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

March 28, 2001

Mr. Craig G. Anderson
Vice President, Operations ANO
Entergy Operations, Inc.
1448 S. R. 333
Russellville, AR 72801

SUBJECT: ARKANSAS NUCLEAR ONE (ANO), UNIT NO. 1 - ISSUANCE OF AMENDMENT RE: STEAM GENERATOR TUBES WITH INDICATIONS OF OUTER DIAMETER INTERGRANULAR ATTACK (ODIGA) (TAC NO. MA9879)

Dear Mr. Anderson:

The Commission has issued the enclosed Amendment No. 213 to Facility Operating License No. DPR-51 for ANO, Unit No. 1. The amendment consists of changes to the Technical Specifications (TSs) in response to your application dated August 29, 2000, as supplemented by letter dated March 2, 2001.

The amendment revises the TS to allow steam generator tubes to remain in service with indications of ODIGA in the upper tubesheet region of the steam generators. The surveillance and evaluation methodology is described in ANO Engineering Report No. 00-R-1005-01, Revision 1, "Management Program for Volumetric Outer Diameter Intergranular Attack in the Tubesheets of Once-Through Steam Generators," which is referenced in TS 4.18.5.a.7.

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

Sincerely,

William Reckley

William Reckley, Project Manager, Section 1
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-313

Enclosures: 1. Amendment No. 213 to DPR-51
2. Safety Evaluation

cc w/encls: See next page

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
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ENTERGY OPERATIONS INC.

DOCKET NO. 50-313

ARKANSAS NUCLEAR ONE, UNIT NO. 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 213
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 August 29, 2000, as supplemented by letter dated March 2, 2001, 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. 213 , 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 and shall be implemented within 30 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

John G. Nakoski for

Robert A. Gramm, Chief, Section 1
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: March 28, 2001

ATTACHMENT TO LICENSE AMENDMENT NO. 213

FACILITY OPERATING LICENSE NO. DPR-51

DOCKET NO. 50-313

Replace the following pages of the Appendix A Technical Specifications with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

Remove	Insert
110j1	110j1
110m	110m
110m1	110m1
110n	110n

a. The first sample inspection during each inservice inspection (subsequent to the baseline inspection) of each steam generator shall include:

1. All nonplugged tubes that previously had detectable wall penetrations (>20%), except tubes in which the wall penetration has been spanned by a sleeve, and

2. At least 50% of the tubes inspected shall be in those areas where experience has indicated potential problems, except where specific groups are inspected per Specification 4.18.3.a.3.

   A tube inspection (pursuant to Specification 4.18.5.a.9) shall be performed on each selected tube. If any selected tube does not permit the passage of the eddy current probe for a tube inspection, this shall be recorded and an adjacent tube shall be selected and subjected to a tube inspection.

3. Tubes in the following groups may be excluded from the first random sample if all tubes in a group in both steam generators are inspected. The inspection may be concentrated on those portions of the tubes where imperfections were previously found. No credit will be taken for these tubes in meeting minimum sample size requirements. Where only a portion of the tube is inspected, the remainder of the tube will be subjected to the random inspection.

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

   (2) Group A-2: Unplugged tubes with sleeves installed.

   (3) 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.

4. Tubes with axially-oriented tube end cracks (TEC) which have been left inservice for the previous cycle shall be inspected with a rotating coil eddy current technique in the area of the TEC and characterized in accordance with topical report BAW-2346P, Rev.0, during all subsequent SG inspection intervals pursuant to 4.18.4. The results of this examination may be excluded from the first random sample. Tubes with axial TECs identified during previous inspections which meet the criteria to remain in service will not be included when calculating the inspection category of the OTSG.

5. Implementation of the upper tubesheet ODIGA alternate repair criteria requires a 100% bobbin coil inspection of the non-plugged and non-sleeved tubes, spanning the defined region of the upper tubesheet, during all subsequent SG inspection intervals pursuant to 4.18.4. Tubes with ODIGA identified during previous inspections which meet the criteria to remain in service will not be included when calculating the inspection category for the OTSG. The defined region begins one inch above the upper tubesheet secondary face and ends at the nearest tube roll transition. ODIGA indications detected by the bobbin coil probe shall be characterized using rotating coil probes in accordance with ANO Engineering Report No. 00-R-1005-01.

4.18.5 <u>Acceptance Criteria</u>

a. As used in this specification:

1. Tubing or Tube means that portion of the tube or sleeve which forms the primary system to secondary system pressure boundary.

2. Imperfection means an exception to the dimensions, finish or contour of a tube from that required by fabrication drawings or specifications. Eddy current testing indications below 20% of the nominal tube wall thickness, if detectable, may be considered as imperfections.

3. Degradation means a service-induced cracking, wastage, wear or general corrosion occurring on either the inside or outside of a tube.

