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Mr. Hugh L. Thompson, Jr.
Director, Division of Licensing
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, DC 20555

SUBJECT: Arkansas Nuclear One - Units 1 & 2
Docket Nos. 50-313 and 50-368
License Nos. DPR-51 and NPF-6
Response to Generic Letter 85-02

Gentlemen:

Per your request, attached is AP&L's response to Generic Letter 85-02. AP&L feels the information provided in this response addresses the issues in the subject letter and outlines AP&L's continuing commitment to an effective program for assuring steam generator tube integrity and tube rupture mitigation.

Very truly yours,

J. Ted Enos
Manager, Licensing

JTE:RBT

Attachment

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OVERALL PROGRAM FOR ASSURING STEAM GENERATOR TUBE INTEGRITY AND FOR STEAM GENERATOR TUBE RUPTURE MITIGATION AT ARKANSAS NUCLEAR ONE (RESPONSE TO NRC GENERIC LETTER 85-02)

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I. INTRODUCTION

The following report was prepared as a response to NRC Generic Letter 85-02, STAFF RECOMMENDED ACTIONS STEMMING FROM NRC INTEGRATED PROGRAM FOR THE RESOLUTION OF UNRESOLVED SAFETY ISSUES REGARDING STEAM GENERATOR TUBE INTEGRITY.

Since the commencement of commercial operation at ANO, AP&L has aggressively addressed the issue of steam generator tube integrity. An integrated approach has been utilized involving both plant and corporate resources.

The programs and practices described in this response reflect the current situation at ANO. These are constantly being re-evaluated in light of ANO and industry experience. Through participation in initiatives undertaken by groups like EPRI (SGOG I & II), NSSS Owners Groups and internal development programs, AP&L remains current with new developments and technology.

AP&L's position in this area remains flexible and is subject to revision as changing conditions dictate. For this reason the programs and practices described should not be construed as a commitment to a definitive program.

It is our opinion that the current practices and programs described in this report adequately address the issue of steam generator tube integrity and tube rupture mitigation at ANO.

II. ANO Steam Generator Tubing Inservice Inspection Program

A. Technical Specifications

The ANO Units' Technical Specifications for steam generator tubing inservice inspection (ISI) are consistent with Standard Technical Specification (STS) requirements. Unit 1 deviates from STS by allowing for "special groups" of tubing that may be independently sampled at 100% rather than including them in the initial 3% sample.

At present, the Unit 1 "special groups" are:

1. Group A-1: Tubes within one, two or three rows of the open inspection lane.

2. Group A-3: Tubes in the wedge-shaped group on either side of the lane region (Group A-1) as defined by Figure 4.18.1 of the ANO-1 Technical Specifications.

These two "special groups" constitute the known problem areas in the Unit 1 steam generators.

Both ANO units have STS definitions (including categories) and inspection frequency language. Thus, both units, theoretically, could use an inspection interval of 80 months for each steam generator.

The initial 3% inspection sample of Unit 1 must be probed full length (except for the "special groups"). For Unit 2, the initial 3% sample need only be probed from the hot leg side, "completely around the U-bend to the top support of the cold leg."

Reporting of ISI results for Unit 1 is done within 45 days of completion of the inspection and annually (by March 1) for Unit 2. The number of tubes plugged for Unit 1 are reported with the ISI results. The number of tubes plugged for Unit 2 are reported within 15 days of the completion of the ISI results. C-3 categories are reported promptly with written follow-up for both ANO units.

The Technical Specification "Steam Generator Tube Inspection Table" for both units has STS wording except that, for Unit 1, indications found in the 100% inspection of the "special groups" tubing do not force increased inspections required by the Table.

B. Practices

The Technical Specifications for each unit are used to establish minimum inspection samples, extent of tube length inspected, reporting requirements, additional inspections required, etc. Inspections are handled on a case basis to determine the correct course of action while using the Technical Specifications to define minimum requirements. It is current AP&L practice to inspect both steam generators at each unit every refueling outage per EPRI PWR STEAM GENERATOR INSPECTION GUIDELINES (Rev 1).

Initial sample sizes are dictated by Technical Specifications for both units. The one exception is Unit 1 "special groups" where a 100% sample is inspected. For Unit 2, at least 50% of the tubes inspected in the initial 3% sample are from known potential "problem areas".

When ANO steam generator eddy current (ET) results are categorized C-2 as a result of indications in the initial 3% sample, the plan for additional sampling is developed on a case specific basis considering:

- The type and location of indications found, [% throughwall (%TW), volume, axial and radial location]

- Comparison of the indications with previous indications

- Location of indications relative to known problem areas, (both at ANO and other plants)

- Comparison of ET results with in situ ET tests on previously pulled tubes where indications were found.

