Georgia Power Company
333 Piedmont Avenue
Atlanta, Georgia 30308
Telephone 404 526-3726

Mailing Address
Post Office Box 4545
Atlanta, Georgia 30302

Georgia Power
the southern electric system

D. O. Foster
Vice President and General Manager
Vogtle Project

April 26, 1984

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

File: X6BB06
Log: GN 352

References: Letter from D. O. Foster (GPC) to H. Denton (NRC) dated November 11, 1983 (Log: GN-281)

NRC DOCKET NUMBERS 50-424 AND 50-425
CONSTRUCTION PERMIT NUMBERS CPPR-108 AND CPPR-109
VOGTLE ELECTRIC GENERATING PLANT - UNITS 1 AND 2
ARBITRARY INTERMEDIATE PIPE BREAKS

Dear Mr. Denton:

In the referenced letter, GPC requested your approval for the application of alternative pipe break criteria which would eliminate the need to postulate arbitrary intermediate pipe breaks, i.e., those break locations which, based on stress analysis, are below the stress limits and the cumulative usage factors specified in the current NRC criteria, but are selected to provide a minimum of two breaks between terminal ends. In this submittal we are providing additional technical information to further justify that request. Specific NRC concerns, as discussed on March 6, 1984, are addressed in attachments a through f as follows:

1. Technical justification for elimination of arbitrary intermediate breaks	Attachment a
2. Provisions for minimizing stress corrosion cracking in high energy lines	Attachment b
3. Provisions for minimizing the effects of thermal and vibration induced piping fatigue	Attachment c
4. Provisions for minimizing water/steam hammer effects	Attachment d

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5. Provisions for minimizing local stresses from welded attachments — Attachment e

6. Postulated pipe break location information — Attachment f

As stated in the referenced letter, the application of the proposed criteria changes will result in the deletion of approximately 182 break locations and 110 pipe whip restraints. The breaks and restraints currently targeted for elimination are listed in that letter. However, it should be noted that piping and system design is an iterative process and that postulated break locations could potentially move as the system design and analysis of structures and piping develops over the course of the design process. Owing to the iterative nature of the design process and its potential for affecting postulated break locations, changes affecting high energy systems are continuously monitored and evaluated to determine the impact on break location. We propose to apply these alternative criteria to any subsequently identified break locations in the systems identified herein, provided the stresses at those locations are below the break selection threshold, and the operational concerns in attachments b through e are adequately addressed. This flexibility is necessary to minimize future requests for break elimination as the location of intermediate break points change during the evolution of the plant design.

We would appreciate a favorable response to our proposed alternative pipe break criteria by June 8, 1984.

Yours truly,

D O Foster

D. O. Foster

DOF/JAB/sw

xc: R. A. Thomas
O. Batum
J. A. Bailey
M. Malcom
M. A. Miller
E. L. Blake, Jr.
J. E. Joiner
J. P. O'Reilly
W. F. Sanders
W. R. Spezialetti

Attachment a

TECHNICAL JUSTIFICATION FOR ELIMINATION OF ARBITRARY INTERMEDIATE BREAKS

The following items provide generic technical justification for the elimination of arbitrary intermediate pipe breaks and the associated pipe whip restraints.

1. The operating procedures and piping and system designs minimize the possibility of stress corrosion cracking, thermal and vibration induced fatigue, and water/steam hammer in these lines in which arbitrary pipe breaks are currently postulated. Detailed descriptions of the design provisions for these phenomena are provided in attachments b, c, and d, respectively.

2. Welded attachments are not located in close proximity to the breaks to be eliminated. Consequently, local bending stresses resulting from these attachments will not significantly affect the stress levels at the break locations (refer to attachment e).

3. The pipe breaks and whip restraints not being eliminated provide an adequate level of protection in areas containing high energy lines.