4. Degraded Tube means a tube containing imperfections $\geq$ 20% of the nominal wall thickness caused by degradation, except where all degradation has been spanned by the installation of a sleeve or repaired by a rerolled joint.

   The reroll repair process can be used to repair tubes with defects in the upper and lower tubesheet areas as described in topical report, BAW-2303P, Revision 4.

5. % Degradation means the percentage of the tube wall thickness affected or removed by degradation.

6. Defect means an imperfection of such severity that it exceeds the plugging limit except where the imperfection has been spanned by the installation of a sleeve. A tube containing a defect in its pressure boundary is defective.

7. Plugging Limit means the imperfection depth at or beyond 40% of the nominal tube wall thickness for which the tube shall be sleeved, rerolled, or removed from service because it may become unserviceable prior to the next inspection. This does not apply to ODIGA indications within the defined region of the upper tubesheet. These indications shall be assessed for continued plant operation in accordance with ANO Engineering Report No. 00-R-1005-01, Rev. 1.

   Axially-oriented TEC indications in the tube that do not extend beyond the adjacent cladding portion of the tube sheet into the carbon steel portion are not included in this definition. These indications shall be assessed for continued plant operation in accordance with topical report BAW-2346P, Rev. 0.

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 tubesheets, that portion of the tube outboard of 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 non-TEC through-wall cracks) required by Table 4.18-2.

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 90 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;

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

e. Summary of the condition monitoring and operational assessment results when applying TEC alternate repair criteria; and

f. Summary of the condition monitoring and the operational assessment results (including growth) when applying the upper tubesheet ODIGA alternate repair criteria.

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.

In general, steam generator tubes that are degraded beyond the repair limit can either be plugged, sleeved, or rerolled. The steam generator (SG) 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. When the tube end cracking (TEC) alternate repair criteria is applied, axially-oriented indications found not to extend from the tube sheet cladding region into the carbon steel region may be left in service under the guidelines of topical report BAW-2346P, Rev. 0. When the upper tubesheet outer diameter intergranular attack (ODIGA) alternate repair criteria is applied, indications found within the defined region of the upper tubesheet may be left in service under the guidelines of ANO Engineering Report No. 00-R-1005-01, Rev. 1. The defined region begins one inch above the upper tubesheet secondary face and ends at the nearest tube roll transition. Following a SG inspection, an operational assessment is performed to ensure primary-to-secondary leak rates will be maintained within the assumptions of the accident analysis.

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 or lower tubesheet to create a new roll area and pressure boundary for the tube. The portion of the tube that is outboard of the repair roll is the portion of the tube closest to the primary side of the tubesheet and includes tubing from the tube end up to and including the heel expansion transition. The 1-inch repair roll is considered to be within the pressure boundary. If more than one repair roll is present, the outboard portion includes tubing from the tube end to the heel transition and the beginning of the 1-inch repair roll that is farthest from the primary side of the tubesheet. The rerolling methodology establishes a new pressure boundary inboard of the degradation, thus permitting the tube to remain in service. The degraded tube outboard of 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 tubesheet. The rerolling repair process will be used to repair defects in the upper and lower tubesheets in accordance with BAW-2303P, Revision 4.

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 can be used to repair tubes with defects in the upper and lower tubesheet areas. Installation of multiple repair rolls in a single tube is 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 or repaired. The reroll repair process is described in the topical report, BAW-2303P, Revision 4.

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 213 TO

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 August 29, 2000, as supplemented by letter dated March 2, 2001, Entergy Operations, Inc. (Entergy or the licensee), submitted a request for changes to the Arkansas Nuclear One (ANO), Unit No. 1, (ANO-1) Technical Specifications (TSs). The requested changes would allow steam generator (SG) tubes to remain in service with indications of outer diameter intergranular attack (ODIGA) in the upper tubesheet region of the steam generators. The surveillance and evaluation methodology is described in ANO Engineering Report No. 00-R-1005-01, Revision 1, "Management Program for Volumetric Outer Diameter Intergranular Attack in the Tubesheets of Once-Through Steam Generators," which the licensee proposed to reference in TS 4.18.3.a.5 and TS 4.18.5.a.7.

The supplemental letter dated March 2, 2001, provided clarifying information that was within the scope of the original application and did not change the staff's initial proposed no significant hazards consideration determination.

The licensee has proposed to revise TS 4.18.3.a.5 and TS 4.18.5.a.7 to incorporate by reference acceptance criteria to allow SG tubes to remain in service with indications of ODIGA in the upper tubesheet region of the SGs. In a previous license amendment dated October 4, 1999, (Amendment 202) the Nuclear Regulatory Commission (NRC) approved a one-cycle amendment for allowing SG tubes to remain in service with ODIGA indications. This request for a license amendment proposes to eliminate the one-cycle restriction, and addresses the technical differences identified in the safety evaluation (SE) for the one-cycle amendment that needed to be resolved for a permanent amendment.

