Georgia Power Company
40 Inverness Center Parkway
Post Office Box 1295
Birmingham, Alabama 35201
Telephone (205) 877-7279

J. T. Beckham, Jr.
Vice President - Nuclear
Hatch Project

Georgia Power
a subsidiary of
The Southern Company

December 17, 1996

Docket Nos. 50-321
50-366

HL-5284

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Edwin I. Hatch Nuclear Plant
Response to Request for Additional Information:
Technical Specifications Revision Request on
Pressure-Temperature Limits

Gentlemen:

On December 2, 1996, you requested additional information regarding our recent Technical Specifications revision request on pressure and temperature limits for Plant Hatch Unit 1 and Unit 2. Enclosed are our responses to your questions. We have revised pages 3.4-22 of the Unit 1 and Unit 2 based on question number 1. Accordingly, these pages are being re-submitted.

Additionally, we are re-submitting the Unit 1 Pressure-Temperature graphs, Figures 3.4.9-1, 3.4.9-2, and 3.4.9-3. These graphs include the 16 Effective Full Power Year (EFPY) curves for Hatch Unit 1. The 16 EFPY curve will aid us in the upcoming Unit 1 outage by reducing the amount of time necessary to reach rated temperature for the pressure tests. We are therefore re-submitting the graphs to include this curve in the Unit 1 graphs.

Enclosure 1 contains our responses to the three questions. Enclosure 2 contains the resubmitted pages and the corresponding mark-ups.

No changes are necessary to the justification and the 10 CFR 50.92 evaluation of the original submittal.

Please contact this office if you have further questions.

Sincerely,

J. T. Beckham, Jr.

A001

Enclosures: (See next page.)

Georgia Power

Enclosures:

1. Response to Request for Additional Information: Technical Sp cifications Revision Request on Pressure-Temperature
2. Page Change Instructions

OCV/eb

cc: *Georgia Power Company*
Mr. H. L. Sumner, Nuclear Plant General Manager
NORMS

U.S. Nuclear Regulatory Commission, Washington, D.C.
Mr. K. Jabbour, Licensing Project Manager - Hatch

U.S. Nuclear Regulatory Commission, Region II
Mr. S. D. Ebneter, Regional Administrator
Mr. B. L. Holbrook, Senior Resident Inspector - Hatch

Enclosure 1

Edwin I. Hatch Nuclear Plant
Response to Request for Additional Information:
Technical Specifications Revision Request on
Pressure-Temperature Limits

The following are the responses to your letter of December 2, 1996, requesting additional information regarding our recent Technical Specifications revision request on pressure-temperature limits for Plant Hatch Units 1 and 2.

A transcription of each question precedes the responses:

1. NRC Request

   It appears that the revised statement of Surveillance Requirement (SR) 3.4.9.1(a) regarding Figures 3.4.9-1, Pressure/Temperature Limits for Inservice Hydrostatic and Inservice Leakage Tests, and 3.4.9-2, Pressure/Temperature Limits for Non-Nuclear Heatup, Low Power Physics Tests, and Cooldown Following a Shutdown, is not consistent with the captions of these figures. Please correct this apparent discrepancy.

   GPC Response

   The descriptions of the figures have been reversed in the text of Surveillance Requirement 3.4.9.1. As a result, page 3.4-22 is being re-submitted for both units. Enclosure 2 includes the re-submitted pages along with their mark-up.

2. NRC Request

   Provide the generic P versus (T-RT_{NDT}) curve and its methodology for the upper vessel that are mentioned in GENE-523-A137-1295, and the ratio of the worst stress around the feedwater nozzle to the membrane stress at places with no geometry discontinuity. Confirm that the generic P versus (T-RT_{NDT}) curve for the bottom head that you are using is the same as that provided by Illinois Power in support of its recent pressure/temperature limits revision (dated February 22, 1996) for the Clinton Power Station that has been reviewed by the staff. Otherwise, please provide similar information as requested for the upper vessel curve.

   GPC Response

   When GE developed non-beltline P-T curves, the approach was to develop curves for a conservatively large BWR/6 (nominal 251-inch inside diameter) and then apply the curves generically to other vessels by using the appropriate RT_{NDT} values.

The one characteristic of the upper vessel and bottom head, that made the analysis different from a shell analysis like that for the beltline, was the presence of nozzles and control rod drive (CRD) penetration holes, with their associated stress concentrations and higher thermal stresses for certain transient conditions.

Since the generic bottom head curve (CRD curve) is the same as provided by Illinois Power in support of its recent P-T limits revision, confirmation that the generic bottom head curve is the same will be provided first. Since the NRC specifically requested information regarding the feedwater nozzle curve, the methodology for the upper vessel (feedwater nozzle) curve will be provided also.

