GENERAL ELECTRIC COMPANY

CLAMP INDUCED STRESS ON HOPE CREEK MAIN STEAM PIPING LINES C AND D

JULY 27, 1984

DESIGN MEMO #170-109

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TABLE OF CONTENTS

1.0 BACKGROUND

ASME III requires that the effects of attachment in producing thermal stresses, stress concentration and restraints on pressure retaining members shall be taken into account in checking for compliance with stress criteria. (NB-3645)

Attachments to piping are generally categorized as integral attachments and non-integral attachments. Lugs and stanchions welded to the pipe wall are examples of integral attachments. Clamps used for attaching hangers and snubbers to the pipe by bolting are non-integral attachments.

The design reports prepared by General Electric specifically address local stresses at integral attachments (lugs) if the loads on the lug are significant. Rules for evaluating local stress at lugs have been defined by ASME Code cases N122 and N318. GE computer programs evaluate local stress at lugs in a manner consistent with these Code cases.

In November of 1983, the Nuclear Regulatory Committee issued IE Information Notice 83-80: Use of Specialized "Stiff" Pipe Clamps, (Appendix C). The information notice identified three concerns with stiff pipe clamps: excessive bolt preload induced stresses in the pipe, small clamp contact bearing areas that could induce local overstress and the effect of clamp on elbow stress indices. Although no response was required from the notice, the issue was raised in question 210.53 of the Hope Creek final safety analysis report. The response to the question committed to evaluate the affect of stiff clamps on the piping.

2.0 PURPOSE

This analysis evaluates the stresses induced by E-System clamps attached to the main steam piping in General Electric's scope of supply.

3.0 DISCUSSION

The Code does not have rules for the evaluation of non-integral attachments; however, methods consistent with the intent of the Code have been developed to address the concerns of Information Notice 83-80 and the Code.

3.1 Primary Membrane Stresses

The existence of a pipe clamp will not affect the calculation for minimum wall, in fact, membrane stresses in the circumferential direction due to pressure will be less in the vicinity of the clamp than in the areas away from the clamp. The primary membrane stress is less than that of straight pipe due to clamp reinforcement of effective thickness.

3.2 Primary Membrane Plus Primary Bending Stresses

Equation 9 is aimed at preventing collapse of the piping system due to loads that produce primary stresses. Collapse is prevented by keeping the stresses due to pressure, dead weight, and inertia effects of dynamic loads to less than prescribed values. The existence of clamps on piping systems do not adversely affect the moment carrying capability nor do they reduce the ability of the piping system to resist collapse under combined loadings that produce primary stresses.

The only concern is the loading transmitted from the snubber through the clamp pad to the pipe. This bearing load will result in local stress in the pipe wall. These stresses are conservatively calculated using the indice method and added to the membrane and overall bending stresses computed by equation 9 of the Code.

3.3 Stresses Due to Preload

When the clamp is initially installed on the piping system and the bolts are tightened, the preload will produce stress in the pipe wall. The stress produced by preload is applied one time and produces a stress of only one quarter cycle. Stresses of this type need not be included in the stress evaluations required by NB-3600. Although bolt preloads are not addressed under the Code, bolt preloads could result in damage to a pipe if a clamp was poorly designed. Calculations have been made to ensure that bolt preloads could not result in local plastic deformation of the piping.

3.4 Clamp Design Criteria

The stiff type clamps were designed to provide a high strength attachment for the pipe which would not slip and would fit on the smallest practical length of pipe. Clamp design of the strap type are too wide to fit in many locations and require lugs to hold them in position. The stiffness of a compact high strength clamp is inherently greater than that of a strap type. General Electric specifications require that all clamps be significantly stiffer than the snubber attached to it. The stiffness requirement does not govern the design of stiff type clamps.

3.5 Protection from Loosening

In order for the clamp to hold its position during vibratory loads, it must grip the pipe with enough force to prevent sliding. The two mechanisms for clamp loosening are loss of tension in the bolt due to nut backing off and bolt stress relaxation. To prevent backing off of the nuts, all bolts have double nuts. The bolt material selected for the clamp is an A490 type commonly used for flange bolts. This material was selected because at the temperatures of concern, it is resistent to relaxation.

3.6 Stress Due to Contraint of Expansion from Internal Pressure

Clamp induced stresses caused by the constraint of pipe expansion due to internal pressure have been added to other operating secondary and peak stresses by calculating special C_1 and K_1 indices for the clamp.

3.7 Stress Due to Constraint of Differential Thermal Expansion

Clamp induced stresses due to differential temperatures and material expansion coefficients have been accounted for by computing special C_3 and K_3 indices for the clamp. The stresses have been added to other operating secondary and peak stresses.

