



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 133 TO

FACILITY OPERATING LICENSE NO. NPF-6

ENERGY OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNIT NO. 2

DOCKET NO. 50-368

1.0 INTRODUCTION

By letter dated March 30, 1992, as supplemented April 7, 1992, and April 16, 1992, Entergy Operations, Inc. (the licensee), submitted a request for changes to the Arkansas Nuclear One, Unit No. 2 (ANO-2) Technical Specifications (TS). The requested changes would revise the surveillance requirements of TS 4.4.5., "Steam Generators," to permit the option of using the Babcock & Wilcox (B&W) kinetic sleeving process for steam generator (SG) tube repair.

On March 9, 1992, the licensee began a forced outage due to a leaking SG tube. By March 15, 1992, the leaking tube was identified and plugged. As a result of the leaking tube, the licensee conducted additional SG eddy current testing (ECT) and discovered 420 defective tubes in the "A" SG and 67 defective tubes in the "B" SG. Based on the ECT results, the licensee requested a TS change to permit SG tube sleeving as a repair method. The staff has determined that, prior to the forced outage, the licensee could not have anticipated the need for extensive SG tube sleeving and that, on analyzing the situation, they promptly applied to the NRC for remedial action. The sleeving proceeded rapidly and the licensee is able to return the unit to power prior to the expiration of the 30-day comment period. The staff finds that an emergency situation exists as defined in 10 CFR 50.91(a)(5).

The April 10, 1992, letter provided clarifying information that did not change the initial proposed no significant hazards consideration determination.

By letter dated April 16, 1992, the licensee requested that the amendment be issued by April 25, 1992, however, the 30-day notice period does not end until May 4, 1992. If the amendment is not issued in a timely manner, the licensee would not be able to commence plant heatup. Due to these circumstances, the staff has determined that the amendment can be issued prior to the end of the 30-day notice period.

2.0 BACKGROUND

The requested TS change will allow the use of B&W Nuclear Service Company (BWNS) sleeves for steam generator tube repair as an alternative to plugging degraded tubes. The purpose of a sleeve is to repair a degraded steam generator tube in order to maintain the function and integrity of the tube. The sleeve functions in essentially the same manner as the original tube. The B&W kinetic sleeve was originally designed for the Westinghouse Model D steam generator and over 3500 have been installed. The change references B&W Topical Report BAW-2045PA-00, "Recirculating Steam Generator Kinetic Sleeve Qualification for 3/4 Inch Steam Generator Tubes." The staff approved the Topical Report for referencing on January 4, 1990. A modified design and installation process that is bounded by the original parameters will be used for ANO-2. B&W Report 51-1212539-G0, "BWNS Kinetic Sleeve Design - Application to ANO Unit 2," is an evaluation of the applicability of the use of a modified design and process to be applied to ANO-2, which is of Combustion Engineering (CE) design, whereas the original topical report covered the sleeves as applied to Westinghouse design steam generators. Both documents are described in the change to TS 4.4.5.4.b.

3.0 DISCUSSION

BAW-2045PA-00 contains the results of the sleeve design verification which included analysis and confirmatory testing to demonstrate the acceptability of the steam generator sleeving technique for defective tubes. The sleeve design to be used in ANO-2 is fabricated from the same material as was previously qualified, thermally treated Alloy 690. This material has been demonstrated to be resistant to corrosion phenomenon by test and service experience, as detailed in BAW-2045PA-00. The explosively welded sleeve-to-tube joint is produced by a kinetic weld/expansion which is subsequently stress relieved. The joint was qualified as both a strength and seal weld for use in a wide range of Alloy 600 tube material, including that used in CE steam generator tubes.

Analyses were performed on the previously approved topical report sleeve design to verify that it conforms to the requirements of the ANO-2 application. The analyses consist of a design stress analysis to support fatigue testing as defined in the ASME Code Section III, Appendix II; analysis of flow induced vibration of sleeved tubes; analysis of a plugging criteria for a degraded sleeve; analysis of the effects of sleeves on heat transfer and flow and a certified stress report.

The licensee has stated that available techniques are capable of providing 20 percent defect sensitivity in the required areas of the tube/sleeve pressure boundary. A proprietary method is described in the topical report with supporting validation data that demonstrates the inspectability of the sleeve and underlying tube.

4.0 EVALUATION

The staff reviewed the evaluation of the applicability of the use of the kinetic welded sleeve in CE-designed steam generators documented in B&W Report 51-1212539-00, "BWNS Kinetic Sleeve Design - Application to ANO Unit 2." The report includes a description and qualitative evaluation of the relevant differences between the sleeving procedure described in the topical report and installation of sleeves in ANO-2 steam generators. The licensee performed load tests on steam generator sleeves installed into ANO-2 size tubing in accordance with the written field installation procedures to provide design verification information. A series of sleeves were installed into ANO-2 mock-ups in order to validate the explosive welding process for the ANO-2 specific application. These tests demonstrated that the structural integrity of the weld is maintained by the sleeving process.

The mock-up assemblies were qualified by axial fatigue tests followed by leak tests to demonstrate the structural adequacy of the sleeves. The tests were performed to demonstrate that the sleeves would be leak-tight under all operating and accident conditions. In all cases, the results of the tests indicated that the sleeve conformed to the original design requirements of the steam generators.

The licensee performed analytical calculations using design and operating transient parameters selected to envelop the loads imposed during normal, upset, and accident conditions. Fatigue and stress analysis of steam generator sleeved tube assemblies was done in accordance with the requirements of the ASME Code, Section III. The staff considers that these tests and analyses demonstrate the structural adequacy of the kinetic sleeve for use in ANO-2.

