ARKANSAS POWER & LIGHT COMPANY
FIRST COMMERCIAL BUILDING/P.O. BOX 551/LITTLE ROCK, ARKANSAS 72203/(501) 371-7901

April 1, 1986

T. GENE CAMPBELL
Vice President
Nuclear Operations

1CAN048601

Mr. J. F. Stolz, Director
PWR Project Directorate No. 6
Division of PWR Licensing - B
U. S. Nuclear Regulatory Commission
Washington, DC 20555

SUBJECT: Arkansas Nuclear One - Unit 1
Docket No. 50-313
License No. DPR-51
Request for Technical Specification
Change to Allow Steam Generator Tube Sleeving

Dear Mr. Stolz:

Pursuant to 10CFR50.90, Arkansas Power and Light Company hereby proposes to amend its operating license, No. DPR-51 for Arkansas Nuclear One - Unit 1, by incorporating the attached changes into the Technical Specifications.

The purpose of these changes to Section 4.18, "Steam Generator Tubing Surveillance," is to 1) modify the designation of those areas identified as special groups in the steam generators where imperfections have previously been found and 2) allow the installation of sleeves as an option to plugging defective steam generator tubes.

We have determined the attached proposed amendments to have No Significant Hazards Considerations and are including the basis of our determination as a part of this amendment package. A copy of this amendment package has been sent to Mr. E. Frank Wilson, Director, Division of Environmental Health Protection, State Department of Health.

We are including five copies of the proprietary and non-proprietary versions of the reports which provide justification for steam generator tube sleeving along with summaries of these reports and a detailed discussion of the proposed Technical Specification changes. Pursuant to 10CFR2.790 we request that the proprietary versions be withheld from public disclosure. The reasons for the proprietary classification of this report are delineated in the enclosed affidavit.

In accordance with 10CFR170.12(c), we are including payment in the amount of $150 for the processing of this amendment.

w/check $150 #3-8430 PA01 1/5 Prop 1/5 NP

Change:	Ltr	Encl
24X	1	1 NP
LPDR	1	1 NP
NRC PDR	1	1 NP

The circumstances of this proposed amendment are not exigent or emergency. However, we do request your prompt review as our current projections are for the ANO-1 seventh refueling outage to begin in mid-August 1986. During this outage we plan to utilize all of the proposed revisions contained herein.

Very truly yours,

T. Gene Campbell

T. Gene Campbell

TGC:ji

Attachments

cc: Mr. E. Frank Wilson, Director
Division of Environmental Health Protection
State Department of Health
4815 West Markham Street
Little Rock, AR 72201

STATE OF ARKANSAS)
) SS
COUNTY OF PULASKI)

I, T. Gene Campbell, being duly sworn, subscribe to and say that I am Vice President, Nuclear Operations for Arkansas Power & Light Company; that I have full authority to execute this oath; that I have read the document numbered 1CAN048601 and know the contents thereof; and that to the best of my knowledge, information and belief the statements in it are true.

T. Gene Campbell

T. Gene Campbell

SUBSCRIBED AND SWORN TO before me, a Notary Public in and for the County and State above named, this 1 day of April, 1986.

Susan K. Gentry

Notary Public

My Commission Expires:
May 7, 1993

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1.0 INTRODUCTION

This amendment package is submitted as justification for steam generator tube sleeving at Arkansas Nuclear One - Unit 1 (ANO-1). Arkansas Power and Light Company (AP&L) has undertaken test, analysis and demonstration programs to provide assurance that this is a safe and effective means of repair for defective steam generator tubes. Subsequent to NRC approval, AP&L plans to conduct steam generator tube sleeving beginning in the ANO-1 seventh refueling outage (1R7) which is currently scheduled to begin August 22, 1986.

Another objective of this amendment package is to modify the designation of special groups of steam generator tubes in which experience has indicated potential problems may exist. The proposed changes define Group A-2 as "Unplugged tubes with sleeves installed" and expand Group A-3 to include an additional 51 tubes surrounding the untubed center portion of the Once Through Steam Generator (OTSG) which are expected to be susceptible to the same form of degradation as the wedge-shaped group surrounding the untubed lane region.