3.8 Fatigue Usage

The fatigue usage at each clamp location has been conservatively computed taking into consideration clamp induced stresses from pressure, temperature and snubber loadings. The clamp induced stresses were added to the stresses computed for each load set using equation 10 and 11 of NB-3650. Cumulative fatigue usage was computed by the rules of the Code.

3.9 Clamps on Elbows

Some clamps are located on or near the ends of elbows because of lack of space. Clamp loadings on elbows due to snubbers, internal pressure and differential expansion are similar to or less than those on straight pipe. The major difference between a clamp on straight pipe and on an elbow is the coupling between the pipe bending and the clamp loads due to elbow ovalization. The clamp tends to resist ovalization by stiffening the pipe wall. This local stiffening results in three effects: a slight stiffening of the elbow in bending, a slight reduction in overall elbow bending stress and a local stress concentration at the clamp pad. The first two effects are small and can be neglected in a stress analysis. The local stress concentration at the clamp pad is caused by the pad preventing the local region of elbow under it from assuming the ovalization curvature. This local resistance to curvature causes the stress concentration by crimping the pipe wall. Bending indices C_2 and and K_2 for elbows with clamps have been calculated to account for this secondary stress concentration effect.

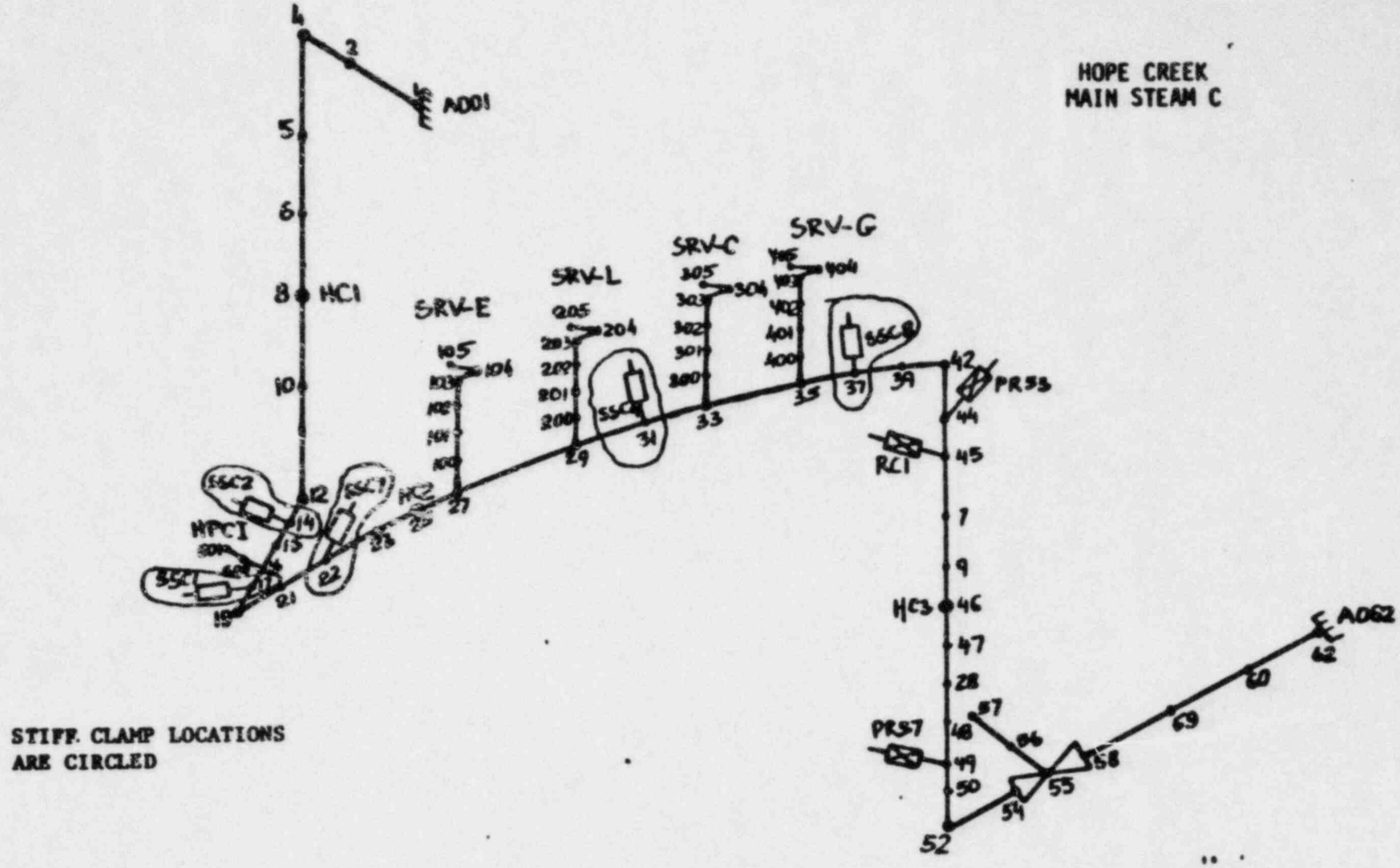


FIGURE A-1 NODE DIAGRAM FOR MAIN STEAM LINE C

Clamp Assembly Properties
Hope Creek Main Steam Line C

Clamp Rating (kips)	E-System Clamp Assembly Dwg.#	Clamp U-Bolt	Preload Torque (1) (ft-lb)	Pipe O.D. (in)	Pipe Nominal Wall Thickness (in)	SNB #	Node #	Location
70	157790, Rev. B	1¼-8UN-2A	700	26.0	1.158	SSC2	014	Riser
70	157790, Rev. B	1¼-8UN-2A	700	26.0	1.158	SSC1	017	Riser
50	157791, Rev. B	1¼-8UN-2A	470	26.0	1.158	SSC7	022	Header
