}{Fo}\right| + \left|\frac{Mi}{Mo}\right| \leq 1$$



where:

Fi = The largest of the three actual external orthogonal forces (Fx, Fy, and Fz)
Mi = The largest of the three actual external orthogonal moments (Mx, My, and Mz)
Fo = The allowable value of Fi when all moments are zero
Mo = The allowable value of Mi when all forces are zero

One coordinate axis must be the nozzle center line. Another coordinate axis must be parallel to the heat exchanger center line except where the heat exchanger center line is parallel to the nozzle center line. In this case, the coordinate axis must be orthogonal to the nozzle center line and 0°-180° or 90°-270° azimuths.

TABLE 3.9B-2o (Cont)

(2)Allowable Limits (Design Basis)

	N1	N2	N3	N4
F_x =	10,500 lb	10,500 lb	13,000 lb	13,000 lb
F_y =	10,500 lb	10,500 lb	13,000 lb	13,000 lb
F_z =	10,500 lb	10,500 lb	13,000 lb	13,000 lb
M_x =	32,000 ft lb	32,000 ft lb	46,000 ft lb	46,000 ft lb
M_y =	32,000 ft lb	32,000 ft lb	46,000 ft lb	46,000 ft lb
M_z =	32,000 ft lb	32,000 ft lb	46,000 ft lb	46,000 ft lb

TABLE 3.9B-2r

RCIC PUMP

Criteria/Loading	Component	Limiting Stress Type	Allowable Stress (psi)	Calculated Stress (psi)
Pressure boundary stress limits of the various components for the RCIC pump assembly are based on the ASME B&PV Code Section III, for pressure boundary parts at 140°F. 1. Forged barrel, SA105 GR. II S_y = 36,000 psi 2. End cover plates, SA 105 GR. II S_y = 36,000 psi 3. Nozzle connections, SA105 GR. II S_y = 36,000 psi 4. Aligning pin, SA~~105 GR. II~~ 515GR-60 S_y = 32,000 psi 5. Closure bolting, SA193 B7 S_y = 105,000 psi 6. Pump holddown bolting, SA325 S_y = 77,000 psi 7. Taper pins, SA108 GR. B1112, S_y = 75,000 psi 8. Axial guide key, SA515, GR. 60, S_y = 32,000 psi				
Normal & Upset Condition Loads:				
1. Design pressure	1. Forged barrel	General membrane	17,500	(1)
2. Design temperature	2. End cover (suction)	General membrane	17,500	(1)
3. Operating basis earthquake	3. End cover (discharge)	General membrane	17,500	(1)
4. Suction nozzle loads				
5. Discharge nozzle loads	4. Nozzle reinforcement	General membrane	17,500	(1)
6. Safety relief valve discharge load				
7. Dead weight	5. Alignment pin	Shear	15,000	(1)
8. Thermal expansion	6. Closure bolting	Tensile	25,000	(1)
	7. Taper pins	Shear	15,000	(1)
	8. Pump holddown bolts	Tensile	40,000	(1)
		Shear	~~17,760~~ 15,000	(1)
	9. Pump anchor bolts	Tensile	17,760	(1)
	10. Pump anchor bolts	Shear	17,760	(1)

TABLE 3.9B-2s (cont'd.)

REACTOR REFUELING AND SERVICING EQUIPMENT

Inclined Fuel Transfer Tube

ACCEPTANCE CRITERIA	LOADING	PRIMARY STRESS TYPE	ALLOWABLE STRESS (psi)	CALCULATED[(1)] STRESS (psi)
The allowable axial plus bending loads are based on ASME code Section. III, CL.2-SA182 for type 304SS.				
F_u = 75,000 psi				
F_y = 30,000 psi				
For normal condition: $S_{limit} = 1.5(0.6)F_y$	For normal condition: 1. Normal Loads	Axial + bending	27,000	7,758
For emergency condition: $S_{limit} = 1.5(0.9)F_y$	For emergency condition: 1. Normal Loads 2. OBE 3. SRV 4. LOCA	Axial + bending	40,500	22,085
For faulted condition: $S_{limit} = 1.5(1.2)F_y$	For faulted condition: 1. Normal Loads 2. SSE 3. SRV 4. LOCA	Axial + bending	54,000	25,728

NOTES: (1) New Loads Stresses Are Lower Than Design Stresses

TABLE 3.9B-2t (Cont)
Control Rod Drive
(Ring Flange)