2.0 BACKGROUND

As a result of degradation in the ANO-1 Once Through Steam Generators, a substantial number of tubes with eddy current indications in excess of the 40% through-wall plugging limit have been removed from service. The suspected mechanism affecting the tubes in the upper tube sheet (UTS) region is intergranular attack (IGA) caused by concentrated chemical contaminants which have been carried by moisture in the steam flowing up through the tube lane region.

The lane region is cooler than the surrounding area due to reduced heat flux and flow resistance. Therefore, more moisture is in the steam in this region. The contaminants carried by this moisture are deposited in the upper tube sheet region. Plugging the tubes in the lane region increases the area of reduced heat flux, thereby increasing the number of tubes affected by moisture in the steam. This aggravates the condition by increasing the amount of contaminants carried by the steam and deposited on the tubes in the UTS region.

To address this problem, AP&L initiated a Steam Generator Integrity Program in 1983. The goal of this program is to identify and initiate changes which will assure that the existing OTSGs can be used for the life of the facility without increased risk to the health and safety of the public or reduction in the unit's performance. A description of this program was provided in our response to Generic Letter 85-02 dated June 14, 1985 (ØCANØ685Ø1).

One portion of this program is a Steam Generator Sleeving Qualification Program which would provide sufficient justification to allow a large-scale sleeving program at ANO-1. The installation of sleeves in the affected tubes should decrease the lane region degradation rate by preventing additional loss of heat transfer area. In addition, the sleeve material has better corrosion resistance than the original tubes. This Qualification Program consists of the tests and analyses presented in this report.

2.1 SLEEVING DEMONSTRATION PROGRAM: During the ANO-1 sixth refueling outage (1R6), ten demonstration sleeves were installed in the OTSGs as described in our letter of August 13, 1984 (1CANØ884Ø4). Leakage performance of the sleeves in ANO tubing is being confirmed by the operation of five of the ten demonstration sleeves which were installed in perforated tubes. To date there has been no detectable leakage from these five sleeves or the five sleeves installed in unperforated tubes.

This demonstration program has been successful in verifying field installation capabilities and verifying actual field leakage rates against design criteria and laboratory leakage rates. Sleeve inspection by eddy current techniques during 1R7 will confirm the reliability of tube sleeves under actual operating conditions. These examination results will be compared to the baseline eddy current examinations performed immediately following sleeve installation. If significant deviations are noted, additional sleeves will not be installed until the reason for the deviation can be identified and resolved.

3.0 SUMMARY OF TESTS AND ANALYSES TO SUPPORT TUBE SLEEVING

3.1 ONCE THROUGH STEAM GENERATOR MECHANICAL SLEEVE QUALIFICATION: The general design criteria for the B&W OTSG sleeves are contained in B&W report BAW-1823P, "Once-Through Steam Generator Mechanical Sleeve Qualification" which was submitted to the NRC as Attachment 4 to our August 13, 1984 letter (1CANØ884Ø4). The key points given in this report are summarized below.

1) Installation: Tooling to permit the installation of an 80-inch sleeve in any tube in an OTSG was developed and qualified.

2) Leakage: Ten thousand (10,000) sleeves with the design average leak rate could be installed in a plant, and the overall steam generator primary to secondary leakage would be only one-tenth of the leakage which requires plant shutdown.

3) Joint Strength and Slippage: No joints failed at loads below the tube yield strength, and the maximum slippage is 0.110 inches under accident loads and 0.030 inches under operating loads. The sleeve joint is stronger than the tube, and both can withstand the maximum axial load resulting from main steam line break conditions. Joint slippage is well within acceptable limits at normal operating and accident conditions.

4) Process Control: The parameters of the sleeve free-span expansion were evaluated. The sleeve installation process is controllable so that predictable joint quality is maintained.

5) Corrosion: The sleeve is fabricated according to standards set by ASME SB-163. Accelerated corrosion tests indicated a reasonable likelihood that the sleeved tubes will not crack.

