April 10, 1998

Mr. C. Randy Hutchinson
Vice President, Operations ANO
Entergy Operations, Inc.
1448 S. R. 333
Russellville, AR 72801

SUBJECT: ISSUANCE OF AMENDMENT NO. 191 TO FACILITY OPERATING LICENSE NO. DPR-51 - ARKANSAS NUCLEAR ONE, UNIT NO. 1 (TAC NO. MA1325)

Dear Mr. Hutchinson:

The Commission has issued the enclosed Amendment No. 191 to Facility Operating License No. DPR-51 for the Arkansas Nuclear One, Unit No. 1 (ANO-1). This amendment consists of changes to the Technical Specifications (TSs) in response to your application dated April 1, 1998, as supplemented by letter dated April 8, 1998. As requested in your letter of April 1, 1998, the amendment is being issued under the emergency provisions of Section 50.91(a)(5) of Title 10 of the Code of Federal Regulations.

The amendment revises TS 4.18.5.b to include five criteria which need to be satisfied to allow steam generator tubes to remain in service during Cycle 15 operation with indications of outer diameter intergranular attack (ODIGA) in the upper tubesheet region of the steam generators. The amendment will allow approximately 440 steam generator tubes with confirmed volumetric indications within the upper tubesheet to remain in service for the upcoming operating cycle while the NRC staff continues its review of your application dated December 12, 1997, for an alternate repair criteria for indications in the upper tubesheet region.

A copy of our related Safety Evaluation is also enclosed. A Notice of Issuance will be included in the Commission's next biweekly Federal Register notice.

Sincerely,
Original Signed By J. Hannon for
William Reckley, Project Manager
Project Directorate IV-1
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-313

Enclosures: 1. Amendment No. 191 to DPR-51
2. Safety Evaluation

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Docket File	PUBLIC	PD4-1 r/f	OGC (15B18)
CHawes	WReckley (2)	GHill (2)	TGwynn, RIV
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THarris (TLH3)	PRush		

Document Name: AR1A1325.AMD *SEE PREVIOUS CONCURRENCE

OFC	PM/PD4-1	LA/PD4-1	EMCB*	OGC*	PD/PD4-1
NAME	WReckley/vw	CHawes	TSullivan	RBachmann	JHannon
DATE	4/10/98	4/10/98	4/8/98	4/9/98	4/10/98
COPY	YES/NO	YES/NO	YES/NO	YES/NO	YES/NO

OFFICIAL RECORD COPY

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DATE	4/8/98	4/8/98	4/8/98	4/9/98	/98
COPY	YES/NO	YES/NO	YES/NO	YES/NO	YES/NO

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

April 10, 1998

Mr. C. Randy Hutchinson
Vice President, Operations ANO
Entergy Operations, Inc.
1448 S. R. 333
Russellville, AR 72801

SUBJECT: ISSUANCE OF AMENDMENT NO. 191 TO FACILITY OPERATING LICENSE NO. DPR-51 - ARKANSAS NUCLEAR ONE, UNIT NO. 1 (TAC NO. MA1325)

Dear Mr. Hutchinson:

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The amendment revises TS 4.18.5.b to include five criteria which need to be satisfied to allow steam generator tubes to remain in service during Cycle 15 operation with indications of outer diameter intergranular attack (ODIGA) in the upper tubesheet region of the steam generators. The amendment will allow approximately 440 steam generator tubes with confirmed volumetric indications within the upper tube sheet to remain in service for the upcoming operating cycle while the NRC staff continues its review of your application dated December 12, 1997, for an alternate repair criteria for indications in the upper tube sheet region.

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Sincerely,

William Reckley, Project Manager
Project Directorate IV-1
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-313

Enclosures: 1. Amendment No. 191 to DPR-51
2. Safety Evaluation

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

ENTERGY OPERATIONS INC.

DOCKET NO. 50-313

ARKANSAS NUCLEAR ONE, UNIT NO. 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No.191
License No. DPR-51

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Entergy Operations, Inc. (the licensee) dated April 1, 1998, as supplemented by letter dated April 8, 1998, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance: (I) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this license amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and Paragraph 2.C.(2) of Facility Operating License No. DPR-51 is hereby amended to read as follows:

   2. Technical Specifications

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 191 , are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. The license amendment is effective as of its date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

John N. Hannon for

William Reckley, Project Manager
Project Directorate IV-1
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: April 10, 1998

ATTACHMENT TO LICENSE AMENDMENT NO. 191

FACILITY OPERATING LICENSE NO. DPR-51

DOCKET NO. 50-313

Replace the following page of the Appendix "A" Technical Specifications with the attached page. The revised page is identified by Amendment number and contain vertical lines indicating the area of change.

REMOVE PAGE	INSERT PAGE
110m1	110m1
110n	110n

8. Unserviceable describes the condition of a tube if it leaks or contains a defect large enough to affect its structural integrity in the event of an Operating Basis Earthquake, a loss-of-coolant accident, or a steam line or feedwater line break as specified in Specification 4.18.4.c.