The licensee established a plugging limit of 40 percent of the original sleeve wall based on Regulatory Guide 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes," guidelines for tube degradation limits. An additional 20 percent of wall thickness is incorporated as a combined allowance for postulated degradation due to corrosion and for eddy current inaccuracy in accordance with staff positions. The staff finds this acceptable.

As part of the topical report qualification, it was demonstrated that eddy current techniques are available to perform necessary sleeve/tube inspections for defect detection and to verify proper installation of the kinetic expanded sleeve. Since the installed configuration of the ANO-2 sleeve is the same as that originally qualified, the licensee warrants that the sensitivity of the eddy current inspections will be 20 percent of wall thickness at all locations. Since the staff has received a commitment from the licensee that they will validate the adequacy of any eddy current testing method that is used for periodic inservice inspections as well as a commitment to upgrade testing methods as better methods are developed and validated for commercial use, this is acceptable.

The staff's approval of the use of the BWNS kinetic sleeve design in ANO-2 is based upon the previous review and approval for referencing of B&W Topical Report BAW-2045PA-00, "Recirculating Steam Generator Kinetic Sleeve Qualification for 3/4 Inch Steam Generator Tubes," and the design verification analysis and testing of the kinetic welding process in ANO-2 steam generator tube mock-ups and load/fatigue testing presented in B&W Report 51-1212539-00, "BWNS Kinetic Sleeve Design - Application to ANO-2." The staff has concluded that there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner and the issuance of the amendment is acceptable.

5.0 FINAL NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

The Commission's regulations in 10 CFR 50.92 state that the Commission may make a final determination that a license amendment involves no significant hazards considerations if operation of the facility in accordance with the amendment would not: (1) involve a significant increase in the probability or consequences of an accident previously evaluated; or (2) create the possibility of a new or different kind of accident from any accident previously evaluated; or (3) involve a significant reduction in a margin of safety.

The Commission has determined that the amendment involves no significant hazards consideration per 10 CFR 50.92, based on the licensee's analysis provided in their March 30, 1992 letter and presented below:

- (1) The proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

The proposed change to permit the use of SG tubing sleeves as an alternative to tube plugging is a safe and effective repair procedure that does not require removing a tube from service. Mechanical strength, corrosion resistance, installation methods, and inservice inspection techniques of sleeves have been shown to meet NRC acceptance criteria.

Analytical verification will be performed using design and operating transient parameters selected to envelop loads imposed during normal operating, upset and accident conditions. Fatigue and stress analysis of sleeved tube assemblies will be completed in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section III. The results of the qualification testing, analyses and plant operating experience will demonstrate that the sleeving process is an acceptable means of maintaining SG tube integrity. Furthermore, the sleeve assemblies can be monitored through periodic inspections with eddy current test techniques.

The TSs continue to require isolation of a tube or sleeve containing a detected 40 percent reduction in the primary to secondary system pressure boundary.

The consequences of accidents previously analyzed are not increased as a result of sleeving activities. In the case of a tube rupture, the sleeve may actually result in a slightly reduced leak/flow rate through the broken tube due to the smaller effective flow area. The minor reduction in flow area associated with a tube sleeve has no significant effect on SG performance with respect to heat transfer or system flow resistance and pressure drop. In any case, all analytical impacts are clearly bounded by evaluations which demonstrate the acceptability of tube plugging which totally removes the tube from service. Therefore, in comparison to plugging, tube sleeving is considered a significant improvement with respect to steam generator performance. The cumulative impact of multiple sleeved tubes is evaluated to ensure the effects remain within the analytical design bases (both normal and accident). Therefore, based on the above, this change does not significantly increase the probability or consequences of an accident previously evaluated.

- (2) The proposed change does not create the possibility of a new or different kind of accident from any previously evaluated. A sleeved tube performs the same function, in the same passive manner, as an unsleeved tube. Tube sleeves are designed, qualified, and maintained under the stress and pressure limits of ASME Section III and Regulatory Guide 1.121. Eddy current testing is performed following installation of each sleeve. This is done to verify proper installation of the sleeve and to obtain a baseline eddy current reading for each sleeve in order to monitor for subsequent degradation of the primary to secondary pressure boundary.

Therefore, the possibility of a new or different kind of accident from any previously evaluated is not created.

- (3) The proposed change does not involve a significant reduction in the margin of safety.

SG tube integrity is maintained under the same limits for sleeved tubes as for unsleeved tubes; i.e., ASME Section III and Regulatory Guide 1.121. The degradation limit at which a tube is considered inoperable remains unchanged and is detectable for sleeves as well as tubes. The TSs continue to require monitoring and restriction of primary to secondary system leakage through the SGs, such that there remains reasonable assurance that a significant increase in leakage, due to failure of a sleeved (or unsleeved) tube, will be detected. The slight reduction in RCS flow, due to sleeving, is considered to have an insignificant impact on SG operation during normal operation

and accident conditions and is clearly bounded by tube plugging evaluations. The TSs will continue to contain reporting requirements for tubes which have had their degradation spanned (regardless whether the tube is plugged or sleeved).

Therefore, this change does not involve a significant reduction in the margin of safety.

The NRC staff has reviewed the licensee's analysis and, based on this review, concluded that the analysis demonstrates that the applicable criteria are met. Accordingly, the Commission has made a final determination that the amendment involves no significant hazards consideration.

6.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Arkansas State official was notified of the proposed issuance of the amendment. The State official had no comments.

7.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 and changes in surveillance requirements. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (57 FR 11526). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

8.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

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Date: April 22, 1992