6) Vibration: The sleeved tube, whether the present tube is severed or not, has a smaller maximum displacement and a greater fluid-elastic stability margin than the unsleeved tube. Maximum stresses are well below allowable stresses.

7) Tube Strain: Tube specimens were processed to evaluate the sleeve and tube elongation due to sleeve rolling. Predictions that the tube is always in tension and the sleeve is always in compression were confirmed.

8) Adjacent Sleeves: Adjacent sleeve installations are unaffected by new sleeve installation.

9) Plant Performance: Ten thousand (10,000) sleeved tubes would slightly reduce primary flow and full power steam superheat. These effects would have a minimal impact on plant operation.

10) Code Requirements: The tube/sleeve functional integrity is maintained under stress and pressure limits of ASME Section III and NRC Regulatory Guide 1.121.

11) Collapse: The sleeve is stronger than the tube under external pressure, and, therefore, collapse is unlikely.

12) Recommendations: Mechanical tube sleeves have been qualified for use in degraded OTSG tubes by a series of tests and analyses. The design is strong enough and sufficiently leak free to be used as a permanent remedy to keep degraded tubes in service. It is recommended that up to 10,000 of these mechanical sleeves be installed in the OTSGs as needed to correct or prevent tube degradation which would otherwise require that the tube be removed from service.

3.2 CORROSION TEST OF A MECHANICALLY SLEEVED ANO-1 OTSG TUBE (APPENDIX A): Since the OD of the tubes to be sleeved in the ANO-1 OTSGs could possibly contain superficial intergranular attack (IGA) at the elevation of the free span roll expansion of the sleeve, this corrosion test was proposed to confirm that the expanded sleeve design would not significantly accelerate or propagate the existing IGA. The possible effects of corrosion propagation during normal operation due to the increased residual stress in the rolled joint and corrosive propagation during wet lay-up were investigated.

To perform this test, a specimen was fabricated from a portion of a tube pulled from the ANO-1 B-OTSG in January 1983 on which IGA was observed. The specimen was fabricated using the process developed for field installation. The specimen was exposed in an autoclave at approximately 600°F to an environment that contains two to six times the typical feedwater contaminant concentrations. A tensile load of approximately 500 lbs. was placed on the expanded joint for the 2000 hour duration of the test. Upon completion of this phase of the test, one of the two expanded joints was removed for metallurgical examination while the other joint was replaced in the autoclave in wet lay-up conditions for 500 hours. This joint was then removed from the autoclave and metallurgically examined for evidence that the existing IGA had not progressed during the testing.

The corrosion test showed essentially the same depth of IGA in specimens removed from the autoclave for operational and wet lay-up simulation as was found in specimens examined prior to the test. This test was intentionally conservative compared to the actual service environment expected at ANO-1. Therefore, this test, in conjunction with the information contained in the referenced reports, further supports the installation of mechanical sleeves in the ANO-1 OTSGs.

The 2000 hour duration of this test is considered adequate since stress corrosion cracking is a relatively rapid phenomenon. Slower corrosion mechanisms such as corrosion in conjunction with cyclic stresses are not expected to be activated by the sleeving process, but are taken into account by the actual operation of the ten demonstration sleeves. Defects should occur in these ten tubes first where they can be found by eddy current testing.

3.3 THE EFFECTS OF ROLLER EXPANDING SLEEVES INSIDE OTSG TUBES AFFECTED BY INTERGRANULAR CORROSION (APPENDIX B): B&W, on contract to AP&L, evaluated the effect of roll expanding a sleeve into existing ANO-1 tubing. The ANO-1 tube samples, each 7 inches long, were cut from a previously pulled ANO-1 tube. The samples were obtained from a portion of the tube adjacent to an area known to have IGA present on the OD surface.

The ID of the samples was chemically decontaminated to eliminate the need for rolling under hot cell conditions. A small section was then cut from both ends of the sample and the IGA categorized for post rolling comparisons.

Upon completion of the ID decontamination, a sleeve was roll expanded into each tube sample to the maximum qualified expansion. The tube samples were then examined by eddy current testing, diameter measurements, metallography and scanning electron microscopy to characterize the effects of sleeve installation on existing IGA.