2.0 BACKGROUND

Previous ANO-1 ODIGA License Amendment History

The intent of the existing depth-based SG tube repair limit (40 percent throughwall (TW)) in the ANO-1 TSs is to ensure adequate tube integrity through the end of the next operating cycle. The licensee has previously received NRC approval for alternate repair criteria (ARC) that included additional inservice inspection, consideration of flaw structural limits based on length rather than depth, and reliance on results of in-situ pressure testing to demonstrate adequate leakage integrity margins. These criteria allowed tubes with ODIGA indications to remain in service in previous operating cycles. The development of this criteria is discussed in this section.

The ANO-1 TSs require that tubes having degradation greater than 40 percent TW be repaired or removed from service. During the SG tube inspection in the refueling outage in September 1996 (1R13), the licensee used an eddy current (EC) 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 EC sizing technique specifically for measuring the depth of the intergranular attack (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 measured to be less than the tube repair limit in the TS. Those IGA indications measured during 1R13 that were thought to exceed the 40 percent TW 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 of indications that bounded the IGA degradation of the tubes that were left in service. After performing burst tests that subjected the tubes to pressures well in excess of normal operating pressure, the licensee compared the actual depths of the IGA degradation measured by destructive examinations to the depths predicted by the EC sizing technique used during the tube inspection program. The comparison uncovered a systematic nonconservatism in the EC sizing technique. The discrepancy in the IGA measurements and predictions raised concerns that some of the tubes left in service actually had IGA degradation that exceeded the TS repair criteria of 40 percent TW.

When the noncompliance 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 percent TW 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.

Subsequent to the NOED, 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 TW depths greater than the plugging limit to remain in service for the remainder of cycle 14. The April 11, 1997, submittal was supplemented by letter dated May 2, 1997, to include an additional TS change which reduced the leakage limit through the SG 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 on May 7, 1997. This amendment allowed the unit to continue operation through the remainder of cycle 14 with tubes that had potential TW defects in excess of the 40 percent plugging limit.

Even before the NOED, prior to 1R13, the Babcock and Wilcox (B&W) Owners Group (B&WOG) was working on the development of an 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. A submittal was transmitted on August 13, 1997, which included a general SG 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. In a submittal dated December 12, 1997, the licensee requested approval of the ARC for the refueling outage (1R14) in April 1998.

Insufficient time was available for the NRC staff and the licensee to resolve the outstanding issues related to the ARC prior to 1R14. Since many of the arguments that supported allowing the tubes with 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 TS change allowed ODIGA flaws in the upper tubesheet to remain in service during cycle 15 while the licensee pursued resolution of the outstanding issues related to the previously submitted ARC proposal.

The licensee assessed ODIGA growth during the previous operating cycle, cycle 14, and used in-situ pressure testing to demonstrate that tubes would not leak under accident conditions. If no growth was detectable, the licensee would assume that no growth was likely to occur in the next cycle of operation. The licensee determined that the ODIGA indications did not grow during cycle 14. Therefore, the licensee was able to demonstrate, using the results of the in-situ pressure test program, that adequate leakage integrity margins were likely to exist for the duration of the next operating cycle.

On May 14, 1999, Entergy submitted a license amendment to address ODIGA degradation in the upper tubesheet region identified during the fifteenth refueling outage (1R15) that was similar to the amendment proposed prior to the 1R14 outage. The application was supplemented by letters dated June 17, and September 7, 15, 17, and 24, 1999. The primary difference between the new license amendment requests and the previous request was that the licensee could rely on the in-situ test results obtained during the prior refueling outage if the ODIGA degradation did not grow during cycle 15. In addition, the NRC staff independently reviewed licensee data to assess ODIGA growth rates during cycle 15 for its evaluation of the proposed license amendment.

The staff independently reviewed the ODIGA growth rate data, and concluded that growth was not apparent during cycle 15. The NRC issued Amendment No. 202 to the ANO-1 license on October 4, 1999, revising the TS requirements to allow the one-cycle use of an ARC for ODIGA in the upper tubesheet region of the SGs. The TS changes required the licensee to perform bobbin and rotating probe EC inspections in the upper tubesheet region, and required the licensee to submit a summary of its condition monitoring and operational assessment results for the ODIGA degradation. The licensee was also required to perform in-situ pressure testing if growth was detected from an assessment of Plus Point voltage amplitude measurements. The sample size for the in-situ tests was defined such that leakage through IGA indications would, with a 95 percent confidence, be less than 1 gallon per minute (gpm) during a main steam line break (MSLB).

Proposed ANO-1 ODIGA License Amendment

By letter dated August 29, 2000, Entergy submitted a license amendment containing the approach and methodology for a permanent ODIGA repair criteria, in order to remove the one-cycle restriction from the TS. This request was supplemented by a letter dated March 2, 2001.