Criteria	Loading	Primary Stress Type	Allowable Stress (psi)	Calculated Stress (psi)
Allowable Primary Membrane Stress plus Bending Stress is based on ASME Boiler & Pressure Vessel Code, Section III for Type F304 Stainless Steel at 250°F $S_m = 20,000$ psi				
For normal and upset condition: $S_{allow} = 1.5 \times S_m$	For normal & upset condition 1. Normal loads(1) 2. Scram with OBE and no buffer	General Membrane + Bending	30,000	17,922
For emergency condition: $S_{allow} = 1.8 \times S_m$	For emergency condition: 1. Normal loads(1) 2. Scram with accumulator at overpressure	General Membrane + Bending	36,000	1,838
For faulted condition: $S_{allow} = 3.6 \times S_m$	For faulted condition: 1. Normal loads(1) 2. Scram with SSE 3. Scram with stuck rod	General Membrane + Bending	71,925	4,041

TABLE 3.9B-2t (Cont)
Control Rod Drive
(Indicator Tube)

Criteria	Loading	Primary Stress Type	Allowable Stress (psi)	Calculated Stress (psi)
Allowable Primary Membrane Stress plus Bending Stress is based on ASME Boiler & Pressure Vessel Code, Section III for Type 316 Stainless Steel at 250°F S_m = 20,000 psi Sm=19,200psi ; at 575°F Sm=17,250psi				
For normal and upset condition: $S_{allow} = 1.5 \times S_m$ @ 400^0F	For normal & upset condition: 1. Normal loads(1) 2. Scram with OBE and ~~no buffer~~ SRV	General Membrane + Bending	28,000 ~~30,000~~	23,700 ~~15,930~~
For emergency condition: $S_{allow} = 1.8 \times S_m$ @ 575^0F	For emergency condition: 1. Normal loads(1) 2. Failure of pressure regulating system 3. Scram with accumulator at overpressure	General Membrane + Bending	31,050	23,826
For faulted condition: $S_{allow} = 3.6 \times S_m$ @ 250^0F	For faulted condition: 1. Normal loads(1) 2. Scram with SSE 3. ~~Scram with stuck rod~~ Annulus Pressurization	General Membrane + Bending	72,000	28,900 ~~14,780(2)~~

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(1) Normal loads include pressure, temperature, weight and mechanical loads.
~~(2) Will probably change when new loads calculations are made.~~

TABLE 3.9B-2u (Cont)

Criteria	Loading	Primary Stress Type	Allowable Stress (psi)	Calculated Stress (psi)~~[2]~~
Primary Stress Limit - The allowable primary membrane stress is based on the ASME Boiler and Pressure Vessel Code, Section III, for Class I vessels.				
For normal and upset condition: $S_{limit} = 1.0\ S_m$	Normal and upset condition loads: 1. Design pressure 2. Stuck rod scram loads 3. Operational basis earthquake, with housing lateral support installed 4. SRV	Maximum membrane stress intensity occurs at the tube to tube weld near the center of the housing for normal, upset and emergency conditions.	RBS-1 16,660 RBS-2 13,725	(304 Stainless) ~~13,677~~ 15,475 (316L Stainless) 13,562
For faulted conditions: $S_{limit} = 1.2\ S_m$[1]	Faulted conditions loads: 1. Design pressure 2. Stuck rod scram loads 3. Safe shutdown earthquake, with housing lateral support installed 4. Annulus Pressurization 5. Jet Reaction		RBS-1 20,000 RBS-2 16,470	15476 ~~14,724~~ 13,677

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[1] Analyzed to emergency conditions limits

~~[2] Calculated stress numbers may change with new loads calculations.~~

TABLE 3.9B-2v

JET PUMPS

Criteria	Loading Combinations	Stress Type	Allowable Stress (psi)	Calculated Stress (psi)
Primary Membrane Plus Bending Stress Based on ASME B&PV Code Section III				
For Service Levels A & B (Normal and Upset) Condition: For Type 304SS at 550 °F S_m = 16,900 psi S_{limit} = 3.0 S_m psi	$F_p + W + F_c + OBE + V + T + SRV_{all}$	Primary Membrane + Bending Secondary Membrane	50,700	47,804
For Service Level C (Emergency) Condition: For Type 304SS at 550 °F S_m = 16,900 psi S_{limit} = 2.25 S_m psi	$F_p + W + F_c$ + ~~OBE~~ LOCA + SRV_{all}	Primary Membrane + Bending	38,025	7,995
For Service Level D (Faulted) Condition: For Type 304SS at 550 °F S_m = 16,900 psi S_{limit} = 3.6 S_m psi	$F_{p_1} + F_{p_{11}} + W + F_c + S + SSE + AP$	Primary Membrane + Bending	60,840	54,910