4. Pipe breaks are postulated to occur at locations where stresses are only 80% of Code allowables (Class 2 and 3) or where the cumulative usage factor is only 10% of the allowable 1.0. The arbitrary breaks to be eliminated all exhibit stresses and usage factors below these conservative thresholds.

5. Pipe rupture is recognized in branch technical position MEB 3-1 as being a "rare event which may only occur under unanticipated conditions."

6. Arbitrary intermediate breaks are only postulated to provide additional conservatism in the design. There is no technical justification for postulating these breaks.

7. Elimination of pipe whip restraints associated with the arbitrary breaks will facilitate in-service inspection, reduce heat losses from the restrained piping, and reduce the unanticipated restraint of piping due to thermal growth and seismic motion.

8. Pipe break related equipment qualification (EQ) requirements will not be affected by the elimination of the arbitrary breaks. Breaks are postulated non-mechanistically for EQ purposes.

It is concluded that the elimination of arbitrary intermediate breaks is technically justified, based on the reasons stated above.

Attachment b

PROVISIONS FOR MINIMIZING STRESS CORROSION CRACKING IN HIGH ENERGY LINES

Industry experience has shown (NUREG 0691) that stress corrosion cracking (SCC) will not occur unless the following conditions exist simultaneously: high tensile stresses, susceptible piping material, and a corrosive environment. Although any stainless or carbon steel piping will exhibit some degree of residual stresses and material susceptibility, Georgia Power Company minimizes the potential for SCC by choosing piping material with low susceptibility to stress corrosion and by preventing the existence of a corrosive environment. The material specifications consider compatibility with the system's operating environment (both internal and external), as well as other materials in the system, applicable ASME code requirements, fracture toughness characteristics, and welding, processing, and fabrication techniques.

The likelihood of stress corrosion cracking in stainless steel increases with carbon content. Consequently, only the lower carbon content stainless steels (304, 304L, 316, 316L) have been used for the primary systems* at Plant Vogtle. The existence of a corrosive environment is prevented by strict criteria for internal and external pipe cleaning, and water chemistry control during startup and normal operation.

For the secondary systems**, ferritic type carbon steel has been the choice for the piping, fittings, and valve bodies forming the pressure boundaries. This ferritic material has been found satisfactory from the standpoint of non-susceptibility to stress corrosion cracking for the service conditions encountered. Since in the case of PWR's the secondary systems are not made of stainless steels, the question of stress corrosion cracking as reported in stainless steels does not arise.

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*Primary Systems:
Reactor Coolant (RCS)
Chemical and Volume Control (CVCS)
Safety Injection (SI)

**Secondary Systems:
Main Steam (MS)
Main Feedwater (MFW)
Auxiliary Feedwater (AFW)
Steam Generator Blowdown (SGBDS)
Steam Generator Wet Layup
Waste Evaporator Steam Supply

All piping involved in the elimination of arbitrary intermediate breaks will be cleaned externally and flushed as part of the startup test program. The piping will be flushed with demineralized water subject to written criteria for limits on total dissolved solids, conductivity, chlorides, fluorides and pH. Flush water quality will be monitored daily. The flushing will be controlled by detailed procedures written for each system. Water chemistry for pre-operational testing will be controlled by written specifications.

During plant operation, primary and secondary side water chemistry will be monitored in the carbon steel and stainless steel piping. Contaminant concentrations will be kept below the thresholds known to be conducive to stress corrosion cracking. The major water chemistry control standards will be included in the plant operating procedures for the lines in which arbitrary breaks were previously postulated. Oxygen concentration in the fluid in the Vogtle stainless steel piping is expected to be less than 0.005 ppm during normal power operation, thus further minimizing the likelihood of stress corrosion cracking.