Flexibility in these sample selections has allowed good definition of known potential problem areas in the ANO steam generators.

The ANO-1 ISI history is as follows:

OUTAGE DATE	TYPE	GENERATORS INSPECTED	MF/SF[1]	APPROX. NO. TUBES INSPECTED	C-2?
FEB 77 1R1	ISI	A&B	SF	980[2]	NO
FEB 78 1R2	ISI	A&B	SF	4810	YES
APR 79 1R3	ISI	A&B	SF	1600	NO
JAN 81 1R4	ISI	A&B	SF	2800	YES
NOV 82 1R5	ISI	A&B	MF	31,000[3]	YES
APR 83	MCO[4]	A&B	MF	10,000[5]	NA
OCT 84 1R6	ISI	A&B	MF	11,000[5]	NO[6]

Notes:

1. Multifrequency (MF) or single frequency (SF)
2. 3%=930 Tubes
3. 100% full length (both generators C-3 outside lane area)
4. Mid-cycle outage resulting from degradation found during 1R5
5. 9000 tubes in lane wedges
6. One lane area C-3

For Unit 1 ISI the initial 3% sample is inspected full length. "Special groups" are inspected in those areas of the tubes where problems have occurred. The November 1982 ISI resulted in a 100% full length inspection of both steam generators. This occurred because several of the approximately 140 defective tubes found early in the inspection had indications below the 15th tube support plate. After reanalysis, these indications were found to be false. However, the 100% inspection provided a good 10-year baseline and resulted in the elimination of one of the "special groups", i.e., the periphery (drilled hole) area, and the addition of the previously mentioned lane wedge area.

The ANO-2 ISI history is as follows:

OUTAGE DATE	TYPE	GENERATORS INSPECTED	MF/SF[1]	APPROX. NO. TUBES INSPECTED	C-2?
APR 81 2R1	ISI	A&B	MF	700[2]	NO
OCT 82 2R2	ISI	A&B	MF	1650	YES
OCT 83 2R3	ISI	A&B	MF	600	NO
MAR 85 2R4	ISI	A&B	MF	800	NO

Notes:

1. Multifrequency (MF) or single frequency(SF)
2. 3%=510 tubes

   Until the recent (March 1985) ISI, the initial (3%) sample has been inspected from the hot leg side, over the U-bend to the first tube support plate. Approximately 100 tubes in each generator were probed full length during these early inspections. During the 2R4 inspection, the tubes were inspected full length, except those in row 1. It will continue to be AP&L's practice to inspect full length as part of the initial (3%) sample where practical.

It is AP&L's opinion that no single policy, other than one which generally states that steam generator tube integrity should be maintained, can cover all the possibilities which could arise. The case specific considerations previously described provide the most reasonable approach to inspection plan development to determine steam generator tubing problems.

C. Recommended Changes to Steam Generator Tube Inspection Technical Specification.

1. For all inspections the concept of "special groups" should be applied. This allows intensified (or 100%) inspection of known potential problem areas without forcing an increased inspection scope in areas unaffected by the problems of the "special groups". It allows a full inspection of the problem areas while maximizing the size of the random sample population to aid in the identification of potential new problem areas.

2. The steam generator tube ISI specifications should be revised to encourage inspection of additional tubes (i.e. beyond the minimum Technical Specification required samples). As presently written, the STS discourages additional inspection by setting minimum sample size and penalizing additional inspection by requiring that any defects/indications found in the additional sample be counted toward determining whether additional samples are required.

   Additional sampling could be encouraged by allowing licensees to define the inspection sample patterns/programs before they start the ET examination. They would then count indications found in the STS mandated sample programs/patterns toward determining the need for required additional inspections. The licensee should be allowed latitude to increase inspection scope based on indications found in tubing inspected (or an expanded basis at the licensee's discretion) without forcing additional inspections in unaffected areas of the steam generator.

III. Chemistry

A. Secondary Chemistry Procedures and Practices

Early in commercial operation at ANO, AP&L recognized that most steam generator tube degradation problems were the result of active corrosion mechanisms. The key elements in the mitigation and elimination of most of these was the maintenance of an optimum water chemistry environment in the steam generators and the elimination of contaminants in the feed and condensate trains.

By means of Plant Administrative Procedures, ANO has established a Secondary Chemistry Monitoring Program, which is designed to maximize the availability and operating life of the steam generators. These procedures are plant specific and were patterned after the EPRI/PWR Secondary Water Chemistry Guidelines, issued in September 1981. AP&L began a program of compliance with the guidelines in November 1981.

Included in each procedure is the chemistry program, responsibility/authority for program development, implementation, compliance, data interpretation, and required approval for deviations. The procedures also contain corrective actions including power reductions and plant shutdowns for excessive off control point conditions. Deviations from these procedures require the approval of ANO Management.