70	157790, Rev. B	1¼-8UN-2A	700	26.0	1.158	SSC4	031	Header
50	157791, Rev. B	1¼-8UN-2A	470	26.0	1.158	SSC8	037	Header

1 - E-Systems Snubber and Accessories Installation Drawing 152943, Rev. B

Table A-2

0725849

HOPE CREEK MS C MAIN STEAM C

THE LOADING COMBINATION USED FOR THE ANALYSIS ** 1*** ARE AS FOLLOW

DESIGN 1	PD + WT1	+ OBE1			
LEVL B 1	PP + WT1	+ SQRT((OBE1	)**2	+ (TSV	)**2)
LEVL B 2	PP + WT1	+ SQRT((OBE1	)**2	+ (RV1	)**2)
LEVL C 1	PP + WT1	+ RV1			
LEVL D 1	PP + WT1	+ SQRT((SSE1	)**2	+ (TSV	)**2)
LEVL D 2	PP + WT1	+ SQRT((SSE1	)**2	+ (RV1	)**2)
LEVL D 3	PP + WT1	+ SQRT((AP1	)**2	+ (SSE1	)**2)

NOTE ALL UNITS ARE IN POUNDS, INCHES EXCEPT NOTED

NOTE IF NO USER INPUT PRESSURE FOR EACH LOAD COMBINATION, PEAK PRESSURE WILL BE USED FOR LEVEL B,C AND D

TABLE A-3
LOAD COMBINATIONS

0725843

GENERAL ELECTRIC COMPANY
BOILING WATER REACTOR SYSTEMS DEPARTMENT

SPEC NO. 23A REV. NO. 0

HOPE CREEK MS C MAIN STEAM C NEAR NODE 014.

OD= 26.000 ID= 23.684 T= 1.158 I= 6986.7 Z= 537.4

B1 = 0.50 C1= 1.49 C2= 1.00 C3= 1.85 C3'= 0.50
B2 = 1.00 K1= 1.00 K2= 1.00 K3= 1.00

STRESS DUE TO LUG SNB 014. SSC2 ARE INCLUDED

A. PRIMARY STRESSES (EQUATION 9)

SERVICE LEVEL	COMB. NO.	PRESSURE STRESS	BENDING AND TORSION STRESS	TOTAL STRESS	ALLOWABLE STRESS	STRESS RATIO
DESIGN	1	7019.	1048.	9520.	26550.	0.359
LEVL B	1	7505.	1215.	12609.	31860.	0.396
LEVL B	2	7505.	1081.	10656.	31860.	0.334
LEVL C	1	7505.	395.	9372.	39825.	0.235
LEVL D	1	7505.	1215.	12849.	53100.	0.242
LEVL D	2	7505.	1081.	11078.	53100.	0.209
LEVL D	3	7505.	1969.	18400.	53100.	0.347

B. PRIMARY PLUS SECONDARY (EQUAT 10)	1 5	55322.	53100.	
C. SECONDARY STRESS RANGE (EQUATION 12)	1 13	2836.	53100.	0.053
D. PRIMA PLUS SECO EXC TH EXP (EQUAT 13)	10 13	30622.	53100.	0.577
E. CLAMP PRE-LOAD STRESS		7277.	27052.	0.269.
F. CUMULATIVE USAGE FACTOR		0.129	1.0	0.129

Table A-4.1

0725043

GENERAL ELECTRIC COMPANY
BOILING WATER REACTOR SYSTEMS DEPARTMENT

SPEC NO. 23A REV. NO. 0

HOPE CREEK MS C MAIN STEAM C NEAR NODE 017.