9. Tube Inspection means an inspection of the steam generator tube from the point of entry completely to the point of exit. For tubes that have been repaired by the reroll process within the upper tubesheet, that portion of the tube above the new roll can be excluded from future periodic inspection requirements because it is no longer part of the pressure boundary once the repair roll is installed.

b. The steam generator shall be determined operable after completing the corresponding actions (plug, reroll, or sleeve all tubes exceeding the plugging limit and all tubes containing through-wall cracks) required by Table 4.18-2 with the following exception:

Tubes with outer diameter intergranular attack indications within the upper tubesheet with potential of through-wall depths greater than the plugging limit, located by eddy current between 2.75 inches above the secondary face and below the roll transition, may remain in service for Cycle 15 contingent upon the following conditions:

1. One hundred percent of the unsleeved tubes are examined by bobbin coil eddy current in the upper tubesheet region during the fourteenth refueling outage,

2. Bobbin coil indications in the upper tubesheet region are examined by rotating pancake coil eddy current and confirmed to be volumetric,

3. A comparison shall be made between the bobbin coil voltage measured during the thirteenth refueling outage for the confirmed indications and the bobbin coil voltage for the same indications measured during the fourteenth refueling outage. The comparison shall confirm essentially no increase in voltage on average,

4. Tubes containing indications with bobbin coil voltage amplitudes > 0.7 volt and having growth > 0.3 volt since the last inspection shall be plugged or repaired, and

5. In-situ pressure testing in the "A" steam generator during the fourteenth refueling outage confirms, at a 95% confidence level, that the bounding accident leakage due to volumetric ODIGA flaws within the upper tubesheet region will be less than 0.5 gallon per minute due to a main steam line break.

4.18.6 Reports

Following each inservice inspection of steam generator tubes, the complete results of the inspection shall be reported to the NRC. This report, to be submitted within 45 days of inspection completion, shall include:

a. Number and extent of tubes inspected;

b. Location and percent of wall-thickness penetration for each indication of an imperfection;

c. Identification of tubes plugged and tubes sleeved; and

d. Number of tubes repaired by rerolling and number of indications detected in the new roll area of the repaired tubes.

This report shall be in addition to a Special Report (per Specification 6.12.5.d) required for the results of steam generator tube inspections which fall into Category C-3 as denoted in Table 4.18-2. The Commission shall be notified of the results of steam generator tube inspections which fall into Category C-3 prior to resumption of plant operation. The written Special Report shall provide a description of investigations conducted to determine cause of the tube degradation and corrective measures taken to prevent recurrence.

Bases

The surveillance requirements for inspection of the steam generator tubes ensure that the structural integrity of this portion of the RCS will be maintained. The program for inservice inspection of steam generator tubes is based on a modification of Regulatory Guide 1.83, Revision 1. Inservice inspection of steam generator tubing is essential in order to maintain surveillance of the conditions of the tubes in the event that there is evidence of mechanical damage or progressive degradation due to design, manufacturing errors, or inservice conditions that lead to corrosion. Inservice inspection of steam generator tubing also provides a means of characterizing the nature and cause of any tube degradation so that corrective measures can be taken.

Steam generator tubes that are degraded beyond the repair limit can either be plugged, sleeved, or rerolled. The steam generator tubes that are plugged are removed from service by the installation of plugs at both ends of the associated tube and thus completely removing the tube from service.

Degraded steam generator tubes can also be repaired by the installation of sleeves which span the area of degradation and serve as a replacement pressure boundary for the degraded portion of the tube, thus permitting the tube to remain in service.

Degraded steam generator tubes can also be repaired by the rerolling of the tube in the upper tubesheet to create a new roll area and pressure boundary for the tube. The rerolling methodology establishes a new pressure boundary below the degradation, thus permitting the tube to remain in service. The degraded tube above the new roll area can be excluded from future periodic inspection requirements because it is no longer part of the pressure boundary once the repair roll is installed in the upper tubesheet. The rerolling repair process will only be used to repair defects in the upper tubesheet in accordance with BAW-10232P, Revision 00.

All tubes which have been repaired using the reroll process will have the new roll area inspected during future inservice inspections. Defective or degraded tube indications found in the new roll and any indications found in the original roll need not be included in determining the Inspection Results Category for the generator inspection.

The reroll repair process will only be used to repair tubes with defects in the upper tubesheet area. The reroll repair process will be performed only once per steam generator tube using a 1 inch roll length. Thus, multiple applications of the reroll process to any individual tube is not acceptable. The new roll area must be free of detectable degradation in order for the repair to be considered acceptable. After the new roll area is initially deemed acceptable, future degradation in the new roll area will be analyzed to determine if the tube is defective and needs to be removed from service. The reroll repair process is described in the topical report, BAW-10232P, Revision 00.

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO.191TO

FACILITY OPERATING LICENSE NO. DPR-51

ENTERGY OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNIT NO. 1

DOCKET NO. 50-313

1.0 INTRODUCTION

By letter dated April 1, 1998, Entergy Operations, Inc. (the licensee) submitted a request for changes to the Arkansas Nuclear One, Unit No. 1 (ANO-1) Technical Specification (TS). The requested changes would allow approximately 440 steam generator tubes with confirmed volumetric indications within the upper tubesheet to remain in service during Cycle 15. The licensee proposed to revise TS 4.18.5.b to incorporate four criteria which need to be satisfied to allow steam generator tubes to remain in service during Cycle 15 with indications of outer diameter intergranular attack (ODIGA) in the upper tubesheet region of the steam generators. A supplemental submittal dated April 8, 1998, added a fifth criterion to address NRC staff concerns about the need to limit observed growth of individual ODIGA indications.

