



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

ENCLOSURE

SUPPLEMENTAL SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

CONCERNING THE USE OF U-BOLT PIPE CLAMPS

TENNESSEE VALLEY AUTHORITY

WATTS BAR UNITS 1 AND 2

DOCKET NOS. 50-390 AND 50-391

1.0 INTRODUCTION

The staff's Integrated Design Inspection (IDI) at Watts Bar, Unit 1 (Inspection Report 50-390/92-201) identified a finding concerning the applicant's use of U-bolts as pipe support clamps. The issue involves the use of U-bolts as pipe clamps in conjunction with pin-connected standard support members such as snubbers. Since the U-bolt could potentially rotate or slide along the pipe when it is loaded, the staff was concerned with the stability of these installations. As a result of the IDI finding, the applicant developed a new design procedure for the U-bolt pipe clamp designs at Watts Bar. The staff's review of the applicant's technical basis for this new design procedure is contained in a safety evaluation (SE) issued on September 13, 1993. In the SE, the staff concluded that the applicant had not provided sufficient justification to demonstrate that the U-bolt pipe clamps as used at Watts Bar were acceptable. The staff further recommended that the applicant replace the U-bolt pipe clamps with either standard pipe clamp designs, or other standard industry pipe support designs.

The applicant met with the staff on October 13, 1993, and provided additional information in support of the Watts Bar U-bolt pipe clamp designs in an October 25, 1993, submittal. The staff reviewed this information during a December 13-15, 1993, site audit. As a result of the site audit, the applicant and the staff held a meeting by teleconference on January 18, 1994, to discuss the outstanding technical issues. The applicant provided its proposed resolution to the outstanding technical issues in a February 2, 1994, submittal.

2.0 EVALUATION

The applicant's design procedure referenced tests and finite element analyses performed by Westinghouse as confirmation of the design methodology. These were supported by additional finite element analysis performed by Robert L. Cloud Associates, Inc. (RLCA). The staff's September 13, 1993, SE identified several concerns with the use of these supporting analyses. The following paragraphs describe the applicant's response to these concerns.

The RLCA report, RLCA/P142/01-86/105, contains the results of finite element analyses of several pipe sizes to determine acceptable local bearing loads on the piping. These finite element models were based on a straight section of

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pipe loaded with a uniform loading. The results of the finite element analyses were then compared to the formulas used in the applicant's design procedure for computing the allowable bearing loads. However, the applicant used the U-bolt pipe clamps on components other than straight sections of pipe. The staff did not consider the finite element analyses or the Westinghouse test to be applicable to these configurations. Therefore, the staff found that the applicant had not provided any technical basis for the use of U-bolts as pipe clamps on fittings. In the February 2, 1994, submittal, the applicant proposed to replace the U-bolt supports on all fittings other than straight pipe. The applicant's replacement of the U-bolt pipe clamps on fittings other than straight pipe resolves the staff's concern regarding the applicability of the finite element analyses to these fittings.

The finite element analyses in the RLCA report also showed large local deflections at the proposed allowable bearing load limits for larger pipe sizes. The staff questioned whether these deflections exceed the allowable global deflection limits specified in the Watts Bar Final Safety Analysis Report (FSAR). The SE noted that the applicant's use of Belleville washers in the U-bolt pipe clamp design resulted in a more flexible joint design under compressive load conditions. Subsequent calculations by the applicant confirmed that the local deflections would exceed the FSAR limits at some U-bolt locations. In the February 2, 1994, submittal, the applicant proposed to eliminate or modify all U-bolt supports where the calculated deflections exceed the FSAR support deflection criteria. The applicant's proposal to modify or replace these supports adequately addresses the staff concern regarding the local deflection issue.

The staff had also questioned whether the Westinghouse test of one 10-inch diameter pipe and U-bolt support assembly was an adequate demonstration of stability of the Watts Bar U-bolt designs for seismic loads. In the February 2, 1994, submittal, the applicant proposed to modify or replace all remaining U-bolt support designs on pipe sizes greater than eight inches in diameter to address the concern of general support stability. The applicant reasons that there is less concern with stability for the smaller pipe sizes because of the lower support masses, smaller support loads, and greater, relative to pipe size, pipe support crosspiece contact length. The staff agrees with the applicant's reasoning with regard to these items, and considers the selection of this pipe size to reasonably address its concern with regard to stability. The staff's original concern regarding stability had been with the larger pipe sizes for which the issues of pipe local deflections and local stresses are also considered much more significant.

During the December 13-15, 1993, site audit, the applicant identified that U-bolt pipe clamps were used on some ASME Class 1 piping systems. The staff questioned whether the piping fatigue analyses had adequately accounted for these designs. In the February 2, 1994, submittal, the applicant proposed to eliminate the U-bolt pipe clamps from the ASME Class 1 systems. The applicant's proposal to eliminate these supports resolves the staff concern with the use of U-bolt pipe clamps on ASME Class 1 systems.

3.0 CONCLUSION

The staff considers the applicant's February 2, 1994, proposal to modify or replace approximately 200 of the U-bolt supports at Watts Bar adequate to resolve the technical issues identified in the staff's September 13, 1993, SE. Therefore, the U-bolt issue is considered resolved at Watts Bar.

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Dated: March 1, 1994

REFERENCES

1. NRC letter from P. S. Tam to M. O. Medford transmitting the SE on the use of U-bolts at Watts Bar, September 13, 1993.
2. TVA letter from W. J. Museler to NRC providing supplemental information on the Watts Bar U-bolt stability program, October 25, 1993.
3. Summary by P. S. Tam of an October 13, 1993, meeting, with TVA regarding the use of U-bolts as pipe clamps at Watts Bar, November, 2, 1993.
4. Summary by P. S. Tam of a January 18, 1994, meeting, with TVA to discuss technical issues regarding the use of U-bolt supports, February 3, 1994.
5. TVA letter from W. J. Museler to NRC providing the proposed disposition of concerns related to the U-bolt support designs at Watts Bar, February 2, 1994.