OD= 26.000 ID= 23.684 T= 1.158 I= 6986.7 Z= 537.4

B1 = 0.50 C1= 1.49 C2= 1.00 C3= 1.85 C3'= 0.50
B2 = 1.00 K1= 1.00 K2= 1.00 K3= 1.00

STRESS DUE TO LUG SNB 017. SSC1 ARE INCLUDED

A. PRIMARY STRESSES (EQUATION 9)

SERVICE LEVEL	COMB. NO.	PRESSURE STRESS	BENDING AND TORSION STRESS	TOTAL STRESS	ALLOWABLE STRESS	STRESS RATIO
DESIGN	1	7018.	2029.	15836.	26550.	0.596
LEVL B	1	7505.	2052.	16913.	31860.	0.531
LEVL B	2	7505.	2075.	16763.	31860.	0.526
LEVL C	1	7505.	596.	10445.	39825.	0.262
LEVL D	1	7505.	2052.	16913.	53100.	0.319
LEVL D	2	7505.	2075.	16763.	53100.	0.316
LEVL D	3	7505.	2337.	18445.	53100.	0.347

B. PRIMARY PLUS SECONDARY (EQUAT 10)	1 5	65414.	53100.	
C. SECONDARY STRESS RANGE (EQUATION 12)	1 12	3493.	53100.	0.066
D. PRIMA PLUS SECO EXC TH EXP (EQUAT 13)	10 13	31603.	33100.	0.595
E. CLAMP PRE-LOAD STRESS		7277.	27052.	0.269
F. CUMULATIVE USAGE FACTOR		0.160	1.0	0.160

Table A-4.2

0725843

GENERAL ELECTRIC COMPANY — SPEC NO. 23A — REV. NO. 0
BOILING WATER REACTOR SYSTEMS DEPARTMENT

HOPE CREEK MS C — MAIN STEAM C — NEAR NODE 022.

OD= 26.000 ID= 23.684 T= 1.158 I= 6986.7 Z= 537.4

B1 = 0.50 C1= 1.35 C2= 1.00 C3= 1.62 C3'= 0.50
B2 = 1.00 K1= 1.00 K2= 1.00 K3= 1.00

STRESS DUE TO LUG SNB 022. SSC7 ARE INCLUDED

A. PRIMARY STRESSES (EQUATION 9)

SERVICE LEVEL	COMB. NO.	PRESSURE STRESS	BENDING AND TORSION STRESS	TOTAL STRESS	ALLOWABLE STRESS	STRESS RATIO
DESIGN	1	7016.	1811.	10512.	26550.	0.396
LEVL B	1	7505.	1866.	12523.	31860.	0.393
LEVL B	2	7505.	1877.	12634.	31860.	0.397
LEVL C	1	7505.	738.	11025.	39825.	0.277
LEVL D	1	7505.	1866.	12946.	53100.	0.244
LEVL D	2	7505.	1877.	13044.	53100.	0.246
LEVL D	3	7505.	2197.	18419.	53100.	0.347

B. PRIMARY PLUS SECONDARY (EQUAT 10) 1 3	53247.	53100.	
C. SECONDARY STRESS RANGE (EQUATION 12) 1 12	3530.	53100.	0.066
D. PRIMA PLUS SECO EXC TH EXP (EQUAT 13)10 13	29530.	53100.	0.556
E. CLAMP PRE-LOAD STRESS	5890.	27052.	0.218
F. CUMULATIVE USAGE FACTOR	0.108	1.0	0.108

Table A-4.3

0725843

GENERAL ELECTRIC COMPANY SPEC NO. 23A REV. NO. 0
BOILING WATER REACTOR SYSTEMS DEPARTMENT

HOPE CREEK MS C MAIN STEAM C NEAR NODE 031.

OD= 26.000 ID= 23.684 T= 1.158 I= 6986.7 Z= 537.4

B1 = 0.50 C1= 1.51 C2= 1.50 C3= 1.85 C3'= 0.50
B2 = 1.01 K1= 1.00 K2= 1.00 K3= 1.00

STRESS DUE TO LUG SNB 031. SSC4 ARE INCLUDED

A. PRIMARY STRESSES (EQUATION 9)

SERVICE LEVEL	COMB. NO.	PRESSURE STRESS	BENDING AND TORSION STRESS	TOTAL STRESS	ALLOWABLE STRESS	STRESS RATIO
DESIGN	1	7016.	2028.	18747.	26550.	0.706
LEVL B	1	7505.	2123.	19735.	31860.	0.619
LEVL B	2	7505.	2170.	20285.	31860.	0.637
LEVL C	1	7505.	1107.	12907.	39825.	0.324
LEVL D	1	7505.	2123.	19735.	53100.	0.372
LEVL D	2	7505.	2170.	20285.	53100.	0.382
LEVL D	3	7505.	2372.	20993.	53100.	0.395

B. PRIMARY PLUS SECONDARY (EQUAT 10) 1 5	71444.	53100.	
C. SECONDARY STRESS RANGE (EQUATION 12) 1 12	5839.	53100.	0.110
D. PRIMA PLUS SECO EXC TH EXP (EQUAT 13)10 13	32851.	53100.	0.619
E. CLAMP PRE-LOAD STRESS	7277.	27052.	0.269
F. CUMULATIVE USAGE FACTOR	0.327	1.0	0.327

Table A-4.4

0725843

GENERAL ELECTRIC COMPANY SPEC NO. 23A REV. NO. 0
BOILING WATER REACTOR SYSTEMS DEPARTMENT

HOPE CREEK MS C BRANCH CONNECTIONS NEAR NODE 037.