Given that the licensee initiated a refueling outage at ANO-1 on March 28, 1998, and that in the absence of the proposed amendment, a significant number of steam generator tubes would require repair or plugging during the outage, the licensee requested that the amendment be considered for issuance under the emergency provisions described in 10 CFR 50.91(a)(5).

2.0 BACKGROUND

The existing depth-based steam generator tube repair limit (40% through-wall) in the ANO-1 TS attempts to ensure adequate tube integrity through the end of the next operating cycle. The licensee has proposed to include additional testing and acceptance criteria for inclusion in the TS that, assuming a successful testing program, would allow the ODIGA indications to remain in service through Cycle 15. The proposed TS define an in-situ testing program that would expand upon previous tests related to the structural and leakage integrity of steam generator tubes with IGA indications. The licensee has proposed to test a sample of those tubes found to have IGA indications in the upper tubesheet. The sample size would be defined such that leakage through IGA indications would, with a 95% confidence, be less than 0.5 gpm following a main steam line break accident. The testing program would also expand upon previous IGA growth studies reported by the licensee

The ANO-1 TS requires that tubes having degradation greater than 40% through wall be repaired or removed from service. During the steam generator tube inspection in the refueling outage in September 1996 (1R13), the licensee used an eddy current bobbin probe to size the depth of indications in the upper tubesheet that were attributed to ODIGA. Prior to the inspection, the

licensee had qualified an eddy current sizing technique specifically for measuring the depth of the IGA indications. As a result of the inspection, a number of tubes with IGA indications were returned to service because the depths of the indications were considered to be less than the tube repair limit in the TS. Those tubes with IGA indications measured during 1R13 that were thought to exceed the 40% though-wall criteria were removed from service during that outage.

During the 1R13 outage, the licensee removed three tubes containing a total of 11 IGA indications for destructive examinations. The tubes were selected on the basis that the indications bounded the IGA degradation of the tubes that were left in service. After performing burst tests that subjected the tubes to pressures in excess of 10,000 psig, the licensee compared the actual depths of the IGA degradation measured by destructive examinations to the depths predicted by the eddy current sizing technique used during the tube inspection program. The comparison uncovered a systematic nonconservatism in the eddy current sizing technique. The discrepancy in the IGA measurements and predications raised concerns that some of the tubes left in service actually had IGA degradation that exceeded the TS repair criteria of 40% through-wall.

When the non-compliance was identified, the licensee requested and was granted a notification of enforcement discretion (NOED) on April 9, 1997. The basis for the NOED was that although some of the IGA indications could exceed the 40% through-wall repair criteria, confidence in the structural and leakage integrity of the tubes was provided by the burst tests performed, the performance history of the tubes at ANO-1, and the added support provided by the upper tubesheet. The licensee submitted an exigent TS change on April 11, 1997, to allow a one time exception to the surveillance requirements of Section 4.18.5.b. This exception allowed tubes with ODIGA indications within the upper tubesheet with potential through-wall depths greater than the plugging limit to remain in service for the remainder of Cycle 14. The April 11, 1997, submittal was supplemented on May 2, 1997, with an additional TS change which reduced the leakage limit through the steam generator tubes from 500 gallons per day (gpd) to 144 gpd for the remainder of Cycle 14. In response to this request, the NRC issued Amendment No. 189 to the ANO-1 license dated May 7, 1997. This amendment allowed the unit to continue operation through the remainder of Cycle 14 with tubes that had potential through-wall defects in excess of the 40% plugging limit.

Prior to 1R13, the Babcock and Wilcox Owners Group (B&WOG) was working on the development of an alternate repair criterion (ARC) for volumetric ODIGA flaws. In response to the events at ANO-1, the B&WOG expedited its schedule and focused its initial work on volumetric ODIGA indications within the tubesheet. ANO-1 is the lead plant for NRC review of proposed TS changes associated with the implementation of the ARC. A submittal was transmitted on August 13, 1997, which included a general steam generator description and discussion of plant chemistry, flaw morphology of pulled tubes, nondestructive examination of pulled tubes, and a comparison of laboratory developed ODIGA and field ODIGA. A second submittal was made on December 12, 1997, with a request for approval for use during 1R14 (which began on March 28, 1998).

Through discussions between the licensee and the NRC staff during March 1998, it was determined that insufficient time was available to resolve outstanding issues related to the ARC prior to 1R14. Since many of the arguments that supported allowing the ODIGA flaws to remain in service during Cycle 14 remained valid for operation during Cycle 15, the licensee decided to strengthen the technical justification for allowing the tubes with ODIGA indications to remain in

service and pursue a one-cycle TS change. The proposed change would allow ODIGA flaws in the upper tubesheet to remain in service during Cycle 15 while resolution of the outstanding issues related to the previously submitted ARC proposal are pursued.

