GENERAL ELECTRIC

NUCLEAR POWER

SYSTEMS DIVISION

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MFN 122-81

June 29, 1981

Mr. R. Bosnak, Chief
Mechanical Engineering Branch
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Bosnak:

SUBJECT: GE POSITION ON FATIGUE ANALYSIS

Reference: Letter, R. Bosnak to W. G. Gang, same subject, dated February 19, 1981

This letter responds to the referenced letter requesting that GE provide assurance that the methodologies employed to evaluate fatigue effects properly considers the combination of the OBE and SRV loads. GE's approach to fatigue evaluations is clarified as follows:

In the fatigue analysis of NSSS equipment, piping, reactor pressure vessel and RPV internal components, the actual calculated loads due to OBE and SRV are combined to show compliance with upset limits for fatigue. This calculation is performed by comparing the "plant unique OBE and SRV loads" with the "original OBE load used for the design basis." If the "plant unique OBE and SRV load" exceeds the "original OBE load used for the design basis," a stress evaluation is done to show the stresses to be within acceptance limits. The larger of the two loads has been evaluated for 10 or more fatigue cycles consistent with upset limits. For reactor vessel nozzle loads, the original OBE load is also the maximum permissible value shown in the interface control document (ICD) issued by General Electric. Consequently, OBE loads have been combined with other upset loads (including SRV) for the fatigue evaluation.

The procedure described above is applied in general to all BWR 4/5/6 requisition projects. The actual calculated loads (OBE + SRV) are more commonly used for BWR 4/5 projects, but in either case, a comparison is made to insure that the ICD loads are not exceeded.

The number of SRV cycles used for these calculations varies widely for BWR 4/5 projects. However, the number of SRV cycles for BWR/6 projects is always less than 13000 because of the low-low set feature which is part of the standard BWR/6 design.

Dupe of. 8107100233

GENERAL ELECTRIC

This approach has been discussed with you and members of your staff and we understand it is acceptable.

Very truly yours,

R. B. Johnson, Acting Manager
BWR Projects Licensing
Nuclear Safety and Licensing Operation

RBJ:sem/1125-26 625

cc: L. S. Gifford

bcc: R. Villa
G. G. Sherwood
P. C. Yin
BWRPL Staff

3.9.3 ASME Code Class 1, 2 and 3 Components, Component Supports, and Core Support Structures

3.9.3.1 Loading Combinations Design Transients and Stress Limits

Question 28

The safety relief valve discharge piping and downcomers are ASME Class 2 and 3 components, a fatigue analysis is not required in their design by the ASME Section III Boiler and Pressure Vessel Code. However, a through wall leakage crack in these lines resulting from fatigue caused by SRV actuations and small LOCA conditions would allow steam to bypass the pressure suppression pool. This could result in an unacceptable overpressurization of the containment. We, therefore, require that the applicant perform a fatigue evaluation on these lines in accordance with the ASME Class 1 fatigue rules.

Response:

A fatigue evaluation using ASME Class 1 fatigue rules is currently being performed for the downcomers and the wetwell portion of the SRV piping potentially subject to bypass leakage.

Summation - The results of this evaluation will be reported in the WNP-2 Design Assessment Report for SRV and LOCA loads. This item is closed.

QUESTION NO. 29
(3.9.3.1)

Provide justification for utilizing one OBE with 10 maximum load cycles specified in Table 3.9-1.

RESPONSE

The justification is provided in the response to Question No. 9. Revision to Table 3.9-1 is attached to the response to Question No. 10.

Summation - This item is closed.

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QUESTION NO. 30
(3.9.3.1)

Provide the basis for utilizing the allowable general membrane stress for the emergency loading conditions as 1.5 Sm in Table 3.9-2(a). ASME Section III Figure 3.2.2.4-1 specifies this limit as the greater of 1.2 Sm or Sy. This table also specifies one of the loads as maximum credible earthquake which has not been clearly defined.

RESPONSE

The listed stress criterion is in typographical error. "1.5 Sm" should be replaced with Sy. See the table revision attached. The maximum credible earthquake is SSE.

Summation - This item is closed.

TABLE 3.9-2 (a) (Continued)

Vessel Support Skirt

Criteria	Loading	Primary Stress Type	Allowable Stress (psi)	Calculated Stress (psi)
ASME B and PVC Sect. III Primary Stress Limit for SA 533 GRB CL1 For normal and upset Condition:	Normal and upset condition loads	General Membrane	26,700	19,911
S_m = 26,700 psi	1. Dead Weight 2. Design earthquake (Operating basis earthquake)			
For emergency condition:	Emergency condition loads	General Membrane	42,300	39,245
~~1.5S_m~~ S_y = 42,300 psi	1. Dead Weight 2. Maximum credible earthquake ~~(Design basis earthquake)~~ (SSE)			
For faulted condition:	Faulted condition loads	General Membrane	42,300	39,245
~~1.5S_m~~ S_y = 42,300 psi	1. Dead Weight 2. Maximum credible earthquake (SSE) 3. Jet reaction forces			

NOTES: The vessel support skirt has been evaluated for buckling.

Faulted category loads were evaluated with emergency allowable loads.

QUESTION NO. 31
3.9.3.1

In Table 3.9-2(a), it is noted that the supported skirt and shroud support legs have been evaluated for buckling, but the buckling criteria are not specified. The applicant should discuss the applicability of the criteria in FSAR Section 3.9.3.4, "Component Supports" to this table.

RESPONSE:

(a) The response to Question 42 addresses the subject of support skirt buckling.

(b) The criterion for the shroud support, which is a core support structure is defined by Equation b in Table 3.9-9 of the FSAR. The maximum faulted condition design load is 854.5 kips per shroud support leg compared to a critical buckling load of 1289 kips. A copy of Table 3.9-9 is attached for reference.

Summation - This item is closed.

TABLE 3.9-9

BUCKLING STABILITY LIMIT

(for reactor internal structures only)

Any One Of (No More Than One Required)	General Limit
a. $\left[\frac{\text{Permissible load, LP}}{\text{Code normal event permissible load, PN}}\right]$	$\leq \frac{2.25}{SF_{min}}$
b. $\left[\frac{\text{Permissible load, LP}}{\text{Stability analysis load, SL}}\right]$	$\leq \frac{0.9}{SF_{min}}$

where

LP = permissible load under stated conditions of normal, upset, emergency or fault.

PN = applicable code normal event permissible load.

SL = stability analysis load. The ideal buckling analysis is often sensitive to otherwise minor deviations from ideal geometry and boundary conditions. These effects shall be accounted for in the analysis of the buckling stability loads. Examples of this are ovality in externally pressurized shells or eccentricity on column members.