Table 1 summarizes the systems in which currently postulated arbitrary intermediate breaks are to be eliminated. Note that a number of these systems operate at temperatures below 200°F. Industry wide experience shows that stress corrosion is not a problem at temperatures this low. The recommended water chemistry requirements for primary systems are provided in Table 5.2.3-3 of the FSAR. Operating water chemistry guidelines for secondary side piping are given in Table 10.3.5-1 of the FSAR. Although the final water chemistry specifications have not been prepared at this time, it is Georgia Power Company's intent to adhere to the guidelines cited above to the greatest extent possible.

Attachment b

TABLE 1
ELIMINATION OF ARBITRARY BREAK
SYSTEMS SUMMARY

Piping System	Piping Material	Vogtle Piping Class	Operating Temp. (°F)	# Of Breaks Deleted (per Unit)
Safety Injection	SS	111, 212	120	14
CVCS - Charging	SS	212	516/130	4/22
CVCS - Letdown	SS	212	293	8
CVCS - RCP Seal Inj.	SS	111, 212	130	13
RCS - Surge Line	SS	111	653	1
RCS - Drains	SS	111	556	7
Auxiliary Feedwater	CS	212, 313, 424	445/70	14/12
Steam Generator Blowdown	CS	212, 427	545/155	24/2
Steam Generator Wet Layup	CS	212	545	8
Main Steam	CS	212, 424 313	545	24
Main Feedwater	CS	212, 424	445	15
Main Steam Atmos. Dump	CS	212	545	8
Waste Evap. Steam Supply	CS	424	360	6

SS - Stainless Steel
CS - Carbon Steel

Attachment c

PROVISIONS FOR MINIMIZING THE EFFECTS OF THERMAL AND VIBRATION INDUCED PIPING FATIGUE

I. GENERAL FATIGUE DESIGN CONSIDERATIONS

For Class 1 lines, fatigue considerations are addressed by the cumulative usage factor (CUF). In order to ensure that piping will not fail due to fatigue, the ASME Code has set the CUF limit at 1.0. By definition, all arbitrary intermediate break locations have CUFs below 0.1.

For Class 2 and 3 lines, fatigue is considered in the allowable stress range check for thermal expansion stresses. This stress is included in the total stress value used to determine postulated break locations. All arbitrary break locations exhibit stresses less than 80% of the code allowables. If the number of thermal cycles is expected to be greater than 7,000, then the allowable stresses are further reduced by an amount dependent on the number of cycles.

II. THERMAL DESIGN CONSIDERATIONS

By limiting the mixing of low velocity, low temperature auxiliary feedwater with high temperature water in the steam generator inlet nozzles, cyclic thermal stresses in the auxiliary feedwater piping of the Vogtle Plant are minimized.

Mixing is prevented in the auxiliary feedwater supply to the 6-inch auxiliary feedwater steam generator inlet nozzle with a vertical piping arrangement followed by a 90 degree elbow welded to the 6-inch inlet nozzle. Stratification and stripping, which promote cyclic thermal stress and subsequent cracking, are eliminated by maintaining a minimum auxiliary feedwater flow rate of 75 gpm during startup and hot standby. Feedwater temperature instrumentation is provided in the vertical run of the inlet elbow to the 6-inch steam generator inlet nozzle to monitor and alarm the backflow of high temperature water.

Mixing of the low velocity, low temperature main feedwater with high temperature water in the steam generator is prevented in the main 16-inch feedwater nozzle by isolating flow to the main nozzle and introducing feedwater to the 6-inch auxiliary feedwater steam generator inlet nozzle for power levels below 15 percent. Above 15 percent power, stratification and stripping are prevented by maintaining a minimum flow rate of 500 gpm. Mixing is prevented in the main feedwater supply to the steam generator by piping arrangement similar to that utilized at the auxiliary feedwater inlet nozzle. Feedwater temperature instrumentation is provided in the vertical run of the inlet elbow to the 16-inch steam generator main feedwater inlet nozzle to monitor and alarm the backflow of high temperature water.