Although eddy current inspection techniques can measure the ODIGA degradation, these methods currently are not qualified to adequately assess tube leakage integrity margins. The licensee has proposed to use in-situ pressure testing to demonstrate that tubes would not leak under accident conditions. Based on previous inspection data and the proposed testing and criteria included in this amendment, the licensee has concluded that the depth of the ODIGA degradation will not increase during the next cycle of operation. This conclusion, considered in conjunction with the in-situ pressure test results, will be used to demonstrate adequate leakage integrity margins for the tubes with IGA indications through the end of the next operating cycle.

3.0 EVALUATION

3.1 Inservice Inspection of Steam Generator Tubes

The inservice inspection scope for the current ANO-1 refueling outage includes an examination of 100 percent of the steam generator tubes in the upper tubesheet region with a bobbin coil eddy current probe. Tube examinations with this probe should identify indications of ODIGA degradation that could potentially degrade the tube structural and leakage integrity margins. The bobbin probe, however, cannot assess the morphology or size of detected indications. Because the proposed TS criteria for allowing tubes to remain in service apply only to ODIGA degradation, the licensee will inspect all indications detected with a bobbin coil probe using a rotating pancake probe (RPC). The rotating probe examinations can confirm that the morphology of a bobbin indication is volumetric which is indicative of ODIGA. In addition, the data acquired in the RPC probe inspections can be used to assess the axial and circumferential length of confirmed tube degradation, and whether it initiated from the inside or outside diameter of the tube.

IGA degradation is characterized as a mode of degradation that is volumetric rather than crack-like in nature. That is, the degradation affects a small volume of tube material and typically has dimensions that extend axially, circumferentially, and radially (depth) in the tube. The ODIGA degradation should exhibit a morphology that extends both along the tube axis and around the circumference. Crack-like indications, however, extend primarily along only two tube directions (i.e., radial/axial, radial/circumferential). Because rotating probes are sensitive to degradation extending in both the axial and circumferential directions, these probes are capable of providing data to allow determination of whether an indication is crack-like or volumetric. In addition, they possess the capability to size the length of steam generator tube degradation. The licensee will inspect all indications detected by bobbin coil with a RPC probe. This will enable the licensee to confirm the mode of the degradation and determine the axial and circumferential length of the indication, if applicable. The staff finds that the proposed inspections are adequate to define the ODIGA indications on which the in-situ testing program will be based.

3.2 Structural Integrity Assessment

The proposed modifications to the ANO-1 TS include changes to the steam generator tube acceptance limits defined in TS 4.18.5.b. The existing requirements specify that tubes shall be repaired or removed from service when degradation exists within the tube that is equal to or greater than 40 percent of the nominal tube wall thickness. In order to address the acceptability

of tubes with confirmed ODIGA degradation, the licensee has proposed to impose additional testing and criteria for allowing tubes with ODIGA indications in the upper tubesheet region to remain in service for Cycle 15 operation. Specifically, the licensee has proposed to allow tubes with ODIGA indications to remain in service only in the area defined to be within the upper tubesheet located by eddy current inspection between 2.75 inches above the secondary face and below the roll transition. The 2.75 exclusion zone was determined by a study of the relationship between the lateral load resulting from cross-flows during a steam line break accident, the bending moment, and the position of the defect within the tubesheet. The resultant exclusion zone outside of which the cross-flow loads during a main steam line break are determined to have a negligible effect on the condition of the volumetric ODIGA defect was 2.50 inches above the secondary face of the tubesheet. The licensee increased the exclusion zone to 2.75 inches to account for eddy current testing uncertainties.

Regulatory Guide (RG) 1.121 specifies that tube structural integrity may be demonstrated by subjecting the tube to the larger of three times the normal operating differential pressure or 1.4 times the main steam line break differential pressure. Tube leakage integrity may be demonstrated by subjecting the tubes to the differential pressure that the tube would experience under a postulated main steam line break. The licensee performed pressure tests on three removed tubes with ODIGA indications in accordance with RG 1.121 and reports that the tubes withstood pressures in excess of 10,000 psig without bursting. The three times normal operating differential pressure for ANO-1 is 3765 psig and the differential pressure that the tubes would experience under a postulated main steam line break is 2500 psid. The burst testing results indicate that substantial structural margin exists for the pulled tubes with ODIGA indications.

The burst testing of pulled tube specimens completed by the licensee did not simulate the tubesheet. In the region affected by the proposed interim repair criteria, the small diametral clearance between the tube and tubesheet would prevent a structural failure of the tube. The licensee has demonstrated the validity of this conclusion through burst tests of laboratory prepared tubes in support of the IGA studies. The burst test program consisted of nine tubes containing drilled through-wall holes up to 0.5 inches in diameter and one tube containing no defects. All tubes with the laboratory defects were tested within a simulated tubesheet. Nine of the specimens burst at pressures greater than 10,941 psig. Each tube burst outside the tubesheet within the non-defected portion of the tubes. Testing problems limited the maximum pressure for one test to 9,577 psig, at which the tube had not yet burst. The burst test results indicate that the tubesheet provides sufficient support to preclude tube burst within the tubesheet.