QUESTION NO. 32
(3.9.3.1)

Provide the basis for utilizing the allowable stress for emergency condition of 1.5 x AISC allowable stresses and for faulted conditions of 1.67 x AISC allowable stresses for the RPV support (bearing plate). For the RPV stabilizer, the allowable stresses are also based on the AISC specification. The allowable stress for the rod is shown as 84,000 psi. What is the basis for this number? For the faulted loading condition, the allowable stress is shown as the material yield strength. Why is the difference from the the previous faulted allowable stress of 1.67 x AISC allowable stress?

RESPONSE

1. Bearing Plate

(a) Faulted Condition

GE Report NEDE-10949-3 and GESSAR establish the basis for the 1.5 x AISC allowable for supports and structures. Since AISC = 2/3 of yield strength for bending, it follows that, for A-36 material,

1.5 x AISC = 1.5 x (2/3 of yield strength) = yield strength = 36,000 psi

(b) Normal and Upset Condition

Two thirds of yield is 24,000 psi, but 22,000 psi is used for conservatism.

(c) Emergency Condition

This condition is not critical to an inactive equipment, therefore, a 1.5 factor is applied to the normal and upset limit to arrive at the emergency limit.

The above clarifications are added to Table 3.9-2(a) as footnotes.

2. RPV Stabilizer

The rod yield strength is 140,000 psi which is used as the faulted limit. Based on the AISC criterion for tension, 0.6 x 140,000 = 84,000 psi is used for normal and upset. Accordingly, the table entry is clarified by the added footnotes.

Summation - This item is closed.

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TABLE 3.9-2 (a) Continued)

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.	Normal and upset condition 1. Dead loads 2. Operating basis earthquake 3. Loads due to scram	Bearing Plate	22,000[(2)]	f_b = 9,000
For normal & upset conditions AISC allowable stresses, but without the usual increase for earthquake loads.				
For emergency conditions 1.5 x AISC allowable stresses.	Emergency condition 1. Dead loads 2. Design basis earthquake 3. Loads due to scram	Bearing Plate	33,000[(3)]	f_b = 16,000
For faulted conditions 1.67 x AISC allowable stresses for structural steel members.	Faulted condition 1. Dead loads 2. Design basis earthquake 3. Jet reaction load	Bearing Plate	36,000[(1)]	f_b = 16,000

(1) For A-36 material, the yield strength is 36,000 psi.

(2) Two-thirds of yield strength for bending gives 24,000 psi, but 22,000 psi is used for conservatism.

(3) A 1.5 factor is applied to the normal and upset limit since the emergency condition is not critical for an inactive equipment.

TABLE 3.9-2 (A) (Continued)

RPV Stabilizer

Criteria	Loading	Location	Allowable Stress (psi)	Calculated Stress (psi)
Primary Stress Limit				
AISC specification for the construction, fabrication, and erection of structural steel for buildings	Upset condition	Rod	84,000 (1)	f_t = 54,000
	1. Spring preload	Bracket	22,000	f_b = 22,000
	2. Operating basis earthquake	Bracket	14,000	f_v = 4,600
For normal & upset conditions AISC allowable stresses, but without the usual increase for earthquake loads				
For emergency conditions 1.5 x AISC allowable stresses	Emergency condition	Bracket	33,000	f_b = 24,400
	1. Spring preload	Bracket	21,000	f_v = 10,600
	2. Design basis earthquake	Rod	126,000 (2)	f_t = 108,000
For faulted conditions Material yield strength	Faulted condition			
	1. Spring preload	Bracket	36,000	f_b = 26,000
	2. Design basis earthquake	Bracket	21,500	f_v = 11,330
	3. Jet reaction load	Rod	140,000	f_t = 132,000

(1) 0.6 x yield based on the AISC criterion for tension.
(2) 1.5 x normal and upset limit.

QUESTION NO. 33
(3.9.3.1)

Table 3.9-2(b) shows the general membrane plus bending allowable stress for emergency conditions as $1.5S_A$ where S_A = 1.5 Sm and for faulted conditions as 2 S_A. What is the basis for these numbers? The ASME Section III code Figure NB3224-1 specifies 1.8 Sm or 1.5 Sy for emergency and Table F1322.2-1 specifies, 2.4 Sm or 0.7 Su for components and 1.5 Sm or 1.2 Sy for component supports, for faulted conditions.

RESPONSE

1. For emergency conditions, the 2.25 Sm limit is same as the limit per ASME Subsection NG.

2. For faulted conditions, the 3.0 Sm limit is more conservative than the 3.6 Sm value in Appendix F, Table F1322.2-1 as shown by the comparison below:

   From Appendix F, $P_m \leq$ 0.7 Su or 2.4 Sm

P (membrane + bending)		
≤ 1.5 x 0.7 Su	or	1.5 x 2.4 Sm
≡ 1.05 Su	or	3.6 Sm
= 1.05 x 63,500	or	3.6 x 16,925
= 66,675 psi	or	60,930 psi

   Hence, in either case, the limit of 50,775 psi is Table 3.9-2(b) is more conservative than Appendix F.

   An error in the stress type is corrected as attached.

Summation - This item is closed.

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TABLE 3.9-2 (b)

REACTOR VESSEL INTERNALS AND ASSOCIATED EQUIPMENT

Criteria	Loading	Primary Stress Type	Allowable Stress (psi)	Calculated Stress (psi)
TOP GUIDE-HIGHEST STRESSED BEAM				
Primary Stress Limit				
The allowable primary membrane stress plus bending stress is based on ASME Boiler and Pressure Vessel Code, Sect. III for type 304 stainless steel plate.				
For normal and upset condition Stress Intensity $S_A = 1.5\ S_m = 1.5 \times 16{,}925$ psi = 25,388 psi	Normal and upset condition loads 1. Operating basis earthquake 2. Weight of structure	General Membrane Plus Bending	25,388	21,676
For emergency condition: $S_{limit} = 1.5\ S_A = 1.5 \times$ 25,338 = 38,081 psi	Emergency condition loads 1. Design basis earthquake 2. Weight of structure	General Membrane Plus Bending	38,081	32,514
For faulted condition: $S_{limit} = 2\ S_A = 2 \times$ 25,208 = 50,775 psi	Faulted condition loads (same as emergency condition)	General Membrane Plus Bending	50,775	32,514

QUESTION NO. 34
(3.9.3.1)

Table 3.9-2(e) shows the allowable for the emergency condition as $Pe \leq 3.0$ Sm. What is the significance and validity of this equation?

RESPONSE

The criterion "$Pe \leq 3.0$ Sm" should be deleted. "Eq. $9 \leq 2.25$ Sm" is the criterion for both emergency load cases. Accordingly, Table 3.9-2(e) is revised as attached.

In the new loads update for BOP, Tables 3.9-16 and 3.9-17 will be upgraded to cover piping, components and supports.

