



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
REGARDING USE OF FORGED FITTINGS IN CLASS 1, 2, AND 3 PIPING

GEORGIA POWER COMPANY, ET AL.

VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2

DOCKET NOS. 50-424 AND 50-425

1.0 INTRODUCTION

By letter dated December 15, 1988, Georgia Power Company (GPC) reported a condition at the Vogtle Electric Generating Plant (Vogtle) Unit 2, pursuant to the reporting requirements of 10 CFR Parts 21 and 50.55(e). A block-forged reducing tee was discovered during a walkdown of a Unit 2 Class 1 piping system to determine its as-built condition, as part of the implementation of a snubber reduction program. GPC then conducted a broadness review and identified 40 additional Class 1 tees, either block-forged or close-die-forged tees, that were not extruded. However, the stress analyses of these tees were based on the ASME Code Class 1 stress indices for extruded tees.

The design of ASME Code Section III piping is based on the use of stress indices and stress intensification factors for determining the maximum stresses in various fittings, including tees. The Code permits the use of such indices for fittings which comply with ANSI B16.9 - 1978, "Factory Made Wrought Steel Butt Welding Fittings," published by the ASME. ASME Code Class 1 stress indices for tees are applicable if the tees are extruded, but not necessarily applicable if they are forged. Additional thermal stress analyses may be required for forged tees to account for different wall thicknesses and structural discontinuities resulting from the forging and machining process. ANSI B16.9 permits the use of forged fittings if the purchaser and the manufacturer agree to the supply of these fittings and if these fittings meet certain material requirements and design proof tests prescribed in the standard.

GPC replaced one of the forged tees with an extruded tee, and performed detailed stress reanalyses of the other Class 1 lines containing the forged tees. GPC found the piping stresses in these lines to be acceptable.

The NRC staff has reviewed GPC's analyses and actions regarding this issue. The results of our review are discussed below.

## 2.0 EVALUATION

The root cause for the forged tees not being considered in the original stress analyses was attributed to the failure by piping vendors to notify GPC and receive concurrence prior to purchasing and installation of the forged tees. This was attributed to a misinterpretation by piping vendors of a note in the Vogtle piping material classification document ("Piping Material Classifications, Vogtle Electric Generating Plant, Units 1, 2, and Common," Revision 19, July 24, 1986, by Bechtel Power Corporation). GPC has contacted the vendors regarding this misinterpretation and has revised the note to more clearly indicate that all forged tees are to be forged and machined according to details that have the purchaser's concurrence. GPC has also removed all Class 1 block-forged tees from the warehouse to prevent them from being installed as replacements in Class 1 piping.

During a meeting with the NRC staff on November 14, 1991 (see the NRC's summary dated March 10, 1992), GPC provided additional information about the installation of forged tees in Class 1, 2, and 3 piping at Vogtle Units 1 and 2. GPC and Westinghouse Electric Corporation presented reevaluations of large-bore and small-bore safety-related piping with non-standard fabricated tees for Vogtle Units 1 and 2. On July 13, 1993, the NRC staff requested additional information regarding the compliance of the installed forged fittings with ANSI B16.9. GPC responded January 14, 1994, with an evaluation showing that the Vogtle forged tees satisfy the acceptance requirements of this standard. GPC's response also attached a letter of November 12, 1993, from Dr. E. C. Rodabaugh of Rodabaugh Associates, to demonstrate that the designs of the large tees have been independently reviewed by a recognized ASME Code expert to verify compliance with the applicable portions of the ASME Code and ANSI B16.9. GPC has also stated that the current quality assurance procedures require performing reviews and re-analysis for conformance with the ASME Code requirements if forged fittings are used in future pipe fitting replacements. During a conference call on February 18, 1994, the NRC requested information relating to the clarification of the material requirement of the forged fittings and control of ASME Class 2 and 3 fittings in the warehouse. The licensee provided the requested information in correspondence to the NRC dated April 14, 1994. The information was evaluated by the NRC staff and found acceptable.

## 3.0 CONCLUSIONS

From its review, the NRC staff agrees with GPC's evaluation that the root cause of this event was the lack of communication between the architect/engineers and GPC during construction of Vogtle Units 1 and 2. GPC has now taken appropriate steps to assure concurrence by the piping vendors in any future installation or replacement of forged fittings. GPC will also perform evaluations, if forged fittings are used in the future, to provide assurance that these fittings comply with the design requirements of the piping Code of Record.

With respect to the existing installation, the NRC staff finds that GPC and its contractors have suitably reevaluated the analyses of safety-related piping systems with forged tees, and have found these systems to comply with ANSI B16.9. The analyses were found to satisfy the design Code requirements for Vogtle.

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