The licensee will complete in-situ pressure testing of a representative sample of steam generator tubes containing ODIGA indications. If the tested tubes retain structural and leakage integrity throughout the test, it provides additional assurance that tubes with indications of ODIGA degradation will have adequate margins for tube integrity. Because the peak accident-induced loads for steam generator tubing are largely a result of thermally-induced stresses rather than internal tube pressure, the in-situ pressure test device will simulate the postulated axial tube loads. Such loads could challenge the structural or leakage integrity of tubes containing circumferentially oriented degradation of significant length or depth. The in-situ test includes subjecting the tube to the main steam line break differential pressure and then a pull cable is tensioned through a reaction sleeve and a hydraulic jack cylinder to achieve the postulated thermally-induced main steam line break axial load.

The staff notes that tubes with volumetric IGA degradation in steam generators at other PWR facilities have also shown significant margins for structural and leakage integrity. Burst tests of tubes removed from service with IGA indications have shown significant margins for structural and leakage integrity under postulated accident conditions. In addition, the licensee for ANO-1 has not attributed any measurable operational leakage in the steam generators to the presence of ODIGA degradation in the tubing. The licensee will support the existing testing data with in-situ pressure and axial loading tests of a representative sample of tubes with ODIGA indications in the "A" steam generator at ANO-1. The staff finds that the limitations proposed by the licensee (restricting ODIGA indications to the defined upper tubesheet region) are supported by the burst tests and other data and are acceptable for Cycle 15 operation.

3.3 Demonstration of Leakage Integrity Margins

The existing depth-based repair criteria are established to ensure steam generator tubes have adequate structural and leakage integrity with appropriate margins of safety under normal operating and postulated accident conditions. The approach proposed by the licensee may permit tubes containing degradation with actual depths greater than the 40 percent depth to remain in service. Under high differential pressures, this degradation could become a leak path for the reactor coolant to the steam generator secondary side. As part of the criteria to address the ODIGA degradation, the licensee will complete in-situ pressure testing of steam generator tubes with ODIGA indications to demonstrate a low leakage potential for tubes containing this mode of degradation.

In-situ pressure testing subjects degraded tubes to conditions that are conservative with respect to internal pressure loadings postulated to occur under accident conditions. Internal pressure within the tube during the test induces axial and circumferential stresses within the tube wall. The purpose of the testing is to assess whether the degraded tubes exposed to these elevated stresses are capable of withstanding the test conditions while retaining leakage and structural integrity. Since previous in-situ pressure testing has not simulated the bounding axial tube loads expected to occur under accident conditions, the testing planned for 1R14 includes the addition of actual axial loads during the performance of the pressure tests. Once the main steam line break differential pressure has been achieved, a pull cable is tensioned through a reaction sleeve and a hydraulic jack cylinder to achieve the postulated thermally-induced main steam line break axial load. Since the test chamber main steam line break pressure creates an axial load, the additional load provided by the cable is intended to create a total axial load of 1402 lbs. (the postulated thermal load for main steam line break at ANO-1). The licensee has stated that the results of this testing has been verified through qualification and analysis.

In addition to the destructive examination of the ODIGA patches removed in 1R13 which showed none of the flaws to be through-wall, the licensee has also completed testing of tubes with holes of various sizes and depths machined into the tubing. The artificial patches were machined to depths ranging from approximately 84% to 95% through-wall, with patch diameters of 0.30 and 0.50 inches. The severity of the machined patches bound the potential effects of having an ODIGA patch in a tube that is of similar depth and diameter. None of the machined patches showed signs of leakage when subjected to accident loads.

To augment the existing database of pulled tube IGA defects, the licensee developed artificial IGA flaws under laboratory conditions. The defects in these tubes were corrosively-induced rather than mechanically-induced in order to closely simulate the degradation found in the

actual steam generator tubes. The licensee subjected a total of 29 simulated IGA defects to design basis loading conditions. All of the tube specimens retained structural and leakage integrity at the target test conditions. This testing provides additional evidence that the ODIGA degradation will not diminish the leakage integrity margins for tubes affected by this mode of degradation.

The laboratory testing performed is consistent with the historical ANO-1 plant data which shows the ODIGA flaws to be resistant to leakage. The licensee has observed that there have been no known primary-to-secondary leaks in the history of ANO-1 attributed to volumetric ODIGA indications despite the fact that many of these indications have remained in service for years. In addition, during a May 1996, plant transient, the "B" steam generator tubing was subjected to a differential pressure of approximately 2100 psid for several hours. No leakage from ODIGA flaws was observed during the event or following subsequent plant startup.