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TABLE 3.9-2 (e)

CLASS I RECIRCULATION LOOP PIPING

LOADING COMBINATIONS AND STRESS LIMITS

Loading Combinations	Allowables
DESIGN	
$P_D + W + OBE_I$	Eq. 9 $\leq$ 1.5 S_m (NB-3652)
NORMAL/UPSET	
P_o, W, OBE_I, OBE_D, TE	U < 1.0 Eq. 12 $\leq$ 3.0 S_m Eq. 13 $\leq$ 3.0 S_m (NB-3653)
EMERGENCY	Eq. 9 $\leq$ 2.25 S_m (NB-3655)
$P_o + W + OBE_I$	$P_e \leq 3.0\ S_m$
$P_e + W$	Eq. 9 $\leq$ 2.25 S_m (NB-3655)
FAULTED	
$P_o + W + SSE_I$	Eq. 9 $\leq$ 3.0 S_m (F-1360 Appendix F)
TEST	
$P_t + W$	$P_m \leq 0.9\ S_y$
P_t	Eq. 9 $\leq$ 1.35 S_y (NB-3226)

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TABLE 3.9-2 (e) (Continued) Page 2 of 2

The definitions of load symbols used in the above table are as follows:

P_D = Load Due to Piping Design Pressure

P_o = Load Due to the Operating Pressure Associated with the Loading Event

P_e = Load Due to the Peak Pressure Occurring During a Transient Event

P_t = Load Due to Testing Pressure

W = Load Due to Weight

OBE_I = Loads Due to Operating Basis Earthquake Vibratory Accelerations

OBE_D = Loads Due to Operating Basis Earthquake Differential Movements

SSE_I = Load Due to Safe Shutdown Earthquake Vibratory Accelerations

TE = Loads Due to Thermal Expansion and Nozzle Movements

P_m = General Primary Membrane Stress Intensity

S_y = Yield Stress at Test Temperature

S_m = Design Stress Intensity

QUESTION NO. 35
(3.9.3.1)

Table 3.9-2 (i) Item 9, Hanger Bracket Combined Stress. In the method of analysis, it is stated that the load = $(W_B + W_C + W_D)$ .33 and that the multiplier (.33) is added as a safety factor specified on the purchase part drawing. Without being able to evaluate the intent of this analysis in detail it appears that this factor results in using only 0.33 of the total weight to determine the stresses. Additional details of this analysis are requested.

RESPONSE

The recirculation pump is suspended from four hanger rods. The load on each rod should be $(W_B + W_C + W_D) \times 0.25$. In the actual design, $(W_B + W_C + W_D) \times 0.33$ is assumed. This provides a 32% safety margin.

This is clarified by the footnote in the attached table revision.

Summation - This item is closed.

TABLE 3.9-2 (i) (Continued)

Criteria	Method of Analysis	Analytical Results	Allow. Stress or Actual Thickness
7. Seal Gland Retainer	$S_s = \frac{W}{\pi dt}$	S_s = 5486 psi	S_s = 9480 psi
A. Loads:			
Normal and upset condition	w = load imposed		
	d = diameter at shear resistance		
Design pressure & temperature	t = thickness at shear resistance		
B. Allowable working stress per ASME Code Sect. VIII.			
8. Shock Suppressor Lug Combined Stress	Loads shall be applied in the normal direction simultaneously to determine tensile, shear and bending stresses in the brackets. Tensile, shear, and bending stresses shall be combined to determine max. combined stresses.	Combined Stress (Shear plus Tensile)	S_m = 19435 psi
A. Loads:			S_y = 21,600 psi
DBE horizontal seismic force = 1.5 g		Lug #1 S_C = 21,430 psi	
		Lug #2 S_C = 20,915 psi	
		Lug #3 S_C = 15,540 psi	
B. Combined Stress Limit:			
Yield stress per ASME Sect. III			
9. Hanger Bracket Combined Stress	Bracket vertical loads shall be determined by summing the equipment and fluid weights and vertical seismic forces.	S_C = 8,327 psi	S_m = 12,600 psi
A. Loads:			
Flooded weight of equipment	Load = $(W_B + W_C + W_D) .33$ *		
DBE vertical seismic force = 0.14 g	Note: the multiplier (.33) is added as a safety factor specified on the Purchase Part Drawing.		
B. Combined Stress Limit:	W_B = weight of motor		
Yield stress per ASME Sect. VIII	W_C = weight of motor mount		
	W_D = weight of pump case		

* The recirculation pump is suspended from four hanger rods. The load on each rod should be $(W_B + W_C + W_D) \times 0.25$. In the actual design, $(W_B + W_C + W_D) \times 0.33$ is assumed to provide a 32% safety margin.

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QUESTION NO. 36
(3.9.3.1)

Table 3.9-2(n) lists the calculated stresses and allowable stress for the ECCS Pumps. The actual stress exceeds the allowable for the RHR suction nozzle. While the excess is small, it is not noted what stresses, normal, upset, emergency or faulted, are being computed, and what loads were considered in determining these stresses. Additional information on the stresses in this area is requested.

In the discussion of the nozzle loads for the RCIC Pump on page 3.9-50, it is not clear how the equation,

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

is to be applied. Is Fi to be the maximum of Fx, Fy and Fz and Mi to be the maximum of Mx, My and Mz? Clarification is requested on this point.

RESPONSE

1. RHR Suction Nozzle Stress

   Table 3.9-2 (n) has been updated and replaced by three comprehensive sub-tables. The requested additional information on the stresses is provided in details shown as attached.

2. RCIC Pump Nozzle Loads

   The clarification is provided in the attached text revision.

Summation - This item is closed.

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TABLE 3.9-2 (n)

ECCS PUMPS

The following is a summary of the design calculations on pump components:

	Calculated Stress (psi)			Allowable (psi)
	RHR	LPCS	HPCS	
Pressure Boundary Parts				
Suction shell	18756	11025	11345	21000
Discharge nozzle	8040	8040	12060	17500
Suction nozzle	27383	14246	14248	27000
Torispherical head of shell	10365	4711	5139	17500
Stuffing box	2028	2230	7847	15000
Nozzle head lower plate	9635	2516	11582	15000
Mech. seal press. bolting	7600	7600	13660	25000
Mounting flange	11293	9838	5846	17500
Nozzle bolting	20978	15676	16545	25000
Non-Pressure Boundary Components				
Motor mounting bolting	21075	18259	12693	25000
Motor mounting flange	860	153	8946	17500

Delete. Replaced with the following 3 pages.

