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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

CONCERNING

ONCE THROUGH STEAM GENERATOR SLEEVED TUBE INSPECTION PROGRAM

FOR

ARKANSAS NUCLEAR ONE, UNIT 1

ARKANSAS POWER AND LIGHT COMPANY

DOCKET NO. 50-313

1.0 INTRODUCTION

Because of the number of defective steam generator tubes being identified in Arkansas Nuclear One - Unit 1 (ANO-1), Arkansas Power and Light Company (AP&L) is initiating a steam generator sleeving qualification program which will provide the basis for a large scale sleeving of defective tubes.

The staff approved the sleeving demonstration program in the Safety Evaluation dated November 8, 1984. However, information on the subsequent inspection of sleeved tubes was incomplete at that time, but the staff noted that the licensee had committed to a program to demonstrate the adequacy of eddy current inspection techniques for inspecting sleeved tubes, and the staff would evaluate the efficacy of the licensee's eddy current inspection techniques when such a program was submitted for review.

By letters dated December 14, 1984 and May 10, 1985, AP&L provided information on the inspection of sleeved tubes that it committed to provide in a letter dated October 10, 1984.

2.0 BACKGROUND

As a result of degradation in the ANO-1 once through steam generators (OTSGs), a substantial number of tubes with eddy current indications in excess of the 40% through-wall plugging limit were removed from service. AP&L is performing a steam generator sleeving qualification program on ten sleeves which will provide the basis for a large scale sleeving program. The suspected corrosion mechanism affecting the tubes in the upper tube-sheet (UTS) region is corrosion attack by concentrated chemical contam-inants carried by moisture in the steam flowing up through the tube lane region. The lane region is cooler; therefore, more moisture would be in the steam in the lane region at the UTS region. The contaminants carried by this moisture would be deposited on the tubes in

the UTS region. Plugging the lane region tubes increases the area of cooler water flowing up through the lane region which increases the amount of moisture in the steam, and thus increases the amount of contaminants carried by the steam to be deposited on the tubes in the UTS region. This aggravates the degradation of the tubes in the UTS region. Sleeving should improve these conditions by preventing additional loss of heat transfer area which will limit the spread of degradation. In addition, the sleeve has better corrosion resistance than the original tubes.

As part of a long range, large scale sleeving program, AP&L has proposed a demonstration sleeving program to verify the field installation capability of the process. The demonstration program will verify and benchmark the actual field leakage rates against design criteria and laboratory leakage rates and confirm the reliability of tube sleeves under actual operating conditions.

3.0 INSPECTION PROGRAM

Before sleeve installation, parent tubes were inspected in October 1984 during the inservice inspection of the OTSGs. Inspections included a full length 0.500 inch diameter differential bobbin coil inspection and a profilometry inspection of the tubes from the primary face of the UTS down to the 14th tube support plate.

After fabrication and prior to bending, the sleeves were inspected with a standard type differential eddy current bobbin coil. This inspection was to assure the integrity of the sleeve prior to its use.

After the sleeves were installed, each sleeved tube was inspected along its full length utilizing a MIZ-18 multifrequency eddy current testing system. A 0.410 inch diameter standard differential bobbin coil probe was used. This examination provided baseline information on the parent tube and the sleeve for comparison with future examination results. The MIZ-18 system is capable of detecting flat bottom holes specified in the ASME Code in the expanded areas of the sleeve/tube assembly and will detect 40 percent (and greater) ASME through-wall defects in the rolled transition area of the sleeve and tube. At this time, these methods do not permit detection of an ASME 40 percent through-wall defect in the parent tube at the sleeve's lower end. However, the parent tube in the vicinity of the sleeve's end was examined prior to the sleeve's installation and found defect free. Also, the area at the sleeve end is not considered to be a critical inspection area for the baseline examination because there are no stresses induced in the tube at this location during sleeving.

At our request, the Licensee provided Babcock and Wilcox (B&W) Report No. 1154532, "Baseline Inspection of OTSG Sleeved Tubes" which showed the MIZ-18 system to have the following capabilities:

- ASME type flaws of 20% TW or greater in the sleeve free span can be detected and quantified.
- ASME type flaws of 20% TW or greater in the parent tube free span can be detected and semi-quantified.
- ASME type flaws of 40% TW or greater in the parent tube can be detected in the center of expansions and at expansion transitions.
- ASME type flaws of 40% TW or greater in the sleeve can be detected at expansion transitions.
- ASME type flaws of 20% TW or greater located at TSP edges in the parent tube can be detected.

5.0 FUTURE PROGRAMS

There are two problem areas in the inspection of sleeved tubes whether installed in OTSG or U-tube steam generators. The first is the rolled transition zones where the joints are made and the second is the parent tube at the sleeve's end. Both problems are related to the change in the tube/sleeve diameters. The main problem area is the inspection of the parent tube at the sleeve's end, due to the abruptness of this transition. However, this is an area that is not mechanically affected by the installation of sleeves and which has historically, in the case of ANO-1, not experienced defects.

AP&L has committed to inspect the 10 sleeved tubes during each inservice inspection until they are certain that they are as resistant to defects as the originally installed tubes. Future inspections of the sleeved tubes will incorporate state-of-the-art technology to more thoroughly assess those areas of the sleeve and tube most susceptible to stress-related cracking as well as other areas where it is more difficult to characterize the extent of the defect.
Future inspections will also utilize the baseline data obtained from the post-installation inspection for comparison. This will enable detection of deviations from the as-installed condition.

The Licensee has committed to participate in research and development programs that will ensure that state-of-the-art technology will be utilized in the inspection program for the sleeved tubes. According to the Licensee, since it is highly desirable from an enhanced detection standpoint to maintain continuity of eddy current test (ECT) analysis, AP&L intends to coordinate the evaluation of ECT techniques for the inspection of sleeved tubes with B&W, its primary vendor for these services. AP&L plans to stay abreast of other ECT vendors' capabilities, as well as the industry's efforts in this area, in order to provide input into the B&W evaluation and to identify alternate inspection vendors, particularly if proprietary methods/equipment are invovled.

Babcock & Wilcox has begun a research and development project entitled "Development of ECT Techniques for OTSG Sleeved Tubes." For this program in which AP&L will be a participant, calibration standards and

inspection samples will be used for technique evaluation and development. The most promising new devices and techniques, such as cross wound probes and large ferrite core probes coupled with two and three frequency mixes, will be selected for further development.

5.0 CONCLUSIONS

Based on our review of the information provided by the Licensee, we find the Licensee's program for eddy current inspection of the steam generator tubes, along with his commitment to utilize state-of-the-art technology in future inspection, to be acceptable.

NRC contributers to this Safety Evaluation: H. Conrad, G. Vissing

Dated August 14, 1985