The licensee addressed in this application those shortcomings that the staff had identified in the previous requests that resulted in amendments that restricted the ARC to one cycle. These shortcomings were related to the licensee's approach for assessing leak rates for indications assumed to leak during postulated accidents, the growth rate criteria for detecting changes for the population of ODIGA indications, and how growth will be taken into account when assessing potential accident-induced leak rates if growth is detected.

The proposed TS changes continue to require the licensee to perform bobbin and rotating probe EC inspections in the upper tubesheet region, and require the licensee to submit a summary of its condition monitoring and operational assessment results for the ODIGA degradation. The proposed amendment request changes the report containing the repair criteria applicable to ODIGA referenced in the TSs from topical report BAW-10235P, "Deterministic Management Program for Volumetric Outer Diameter Intergranular Attack in the Tubesheets of Once-Through Steam Generators," Revision 1, to ANO Engineering Report No. 00-R-1005-01, "Management Program for Volumetric Outer Diameter Intergranular Attack in the Upper Tubesheets of Once-Through Steam Generators," Revision 1.

3.0 EVALUATION

3.1 Inservice Inspection of SG Tubes

The inservice inspection scope required to implement the ODIGA SE currently in the TS included an examination of 100 percent of the SG tubes in the upper tubesheet region with a bobbin coil EC probe. Tube examinations with this probe were expected to identify indications of ODIGA degradation that could degrade the tube structural and leakage integrity margins. The bobbin probe, however, cannot assess the morphology or size of detected indications. Therefore, the licensee inspects all potential ODIGA indications detected with a bobbin coil probe using rotating EC probes. These rotating probe examinations can confirm that the morphology of bobbin indications is volumetric, and therefore, indicative of ODIGA. In addition, the data acquired in the rotating probe inspections is 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 is expected to 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 SG tube degradation in the axial or circumferential directions.

As part of the proposed license amendment, the licensee will continue to inspect all ODIGA indications detected by bobbin coil with a rotating probe that includes both Plus Point and pancake coils per TS 4.18.3.a.5. This will enable the licensee to confirm the mode of the degradation, measure the Plus Point coil voltage amplitude response from the degradation, and determine the axial and circumferential length of the indication, if applicable. The staff finds that the inspections performed in 1R15, and proposed for future inspections, are adequate to define the ODIGA indications on which the in-situ testing program will be based.

3.2 Structural Integrity Assessment

The existing TS 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. The current TSs also address the acceptability of tubes with confirmed ODIGA degradation with a one-cycle amendment that allows tubes with ODIGA degradation to remain in service. The determination of acceptability is based on performing the additional inspections noted in Section 3.1 of this SE, imposing alternate structural acceptance criteria to the depth-based requirements currently in the TSs, and demonstrating no growth for the population of ODIGA indications in the ANO-1 once-through SGs (OTSGs) over the previous operating cycle. The TS only allow tubes with ODIGA indications to remain in service in the area defined to be within the upper tubesheet located by EC inspection between 1-inch above the secondary face and below the roll transition. The 1-inch exclusion zone above the tubesheet secondary face was established to ensure proper characterization of indications detected during the EC inspections. Indications located in the portion of the tube not enclosed by the tubesheet are not precluded from tube burst, and were not addressed in this license amendment request or the previous one-cycle amendment.

The licensee performed burst tests for the previous one-cycle amendment to demonstrate that the diametral clearance between the tube and adjacent tubesheet prevents tubes with simulated ODIGA flaws from deforming sufficiently to cause burst. The burst test program consisted of nine tubes containing drilled TW holes up to 0.5 inch in diameter and one tube containing no defects. All tubes with the laboratory defects were tested within a simulated tubesheet. None of the specimens burst at pressures greater than 10,941 pounds per square ince, guage (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 submitted a description of the test program and discussion of this conclusion in Topical Report BAW-10226P, "Alternate Repair Criteria for Volumetric Outer Diameter Intergranular Attack in the Tubesheets of Once-Through Steam Generators," Revision 0, submitted August 13, 1997.

In the 1R14 outage, the licensee completed in-situ pressure testing of tubes containing 40 ODIGA indications. No in-situ pressure tests were performed in 1R15. For the testing, tubes were pressurized to a pressure of 2,900 psig, which is in excess of pressures expected to occur during an MSLB accident. Because the peak accident-induced loads for SG tubing are largely a result of thermally induced stresses rather than internal tube pressure, in-situ pressure tests on 36 of the 40 ODIGA indications imposed axial tube loads in conjunction with the internal pressure. These loads could challenge the structural or leakage integrity of tubes containing circumferentially oriented degradation of significant length or depth. None of the tubes with indications tested under these conditions leaked. The licensee subjected the four remaining ODIGA indications that were in-situ pressure tested to internal pressure loads only. However, the maximum internal pressure imposed during the testing was 6,500 psig, more than 2.5 times the MSLB differential pressure. No leakage was detected from tubes with these indications during the tests.