As expected, the rolling slightly widened the IGA cracks, but there was no inward propagation of cracks due to rolling. The data obtained from this test served as the baseline for comparison to the corrosion test described in Section 3.2.

3.4 REPORT OF OTSG MECHANICAL SLEEVE 40% WALL REDUCTION TEST (APPENDIX C): The ability of the joint to maintain structural adequacy and leakage control was assessed by performing a pull and leakage test using tubing that had 40% of the wall machined off prior to rolling of the sleeve joint. Two tubes were each sleeved by rolling and the assemblies were subjected to incremental axial loads while the joint slippage and leakage under 1600 psi internal pressure were measured.

This test is quite conservative because complete removal of 40% of the tube wall eliminates any contribution of the undegraded portion of a tube which would not be suffering from the 40% through-wall defect.

Ultimate failure of one specimen occurred in the thin portion of the tube. This indicates that the sleeve joint is stronger than the tube and both can withstand the maximum axial load which results from worst case accident conditions. The other specimen was not pulled to failure.

The specimen which was not pulled to failure was rolled in an abnormal manner due to the failure of a tooling adapter fabricated specifically for use in this test. Because of this failure, we do not believe the resulting slippage and leakage of this specimen are representative of a normal rolled joint. The specimen which was pulled to failure represents the expected performance of this joint. However, both specimens were well within the design criteria for strength and leakage.

The results of this test indicate that even when a sleeve is rolled in a tube whose wall thickness has been reduced by 40%, leakage and joint slippage are well within acceptable limits during both normal and accident conditions.

4.0 SUPPLEMENTAL TESTING: In addition to the B&W corrosion test performed on actual ANO-1 tubing (summarized in Section 3.2), AP&L initiated an independent test program as a contingency to the B&W sleeving program. Although the B&W corrosion test is felt to be conservative, it is difficult to predict the local conditions which can or could exist in the vicinity of the free span roll for all potentially sleeved tubes. For this reason, it was decided that a different approach for determining the corrosion effects of roller expansion should also be pursued to supplement the results of previous tests.

The purpose of this test, which was performed by Westinghouse, was to examine the effects of two different types of sleeving processes on actual ANO-1 tubing. To accomplish this, a detailed characterization of the existing conditions was performed on tubing removed from the ANO-1 OTSGs. The characterization included NDE, analysis of OD tube deposits, micro-examination and sensitization testing. Sleeving was then performed using both mechanical and braze processes. The mechanical process used by Westinghouse, although not exactly like that used by B&W, is very similar. After each step in the sleeving process, the OD surface of the tube was examined and photographed. From their observation, it was determined that the sleeving process used did not widen any IGA areas, such as to make them detectable by eddy current, radiography or visual inspection.

Residual stress measurements, determined by polythionic acid testing, were performed on Westinghouse brazed sleeves and on Westinghouse mechanically expanded sleeves using ANO-1 OTSG tubing. It was verified that the OD residual stresses from roller expansion and brazing process are significantly low and are considered acceptable for a sleeve design.

5.0 EDDY CURRENT TESTING DETECTABILITY (APPENDICES D AND E):

AP&L has coordinated an evaluation of Eddy Current Test (ECT) techniques for the inspection of sleeved tubes with Babcock and Wilcox (B&W). Additionally, AP&L has stayed abreast of other ECT vendors' capabilities and the industry's efforts in this area to provide input into the B&W evaluation and to identify alternate inspection vendors.

There are two problem areas in the inspection of sleeved tubes: the roll transition zones where the joints are made and in the parent tube at the sleeve's lower end. Both problems are related to the change in tube/sleeve diameters.

The primary purpose of the R&D effort described in our May 10, 1985 letter (1CAN058503) was to address these two areas. The methods explored were specifically targeted at suppressing the effects of diameter transition so that it does not interfere with the tube/sleeve inspection.

As a result of these efforts, the ability to detect 40% through-wall defects in all regions of the sleeve and parent tube has been demonstrated using existing ECT techniques. The ability to detect 20% through wall penetrations has been demonstrated for all regions of the sleeve/tube combination with the exception of the tube at the sleeve end. The large signal produced by the I.D. transition at the end of the sleeve masks the signal for the 20% through-wall tube inspection.