For the inspections planned for 1R14, the licensee will select a number of tubes with ODIGA indications for in-situ testing. By testing the integrity of a representative sample of tubes, the licensee can assess the potential for leakage from all of the tubes identified by the eddy current inspections to have ODIGA indications. Based upon previous studies of the size of the ODIGA indications in the upper tubesheet region of the ANO-1 steam generators, the licensee selected a conservative assumed ODIGA axial flaw length of 0.3 inches. The results from previous destructive examinations of ODIGA volumetric indications were used to determine that it would be conservative to assume an axial through-wall crack of 50% of the ODIGA length. The hypothetical leak rate was then calculated consistent with the conditions for a main steam line break accident. Assuming 50% of the length of a 0.3 inch axial flaw will be 100% through-wall, a leak rate of 0.0126 gpm through the crack was calculated. The staff notes that the magnitude of the calculated leak rate is consistent with other industry steam generator tube leak rate data. Assuming that the ODIGA patches can contribute approximately 0.5 gpm of the licensing basis leak rate (1.0 gpm), 39 ODIGA patches can be assumed to leak and the current licensing basis leak rate would be maintained. Given the maximum allowable number of leaking ODIGA patches (39) and the total number of ODIGA indications that are identified during the inspections to be performed during 1R14, a statistical determination of the number of tubes to be in-situ tested is performed. Based on the previous identification of more ODIGA indications in the "A" steam generator than in the "B" steam generator, the determination of the number of tubes to be tested and the actual in-situ testing will be performed in the "A" steam generator. The sample size will be increased if any of the in-situ tests result in leakage from an ODIGA indication. The testing program to justify allowing the ODIGA indications to remain in service for Cycle 15 will demonstrate at a 95% level of assurance that the total leakage from ODIGA indications should not exceed 0.5 gpm during a main steam line break accident.

The staff finds that the performance of the proposed in-situ testing will effectively demonstrate the leakage integrity of tubes with ODIGA degradation. Since, as discussed in the following section, the growth of ODIGA degradation in the ANO-1 steam generator tubes is expected to be minimal over the next cycle of operation, the in-situ pressure test results will provide assurance that the leakage integrity margins for tubes with ODIGA indications are maintained through the end of the next cycle of operation. Based on the planned in-situ testing and the previous testing completed on tubes with simulated IGA degradation, the staff finds that the tubes to be returned to service with ODIGA indications in the upper tubesheet of the steam generators at ANO-1 should have acceptable margins for leakage integrity.

3.4 Analysis of Growth Rate for ODIGA Degradation

In accordance with the guidance provided in NRC Regulatory Guide 1.121, steam generator tube repair limits generally incorporate an allowance for degradation growth over the next cycle of operation. Such criteria accounts for the progression of steam generator tube flaws in length or depth during operation that could potentially degrade the margins for tube integrity below acceptable limits. The proposed in-situ testing method for the ODIGA indications in the upper tubesheet for Cycle 15 at ANO-1 does not utilize dimensional limits nor include an allowance for growth. Therefore, the licensee's proposal to use in-situ pressure testing during the outage is only capable of demonstrating that the population of tubes with ODIGA indications has adequate leakage integrity at the time of the test. If it can be demonstrated that the expected flaw growth rate for the ODIGA degradation is negligible, then the in-situ pressure testing will provide assurance that the affected tubes will have sufficient margins for structural and leakage integrity beyond the outage, throughout the next cycle of operation.

The licensee has previously completed a growth assessment for ANO-1 eddy current bobbin indications. The change in bobbin voltage amplitude from 1993-1996 was determined for 129 upper tubesheet indications. The results show that the average voltage change per effective full power year is "zero". The licensee attributed the variability about this average to eddy current uncertainty. Of the 129 indications that were studied, 25 were removed from service during 1R13. Per the proposed TS change, a growth rate study will be conducted during 1R14 utilizing the remaining 104 indications. This study will confirm there has been essentially no growth in the confirmed indications since the 1R13 outage (no more than the normal variability in the results due to equipment setup and analyst interpretation of data). If a significant increase in the voltage for this sample of indications is noted from the growth rate study (i.e., average increase in voltage of 0.1 volts), the licensee will not apply the proposed ODIGA repair criteria.

During the 1R14 outage, the licensee will calculate the voltage growth of all confirmed ODIGA indications with voltages exceeding 0.7 volts. Those indications that experience a bobbin coil voltage change greater than 0.3 volts will be removed from service or repaired. The 0.7 volt threshold voltage was selected to minimize amplitude measurement uncertainty for those indications with voltages on the order of the noise evident in the tubing. Voltage changes in excess of 0.3 volts to identify actual flaw progression are based on the licensee's assessment of NDE uncertainty provided in the submittal dated December 12, 1997. This criterion should ensure that all identified IGA indications considered for in-situ pressure testing are of the same population (i.e., degradation mode), and thus, the assumption of zero growth for each indication remains valid.

Since the bobbin coil voltage amplitude is sensitive to the size of volumetric indications, the bobbin probe data should be an effective screening tool for the detection of growth for the IGA indications at ANO-1. However, the outage-to-outage variation in voltage for these indications may vary between successive inspections complicating the ability to accurately assess growth. The existing analysis completed by the licensee did not reveal a well defined increase in the mean voltage for the population of indications studied. An element of the proposed testing program to be performed during 1R14 will compare the mean voltage of the ODIGA indications studied last outage to confirm that there has been essentially no growth. This required comparison will ensure that the growth of the IGA defects is below the level of scatter in the voltage measurements due to nondestructive evaluation (NDE) uncertainty. In the absence of a

definitive assessment of NDE uncertainty, the NRC staff concludes that the population of IGA indications may be experiencing limited growth during operation. However, since the potential growth for the next cycle would be expected to proceed at a rate similar to prior operational cycles, the staff concludes that tubes proposed to be left in service should maintain similar structural and leakage integrity margins through the end of the next operating cycle.