To minimize the potential for structural failure of tubes with ODIGA degradation, the licensee has proposed to remove from service those tubes containing degradation expected to exceed length-based and voltage-based repair limits included in ANO Engineering Report No. 00-R-1005-01, Revision 1, contained in the licensee's March 2, 2001, supplemental letter. The repair limits are identical to those cited in the one-cycle amendment and were used for dispositioning tubes in 1R15.

The length-based limits require the licensee to remove from service tubes with ODIGA flaws that exceed 0.5 inch in length in either the axial or circumferential direction of the tube. Tube structural failure due to axially oriented flaws in the upper tubesheet region is precluded by the presence of the tubesheet. Tubes with circumferential flaws, however, could fail due to axial tube loads. Testing completed by the licensee indicates that TW flaws with circumferential extents up to 140° (0.72 inch) will have structural margins commensurate with the margins specified in Regulatory Guide (RG) 1.121, "Bases for Plugging Degraded PWR [Pressurized-Water Reactor] Steam Generator Tubes." Limiting ODIGA flaws to less than 0.5 inch in circumferential length will provide additional margin to account for uncertainty in measuring the flaw with nondestructive testing methods. The voltage limit requires the licensee to remove from service tubes with ODIGA flaws that exceed 1.14 volts, which is the maximum in-situ test sample voltage from the licensee's tests, with additional margin to account for uncertainty in nondestructive testing methods. The voltage repair limit is based on the Plus-Point 300 kilo-Hertz (kHz) voltage peak-to-peak response.

These limits were established to provide assurance that leak testing that has been performed on tubes with ODIGA will bound indications that are left in service based on the licensee's testing program. The measured lengths and voltages will also provide data to support the licensee's assumption of no growth in the ODIGA patches. The staff concludes that the proposed length-based and voltage-based repair limits are adequate to ensure that tube structural integrity margins will be maintained in accordance with guidance provided in RG 1.121.

The staff also notes that tubes with volumetric IGA degradation in SGs 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 SGs to the presence of ODIGA degradation in the tubing. The licensee also has extensive testing data from in-situ pressure tests completed in the 1R14 outage that indicates that this mode of degradation does not significantly degrade the structural margins of the OTSG tubing. On the basis of the conservatism in the length-based repair limits, assumption of no growth in the ODIGA that has been observed, and the empirical data indicating a low likelihood of burst for ODIGA degradation, the staff concludes that the proposed amendment will ensure that the structural margins for OTSG tubing with ODIGA degradation will be maintained.

If growth is detected, as discussed in Section 3.4 of this SE, the licensee will be required to perform in-situ tests on the tubes with ODIGA patches exhibiting growth. In addition, TS 4.18.5.a.7, through its reference to ANO Engineering Report No. 00-R-1005-01, requires the licensee to submit a new license amendment request to the NRC upon detection of growth from the statistical growth tests performed. The new license amendment request will discuss the growth analysis to be performed and the basis for the analysis.

3.3 Demonstration of Leakage Integrity Margins

In-situ Pressure Testing to Demonstrate Leakage Integrity

The existing depth-based repair criteria are established to ensure SG 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 40 percent to remain in service. Under high differential pressures, this degradation could become a leak path for the reactor coolant to the SG secondary side. The licensee will rely on previously completed in-situ pressure testing of SG tubes with ODIGA indications and an assessment of ODIGA growth rates to demonstrate a low leakage potential for tubes containing this mode of degradation. The statistical tests to measure growth rate of ODIGA indications performed by the licensee each outage must conclude that there is a low likelihood that the ODIGA degradation grew during the previous cycle of operation in order for the licensee to use the in-situ pressure test results obtained in the 1R14 outage. Detection of flaw growth will necessitate the performance of additional in-situ pressure testing in future outages to reassess tube leakage integrity margins, as well as require a license amendment request from the licensee to address their proposed growth analysis (discussed in Section 3.4 of this SE).

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.

Prior In-situ Tests and Laboratory Results

There is a substantial database that indicates that leakage from ODIGA degradation is unlikely to occur. Destructive examinations of the ODIGA patches in tubes removed in 1R13 showed none of the flaws to be TW. The licensee has also completed testing of tubes with electrical discharge machining (EDM) holes of various sizes and depths machined into the tubing. The artificial patches were machined to depths ranging from approximately 84 percent to 95 percent TW, with patch diameters of 0.10, 0.30, and 0.50 inch. 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. The EDM sizes exceeded the size of all pulled tube samples of IGA in all directions (length, width, and diameter). None of the machined patches showed signs of leakage when subjected to accident loads.