It is our opinion that our established programs as mandated by these procedures would meet the NRC recommendations for secondary chemistry.

B. Condenser Integrity

As noted earlier, AP&L recognized that the elimination of contaminants from the feed and condensate trains played a major role in the mitigation of corrosive attacks to steam generator tubing. Historically, industry experience has shown that Main Condenser in-leakage is a major source of these contaminants.

The ANO Steam Generator Chemistry Monitoring Program is mandated by procedures classified as "Safety-Related" and serves to operationally limit condenser in-leakage in order to maintain identified chemistry parameters within specification. This forces timely repairs when leakage occurs. For this reason a separate condenser inservice inspection procedure does not exist at ANO.

A comprehensive program is in effect to locate, repair and determine the cause of condenser tube degradation. This program is visible to and supported by Corporate Management. Non-destructive examinations, (ET, UT and/or visual) are conducted on each condenser virtually every refueling outage, with the scope based on previous cycle performance and findings of the inspection.

AP&L routinely performs NDE of condenser tubing during refueling outages. The examinations include known problem areas including areas where tube erosion can be expected. Implementing a "plug before leak" philosophy, tubes are generally plugged using a 40%TW criterion, which is conservative by industry standards. This tube plugging criterion is flexible dependant upon the defect mechanism.

Methods used to find and identify condenser in-leakage on both ANO Units include ultra sound and helium detection. Also, condenser water box samples are taken to identify leaking tubes. Once the leak location is determined, the cause can be identified and eliminated. Leaking tubes are identified on a tube-sheet map and removed from service with an appropriate plug.

AP&L has pulled degraded tubes from the condensers for visual, chemical and destructive analysis as part of an on-going root cause evaluation.

The inside of condenser tubing is mechanically cleaned periodically to reduce the likelihood of corrosion under fouling deposits and to improve heat transfer. Unit 2 has an on-line (Amertap) cleaning system.

It is AP&L's conclusion that this program provides adequate condenser inspection, preventative maintenance and adequate response when leaks occur.

C. Plant Modifications

ANO has in place, under construction or in design several major balance of plant modifications which facilitate the optimization of steam generator water chemistry and the elimination of feed and condensate train contaminants. A list of these modifications and their scheduled implementation dates is provided below:

ANO-1

Heater Drain Pump Mechanical Seals	-	1984
Condensate Makeup Degasification System	-	1985
Condensate Storage Tank Floating Lid	-	1984
Sample System Upgrade	-	1985
Ammonia Pump Replacement	-	1984
Steam Generator Recirculation System	-	1986

ANO-2

Ammonia Pump Replacement	-	1984
Feedwater Heater Bundle Replacement	-	1983
Condensate Storage Tank Floating Lid	-	1984
Condensate Makeup Degasification System	-	1985
Secondary Boric Acid Addition System	-	1983

COMMON

Increased Storage and Supply Facilities for N_2 Blanketing	-	1984

At the present time a redundant safety grade condensate storage tank is in the design/construction phase to provide a dedicated source of de-oxygenated water to the ANO-1 Emergency Feedwater Pumps.

Also under consideration by AP&L are several other secondary upgrade projects, including the upgrade of the ANO makeup water plant and modification of the ANO-2 condenser to improve its integrity and performance.

It is AP&L's conclusion that our commitment of significant corporate resources to secondary upgrades clearly illustrates our intent to achieve and maintain optimum steam generator water chemistry.

IV. Steam Generator Maintenance

A. Procedures and Practices (Loose Parts Prevention)

Work plans or procedures that involve entry into the secondary (steam) side of the ANO steam generators are classified as "Safety-Related", requiring a thorough review prior to implementation. Necessary controls to preclude loose parts generation and the possibility of introduction of contaminants during maintenance are provided.

These procedures include tool/material accountability logs, QC hold points, fastener torque specifications, etc. At the present time neither ANO Unit has installed an on-line secondary loose parts monitoring system. However, it is our experience that well planned, thoroughly reviewed maintenance procedures and visual inspections eliminate the need for such monitors.

Of major concern to AP&L was the steam generator secondary side environment during wet or dry layup conditions. Proper wet layup chemistry is procedurally assured. During dry layup conditions a positive nitrogen pressure is maintained in the steam generator whenever possible. When personnel safety is an over-riding consideration, this may be omitted.

Care is exercised to minimize the number of open steam generator secondary side penetrations when maintenance is performed. This is accomplished by specific steps or cautions in the procedures. Typically inflatable rubber bladders or temporary covers are used.

B. Steam Generator Scheduled Maintenance and Visual Inspections

Visual inspections of the secondary side of the ANO steam generators are conducted when penetrations are opened for other maintenance. During these inspections tube wipe and scrape samples and sludge pile samples are obtained for later analysis whenever possible.