OD= 26.000 ID= 23.684 T= 1.158 I= 6986.7 Z= 537.4

B1 = 0.50 C1= 1.37 C2= 1.50 C3= 1.62 C3'= 0.50
B2 = 1.01 K1= 1.00 K2= 1.00 K3= 1.00

STRESS DUE TO LUG SNB 037. SSCS ARE INCLUDED

A. PRIMARY STRESSES (EQUATION 9)

SERVICE LEVEL	COMP. NO.	PRESSURE STRESS	BENDING AND TORSION STRESS	TOTAL STRESS	ALLOWABLE STRESS	STRESS RATIO
DESIGN	1	7016.	1102.	13550.	26550.	0.510
LEVL B	1	7505.	1567.	17298.	31860.	0.543
LEVL B	2	7505.	1286.	14955.	31860.	0.469
LEVL C	1	7505.	693.	11110.	39825.	0.279
LEVL D	1	7505.	1567.	17377.	53100.	0.327
LEVL D	2	7505.	1286.	15060.	53100.	0.284
LEVL D	3	7505.	1436.	16680.	53100.	0.314

B. PRIMARY PLUS SECONDARY (EQUAT 10)	1 5	66583.	53100.	
C. SECONDARY STRESS RANGE (EQUATION 12)	1 12	12965.	53100.	0.244
D. PRIMA PLUS SECO EXC TH EXP (EQUAT 13)	10 13	29621.	53100.	0.558
E. CLAMP PRE-LOAD STRESS		5890.	27052.	0.218
F. CUMULATIVE USAGE FACTOR		0.195	1.0	0.195

Table A-4.5

Highest Clamp Induced Stress Intensities
Hope Creek Main Steam Line C

Item Evaluated (1)	Highest Calulated Usage/Factor (psi)	Allowable Limits	Ratio Actual/Allowed	Governing Load (2) Comb. No.	Identification of Location of Highest Stress Points
Primary Stress Eq. 9 $\leq$ 1.5Sm Design Condition	18747	26550	0.706	1	SSC4, Header
Primary Stress Eq. 9 $\leq$ 1.8Sm & 1.5Sy Service Level B	20285	31860	0.637	2	SSC4, Header
Primary Stress Eq. 9 $\leq$ 2.25Sm & 1.8Sy Service Level C	12907	39825	0.324	1	SSC4, Header
Primary Stress Eq. 9 $\leq$ 3.0Sm Service Level D	20993	53100	0.395	3	SSC4, Header
Primary plus Secondary Eq. 10 $\leq$ 3.0Sm	71444	53100	1.345 (3)	-	SSC4, Header
Secondary Stresses Eq. 12 $\leq$ 3.0Sm	12965	53100	0.244	-	SSC8, Header
Primary plus Secondary Stress without Thermal Expansion Eq. 13 $\leq$ 3.0Sm	32851	53100	0.619	-	SSC4, Header
Cumulative Usage Factor U $\leq$ 1.0	0.327	1.0	0.327	-	SSC4, Header