To augment the existing database of pulled tubes and machined IGA defects, the licensee developed artificial IGA flaws under laboratory conditions. Although many volumetric ODIGA patches have been removed from OTSGs, all have been too small to have any significant impact on the structural or leakage integrity of the tube. The lack of large IGA patches that challenge structural integrity, or that can be made to leak, have made it difficult to develop the structural and leakage correlations necessary for the development of an ARC.

The artificially developed IGA flaws were corrosively-induced rather than mechanically induced in order to more closely simulate the degradation found in the actual SG tubes. However, in trying to generate deep enough IGA that would potentially leak, many of the test specimens with 80 percent to 100 percent TW ODIGA developed circumferential cracks. Since the intent of the testing program was to develop a leakage correlation for IGA, samples with crack-like indications were removed from the database. The samples tested included 46 volumetric ODIGA samples made in a laboratory environment and 6 EDM holes, which were subjected to design-basis loading conditions. The maximum percent TW of the penetration of the tested specimens was 98 percent TW. The sizes of these defects bounded those of the ODIGA flaws presently in the ANO-1 OTSG tubing. All of the tube specimens retained structural and leakage integrity at the target test conditions.

The licensee reports 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” SG tubing was subjected to a differential pressure of approximately 2,100 pounds per square inch, differential(psid) for several hours. No leakage from ODIGA flaws was observed during the event or following plant startup.

In-Situ Pressure Tests Performed in 1R14

The licensee implemented an ODIGA repair criteria in 1R14 that required in-situ pressure testing a number of tubes with ODIGA indications. The objective of the testing was to demonstrate a 0.95 probability at a 95 percent confidence level that the total leakage from ODIGA indications would not exceed 0.5 gpm during an MSLB accident. By testing the integrity of a representative sample of tubes, the licensee could assess the potential for leakage from all of the tubes identified by the EC inspections to have ODIGA indications. To estimate a bounding accident leakage value, the total leak rate from this effort was calculated rather than measured, since none of the tubes leaked during the in-situ pressure tests.

The licensee assumed for this calculation a total ODIGA flaw length of 0.3 inch that is TW over 50 percent of the length. The leak rate was analytically determined using a computer program, KRACKFLO3. The staff had previously expressed concerns in the one-cycle ODIGA amendment about the leak rates that were calculated using this code. The staff noted that the licensee should benchmark the code against actual leakage data for flawed tube specimens representative of the ODIGA flaws at ANO-1. Also, the staff recommended that the licensee quantify the uncertainties associated with the leak rate estimates.

Based on these concerns, the licensee provided additional information to the NRC regarding the certification of the code by comparing the values obtained with KRACKFLO3 with those obtained using PICEP, another code used industry-wide to calculate leak rates. Although the licensee was unable to benchmark the leakage predicted by the codes based on actual leakage from ODIGA patches, the licensee believes that use of the code is conservative based on the licensee’s treatment of uncertainties. Considerable uncertainty lies in the true sizing of the ODIGA patch. Destructive examination has shown that rotating pancake coil overestimates the dimensions of the ODIGA indications, so the dimensions used in the code would most probably be larger than the actual patch size. In addition, the leakage calculations assume that all indications contain a 100 percent TW component over 25 percent of the axial extent of the

ODIGA indication, which is a conservative assumption. The leak rate code also makes a conservative assumption by not taking any credit for ligaments that are present or turns in the flow path which would both reduce the flow rate expected.

Using the KRACKFLO3 code, the licensee then calculated a hypothetical leak rate consistent with the conditions for an MSLB. The licensee estimated a leak rate of 0.0185 gpm through the assumed flaw geometry. Assuming that the ODIGA patches could contribute approximately 0.5 gpm of the licensing-basis leak rate (1.0 gpm), 39 ODIGA patches with an assumed flaw length of 0.3 inch with a TW component of 50 percent of its length could 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 were identified during the inspections to be performed during 1R14, the licensee statistically determined the number of tubes to be in-situ tested. As indicated in Section 3.2 of this SE, the licensee tested 40 ODIGA indications during 1R14, and no leakage was detected during any of these tests. The staff addressed the adequacy of the in-situ testing in the SE for Amendment No. 202.

Leakage Integrity Methodology For Proposed License Amendment

Based on the difficulty growing TW ODIGA patches in laboratory specimens, and based on observations in the field, the licensee concluded that the ODIGA patches would not leak in their current state. The licensee believes that as the ODIGA approaches 100 percent TW, the local stresses in the remaining cross sectional area increase. At some point before the ODIGA can progress to 100 percent TW, the cross section of the degraded tube will reach the critical stress needed for crack initiation. The crack may then progress to 100 percent TW, but this is now a mixed mode or linear form of degradation that must be repaired. This explanation is consistent with their laboratory experience, which required that stress be applied to obtain deep TW penetration of ODIGA. The application of stress resulted in the initiation of cracks from the ODIGA patches. However, as noted in the March 2, 2001, supplement, no crack-like ODIGA patches have been detected in the ANO-1 SG tubes to date.