Our current inspection capability meets the ASME Code and Technical Specification requirements with the exception that both Code and Technical Specifications require sensitivity to 20% through-wall, which is not attainable for the tube at the sleeve end. Per EPRI sleeve design guidelines, this condition appears to be common to sleeved tubes within the industry. Although it is a departure from the Code and Technical Specification requirements, the reduced detection capability at the sleeve end is considered acceptable for the following reasons: 1) this region is inspected prior to sleeve installation when the 20% through wall sensitivity is available, 2) a base-line ECT signal is determined immediately after sleeve installation such that any subsequent changes in the signal can be evaluated if they occur, 3) the region affected by this limitation historically has not been subject to degradation at ANO-1 and the sleeve installation should not affect this area (it is at a minimum 1¼" below the roll affected region), and 4) 40% through-wall degradation is detectable, and since this is the plugging criterion, no action (other than reporting of "degraded" tubes) is required in the affected range of the 20-40% through-wall.

As improvements in ECT inspectability of sleeved tubes is an ongoing activity, AP&L plans to continue to stay abreast of new ECT techniques as they develop to ensure that state-of-the-art technology is utilized in the inspection of sleeved tubes.

6.0 HEALTH PHYSICS MEASURES ASSOCIATED WITH SLEEVE INSTALLATION:

Radiological protection requirements will comply with Arkansas Nuclear One Procedure 1622.026, "Health Physics Requirements for Steam Generator Entries," and the Radiological Work Permit to be written for tne job.

The steam generator tube sleeving project will be reviewed by the ALARA Committee because of the high radiation dose rates which will be encountered. The ALARA Committee will review each step of the work to identify methods of reducing personnel radiation exposure. The ALARA Committee will assign responsibilities to ensure identified exposure reduction methods are practiced.

In order to reduce personnel exposure, the majority of the work to be performed in the steam generator associated with sleeving is planned to be performed by B&W's Remote Operated Generator Examination and Repair robot (ROGER). However, even with the use of ROGER a limited number of entries by workers will be required. To accommodate these entries Health Physics (HP) personnel will provide continuous coverage for personnel working the sleeving project.

Each individual who is to enter the steam generator will be assigned a stay time based on measured radiation levels in the steam generator and his allowable dose. A Health Physics Technician stationed outside the steam generator will use a stopwatch to monitor the time spent by the individual inside the steam generator to ensure his stay time is not exceeded. Each individual entering the steam generator will be required to wear cloth anticontamination clothing and a plastic suit. Headsets will be worn to provide communications. Airlines and double-face lens respirators for beta protection will be required. TLDs will be required for monitoring exposure to the individual's head, lens of eyes, chest, upper leg, wrist and ankle.

Upon exiting containment, the current exposure status of each individual who entered the steam generator will be determined by reading his TLDs and updating his exposure records before he is allowed reentry to controlled access. Individual exposure limits will be assigned and controlled in accordance with existing ANO Health Physics procedures. No individual will be assigned an exposure limit greater than 2500 millirem per quarter.

7.0 NO SIGNIFICANT HAZARDS DETERMINATION

Description of amendment request:

The proposed amendment would change Arkansas Nuclear One - Unit 1 (ANO-1) Technical Specification 4.18, "Steam Generator Tubing Surveillance," to modify the designation of those areas identified as special groups in the steam generators where imperfections have previously been found and to allow the installation of steam generator tube sleeves as an option to plugging defective tubes. The modification of special groups would require equally or more stringent surveillance requirements of tubes in the identified areas. The installation of sleeves in defective tubes would reduce the number of tubes that must be plugged and removed from service.

Numerous tests and analyses have been performed to ensure that sleeving is a safe and effective means of repair for defective steam generator tubes. Additionally, a sleeving demonstration program was undertaken at ANO-1 to provide further assurance of the viability of this repair method.

BASIS FOR NO SIGNIFICANT HAZARDS DETERMINATION:

The proposed changes do not involve a significant hazards consideration because operation of ANO-1 in accordance with this change would not:

1) Involve a significant increase in the probability or consequences of an accident previously evaluated.