The bottom head methodology is as follows:

The generic pressure test P-T curves for the bottom head are the same as those provided by Illinois Power in support of its recent P-T limits revision. The generic pressure test P-T curve was generated by scaling the K_I of 154.3 ksi√in by the nominal pressures and calculating the associated ($T-RT_{NDT}$):

Nominal Pressure (psig)	K_I (ksi√in)	($T-RT_{NDT}$) (°F)
1563	154.3	161
1400	138.2	151
1200	118.5	138
1000	98.7	121
800	79.0	99
600	59.2	66
400	39.5	1

The generic curves are applicable to Plant Hatch as follows:

The P-T curve is dependent on the K_I value calculated, which is proportional to the stress and the crack depth according to the relationship:

$$K_I \; \alpha \; \sigma \sqrt{\pi a}$$

The stress is proportional to R/t and, for the P-T curves, crack depth, a, is t/4. Thus, K_I is proportional to $R/\sqrt{t}$. The generic curve value of $R/\sqrt{t}$, based on the BWR/6, 251-inch bottom head dimensions, is

$$\text{Generic } R/\sqrt{t} = 138 / \sqrt{8} = 49$$

The Hatch specific bottom head dimensions are R = 110.5 inches and t = 7 inches.

$$\text{Hatch specific } R/\sqrt{t} = 110.5 / \sqrt{7} = 42$$

Since the generic value of $R/\sqrt{t}$ is greater than that for Hatch, the generic P-T curve is conservative when applied to the Hatch bottom head.

As discussed below, the highest RT_{NDT} for the bottom head materials is 10°F for Unit 1 and 50°F for Unit 2. The generic pressure test P-T curve is applied to the Hatch bottom head by shifting the P vs. ($T-RT_{NDT}$) values above to reflect the RT_{NDT} value of 10°F for Unit 1 and 50°F for Unit 2.

The resulting P-T Values are listed below:

Nominal Pressure (psig)	Bottom Head Temperature (°F)	
	Unit 1	**Unit 2**
1400	161	201
1200	148	188
1000	131	171
800	109	149
600	76	116
400	11	51

The highest RT_{NDT} for the bottom head plates and welds is 10°F for Unit 1 and 50°F for Unit 2, based on fracture toughness data for the plates, shown in Table 1 (below). The bottom head welds have RT_{NDT} values less than 10°F for Unit 1 and 50°F for Unit 2, based on the vessel purchase specification requirements and QA documentation confirming that there were no bottom head plate or weld RT_{NDT} values greater than 10°F for Unit 1 and 50°F for Unit 2.

Table 1. Fracture Toughness of Bottom Head Plates

Plate Location	Heat No.	Charpy Test Temperature (°F)	Long Impact Energy (ft-lb)	Drop Weight (°F)	RT_{NDT} (°F)	Comments
Unit 1 Bottom Head Recirculation Outlet Nozzle	AV-2798	10	35,51,42	0	10	2°F/ft-lb correlation applied.
Bottom Head Dome Plates	C4351-3	10	70,68,60	10	10	Drop weight bounding.
Unit 2 Bottom Head Dome Plates	C8658-2	40	30,32,34	20	50	2°F/ft-lb correlation applied.

The upper curves methodology is as follows:

CBI Nuclear (CBIN) modeled the BWR/6, 251-inch feedwater nozzles to compute local stresses for determination of the stress intensity factor, K_I. The results of that computation were $K_I = 143.1$ ksi√in for an applied pressure of 1563 psig preservice hydrotest pressure. The computed value of $(T-RT_{NDT})$ was 154°F.

To evaluate the CBIN result, K_I is calculated for the upper vessel nominal stress, PR/t, according to the methods in ASME Code Appendix G (Section III or XI). The result is compared to that determined by CBIN in order to quantify the K magnification associated with the stress concentration created by the feedwater nozzles.

A calculation of K_I shown below using the BWR/6, 251-inch dimensions:

Vessel Radius, R	126.7 inches
Vessel Thickness, t	6.5 inches
Vessel Pressure	1563 psig

Pressure stress

$$\sigma = PR/t = \frac{1563 \text{ psig} * 126.7 \text{ inches}}{(6.5 \text{ inches})}$$

$$\sigma = 30466 \text{ psi}$$

The factor $F(a/r_N)$ from Figure A5-1 of WRC - (Welding Research Council) Bulletin 175 is 1.6 where:

a = lesser of 1/4 T_N or 1/4 T_v
T_N = 7 1/8 inch
Tv = 6 1/2 inch

r_N = $R_i + 0.29 R_e$
R_i = apparent radius of nozzle = 6 inches
R_e = actual inner radius of the nozzle = 3.25 inches
a/r_N = 1.63/6.94 = 0.23

Therefore, the ratio of stress around the feedwater nozzle to the membrane stress at places with no geometric discontinuity is 1.6.