The licensee, therefore, assumed that the ODIGA must form a crack in order to have a potential for leakage. Since OTSG tubes are in compression during steady-state operation, which inhibits the initiation of a circumferential crack, the hoop stresses caused by primary-to-secondary pressure differential favor the formation of an axial crack. Axial depth profiles from ODIGA patches with maximum depths greater than 70 percent TW were evaluated to predict a representative leak path length. The licensee concluded that the axial length of the deepest 10 percent of the patch averaged about 21 percent of the axial extent of the patch. Therefore, when calculating population leak rates, the assumed individual leak rates will be conservatively calculated based on a 100 percentTW crack whose length is 25 percent of the total axial extent of the IGA patch.

To provide a reasonable assurance that the leakage rate, 1 gpm, will not be exceeded, MSLB primary-to-secondary leak rates must be determined as a function of the axial extent of the assumed crack. The predicted leak rates are evaluated based on an assumed 100 percent TW crack length. For purposes of evaluating leakage, it is assumed that the maximum depth of ODIGA must be at least 70 percent TW or deeper for there to exist a reasonable probability of leakage. The licensee assumes that 90 percent of the ODIGA defects with any chance of leaking (i.e., greater than 70 percent TW) will be found during an in-service inspection (based on 100 percent examination of the upper tubesheet region in the SG tubes).

Since there is no qualified depth sizing technique to determine which indications are 70 percent TW or deeper, the licensee will conservatively assume that all indications that are found are greater than 70 percent TW, and the entire population will be increased by 10 percent to account for indications that may have been missed (probability of detection). The licensee will then separate the indications by the EC measured axial extent into 0.10 inch increment bins (0.10, 0.20, 0.30, etc.). Individual leak rates will be assigned to each indication, according to the calculated leakage for each axial extent bin size, and summed to obtain a total leak rate. This leak rate will be evaluated with respect to the allowable MSLB leakage rate for the population of ODIGA indications. Other potential sources of leakage include plugs, sleeves, other damage mechanisms, and repair rolls. Based on the condition of the SG, the allowed leakage rate for volumetric ODIGA may change from inspection to inspection, but the cumulative leakage rate from all leakage sources must be less than 1 gpm in order to remain consistent with the existing licensing basis for the plant.

As previously discussed, the licensee has performed a number of in-situ pressure tests on tubes with ODIGA indications without causing the tested tubes to leak. The inspection and testing methodology defined by the licensee includes an evaluation to determine if additional in-situ pressure testing is required. Following the required inservice inspection of the SGs to define the population of tubes with ODIGA indications, the licensee will evaluate the number of in-situ pressure tests needed to provide a 95 percent confidence that the number of potential leaking tubes within that population would not exceed the established limit. The limit on the number of tubes that could potentially leak is set by the hypothetical leak rates calculated by modeling the ODIGA indications as axial cracks and the acceptable leakage defined as that portion of the 1 gpm leakage limit that has been allotted to ODIGA. With a defined total population of ODIGA indications and the maximum allowable number of those indications that could result in primary-to-secondary leakage, the licensee determines the number of in-situ tests required to provide a 95 percent confidence that the number of leaking tubes does not exceed the established limit. If the amount of in-situ tests required exceeds the amount of tests performed previously, the licensee must in-situ test additional tubes. The staff notes that the use of a statistical evaluation assuming a Poisson distribution is the preferred approach over the hypergeometric distribution approach described in ANO Engineering Report No. 00-R-1005-01, Revision 1. The approach proposed by the licensee (as applied to the submitted data) does, however, provide the necessary level of assurance for this application.

Based on the licensee's determination of no ODIGA growth during cycle 15, the licensee relied on the in-situ tests performed in 1R14 to demonstrate leakage integrity. The absence of growth during cycle 15 indicated that the integrity of the OTSG tubes with ODIGA degradation was unchanged from the previous refueling outage. Therefore, the licensee believed that conclusions made with regard to the in-situ pressure test program remained valid.

The staff finds that the licensee's method of estimating the total leak rate for the total population of ODIGA flaws in the faulted OTSGs for the upcoming cycles is conservative. This is based on the staff's finding (discussed in Section 3.4 below) that the ODIGA indications are no longer experiencing significant growth and the staff's belief that the licensee's estimate of the number of ODIGA flaws that may leak during postulated accidents is very conservative.