TABLE

ECCS PUMPS

RESIDUAL HEAT REMOVAL PUMP

LOCATION	LOADING CONDITION	CRITERIA	CALCULATED STRESS (PSI) OR ACTUAL THICKNESS (IN.)	ALLOWABLE STRESS (PSI) OR MIN. THICKNESS (IN.)
Suction Barrel Shell	FAULTED CONDITION Design Pressure Static Loads Dynamic Loads	ASME Boiler & Pressure Vessel Code, Section III	6,399	20,400
Stuffing Box Pipe	Design Pressure Static Loads Dynamic Loads	ASME Boiler & Pressure Vessel Code, Section III	13,680	18,000
Nozzle Shell Inter Section	FAULTED CONDITION Design Pressure Static Loads Dynamic Loads	ASME Boiler & Pressure Vessel Code, Section III	19,029	34,650
Discharge Elbow or Suction Pipe (max.)	FAULTED CONDITION Design Pressure Static Loads Dynamic Loads	ASME Boiler & Pressure Vessel Code, Section III	10,643	21,600
Motor stand	FAULTED CONDITION Static Loads Dynamic Loads	Bolting Loads & Stresses per ASME, Section III Subsection NF	2,996	15,200
Motor Bolting	FAULTED CONDITION Static Loads Dynamic Loads	Bolting Loads & Stresses per ASME, Section III Subsection NF	6,081	17,500

TABLE 3.9-2n (Continued)

ECCS PUMPS

LOW PRESSURE CORE SPRAY PUMP

LOCATION	LOADING CONDITION	CRITERIA	CALCULATED STRESS (PSI) OR ACTUAL THICKNESS (IN.)	ALLOWABLE STRESS (PSI) OR MIN. THICKNESS (IN.)
Suction Barrel Shell	FAULTED CONDITION Design Pressure Static Loads Dynamic Loads	ASME Boiler & Pressure Vessel Code, Section III	9,037	21,000
Stuffing Box Pipe	Design Pressure Static Loads Dynamic Loads	ASME Boiler & Pressure Vessel Code, Section III	11,355	15,000
Nozzle Shell Inter Section	FAULTED CONDITION Design Pressure Static Loads Dynamic Loads	ASME Boiler & Pressure Vessel Code, Section III	12,170	34,650
Discharge Elbow or Suction Pipe (max)	FAULTED CONDITION Design Pressure Static Loads Dynamic Loads	ASME Boiler & Pressure Vessel Code, Section III	8,758	17,500
Motor Stand	FAULTED CONDITION Static Loads Dynamic Loads	Bolting Loads & Stresses per ASME, Section III, Subsection NF	2,623	15,200
Motor Bolting	FAULTED CONDITION Static Loads Dynamic Loads	Bolting Loads & Stresses per ASME, Section III, Subsection NF	4,824	17,500

TABLE 3.9-3n - (Continued)

ECCS PUMPS

HIGH PRESSURE CORE SPRAY PUMP

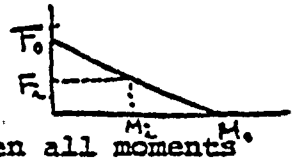
LOCATION	LOADING CONDITION	CRITERIA	CALCULATED STRESS (PSI) OR ACTUAL THICKNESS (IN.)	ALLOWABLE STRESS (PSI) OR MIN. THICKNESS (IN.)
Suction Barrel Shell	FAULTED CONDITION Design Pressure Static Loads Dynamic Loads	ASME Boiler & Pressure Vessel Code, Section III	5,115	21,000
Stuffing Box Pipe	Design Pressure Static Loads Dynamic Load	ASME Boiler & Pressure Vessel Code, Section III	12,851	18,000
Suction Nozzle Shell Inter Section	FAULTED CONDITION Design Pressure Static Loads Dynamic Load	ASME Boiler & Pressure Vessel Code, Section III	13,733	39,650
Discharge Elbow or Suction Pipe (Max.)	FAULTED CONDITION Design Pressure Static Loads Dynamic Loads	ASME Boiler & Pressure Vessel Code, Section III	12,499	21,000
Motor Stand	FAULTED CONDITION Design Pressure Static Loads Dynamic Loads	Bolting Loads & Stresses per ASME Section III, Subsection NF	1,348	15,200
Motor Bolting	FAULTED CONDITION Static Loads Dynamic Loads	Bolting Loads & Stresses per ASME Section III, Subsection NF.	3,821	21,000

g. Nozzle Loading:

Pump nozzles are subject to loading from the connecting pipe. The nozzle pipe reactions to the allowable forces and moments on the equipment is expressed as:

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

~~$Fi = Fx = Fy = Fz$~~
~~$Mi = Mx = My = Mz$~~



Fo = The allowable value of Fi when all moments are zero; and

Mo = The allowable value of Mi when all forces are zero. Therefore, the equipment shall be designed to be capable of:

a. Withstanding the three external orthogonal forces, all equal to Fo with no moments.

b. Withstanding the three external orthogonal moments, all equal to Mo with no forces.

Table 3.9-2(r) contains a summary of the design calculation for the RCIC pump components.

3.9.3.1.11 ECCS Pumps

Design condition for RHR, LPCS, and HPCS pumps are as follows:

	RHR	LPCS	HPCS
Design pressure			
Suction	220 psig	100 psig	100 psig
Discharge	500 psig	550 psig	1715 psig
Design Temperature	40-360°F	40-212°F	40-212°F

F_i = largest of the three external orthogonal forces (F_x, F_y, and F_z) imposed by the pipe.
M_i = largest of the three external orthogonal moments (M_x, M_y, and M_z) permitted from the pipe when they are combined simultaneously for a specific condition.

QUESTION NO. 37
(3.9.3.1)

Table 3.9-2(s). Justification is required for the usage of the AISC for the source of the allowable stresses and the source of the 1.6 S factor as the allowable stress. An explanation is also requested for the allowable stress of 0.7 ULT being equal to 35000 psi. If the material is 6061-T6 aluminum as noted in note a, the ultimate strength per ASTM 8308 is 38000 psi so the allowable would be 0.78(38000) = 26600 psi.

RESPONSE

1. Justification of AISC

   Fuel storage racks are not governed by the ASME design codes, hence the AISC was selected on the premise that the source reference would be conservative when applied to the storage racks calculations. AISC provides an industry-wide code of standard practice for the design, fabrication, and erection of structural components. The "1.6 factor" is a typographical error and should be deleted.

2. Allowable Stresses

   The limit of 0.7 Fu is not used. A new table is provided using a factor of 1.33 to raise the normal allowable for the upset allowable in accordance with AISC, Part 1, Section 1.5.6. The upset allowable is then used for the emergency and faulted conditions as shown in the new table attached.

Summation - This item is closed.