Including the safety factor of 1.3, the stress intensity factor, K_I is $1.3\ \sigma \sqrt{\pi a} * F(a/r_N)$:

$$\text{Nominal } K_I = 1.3 * 30.466 * \sqrt{\pi * 1.63} * 1.6 = 143 \text{ ksi}\sqrt{\text{in}}$$

The method to solve for $(T\text{-}RT_{NDT})$ for a specific K_I is based on the curve in Figure G-2210-1 in ASME Appendix G:

$$(T\text{-}RT_{NDT}) = \ln[(K_I - 26.78) / 1.223] / 0.0145 - 160$$

$$(T\text{-}RT_{NDT}) = \ln[(143 - 26.78) / 1.223] / 0.0145 - 160$$

$$(T\text{-}RT_{NDT}) = 154°F$$

The generic pressure test P-T curve was generated by scaling 143 ksi√in by the nominal pressure and calculating the associated $(T\text{-}RT_{NDT})$:

Nominal Pressure (psig)	K_I (ksi√in)	$(T\text{-}RT_{NDT})$ (°F)
1563	143	154
1400	128	145
1200	110	131
1000	92	114
800	73	91
600	55	56
400	37	-16

The generic upper vessel curve methodology is applied to Plant Hatch as follows:

The P-T curve is dependent on the K_I value calculated, which is proportional to the stress and the crack depth according to the relationship:

$$K_I \propto \sigma \sqrt{\pi a}$$

The stress is proportional to R/t and, for the P-T curves, crack depth, a, is t/4. Thus, K_I is proportional to $R/\sqrt{t}$. The generic curve value of $R/\sqrt{t}$, based on the BWR/6, 251-inch feedwater nozzle dimensions, is

$$\text{Generic } R/\sqrt{t} \quad = \quad 127 / \sqrt{6.5} \quad = \quad 50$$

The Hatch specific dimensions applicable to the feedwater nozzle are R = 110 inches and t = 5 inches.

$$\text{Hatch specific } R/\sqrt{t} \quad = \quad 110 / \sqrt{5} \quad = \quad 49$$

Since the generic value of $R/\sqrt{t}$ is greater than that for Hatch, the generic P-T curve is conservative when applied to the Hatch feedwater nozzle.

As discussed below, the highest RT_{NDT} for the nozzle materials is 40°F for Unit 1 and 26°F for Unit 2. The generic pressure test P-T curve is applied to the Hatch feedwater nozzle curve by shifting the P vs. $(T-RT_{NDT})$ values above to reflect the RT_{NDT} value of 40°F for Unit 1 and 26°F for Unit 2. The resulting P-T values are below:

Nominal Pressure (psig)	Upper Vessel Temperature (°F)	
	Unit 1	**Unit 2**
1400	185	171
1200	171	157
1000	154	140
800	131	117
600	96	82
400	24	10

The highest RT_{NDT} for the upper vessel nozzles, plates and welds is 40°F for Unit 1 and 26°F for Unit 2, based on fracture toughness data for the plates, shown in Table 2 (below). The upper vessel welds have RT_{NDT} values less than 40°F for Unit 1 and 26°F for Unit 2, based on the vessel purchase specification requirements and QA documentation confirming that there were no upper vessel plate or weld RT_{NDT} values greater than 40°F for Unit 1 and 26°F for Unit 2.

Table 2. Fracture Toughness of Upper Vessel Plate

Plate Location	Heat No.	Charpy Test Temperature (°F)	Long Impact Energy (ft-lb)	Drop Weight (°F)	RT_{NDT} (°F)	Comments
Unit 1 Upper Vessel Steam Outlet Nozzle	AV-1576	10	42,44,64	40	40	2°F/ft-lb correlation applied, but drop weight bounding.
Unit 2 Upper Vessel Steam Outlet Nozzle	Q2Q30W	10	27,34,33	10	26	2°F/ft-lb correlation applied.

3. NRC Request

Provide the copper and nickel contents of the beltline limiting material for the Hatch Unit 2 vessel and confirm that all chemistry and material data used in generating the beltline P-T limit curves for Unit 2 are the same as those in your Generic Letter 92-01 submittals.

GPC Response

The Hatch Unit 2 copper and nickel contents of the limiting beltline material are shown in the table below for report GE-NE-523-A137-1295 and the Generic Letter 92-01 submittal.

Chemistry for the Limiting Beltline Material
Lower Longitudinal Weld, ID. 101-842, Heat 10137, Linde 0091

	Source	% Cu	% Ni	CF	Initial RT_{NDT}
	GE-NE-523-A137-1295	0.23	0.50	154.5	-50
	Generic Letter 92-01	0.23	0.50	154.5	-50