3.5 Proposed Changes to Technical Specifications

In order to implement the proposal for allowing tubes to remain in service with ODIGA indications in the upper tubesheet which might exceed the 40% through-wall repair criteria, the licensee has proposed to add the following exception to the steam generator operability requirements of TS 4.18.5.b:

> Tubes with outer diameter intergranular attack indications within the upper tubesheet with potential of through-wall depths greater than the plugging limit, located by eddy current between 2.75 inches above the secondary face and below the roll transition, may remain in service for Cycle 15 contingent upon the following conditions:
>
> 1. One hundred percent of the unsleeved tubes are examined by bobbin coil eddy current in the upper tubesheet region during the fourteenth refueling outage,
>
> 2. Bobbin coil indications in the upper tubesheet region are examined by rotating pancake coil eddy current and confirmed to be volumetric,
>
> 3. A comparison shall be made between the bobbin coil voltage measured during the thirteenth refueling outage for the confirmed indications and the bobbin coil voltage for the same indications measured during the fourteenth refueling outage. The comparison shall confirm essentially no increase in voltage on average.
>
> 4. Tubes containing indications with bobbin coil voltage amplitudes > 0.7 volt and having growth > 0.3 volt since the last inspection shall be plugged or repaired, and
>
> 5. In-situ pressure testing in the "A" steam generator during the fourteenth refueling outage confirms, at a 95% confidence level, that the bounding accident leakage due to volumetric ODIGA flaws within the upper tubesheet region will be less than 0.5 gallon per minute due to a main steam line break.

The staff finds that the proposed TS adequately define the limitations and requirements for the in-situ test program for allowing tubes to remain in service during Cycle 15 at ANO-1 with ODIGA indications in the upper tubesheet region of the steam generators. The licensee included a proposed change to TS 3.1.6.3.b to reduce the allowable leakage for the tubes of any one steam generator to 150 gpd. This same request was also included in the amendment request dated February 9, 1998, that proposed to allow the use of repair roll technology (reroll) for indications in the upper tubesheet region of the steam generators. The proposed reduction in the allowable primary to secondary leakage rate is addressed in the

staff's safety evaluation for the reroll amendment request and will be (or has been) transmitted separately from this evaluation.

3.6 Summary

The licensee has proposed to perform in-situ testing of a representative sample of steam generator tubes with ODIGA indications in the upper tubesheet region in order to demonstrate adequate structural and leakage integrity margins for a number of tubes affected by ODIGA during Cycle 15 operation. ODIGA indications may remain in service provided they exist within a specified region of tube in the upper tubesheet and their voltage is relatively unchanged from previous inspections. The presence of the surrounding tubesheet precludes the structural failure of the tube in the areas with confirmed indications. Also, additional burst testing on tubes with actual and simulated IGA degradation has demonstrated that this mode of degradation does not significantly diminish the margins for tube structural integrity without the presence of a surrounding tubesheet under normal operating and postulated accident conditions. The licensee has completed testing of artificial tube flaws that demonstrates the resistance of ODIGA degradation to leakage, and will complete in-situ testing to assess the leakage integrity of the tubes affected by ODIGA to ensure, with a 95% confidence, that the leakage will be less than 0.5 gpm. Successful in-situ pressure testing (i.e., without measurable leakage) completed on a limited sample of tubes will also provide additional validation of tube structural integrity margins. The staff has reviewed the proposed criteria as well as the growth rate assessment for the indications of ODIGA degradation and concluded that the limits are acceptable to justify allowing tubes with ODIGA indications to remain in service during Cycle 15 operation.

4.0 EMERGENCY CIRCUMSTANCES

In its letter dated April 1, 1998, the licensee requested that the proposed changes to the TS be considered under the emergency provisions described in 10 CFR 50.91(a)(5).

Following the identification of IGA indications in 1997 that potentially exceeded the standard depth-based repair criteria for steam generator tubes, the licensee requested and was granted an NOED and subsequent changes to the ANO-1 technical specifications to allow operation during Cycle 14 with the affected tubes remaining in service (see Amendment No. 189). Shortly thereafter, the licensee and B&WOG developed an alternate repair criteria (ARC) that was intended to justify the continued use of many of the steam generator tubes with IGA indications during Cycle 15 and subsequent operating cycles at ANO-1. In support of this proposal, the licensee made submittals to the NRC on August 13 and December 12, 1997. In late March 1998, the NRC staff informed the licensee that its review of the proposed ARC amendment would not be completed in time to support the steam generator inspections scheduled during the current refueling outage. The need for additional staff review of the ARC amendment is largely because the proposed methodology addresses tube degradation mechanisms beyond the known IGA indications and questions arose regarding the broad application of the ARC criteria during future inspections. In order to preclude unnecessarily removing tubes from service solely because of the IGA indications in the upper tubesheet, the licensee quickly developed and submitted on April 1, 1998, the subject amendment and supporting information. In response to NRC staff concerns about the need to limit observations of growth for individual ODIGA indications, the licensee revised the submittal on April 8, 1998.