PCY:ggt:rf/45L19
9/23/81

TABLE 3.9-2 (B)

FUEL STORAGE RACKS

CRITERIA	LOADING	LOCATION	ALLOWABLE STRESS (0.7 ULT)	CALCULATED STRESS
1. NEW FUEL STORAGE RACKS	FAULTED CONDITION "A"			
Stress due to normal upset or emergency loading shall not cause a failure so as to result in a critical array	1. Dead Loads 2. Full Fuel Load in rack 3. S.S.E. 4. Thermal (not applicable)	1. Beam (Axial) 2. Beam (Trans.) 3. Combined	1. 35,000 #/in^2 2. 35,000 #/in^2 3. 35,000 #/in^2	1. 15,090 #/in^2 2. 6,673 #/in^2 3. 16,500 #/in^2

NOTES:

Source of Allowable Stress (0.7 ULT)

a. ASTM B308 Alloy 6061-T6
b. ASME Code - Boilers and Pressure Vessels, Sect. III, NA
c. Product Safety Standards for BWR-6-Mark III, Sect. VI, A. (3).
d. ASME - Pressure Vessels and Piping: Design and Analysis, Volume One, Page 69.
e. ASTM code for Boilers and Pressure Vessels was selected on the premise that data used from this source would necessarily be on the conservative side as applied to the fuel storage rack calculations.

Delete.
Use next page.

TABLE [illegible]

REACTOR REFUELING AND SERVICING EQUIPMENT

Fuel Storage Racks

ACCEPTANCE CRITERIA	LOADING	PRIMARY STRESS TYPE	ALLOWABLE STRESS (psi)	CALCULATED STRESS (psi)
The allowable stress is based on Part 1 of AISC Manual for type ASTM B221, 6061-T6 Alum Alloy F_u = 38,000 psi F_y = 35,000 psi				
For normal condition: S_{limit} = 0.66 F_y	For normal condition: Normal operating loads	Axial Load + Bending	23,100	15,230
For emergency condition:(1),(2) S_{limit} = 0.88 F_y	For emergency condition: Normal operating loads Operating Basis Earthquake Safety Relief Valve LOCA	Axial Load + Bending	30,800	30,800
For faulted condition: S_{limit} = 0.88 F_y	For faulted condition: Normal operating loads Safe Shutdown Earthquake Safety Relief Valve LOCA	Axial Load + Bending	30,800	30,800

(1) A one-third margin is added to the normal limit to obtain the upset limit per AISC, 7th Edition, Part 1, Section 1.5.6

(2) The upset allowable is used to evaluate emergency and faulted conditions for conservatism.

TABLE 3.9-2 (s) (Continued)

~~SOURCE OF LOADS AND STRESSES~~

~~S.S.E. loads derived by dynamic analysis. Total stress refers to combined earthquake and thermal load at highest expected pool temperature. Earthquake stresses obtained by square root of the sum of the squares method for a response due to tri-axial excitation. Stress given is the highest in the total structural array.~~

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TABLE 3.9-2 (s) (Continued)

2. SPENT FUEL STORAGE RACKS	FAULTED CONDITION	LOCATION	ALLOWABLE STRESS (1.6S)	CALCULATED STRESS
Stresses due to normal upset or emergency loading shall not cause a failure so as to result in a critical array.	Dead loads plus thermal loads plus SSE.	a. Upper grid welding	17,600	17,256
		b. Base grid	26,400	23,700
		c. Fuel Cans	26,400	26,335
		d. N-S upper bracket bending	26,400	23,418
		e. Restraint weld N-S upper bracket 1-1/4" gusset to plate weld	17,600	16,743

NOTES:

Source of Allowable Stress (1.6S)

AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings", where "S" equals required section strength based on the elastic design method and the allowable stresses defined in Part 1 of AISC

Calculated Stresses

The calculated stresses shown represent the highest stresses on the welds and base metal.

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QUESTION NO. 38
(3.9.3.1)

Table 3.9-2(w). An explanation is requested for the 1.5 Sm and 2.25 Sm emergency stress limits and the 2 Sm and 3 Sm faulted stress limits.

RESPONSE

The current Table 3.9-2(w) is superseded by a new table which provides the stress limits on the basis of the ASME Boiler and Pressure Vessel Code, Section III, Subsection NG. The FSAR text description of jet pumps is also revised accordingly.

Summation - This item is closed.

PCY:ggt:rf/45L18
9/23/81

3.9.1.4.2 Standard Reactor Interior Components

3.9.1.4.2.1 CR Guide Tube

The maximum calculated stress on the CR guide tube occurs in the base during an SSE and is 19,654 psi. The faulted limit is the lesser of 2.4 Sm or 0.7 Su at the design temperature per ASME Code, Section III, Table I-1.2 and F 1322-1. The faulted condition loads are shown on Table 3.9-2(aa). The faulted condition stresses are within elastic limits and are also shown on this table.

3.9.1.4.2.2 Incore Housing

The faulted condition maximum calculated stress on the Incore Housing occurs at the outer surface of the vessel penetration during a SSE and is 15,290 psi. The allowable stress for the elastic analysis used is Sm = 20,000 psi and the ultimate strength of the material is 57,500 psi. Table 3.9-2(ab) shows the faulted loads applied. The stresses are within elastic limits.

3.9.1.4.2.3 Jet Pump

The elastic analysis for the jet pump faulted conditions shows that the maximum stress occurs at the riser brace ~~is due to impulse loading of the diffuser during a pipe rupture and blowdown~~ and is 54,450 ~~39,600~~ psi. The maximum allowable for this condition per ASME code Section III, Subsection NG, is 3.6 Sm or 60,840 psi. ~~is 3 Sm or 60,000 psi.~~ ~~The maximum stress under faulted loading conditions at any point in the jet pump other than that discussed above is approximately 2,500 psi.~~ Table 3.9-2(w) shows the ~~faulted~~ loads ~~applied~~ summary.

3.9.1.4.2.4 LPCI Coupling

The maximum stress during a SSE on the LPCI coupling occurs at the "bellows" which is a purchased component designed to GE requirements for 120 normal operating condition cycles and 10 SSE cycles. The stresses on the bellows are within elastic limits.

3.9.1.4.2.5 Orificed Fuel Support

Due to its complex configuration, a series of vertical and horizontal load tests were performed on the orificed fuel support (OFS) in order to verify the design. Results from these tests indicate that the component and seismic loading

TABLE 3.9-2 (w) Page 1 of 2

JET PUMPS

Jet Pumps

	Operating Conditions	Loading Combinations
A.	Normal & Upset	$F_p + W + F_C + OBE + V + T + P$
B.	Emergency	$F_p + W + F_C + OBE + P$
C.	Faulted	$F_p^1 + F_p^{1i} + W + F_C + S + SSE + P$

Stress Limits at Design Temperature

	Membrane	Membrane and Bending
VA —	S_m	1.5 S_m
VB —	1.5 S_m	2.25 S_m
VC —	2. S_m	3 S_m

where:

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^{1i}=Design internal pressure, and hydraulic and pressure reaction loads (inlet mixer and diffuser)

Delete. Replaced with next page.