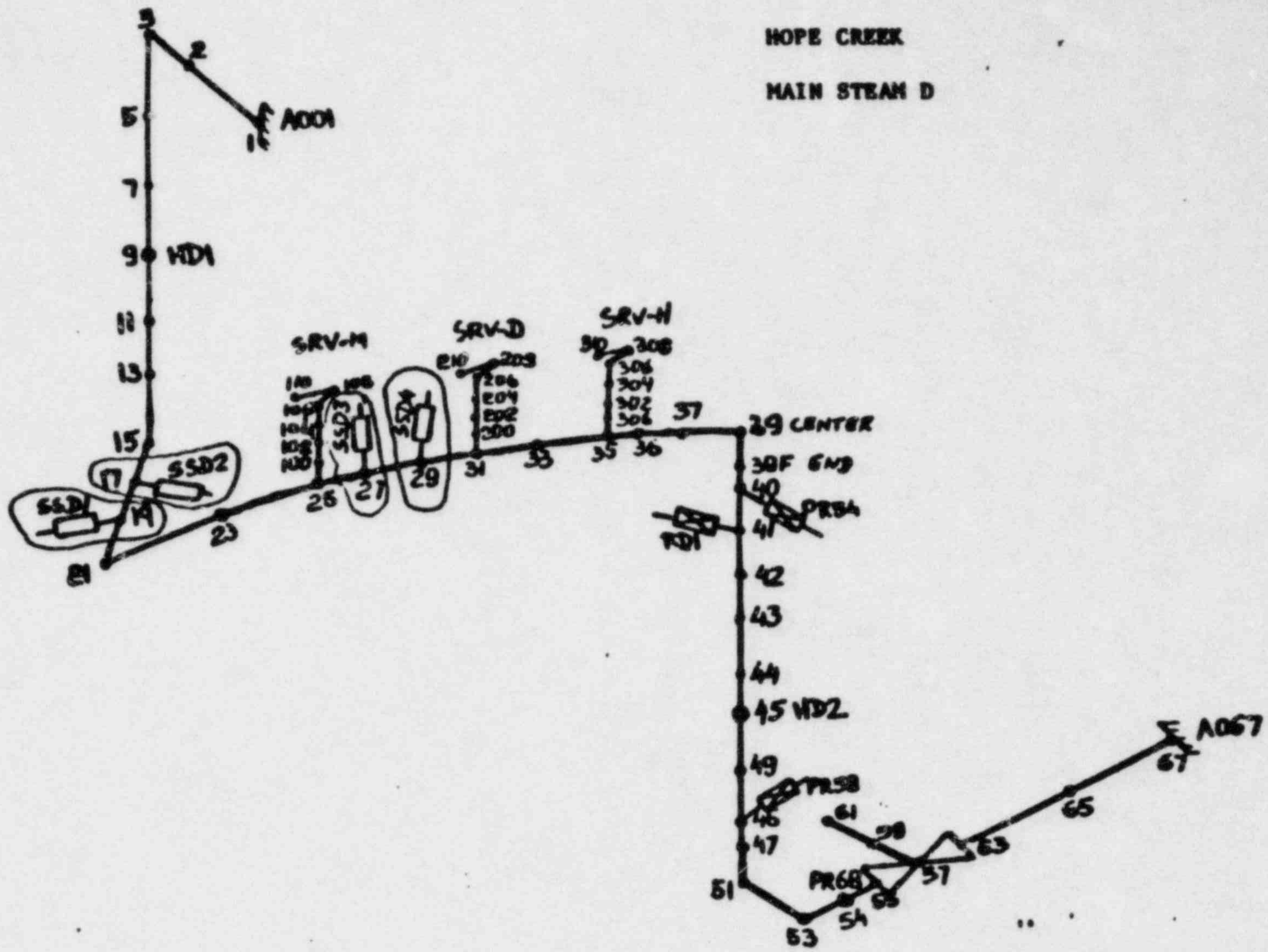
(1) All equations used are from ASME B&PV Code, Sec. III - NB-3650.
(2) See Table A-3

(3) Eqn. 10 triggers fatigue usage calculation using low cycle fatigue method. Since fatigue usage is within allowable, the higher ratio is acceptable.

Table A-5

HOPE CREEK

MAIN STEAM D



STIFF CLAMP LOCATIONS
ARE CIRCLED

FIGURE B-1 - NODE DIAGRAM FOR MAIN STEAM LINE D

Clamp Assembly Properties
Hope Creek Main Steam Line D

Clamp Rating (kips)	E-System Clamp Assembly Dwg.#	Clamp U-Bolt	Preload Torque (1) (ft-lb)	Pipe O.D. (in)	Pipe Nominal Wall Thickness (in)	SNB #	Node #	Location
70	157790, Rev. B	1½-8UN-2A	700	26.0	1.158	SSD2	017	Riser
70	157790, Rev. B	1½-8UN-2A	700	26.0	1.158	SSD1	019	Riser
70	157790, Rev. B	1½-8UN-2A	700	26.0	1.158	SSD3	027	Header
70	157790, Rev. B	1½-8UN-2A	700	26.0	1.158	SSD4	029	Header

1 - E-Systems Snubber and Accessories Installation Dwg. 152943, Rev. B

Table B-2

0728843

GENERAL ELECTRIC COMPANY SPEC NO. 23A REV. NO. 0
BOILING WATER REACTOR SYSTEMS DEPARTMENT

HOPE CREEK MS D MAIN STEAM D

THE LOADING COMBINATION USED FOR THE ANALYSIS ** 1*** ARE AS FOLLOW

DESIGN 1	PD + WT1	+ OBEI			
LEVL B 1	PP + WT1	+ SQRT((OBEI)**2	+ (TSV)**2	)	
LEVL B 2	PP + WT1	+ SQRT((OBEI)**2	+ (RV1)**2	)	
LEVL C 1	PP + WT1	+ RV1			
LEVL D 1	PP + WT1	+ SQRT((SSEI)**2	+ (TSV)**2	)	
LEVL D 2	PP + WT1	+ SQRT((SSEI)**2	+ (RV1)**2	)	
LEVL D 3	PP + WT1	+ SQRT((API)**2	+ (SSEI)**2	)	