The licensee's request to consider the amendment under emergency circumstances is related to the fact that ANO-1 entered a refueling outage on March 28, 1998. The requested date of April 9, 1998, for issuance of the amendment is associated with the inspections, and possibly repair or plugging, of steam generator tubes that will be performed early in the outage. Assuming the successful completion of the testing program incorporated into the TS by this amendment, the plugging of the tubes with IGA indications in the upper tubesheet region is considered unnecessary to ensure tube integrity or to limit the leakage through the tubes following an accident. Plugging of the steam generator tubes with the IGA indications would remove a substantial portion of the heat transfer area between the reactor coolant system and the secondary steam plant. Such a reduction in heat transfer area reduces the efficiency of the unit, potentially causes a reduction in the power output from the unit, and would effectively be a derating of ANO-1. Repair of the tubes by sleeving would result in a delay in the unit's restart for several weeks since the licensee would need to procure equipment and services that were not included in the current planning for the outage. The licensee has requested another TS change to allow the use of the reroll technology to repair indications in the upper tubesheet region of the ANO-1 steam generators. While the proposed amendments (this amendment and the reroll amendment) both relate to IGA indications in the upper tubesheet region of the steam generators, the proposal dated April 1, 1998, is primarily a change to the repair criteria (limited to ODIGA indications in the upper tubesheet) while the proposed reroll amendment is an alternate repair methodology that takes advantage of the structural support that is provided by the tubesheet. While related, the proposed amendments are not considered to be interchangeable. In addition, the staff had not issued a decision on the use of the reroll technology at ANO-1 at the time the licensee submitted the proposed emergency amendment.

The staff concludes that an emergency condition exists in that failure to act in a timely way would result in either derating or delaying the restart of ANO-1 from its current refueling outage. In addition, the staff has assessed the licensee's reasons for filing this application under emergency circumstances and concludes that the licensee had submitted and has been working in good faith with the staff on proposals to address the IGA indications in the upper tubesheets of the steam generators at ANO-1 (i.e., the ARC and reroll amendment requests). Upon determining that the ARC proposal would not be available to justify leaving the tubes with ODIGA indications in the upper tubesheet in service, the licensee promptly developed and submitted an alternate approach to remedy the situation. The staff concludes that the licensee has not abused the emergency provisions by failing to make a timely application for the amendment. The conditions needed to satisfy 10 CFR 50.91(a)(5) exist, and the amendment is being processed on an emergency basis.

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.

Operation of the facility in accordance with the proposed amendment will not involve a significant increase in the probability or consequences of an accident previously evaluated. A

steam generator tube failure is a breach of the reactor coolant pressure boundary. This type of an event is analyzed in the ANO-1 Safety Analysis Report (SAR). The existing TS requirements for a depth-based repair criteria provides a high degree of confidence in the structural and leakage integrity of steam generator tubes during each operating cycle. Allowing tubes with ODIGA indications in the upper tubesheet region of the steam generators to remain in service for the upcoming ANO-1 operating cycle does not significantly increase the probability of tube failure. The potential for catastrophic tube failure is reduced by the fact that the tubesheet provides structural support for the tube segments that might have ODIGA indications that exceed the 40% through-wall repair criteria. Licensee test results verify that catastrophic tube failures are not likely to occur in the tubesheet region. The in-situ testing program associated with the proposed amendment will likewise provide a high degree of confidence that the ODIGA indications would not leak at a rate that exceeds the assumptions in the evaluation of the consequences of a steam line break accident. It is expected that tube leaks that could develop in the tubesheet region would be detected during operation and the licensee would be required to shut down the reactor well before the leakage challenged the assumptions used in the accident evaluations described in the SAR.

Operation of the facility in accordance with the proposed amendment will not create the possibility of a new or different kind of accident from any accident previously evaluated. This change proposes a testing program and acceptance criteria to justify the continued operation of steam generator tubes with ODIGA indications and is limited to the tube segments within the upper tubesheet. Other than providing an exception to the current 40% through-wall repair criteria, the proposed change does not involve changes to the actual design requirements or physical condition of plant equipment. The proposed amendment does not change operating practices such that the resulting plant configuration or operator actions vary from those previously evaluated.

Operation of the facility in accordance with the proposed amendment will not involve a significant reduction in a margin of safety. As noted above, operation with ODIGA flaws exceeding the 40% through-wall criteria is confined to the tubesheet region and does not significantly increase the probability or consequences of an accident previously evaluated. The margin inherent in the previous acceptance criteria, flaws less than 40% through-wall, is maintained by limiting the applicability of this amendment to the upper tubesheet region, by the existing burst and leakage testing data, and by the in-situ testing and associated acceptance criteria that are proposed in this amendment.

Based on the above considerations, the staff concludes that the amendment meets the three criteria of 10 CFR 50.92. Therefore, the staff has made a final determination that the proposed amendment does not involve a significant hazards determination.

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

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 made a final no significant hazards consideration determination with respect to this amendment. 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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