TABLE 3.9-2H

JET PUMPS

CRITERIA	LOADING COMBINATIONS	STRESS TYPE	ALLOWABLE STRESS (PSI)	CALCULATED STRESS (PSI)
PRIMARY MEMBRANE PLUS BENDING STRESS BASED ON ASME B&PV CODE SECTION III, SUBSECTION NG.				
FOR SERVICE LEVELS A & B (NORMAL AND UPSET) CONDITION: FOR TYPE 304 S.S. @ 550 °F S_m = 16,800 psi S_{limit} = 1.5 S_m psi	Normal Loads[1] + OBE + SRV	PRIMARY MEMBRANE PLUS BENDING	25,200	6,618
FOR SERVICE LEVEL C (EMERGENCY) CONDITION: FOR TYPE 304 S.S. @ 550 °F S_m = 16,800 psi S_{limit} = 2.25 S_m psi	Normal Loads[1] + LOCA + SRV	PRIMARY MEMBRANE PLUS BENDING	37,800	6,946
FOR SERVICE LEVEL D (FAULTED) CONDITION: FOR TYPE 304 S.S. @ 550 °F S_m = 16,800 psi S_{limit} = 3.6 S_m psi	Normal Loads[2] + LOCA + SSE	PRIMARY MEMBRANE PLUS BENDING	60,840	54,450[3] ~~32,232~~

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

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

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

TABLE 3.9-2 (w) (Continued) Page 2 of 2

F_C = Inlet - mixer-to-riser clamping force

W = Static weights

OBE/SSE = Seismic load

V = Vibratory forces

T = Thermal loads

S = Shock wave loads (Diffuser only)

P = Pressure expansion loads

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QUESTION NO. 39
(3.9.3.1)

Table 3.9-2(y) does not present adequate information for evaluation. What is meant by stress limits for VI and VII, and what are the stresses being evaluated?

RESPONSE

Table 3.9-2(y) is revised as attached.

Summation - This item is closed.

PCY:ggt/45L16
9/22/81

TABLE 3.9-2 (y)

LPCI COUPLING

	Operating Conditions	Loading Combinations
A.	Normal & Upset	ΔP + W + C + V + OBE
B.	Faulted	ΔP + N + C + V + SSE

Stress Limits for VI & VII:

A — Sm at design temperature
B — 3Sm at design temperature

ΔP: Differential pressure

W: Weights

V: Vibration loads

J: Impingement loads

C: Restraint loads

Deleted
Replaced with next page

TABLE 3.9-2 (y)

LPCI COUPLING

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 316L STAINLESS STEEL FOR SERVICE LEVELS A & B (NORMAL & UPSET) CONDITION: $S_{LIMIT} = 3S_m = 41,850$ psi	Normal + OBE + SRV_{ALL}	PRIMARY and secondary MEMBRANE + BENDING *	41,850	13,455
FOR SERVICE LEVEL C (EMERGENCY) CONDITION: $S_{LIMIT} = 2.25S_m = 31,400$ psi	Normal + LOCA (chugging) + SRV_{ADS}	PRIMARY MEMBRANE + BENDING	31,400	22,938
FOR SERVICE LEVEL D (FAULTED) CONDITION: $S_{LIMIT} = 3.6S_m = 50,220$ psi	Normal + SSE + LOCA (Annulus Pressurization)	PRIMARY MEMBRANE + BENDING	50,220	33,660

* Excluding thermal bending per NB-3228.3.

QUESTION NO. 40
(3.9.3.1)

Table 3.9.2(aa). The stresses evaluated are Normal and Upset and the faulted loading condition. Why is there no emergency loading condition for this component.

RESPONSE

For control rod guide tube, there is no emergency load condition.

Summation - This item is closed.

3.9.3.3 Design and Installation of Pressure Relief Devices

Question 41

a. The response to Question 110.031 in the FSAR, Amendment 9, does not comply with the guidelines in Regulatory Guide 1.67, "Installation of Overpressure Devices" concerning dynamic load factor, Paragraph 3.9.3.3.2 of the FSAR, "Open Relief Systems", implies that there may be pressure relief devices of the WNP-2 plant which relieve to open discharge systems. More information on what dynamic load factor was used and how it was determined is required. In addition, the applicant is requested to provide a commitment that all of the information in Sections 3.9.3.3.2 and 3.9.3.3.3 of the FSAR are applicable to both NSSS and BOP supplied components.

b. Indicate how relief valve transients are treated. Clarify whether it is the intention of the FSAR to indicate that all relief valve transients are treated using detailed dynamic analysis techniques.

RESPONSE

a. See revised 3.9.3.3.2 of the FSAR. WNP-2 design does not include any open relief system, therefore, 3.9.3.3.2 has been deleted from the FSAR. Section 3.9.3.3.3 is applicable to both NSSS and BOP supplied components.

b. Relief valves which produce transient loadings are evaluated using detailed dynamic analysis techniques.

1) Detailed dynamic analysis techniques are applied for the evaluation of the 18 mainsteam safety relief lines (See FSAR Section 3.9.3.3.1).

2) Transient analyses for the relief valves listed below are performed using detailed dynamic analysis methods as described in FSAR Section 3.9.3.3.3.

RHR-RV-95A
RHR-RV-95B
RHR-RV-55A
RHR-RV-55B
RHR-RV-36

See revised 3.9.3.3 of the FSAR.

To clarify the FSAR, the attached revisions have been prepared.

Summation - This item is closed.

Insert to 3.9.3.3.

Detailed evaluations are performed only for valves which produce transient effects; small relief valves (for example, those relieving temperature induced water expansion), where pressure relief is accomplished without transient effects, are not evaluated.

Qualification testing of sensitive electrical/pneumatic equipment to meet performance requirements defined in Tables 3.11-1, 3.11-2 and 3.11-3 is completed.

Seismic tests have been conducted on the safety relief valves and the natural frequencies have been determined to be ≥ 33Hz. The tests also determined that the equipment remains functional during application of the specified "G" loads.

In addition to testing described above and in 3.9.2.2.2, the sensitive electrical/pneumatic equipment of the safety/relief valve has been qualified to performance requirements during and after emergency environment conditions defined in Tables 3.11-1, 3.11-2 and 3.11-3.

The MSIV and S/RV (Safety/Relief Valve) analytical qualification results are shown in Tables 3.9-2(h) and 3.9-2(g) respectively.

3.9.3.3 Design and Installation Details for Mounting of Pressure Relief Devices

The design criteria for all safety and relief piping are in accordance with the rules in Subarticles NB-3677 and NC-3677 of ASME Section III, and the rules of Code Case 1569, applicable to the classification of the piping component under investigation. For relief systems the design criteria and the analyses used to calculate maximum stresses and stress intensities are in accordance with Subarticles NB-3600 and NC-3600 of ASME Section III. The maximum stresses are calculated based upon the full discharge loads, including the effects of the system dynamic response, and the system design internal pressure. Stresses are determined for all significant points in the piping system including the safety valve inlet pipe nozzle and the nozzle to shell juncture.