NOTE ALL UNITS ARE IN POUNDS, INCHES EXCEPT NOTED

NOTE IF NO USER INPUT PRESSURE FOR EACH LOAD COMBINATION, PEAK PRESSURE WILL BE USED FOR LEVEL B,C AND D

TABLE B-3
LOAD COMBINATIONS

0725643

GENERAL ELECTRIC COMPANY SPEC NO. 23A REV. NO. 0
BOILING WATER REACTOR SYSTEMS DEPARTMENT

HOPE CREEK MS D MAIN STEAM D NEAR NODE 017.

OD= 26.000 ID= 23.684 T= 1.158 I= 6986.7 Z= 537.4

B1 = 0.50 C1= 1.49 C2= 1.00 C3= 1.85 C3'= 0.50
B2 = 1.00 K1= 1.00 K2= 1.00 K3= 1.00

STRESS DUE TO LUG SNB 017. SSD2 ARE INCLUDED

A. PRIMARY STRESSES (EQUATION 9)

SERVICE LEVEL	COMB. NO.	PRESSURE STRESS	BENDING AND TORSION STRESS	TOTAL STRESS	ALLOWABLE STRESS	STRESS RATIO
DESIGN	1	7016.	552.	9523.	26550.	0.359
LEVL B	1	7505.	605.	10440.	31860.	0.328
LEVL B	2	7505.	743.	10474.	31860.	0.329
LEVL C	1	7505.	546.	9117.	39825.	0.229
LEVL D	1	7505.	605.	10440.	53100.	0.197
LEVL D	2	7505.	743.	10474.	53100.	0.197
LEVL D	3	7505.	1116.	13393.	53100.	0.252

B. PRIMARY PLUS SECONDARY (EQUAT 10)	1 5	58643.	53100.	
C. SECONDARY STRESS RANGE (EQUATION 12)	1 12	5454.	53100.	0.103
D. PRIMA PLUS SECO EXC TH EXP (EQUAT 13)	10 13	30126.	53100.	0.567
E. CLAMP PRE-LOAD STRESS		7277.	27052.	0.269
F. CUMULATIVE USAGE FACTOR		0.151	1.0	0.151

Table B-4.1

GENERAL ELECTRIC COMPANY
BOILING WATER REACTOR SYSTEMS DEPARTMENT

SPEC NO. 23A REV. NO. 0

HOPE CREEK MS D MAIN STEAM D NEAR NODE 019.

OD= 26.000 ID= 23.684 T= 1.158 I= 6986.7 Z= 537.4

B1 = 0.50 C1= 1.49 C2= 1.00 C3= 1.85 C3'= 0.50
B2 = 1.00 K1= 1.00 K2= 1.00 K3= 1.00

STRESS DUE TO LUG SNB 019. SSD1 ARE INCLUDED

A. PRIMARY STRESSES (EQUATION 9)

SERVICE LEVEL	COMB. NO.	PRESSURE STRESS	BENDING AND TORSION STRESS	TOTAL STRESS	ALLOWABLE STRESS	STRESS RATIO
DESIGN	1	7016.	595.	9578.	26550.	0.361
LEVL B	1	7505.	642.	10211.	31860.	0.320
LEVL B	2	7505.	802.	10494.	31860.	0.329
LEVL C	1	7505.	581.	9043.	39825.	0.227
LEVL D	1	7505.	642.	10356.	53100.	0.195
LEVL D	2	7505.	802.	10631.	53100.	0.200
LEVL D	3	7505.	1142.	13138.	53100.	0.247

B. PRIMARY PLUS SECONDARY (EQUAT 10)	1 5	57694.	53100.	
C. SECONDARY STRESS RANGE (EQUATION 12)	1 12	5709.	53100.	0.108
D. PRIMA PLUS SECC EXC TH EXP (EQUAT 13)	10 13	30169.	53100.	0.568
E. CLAMP PRE-LOAD STRESS		7277.	27052.	0.269
F. CUMULATIVE USAGE FACTOR		0.148	1.0	0.148

Table B-4.2

0728843

GENERAL ELECTRIC COMPANY SPEC NO. 23A REV. NO. 0
BOILING WATER REACTOR SYSTEMS DEPARTMENT

HOPE CREEK MS D MAIN STEAM D NEAR NODE 027.