NOMENCLATURE:

F_p = Design internal pressure, and hydraulic and pressure reaction loads (all components except riser brace)
F_{p_1} = Design external pressure, and hydraulic and pressure reaction loads (riser and mixer)
$F_{p_{11}}$ = Design internal pressure, and hydraulic and pressure reaction loads (inlet mixer and diffuser)
F_c = Inlet - mixer-to-riser clamping force
W = Static weight
OBE/SSE = Seismic load
V = Vibratory forces
T = Thermal loads
S = Shock wave loads
S_m = Stress intensity at design temperature
LOCA = Loss of Coolant Accident
SRV_{all} = Safety Relief Valve
AP = Annulus Pressurization

~~NOTE: Information to be provided upon completion of new loads program.~~

TABLE 3.9B-2w

HIGHEST STRESSED REGION ON THE LPCI COUPLING ~~(ATTACHMENT RING)~~ (Strut to Weld)(1)

Criteria	Loading Combinations	Stress Type	Allowable Stress (psi)	Calculated Stress (psi)
Primary Membrane Plus Bending Stress Based On ASME B&PV Code Section III ~~For Type~~ NG 3000 316L				
For Service Levels A & B (Normal & Upset) Condition: $S_{Limit}=1.5x0.7Sm=1.5x0.7x14,150$	Normal & Upset Condition Loads: $NL+Pu+OBE+SRV_{all}$	Primary Membrane + Bending	14,858	2,994
For Service Level C (Emergency) Condition: $S_{Limit}=1.5x1.5x0.7x14,150$	Emergency Condition Loads: $NL+Pu+Chg+SRV_{ADS}$	Primary Membrane + Bending	22,286	5,542
For Service Level D (Faulted) Condition: $S_{Limit}=2.4x1.5x0.7x14,150$	Faulted Condition Loads: $NL+P_A+JR+\frac{AP}{F}+SSE$	Primary Membrane + Bending	35,658	14,694

NOMENCLATURE:

$\Delta P_{u,e,f}$ = Pressure differential for Service Levels B, C and D (upset, emergency, and faulted) conditions, respectively

W = Static weights

T = Thermal loads

V = Vibratory forces

R = Vessel constraint

C = Internal constraint

J = Jet impingement effects

$D_{u,f}$ = Dynamic loads for Service Levels B and D (upset and faulted) conditions, respectively

P = Pressure transients

NL=Normal Loads (metal + water weight)
OBE =Operating Basis Earthquake
Chg =Chugging
AP/F =Annulus Pressurization/ Modifying Factor
SRV_{all}=Safety Relief Valves, all
SRV_{ADS}=Safety Relief Valves, Automatic Depressurization System
JR=Jet Reaction
SSE=Safe Shutdown Earthquake

S_m = Stress intensity at design temperature

~~NOTE: Information to be provided upon completion of new loads program.~~

(1) Highest Stressed Location

TABLE 3.9B-2x

CONTROL ROD GUIDE TUBE

Criteria	Loading	Primary Stress Type	Allowable Stress (psi)	Calculated Stress~~[1]~~ (psi)
CONTROL ROD GUIDE TUBE				
Primary Stress Limit				
The allowable primary membrane stress plus bending stress is based on the ASME Boiler and Pressure Vessel Code, Section III, Class CS for Type 304 stainless steel material				
For Service Levels A & B (normal and upset) conditions: $1.5\ S_m = 1.5 \times 16{,}000$ $= 24{,}000$ psi	Service Levels A and B (Normal and Upset Condition) Applied Loads 1. External Pressure 2. Vertical Seismic and Weight 3. Horizontal Seismic 4. Lateral Flow Impingement 5. Vibration	Applying Vertical Seismic plus dead weight, the maximum stress under Service Levels A & B (normal and upset) conditions occurs at the guide tube base.	24,000	16,340
For Service Level D (faulted) condition: $S_{limit} = 2.4\ S_m$ $= 2.4 \times 16{,}000$ $= 38{,}400$ psi	Service Level D (Faulted) Condition Applied Loads 1. External Pressure 2. Vertical Seismic and Weight 3. Horizontal Seismic 4. Lateral Flow Impingement 5. Vibration	Applying Vertical Seismic plus dead weight, the maximum stress under Service Level D (faulted) loading conditions occurs at the guide tube base.	38,400	21,763

~~[1] Calculated stresses may change when new load calculations are made.~~

New Load Stresses Are Lower Than Design Stresses.