The physical layout of the main/auxiliary feedwater piping temperature monitoring/alarm instrumentation, and minimum feedwater flow rates are in compliance with the Westinghouse design criteria for the main/auxiliary feedwater supply piping to the steam generators.

Cyclic thermal stress is prevented in the other lines containing arbitrary intermediate breaks by maintaining uniform temperatures with no mixing.

III. VIBRATION DESIGN CONSIDERATIONS

Piping in Plant Vogtle is designed and supported to minimize transient and steady state vibration. Although the piping system vibration tests have not yet been defined, testing will be performed as described in Section 3.9.B.2 of the FSAR to ensure that vibration of the piping systems is within allowable levels.

Attachment d

PROVISIONS FOR MINIMIZING STEAM/WATER HAMMER EFFECTS

Systems within Westinghouse scope of supply are not, in general, susceptible to water hammer. The reactor coolant, chemical and volume control, and residual heat removal systems have been specifically designed to preclude water hammer. Preoperational testing and operating experience have verified the Westinghouse design approach and furthermore, have indicated that significant water hammer events have usually been initiated in secondary systems within the Balance of Plant (BOP) scope of supply. Westinghouse has conducted a number of investigations into the causes and consequences of water hammer events. The results of these investigations have been reported to Westinghouse operating plant customers and have been reflected in design interface requirements to the BOP designer for plants under construction, to assure that water hammer events initiated in the secondary systems do not compromise the performance of the Westinghouse supplied safety-related systems and components.

Some of the lines in which arbitrary intermediate breaks are to be eliminated have the potential for water/steam hammer effects. These lines have been designed to minimize or preclude such effects. Water hammer in each of the systems involved in the elimination of arbitrary breaks is described below:

1. <u>Safety Injection System</u>

   The safety injection lines are all water solid and at ambient temperature, thus no water hammer is expected.

2. <u>Chemical and Volume Control System (CVCS)</u>

   Normally, the CVCS is water solid. In the low temperature lines (less than 125°F) water hammer would not be expected because of the small probability of steam void formation. In the high temperature lines, the piping has been designed to maintain water solid conditions during normal operation, thus minimizing the possibility of water hammer éffects.

3. <u>Reactor Coolant System</u>

   There is a low potential for water hammer in the reactor coolant system, because it is designed to preclude steam void formation. However, excessive cooling of the reactor coolant system, which initiates safety injection, could potentially result in water hammer. If any problems are experienced during preoperational test, they will be eliminated by modifying operating procedures.

4. Auxiliary Feedwater

A separate auxiliary feedwater line and nozzle has been provided to each steam generator to minimize the potential for water hammer. Each steam generator inlet nozzle utilizes a 90° elbow connected immediately to a vertical run of pipe to minimize steam voids. Tempering flow is maintained so the line will be filled with water at all times.

It is recognized, however, that some potential for water hammer in the auxiliary feedwater lines exists. Consequently, the temperature in these lines is monitored so that they may be filled slowly and flow initiated gradually when steam voids are suspected. The piping involved in the arbitrary intermediate breaks contains thermowells allowing such temperature increases to be detected and the proper operating procedures to be implemented. The associated valves are periodically checked for leaks. Following the implementation of design guidelines and testing contained in BTP ASB 10-2, steam generator water hammer in top feedring design steam generators is not expected to occur.

Auxiliary feedwater design and operation are described further in attachment C.

5. Steam Generator Blowdown (SGBS)

Blowdown flow from the steam generators is normally two-phase and of 0-10 percent quality. The piping layout is routed continuously downward starting from the steam generator blowdown nozzle connection and continuing to the containment penetration thus minimizing the formation of water pockets. Therefore, the potential for water hammer is minimized for the blowdown lines within containment. Water hammer may occur downstream of the isolation valves upon reinitiation of blowdown flow following isolation. Minimal water hammer problems are expected due to providing operating procedures to gradually repressurize the downstream piping before establishing full flow. No valves exist between the SGBS isolation valves and the SGBS coolers.