Insert

3.9.3.3.1 Main Steam Safety/Relief Valves

Safety/relief valve lift results in a transient that produces momentary unbalanced forces acting on the discharge piping system for the period from opening of the safety/relief valve until a steady discharge flow from the reactor pressure vessel to the suppression pool is established. This period includes clearing of the water slug from the end of the discharge piping submerged in the suppression pool. Pressure waves traveling through the discharge piping following the relatively rapid opening of the safety/relief valve cause the safety/relief valve discharge piping to vibrate. This in turn produces forces that act on the main steam piping.

The analysis of the relief valve discharge transient consists of a stepwise time history solution of the fluid flow equation, to generate a time-history of the fluid properties at numerous locations along the pipe. Simultaneously, reaction loads on the pipe are determined at each location corresponding to the position of an elbow. These loads are composed of pressure-times-area, momentum change, and fluid friction terms. Figure 3.9-3 shows a set of fluid property and pipe section load transients typical of those produced by relief valve discharge.

The method of analysis applied to determine piping system response to relief valve operation is time history integration. The forces are applied at locations on the piping system where fluid flow changes direction, thus causing momentary reactions. The resulting loads on the safety/relief valve, the main steam line, and the discharge piping are combined with loads due to other effects as specified in 3.9.3.1. The Code stress limits, corresponding to load combinations classification as normal, upset, emergency and faulted, are applied to the steam and discharge pipe.

3.9.3.3.2 Open Relief Systems

~~The total steady state discharge thrust load for an open dis-~~ charge system is expressed as the sum of the pressure and momentum forces as follows:

$$\frac{F}{A} = 144\,(P) + \frac{V^2\rho}{g}$$

where
F = Total Reaction Force lbf.
A = Exit Flow Area, ft^2
P = Exit Pressure, lbf/in^2 gage
V = Exit Fluid Velocity, ft/sec
ρ = Exit Fluid Density, lbm/ft^3
g = Gravity Acceleration, 32.2 $\frac{lbm\text{-}ft}{lbf\text{-}sec^2}$

To ensure consideration of the effects of the suddenly applied loads on the valve nozzle and pipe junction, a dynamic load factor is computed. The calculation of dynamic load factor is based on modeling the valve and nozzle as a single degree of freedom dynamic system. The lumped mass of this system corresponds to the weight of the valve and nozzle ~~and is assumed to be at the valve center of gravity. The~~

There are no open discharge pressure relief valves mounted on class 1, 2, or 3 systems.

~~rotational degree of freedom of this system is considered to~~ be in the direction that causes maximum bending stress in the nozzle at the junction of the nozzle and run-pipe. Rotational flexibility of the system is computed by a series combination of nozzle flexibility and local run-pipe flexibility (at the junction of the nozzle and run-pipe).

The rise time of the discharge force at the outlet of the safety valve elbow is assumed to be the minimum valve opening time, and the discharge force is assumed to rise linearly with time. The ratio of maximum dynamic rotations predicted by this single degree of freedom system to the static rotation caused by the steady-state discharge force represents the dynamic load factor.

To ensure the consideration of the effects of the suddenly applied loads on the pipe system, a dynamic time history analysis is performed on the piping system. The forcing function applied at the point of discharge is a linear force change from zero to the value of (F) that is determined in the above equation over a time period (t) that corresponds to the valve opening time which is provided by the valve manufacturer. After time (t) has been reached the force remains at the value of (F) until the conclusion of the time history integration. The lumped mass model that represents the piping system includes the safety-relief valves.

Where more than one valve is mounted on a common header, two cases are computed. In the first, full discharge of all valves is assumed to occur simultaneously. In the second the forcing functions are applied to a combination of valves that yields the worst load case. This worst load case is first ~~verified by trial through a series of static load cases.~~

3.9.3.3.3 Closed Relief System

For relief valve discharging into closed system, an analytical model of one-dimensional transient flow characteristics following the blow-off of the upstream safety/relief valve into the discharging piping system is established. The time-dependent pressure, temperature, density, velocity and hence the momentum of the downstream pipe flow are then computed from this conservative hydrodynamic/thermodynamic flow model. The phenomena such as flow restrictions, frictional resis-

QUESTION NO. 42
(3.9.3.4)

The applicant's response to NRC Question 110.29 is not completely acceptable. Paragraph 3.9.3.4 implies that the reactor vessel support skirt was designed to an allowable compressive load of .8 material yield stress. It is not clear how the applicant's design would meet the staff's acceptable allowable load of two-thirds of critical buckling load. In addition, the applicant has assumed the critical buckling stress as the material yield stress at temperature. Provide basis for this assumption.

RESPONSE

Per GE design specification, the permissible compressive load on the reactor vessel support skirt cylinder (plate and shell type component support) was limited to 90 percent of the load which produces yield stress, divided by the safety factor for the condition being evaluated. The effects of fabrication and operational eccentricity was included. The safety factor for faulted conditions was 1.125.

An analysis of reactor pressure vessel support skirt buckling for faulted conditions shows that the support skirt has the capability to meet ASME Code Section III, Paragraph F-1370(c) faulted condition limits of 0.67 times the critical buckling strength of the support at temperature. The faulted condition analyzed included the compressive loads due to the design basis maximum earthquake, the overturning moments and shears due to the jet reaction load resulting from a severed pipe, and the compressive effects on the support skirt due to the thermal and pressure expansion of the reactor vessel. The expected maximum earthquake loads for the Hanford 2 reactor vessel support skirt are less than 50% of the maximum design basis loads used in the buckling analysis described; therefore, the expected faulted loads are well below the critical buckling limits of Paragraph F-1370(c) for this reactor vessel support skirt. The expected earthquake loads for this reactor were determined using the seismic dynamic analysis methods described in Section 3.7 of the WNP-2 Final Safety Analysis Report.

The assumption that the critical buckling stress in the material yield stress at temperature is not needed in the design analysis.

Summation: This item is closed.

QUESTION NO. 43
(3.9.3.4)

The applicant has supplied information concerning the design of not only the bolts but also the baseplates into which the bolts are inserted and which the bolts connect to the underlying concrete or steel structures. This information has been submitted as a response to our Office of Inspection and Enforcement Bulletin 79-02, "Pipe Support Base Plate Design Using Concrete Expansion Anchor Bolts". The review of this information is being performed jointly by our Office of Inspection and Enforcement and our Office of Nuclear Reactor Regulation. We will report the results of our review in a supplement to this Safety Evaluation Report.

Summation - No action. Closed item for MEB.

QUESTION NO. 44
(3.9.4)

Paragraph 3.9.4.3 (Page 3.9-73) states that deformation is not a limiting factor in the analysis of the CRD's components since the stresses are in the elastic region. This statement is not necessarily valid. It seems that elastic deformations and thermal deformations could possibly result in critical displacements. Have these areas been considered in the analysis?