TABLE 3.9B-2y

INCORE HOUSING

Criteria	Loading	Primary Stress Type	Allowable Stress (psi)	Calculated Stress (psi)
Primary Stress Limit - The allowable primary membrane stress is based on ASME Boiler and Pressure Vessel Code, Section III for Class I vessels for type Inconel 600 austenitic high nickel alloy steel				
For Service Levels A & B (normal and upset) $S_{limit} = 1.0S_m$ = 23,300 psi at 575°F	Service Levels A & B (Normal and Upset) Condition Loads 1. Design Pressure 2. Operating Basis Earthquake 3. Safety Relief Valve	Maximum membrane stress intensity occurs at the outer surface of the vessel penetration	23,300	17,800
Service Level D (Faulted) Condition Stress limit is the lesser of 0.7 Su = 0.7 x 80,000 = 56,000 or 2.4 sm = 2.4 x 23,000 = 55,920	Service level D (Faulted) Condition Loads 1. Design Pressure 2. Static Weights 3. Safe Shutdown Earthquake 4. Safety Relief Valve 5. Loss of Coolant Accident		55,920	22,000

TABLE 3.9B-2z

REACTOR VESSEL SUPPORT EQUIPMENT (CRD HOUSING SUPPORT)

Criteria	Loading	Location	Allowable Stress (psi)	Calculated Stress (psi)
Primary Stress Limit				
AISC specification for the design, fabrication, and erection of structural steel for buildings	Faulted condition loads:	Beams (top chord)	33,000	f_a = 14,000
	1. Deadweight 2. Impact force from failure of a CRD housing		33,000	f_b = 20,000
		Beams (bottom chord)	33,000	f_a = 11,700
			33,000	f_b = 21,000
For normal & upset condition:	(Deadweights and earthquake loads are very small compared to impact force)	Grid structure		
$f_a = 0.60\ f_y$ (tension) $f_b = 0.66\ f_y$ (bending) $f_v = 0.40\ f_y$ (shear)				
For faulted conditions:	Faulted condition loads:			
f_a limit = 1.5 f_a (tension)	1. Weight of structure		41,500	f_b = 40,500
f_b limit = 1.5 f_b (bending) f_v limit = 1.5 f_v (shear) f_y = Material yield strength	2. Impact force from failure of a CRD housing		27,500	f_v = 11,600

New Load Stresses Are Lower Than Design Stresses.

TABLE 2.9B-z (cont'd.)

RPV SUPPORT (BEARING PLATE)

Criteria	Loading	Location	Allowable Stress (psi)	Calculated Stress (psi)
Primary Stress Limit				
AISC specification for the design, fabrication, and erection of structural steel for buildings				
For normal & upset conditions AISC allowable stresses, but without the usual increase for earthquake loads	Normal and upset condition: 1. Dead Loads 2. OBE 3. Loads due to scram	Bearing plate	F_c (bearing) 32,400	$f_c = 1,894$
For emergency and faulted conditons 1.5 x AISC allowable stresses for structural steel members	Faulted condition: 1. Dead loads 2. Design basis earthquake 3. Jet reaction loads	Bearing plate	F_c (bearing) 48,600	$f_c = 4,560$

Table 3.9B-2aa

FUEL ASSEMBLY (INCLUDING CHANNEL) PEAK ACCELERATION

Acceptance Criteria	Loading	Primary Load Type	Calculated Peak Acceleration	Evaluation Basis Acceleration
Acceleration Envelope	Horizontal Direction: 1. Peak Pressure 2. Safe Shutdown Earthquake 3. Annulus Pressurization	Horizontal Acceleration Profile	2.0 g	(1)
	Vertical Direction: 1. Peak Pressure 2. Safe Shutdown Earthquake 3. Annulus Pressurization 4. Scram	Vertical Accelerations	4.9 g(4)	(1)

NOTES:

(1) Evaluation Basis Accelerations and Evaluations are contained in NEDE-21175-3-P-A.

(2) The calculated maximum fuel assembly gap opening for the most limiting load combination is 0.19(4) inches.

(3) The fatigue analysis indicates that the fuel assembly has adequate fatigue capability to withstand the loadings resulting from multiple SRV actuations and the OBE+SRV event.

(4) These values are determined using methodology contained in NEDE-21175-3-P-A.