6. Steam Generator Wet Layup

During full power operation, there is no flow in the wet layup piping. During operation of the wet layup system the steam generator will not be a source of high energy fluid. Consequently, water hammer is not expected in this system.

7. Main Steam

The main steam piping from the 5 way restraints just outside containment to the main turbine is sloped at 1/16 of an inch per foot to assure proper drainage during the various phases of operation. 18-inch diameter drip legs approximately five feet long are installed upstream of the main turbine inlet on the 36-inch and 38-inch main steam lines to collect and dispense drainage to the condenser. The branch lines that tee off the main steam lines are properly sloped with drain provisions to eliminate the possibility of water hammer to occur due to condensate-drain water pockets collecting in low points or pipe loops.

8. Main Feedwater

The routing of the main feedwater piping, which varies in temperature from approximately 300°F at low load to 445°F at full load, into the steam generators, which operate between 545°F to 557°F during normal operation, is in compliance with the Westinghouse criteria for layout, temperature monitoring/alarm, and operational procedures to minimize or eliminate water hammer.

In Westinghouse plants with a top feedring steam generator design, water hammer has been experienced in main feedwater lines in cases where feedwater spargers or feedrings have become uncovered or drained, and subsequently recovered with water. The water hammer has been identified as steam-water slugging resulting from the sudden collapse of steam trapped in the feedwater line due to contact with cold feedwater. The VEGP steam generators have J-tubes installed on top of the feedring to prevent or delay water draining from the feedring following a drop in steam generator water level. This approach has been shown to be effective in minimizing the potential for steam bubble collapse water hammer in the feedring. Additional descriptions of the main feedwater system design and operation are provided in attachment C, Item II.

9. Main Steam Atmospheric Dump

The steam piping to the inlet of the main steam atmospheric dump valves is sloped so that condensate drains back into the main steam header when the valve is closed. The valve discharge piping continuously drains to the nearest floor drain. When the valve opens, steam and/or drains will be routed to the nearest floor drain.

10. <u>Waste Evaporator Steam Supply</u>

The waste evaporator steam supply piping is routed through the auxiliary building with a continuous downward slope to the radwaste evaporators located at level C to eliminate pockets of condensate. Where low points exist, adequate drain lines and traps are provided to continuously dispense condensate. Consequently, the possibility of water/steam hammer has been minimized.

Attachment e

PROVISIONS FOR MINIMIZING LOCAL STRESSES FROM WELDED ATTACHMENTS

We have reviewed all arbitrary intermediate break locations to be eliminated and have determined that in no cases are welded attachments closer than five piping diameters from postulated break locations. At this distance, local bending stresses induced by the attachment will not affect the stresses at the postulated break point. To ensure that this is the case, the local stresses have been determined and added to the primary stress report.

Attachment f

POSTULATED PIPE BREAK LOCATION INFORMATION

A detailed listing of the currently postulated pipe breaks to be eliminated was provided in attachments A and B of our November 11, 1983 submittal. Inside containment, 92 breaks and 89 restraints are to be deleted, leaving 256 breaks and 103 restraints in the design. Outside containment, 90 breaks and 21 restraints are to be deleted, leaving 138 breaks and 20 restraints in the design. The actual locations of the breaks and restraints to be eliminated can be determined by examination of the FSAR Figures referenced in the November 11 letter.

The distribution of the breaks and restraints to be deleted is relatively even throughout the plant. Consequently, the remaining breaks and restraints still provide an adequate level of protection in all areas containing high energy lines.

The above information reflects the break arrangement in Unit 1. However, the majority of the breaks in Unit 2 will be mirror image to the Unit 1 breaks. The justifications for the elimination of Unit 1 breaks will be extrapolated for elimination of non-mirror image Unit 2 breaks provided the requirements of the alternative pipe break criteria are satisifed at those locations.