RESPONSE

Elastic and thermal deformation have both been considered in the design of the reactor internals and control rod drives to ensure that the rod insertability is not affected, i.e. no mechanical interference, during and after an accident. Studies show that no plastic deformation occurs.

Summation - This item is closed.

PCY:rf/45E15
8/18/81

QUESTION NO. 45
(3.9.4)

Table 3.9-2(v) (pages 3.9-167) lists the stress limit for faulted conditions as: S_{limit} = 1.2 Sm = 1.2 x 16660 = 20,000 psi, with a note: Analyzed to emergency conditions limits then in the column of Allowable Stress is listed 24990 psi, and a calculated stress of 22030. The calculated stress is within the limits for an allowable stress of 24990 but not for an allowable stress of 20000 psi. Clarification is requested of this area (Ref. Section 3.9.3.1(a) of this draft SER).

RESPONSE

At the time the allowable stress was originally calculated, the emergency limit for "membrane plus bending" was 1.5 Sm or 24,990 psi. Since then, the code has adopted an S'm which is 1.2 Sm. Therefore the allowable is now 1.5 S'm = 1.5 x (1.2 x Sm) = 1.5 x (1.2 x 16,660) = 29,990 psi. Accordingly, the table entry is revised as attached.

Summation - This item is closed.

PCY:ggt:rf/45L17
9/23/81.

TABLE 3.9-2 (v)

CONTROL ROD DRIVE HOUSING

	Operating Condition	Loading Combinations
A.	Normal & Upset	$P_D + F_{SR} + W + OBE$
B.	Emergency	$P_P + F_{SRP} + W + SSE$

Stress Limits:

The stress limits for the CRD are per ASME Boiler and Pressure Vessel Code and are listed on the attached tables.

P_D: Design pressure

P_P: Peak pressure

F_{SR}: Load due to stuck rod scram at design pressure

F_{SRP}: Load due to stuck rod scram at peak pressure

W: Static weights

TABLE 3.9-2 (v) (Continued)

Criteria	Loading	Primary Stress Type	Allowable Stress (psi)	Calculated Stress (psi)
Primary Stress Limit - The allowable primary membrane stress is based on the ASME Boiler and Pressure Vessel Code, Section III, for Class 1 vessels, for type 304 stainless steel.	Normal and upset condition loads 1. Design pressure 2. Stuck rod scram loads 3. Operational basis earthquake, with housing lateral support installed.	Maximum membrane stress intensity occurs at the tube to tube weld near the center of the housing for normal, upset and emergency conditions.	16,660 16,660	11,900 14,480 ~~1,448~~
For normal and upset conditions: S_m = 16,660 psi @ 575°F				
For faulted conditions: ~~S_{limit} = 1.2S_m = 1.2 x 16,660 = 20,000 psi~~ Note: Analyzed to emergency conditions limits.	Emergency conditions loads 1. Design pressure 2. Stuck rod scram loads 3. Design basis earthquake, with housing lateral support installed.		29,990 ~~21,990~~	22,030

$S_{limit} = 1.5 \times 1.2 \times S_m$
$= 29,990$ psi

(A-1)

WNP-2

QUESTION NO. 46
(3.9.5)

Table 3.9-13 establishes stress intensity limits for the core support structure faulted loading conditions. As this table is somewhat different than the limits from Section III Appendix F, what is the basis and justification for Table 3.9-13? Would the computed stresses be in compliance with the faulted condition limits of Section III Appendix F?

RESPONSE

The limits outlined in Table 3.9-13 were based on a draft of ASME Code Section III Subsection NG issued in January 1971. The limits are not significantly different from those shown in Appendix F of the current code. The attached Table shows that in many cases 3.9-13 is more conservative than Appendix F. But in one case it is slightly lower (0.75 Su instead of 0.7 Su). Overall there are no significant differences between the 2 sets of limits. It is therefore shows that the stresses would meet Appendix F also.

TABLE 3.9-13

CORE SUPPORT STRUCTURES

STRESS CATEGORIES AND LIMITS OF STRESS INTENSITY FOR FAULT CONDITIONS

STRESS CATEGORIES	PRIMARY STRESSES: MEMBRANE, P_m (NOTES 1,2&3) — P_m		PRIMARY STRESSES: BENDING, P_B (NOTES 1,2&3) — $P_m + P_B$		SECONDARY STRESSES: MEMBRANE & BENDING SECONDARY, Q	PEAK STRESSES: PEAK F
FAULT (NOTE 9)	$2.4S_m$	ELASTIC ANALYSIS	$3.0S_m$ 3.6Sm Appendix F	ELASTIC ANALYSIS	EVALUATION NOT REQUIRED	EVALUATION NOT REQUIRED
	OR		OR			
	$0.75S_u$ 0.7Su per Appendix F	(NOTE 5)	$1.33L_L$	LIMIT ANALYSIS (NOTE 4)		
	OR		OR			
	$1.33L_L$	LIMIT ANALYSIS (NOTE 4)	$0.75S_u$	PLASTIC ANALYSIS (NOTES 5&6)		
	OR		OR			
	$0.67S_u$	PLASTIC ANALYSIS (NOTES 5&6)	$0.8L_T$	TEST (NOTE 7)		
	OR		OR			
	$0.8L_T$	TEST (NOTE 7)	KS_f	STRESS-RATIO ANALYSIS (NOTE 8)		
	OR					
	S_f	STRESS-RATIO ANALYSIS (NOTE 8)				

Essentially same as Appendix F

TABLE 3.9-12 (Continued)

the ultimate strength or other governing material properties of the actual part and the tested parts to assure that the loads obtained from the test are a conservative representation of the load carrying capability of the actual component under postulated loading for emergency conditions.

NOTE 8 - Stress ratio is a method of plastic analysis which uses the stress ratio combinations (combination of stresses that consider the ratio of the actual stress to the allowable plastic or elastic stress) to compute the maximum load a strain hardening material can carry. K is defined as the section factor; $S_e \leq 2S_m$ for primary membrane loading.

NOTE 9 - Where deformation is of concern in a component, the deformation shall be limited to two-thirds the value given for Emergency Conditions in the Design Specification.

NOTE 10 - When loads are transiently applied, consideration should be given to the use of dynamic load amplification and possible change in modulus of elasticity.

QUESTION No. 47

It is the staff position that all BWR's under construction should document their actions being taken with respect to the problem of cracking of jet pump holddown beams. We will require the applicant's response to the letter from R. Tedesco to N. Strand, "Cracking of BWR Jet Pump Holddown Beam", dated August 5, 1980.

RESPONSE

The supply System's response to the letter from R. Tedesco to N. Strand "Cracking of BWR Jet Pump Holddown Beam", dated August 5, 1980, is contained in the letter from G. Bouchey to R. Tedesco dated December 4, 1980 (GO2-80-279). This letter states the action which will be taken by the Supply System with respect to the problem of jet pump holddown beam cracking.

Summation - This item is closed.