OD= 26.000 ID= 23.684 T= 1.158 I= 6986.7 Z= 537.4

B1 = 0.50 C1= 1.52 C2= 1.50 C3= 1.85 C3'= 0.50
B2 = 1.01 K1= 1.00 K2= 1.00 K3= 1.00

STRESS DUE TO LUG SNB 027. SSD3 ARE INCLUDED

A. PRIMARY STRESSES (EQUATION 9)

SERVICE LEVEL	COMB. NO.	PRESSURE STRESS	BENDING AND TORSION STRESS	TOTAL STRESS	ALLOWABLE STRESS	STRESS RATIO
DESIGN	1	7018.	777.	9447.	26550.	0.356
LEVL B	1	7505.	1104.	11288.	31860.	0.354
LEVL B	2	7505.	1032.	12313.	31860.	0.386
LEVL C	1	7505.	917.	11818.	39825.	0.297
LEVL D	1	7505.	1124.	11344.	53100.	0.214
LEVL D	2	7505.	1056.	12362.	53100.	0.233
LEVL D	3	7505.	1311.	13377.	53100.	0.252

B. PRIMARY PLUS SECONDARY (EQUAT 10)	1 5	62434.	53100.	
C. SECONDARY STRESS RANGE (EQUATION 12)	13 35	6915.	53100.	0.130
D. PRIMA PLUS SECO EXC TH EXP (EQUAT 13)	10 13	31126.	53100.	0.586
E. CLAMP PRE-LOAD STRESS		7277.	27052.	0.269
F. CUMULATIVE USAGE FACTOR		0.175.	1.0	0.175

Table B-4.3

0725843

GENERAL ELECTRIC COMPANY SPEC NO. 23A REV. NO. 0
BOILING WATER REACTOR SYSTEMS DEPARTMENT

HOPE CREEK MS D MAIN STEAM D NEAR NODE 029.

OD= 26.000 ID= 23.684 T= 1.158 I= 8986.7 Z= 537.4

B1 = 0.50 C1= 1.52 C2= 1.50 C3= 1.86 C3'= 0.50
B2 = 1.01 K1= 1.00 K2= 1.00 K3= 1.00

STRESS DUE TO LUG SNB 029. 8SD4 ARE INCLUDED

A. PRIMARY STRESSES (EQUATION 9)

SERVICE LEVEL	COMB. NO.	PRESSURE STRESS	BENDING AND TORSION STRESS	TOTAL STRESS	ALLOWABLE STRESS	STRESS RATIO
DESIGN	1	7016.	778.	8647.	26550.	0.326
LEVL B	1	7505.	1088.	9677.	31860.	0.304
LEVL B	2	7505.	994.	11579.	31860.	0.363
LEVL C	1	7505.	870.	11334.	39825.	0.285
LEVL D	1	7505.	1106.	9787.	53100.	0.184
LEVL D	2	7505.	1020.	11637.	53100.	0.219
LEVL D	3	7505.	1290.	11914.	53100.	0.224

B. PRIMARY PLUS SECONDARY (EQUAT 10) 1 5	60612.	53100.	
C. SECONDARY STRESS RANGE (EQUATION 12)13 38	7264.	53100.	0.137
D. PRIMA PLUS SECO EXC TH EXP (EQUAT 13)10 13	31127.	53100.	0.586
E. CLAMP PRE-LOAD STRESS	7277.	27052.	0.269
F. CUMULATIVE USAGE FACTOR	0.165	1.0	0.165

Table B-4.4

Highest Clamp Induced Stress Intensities
Hope Creek Main Steam Line D

Item Evaluated (1)	Highest Calulated Usage/Factor (psi)	Allowable Limits	Ratio Actual/Allowed	Governing Load (2) Comb. No.	Identification of Location of Highest Stress Points
Primary Stress Eq. 9 $\leq$ 1.5Sm Design Condition	9578	26550	0.361	1	SSD1, Riser
Primary Stress Eq. 9 $\leq$ 1.8Sm & 1.5Sy Service Level B	12313	31860	0.386	2	SSD3, Header
Primary Stress Eq. 9 $\leq$ 2.25Sm & 1.8Sy Service Level C	11818	39825	0.297	1	SSD3, Header
Primary Stress Eq. 9 $\leq$ 3.0Sm Service Level D	13393	53100	0.252	3	SSD2, Riser
Primary plus Secondary Eq. 10 $\leq$ 3.0Sm	62434	53100	1.176 (3)	-	SSD3, Header
Secondary Stresses Eq. 12 $\leq$ 3.0Sm	7284	53100	0.137	-	SSD4, Header
Primary plus Secondary Stress without Thermal Expansion Eq. 13 $\leq$ 3.0Sm	31127	53100	0.586	-	SSD4, Header
Cumulative Usage Factor U $\leq$ 1.0	0.175	1.0	0.175	-	SSD3, Header

(1) All equations used are from ASME B&PV Code, Sec. III - NB-3650.
(2) See Table B-3
(3) Eqn. 10 triggers fatigue usage calculation using low cycle fatigue method. Since fatigue usage is within allowable, the higher ratio is acceptable.

Table B-5