The ANO-2 steam generator steam separator area and the top of the tube bundle are visually inspected every refueling outage. When sludge lancing is conducted on the ANO-2 steam generators the tube sheet and annulus area are visually inspected. Whenever possible, these inspections are recorded on video tape or with 35mm photographs.

Recently AP&L along with B&W and two other B&W Owners funded the development of fiberoptic equipment for a "deep bundle" inspection of the ANO-1 steam generators. This equipment was used to conduct visual examinations of the "A" steam generator during refueling outages 1R6 and 1R5.

The ANO-2 steam generators have been sludge lanced twice (2R3 and 2R4) as preventative maintenance. There is no current evidence of an "under pile" corrosion problem. Decisions to sludge lance are based on operational mass-transport studies, hideout tests, chemistry performance, industry experience and risk benefit analysis.

Currently there is no proven method available to sludge lance the ANO-1 steam generators. However, there has not been a significant concern about tube degradation in the lower tube sheet area of B&W Once Through Steam Generators (OTSGs) due to the relatively small sludge piles observed to date. B&W is developing the adaptation of a European recirculating steam generator lancing process to the B&W OTSGs. This process has yet to be demonstrated in the field. Preliminary tests conducted in the ANO-1 "A" OTSG with an experimental water lance during 1R6 revealed that the sludge pile is not tenacious and can be easily moved by a high pressure water lance. Although there is presently no indication of an "under-pile" corrosion problem in the ANO-1 OTSGs, AP&L Management is considering undertaking the development of a viable sludge lancing process for OTSGs. Support and input from other B&W Owners will be solicited for this proposal.

V. ANO Steam Generator Integrity Program

As discussed earlier, AP&L has addressed steam generator tube integrity with an integrated, programatic approach. This was formalized in early 1981 with the formation of an internal Steam Generator Integrity Program. This program is managed at the corporate level by a dedicated coordinator and involves the dedicated participation of a number of different groups and disciplines within the company and at ANO. These include:

- ANO Plant Operations
- ANO Plant Technical Analysis (Chemistry)
- ANO Plant Maintenance
- ANO Plant Engineering
- Corporate Engineering Services
- Corporate Technical Services (Materials/Chemistry)
- Corporate Nuclear Services
- ANO Project Management
- ANO Plant Performance

Representatives from each organization meet as a committee on a regular, periodic basis. Within the committee current problems and ISI/inspection results are evaluated, on-going projects are reviewed and new initiatives are proposed. Action items are assigned to appropriate groups and consensus recommendations are developed, then presented for management review in the form of specific proposals. This integrated approach ensures proper prioritization of concerns. Most of the secondary upgrades earlier described, as well as procedure changes and maintenance practices are products of this program. Current programs and issues being coordinated by or evaluated by the committee include:

- Development of a sludge lancing process for ANO-1
- Development of a "water-slap" cleaning process to remove the material fouling the ANO-1 steam generator tube support plates (root cause evaluation)
- Development of technology for sleeving ANO-1 degraded steam generator tubes
- Development of new steam generator inspection techniques
- Evaluation and potential further development of chemical cleaning processes
- Evaluation of ANO-2 steam generator boric acid addition program ("denting" mitigation)
- Evaluation of ANO-2 condenser

During refueling outage 1R6 (Fall 1984) B&W installed 10 demonstration tube sleeves in the ANO-1 "A" steam generator. Their performance will be monitored this operating cycle. AP&L has taken the lead in this program to develop an acceptable tube sleeving method as an alternative to plugging degraded tubes in OTSGs.

While it is recognized that some of these efforts do not directly address NRC recommendations on steam generator tube integrity, AP&L takes credit for the fact that our integrated approach allows information gathered in related efforts to synergize and therefore enhances the overall program.

The ANO Steam Generator Integrity Program also serves as the internal focal point for AP&L participation in various owners group activities.

VI. Steam Generator Tube Rupture Mitigation

Presently in place at ANO-1 & 2 are emergency operating procedures developed in accordance with NUREG-0737 Supplement 1. These procedures contain operator guidance in the diagnosis and mitigation of steam generator tube leaks/ruptures.

Both ANO Units have 1 GPM primary to secondary leak rate limits. ANO-2 has the STS limit of 0.5 GPM/steam generator.

ANO-2 has the STS limit for coolant iodine activity. The ANO-1 coolant iodine activity limit is less restrictive than the STS limit. The NRC Licensing Basis Documents for ANO-1 and ANO-2 indicate that off-site dose rates resulting from a SGTR considering worst-case Technical Specification iodine activities are a small fraction of 10 CFR part 100 guidelines.

ANO-1 and ANO-2 do not have "Safety Injection Signal Reset", therefore the staff recommendation is not applicable to ANO-1 or 2.