   Modifying the designation of those areas identified as special groups in the steam generators where imperfections have previously been found does not increase the probability or consequences of an accident previously evaluated. This modification requires equally or more stringent surveillance of the tubes comprising the special groups.

   Conservative evaluations of postulated accidents which would affect steam generator tube integrity are presented in the FSAR. The proposed sleeves to be installed in the ANO-1 steam generators were designed with consideration to these accidents. The sleeves are considered to be structural members and have been demonstrated to meet normal, upset, emergency and faulted conditions resulting from normal operation and accident transients. Additionally, the sleeves have been demonstrated to be mechanically stronger than the tubes themselves. Therefore, a sleeved tube is no more likely to rupture, collapse, or be pulled apart than an unsleeved tube so the probability of a previously evaluated accident is not increased.

   Also, the consequences of a previously evaluated accident are not increased by the installation of steam generator tube sleeves. Due to the decrease in flowrate in the sleeved tubes, the improbable rupture of a sleeved tube would result in no more primary system to secondary system leakage than the rupture of an unsleeved tube.

2) Create the possibility of a new or different kind of accident from any accident previously evaluated.

By including the tubes surrounding the untubed center portion of the steam generator into an existing special group and adding sleeved tubes as a special group, equal or greater scrutiny will be applied to these areas during steam generator tube inspections. Therefore, the possibility of a new or different kind of accident is not created.

Tube sleeves are designed, qualified and maintained under the stress and pressure limits of ASME Section III, Appendix F and draft NRC Regulatory Guide 1.121 and their proper installation is immediately verified by eddy current testing. The sleeved tubes perform the same function in the same manner as unsleeved tubes; therefore, there is no risk of a new or different accident.

3) Involve a significant reduction in a margin of safety.

A margin of safety is not reduced by the modification of the designation of special groups of tubes in the steam generator. If the tubes which are included in the special group were subjected to the same inspection criteria as other tubes (i.e. random selection), they might not be inspected at all. The inclusion of these tubes in special groups requires equal or greater scrutiny than previously existed; therefore, the margin of safety is not reduced.

The margin of safety is not significantly reduced by the installation of sleeves in the steam generator tubes. Assurance that the sleeves have been properly installed is provided by eddy current testing following installation, steam generator tube integrity is maintained under the same limits (ASME Section III and draft NRC Regulatory Guide 1.121) for sleeved tubes as for unsleeved tubes, and the slight reduction in primary flow and full-power steam superheat would have an insignificant impact on the performance of the steam generators under accident conditions.

The Commission has provided guidance concerning the application of the standards for determining whether a significant hazards consideration exists by providing certain examples (48 FR 14870) of amendments that are considered not likely to involve significant hazards consideration. Example (ii) relates to a change that constitutes an additional limitation, restriction or control not presently included in the technical specifications: for example, a more stringent surveillance requirement. Example (iv) relates to a relief granted upon demonstration of acceptable operation from an operating restriction that was imposed because acceptable operation was not yet demonstrated. This assumes that the operating restrictions and the criteria to be applied to a request for relief have been established in a prior review and that it is justified in a satisfactory way that the criteria have been met.

The proposed amendment change to modify the designation of those areas identified as special groups in the steam generators where imperfections have previously been found is similar to Example (ii) in that equally or more stringent surveillance requirements constituting additional controls are applied to these special groups.

The proposed amendment change to allow the installation of sleeves as an option to plugging defective steam generator tubes is similar to Example (iv) in that demonstration of acceptable operation of steam generator tube sleeves has been established by the operation of ten demonstration sleeves in the ANO-1 OTSGs, the "Once Through Steam Generator Mechanical Sleeve Qualification" report submitted in our August 13, 1984 letter (1CANØ88ØØ4) and the additional reports submitted as part of this amendment package. Collectively, these demonstration, test and analysis programs satisfactorily justify that the criteria applied to this amendment request have been met.

Therefore, based on the above, AP&L has determined that this change does not involve a significant hazards consideration.