Although this amendment request was not reviewed as a risk-informed application (per discussions between the staff and licensee, and the licensee's supplemental letter dated March 2, 2001), the staff takes issue with one statement in the licensee's discussion of severe accident considerations that was included in the original submittal dated August 29, 2000. The licensee stated that the NRC concluded in NUREG-1570, "Risk Assessment of Severe Accident-Induced Steam Generator Tube Rupture," that severe accident thermal challenges to SG tubes are not a concern for the B&W design. Although the OTSGs are not susceptible to tube heating during severe accidents by the same type of counter-current circulation found in U-tube SGs, the staff has found (since NUREG-1570 work was completed) that severe accidents with slow leak-down of the reactor coolant system (RCS) may result in periods of full-loop natural circulation that would heat the tubes. In one thermal hydraulics code case run by the NRC, it is clear that tubes with significant flaws in the free span would have been predicted to creep rupture before any other RCS component, although the pristine tubes were not predicted to do so. However, because the ODIGA at ANO-1 is within the upper tube sheet, full loop circulation is not expected to be an issue for that type of degradation, so long as the leakage it could create is too small to depressurize the RCS after it is voided during a severe accident. Therefore, the staff has concluded that the ODIGA currently observed at ANO-1 does not present a potential leakage concern during severe accidents.

3.4 Analysis of Growth Rate for IGA Degradation

In accordance with the guidance provided in NRC RG 1.121, SG tube repair limits generally incorporate an allowance for degradation growth over the next cycle of operation. Such criteria account for the progression of SG tube flaws in length or depth during operation that could potentially degrade the margins for tube integrity below acceptable limits. The in-situ testing method for the ODIGA indications in the upper tubesheet 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 EC bobbin indications. The change in bobbin voltage amplitude from 1993 to 1996 was determined for 129 upper tubesheet indications. The results showed that the average voltage change per effective power year was "zero". The licensee attributed the variability about this average to EC uncertainty. Of the 129 indications that were studied, 25 were removed from service during 1R13. The licensee reevaluated the growth rates for the remaining 104 ODIGA indications during the 1R14 outage. As documented in a licensee submittal dated May 1, 1998, the assessment confirmed that there was essentially no growth for the ODIGA degradation during cycle 14.

For the 1R15 outage, the licensee reevaluated the growth of ODIGA indications in the ANO-1 OTSGs. In the previous inspections, growth rates were assessed using bobbin coil EC data. The 1R15 growth rate evaluation used data obtained from rotating EC probes. The licensee used pancake coil data to evaluate the length (axial and circumferential) of each indication and Plus Point coil data to assess changes in voltage amplitude. Use of the repair criteria to disposition indications was based on no growth detected for two of the three parameters (axial length, circumferential length, or voltage) for the population of indications. Growth was confirmed for a parameter when the 95 percent lower confidence limit for the mean of the distribution of measured changes was greater than zero. The licensee also applied criteria to identify potential growth of individual indications. Changes in lengths or voltages of individual ODIGA indications that exceeded the limits specified in BAW-10235P, Revision 1, were removed from service.

Using this criteria during the 1R15 outage, three tubes were removed from service based on predictions that indications found in those tubes would exceed a repair limit before the next scheduled inspection, based on assessments contained in BAW-10235P, Revision 1. The measured EC lengths and voltages for the indications in 1R15 were all under the criteria that would have indicated growth (0.5 inch in axial or circumferential length, 1.14 volts). One tube was plugged because the 1998 EC voltage measurement exceeded the repair criteria, although the 1999 EC voltage measurement did not. This difference can probably be attributed to inspection variability.

In response to NRC concerns, the licensee attempted to quantify inspection variability. Minor changes were made to the inspection process, such as the use of a master calibration standard, to minimize some of the inspection variability. The licensee attributed observed variability of the measured parameters to non-destructive examination (NDE) uncertainty. The NDE uncertainty includes: analyst-to-analyst variability, variability between NDE field size and ground truth from destructive examinations, and variability due to true changes in flaw dimensions. The licensee believes that the apparent changes in the flaw features were consistent with a zero mean change and relatively small variability. The licensee provided the results of a study that was conducted to estimate the contribution of analyst-to-analyst variability to NDE uncertainty. The results indicated that the extent of analyst-to-analyst variability was similar to the apparent variability from the field flaw size measurements.

The licensee's proposed amendment (through its references to ANO Engineering Report No. 00-R-1005-01, Revision 1, in TS 4.18.3.a.5 and TS 4.18.5.a.7) requires that growth rates be evaluated using criteria to address changes for individual indications. Specifically, the licensee will perform several statistical tests to confirm the hypothesis that the ODIGA indications are not growing. The licensee will compare the inspection results (both Plus Point volts and axial length) for each indication with the measurements taken the previous cycle. The licensee provided an evaluation that shows that measurement uncertainty and analyst-to-analyst variability in evaluating the EC data results in most of the observed cycle-to-cycle changes in the observed ODIGA indications.

The differences in the measurements for each indication will be evaluated using the Sign Test, Paired t-Test, and Extreme Value Test. The Sign Test compares the number of measured indications that have an apparent positive growth and compares that number to a critical value that would seriously question the no-growth hypothesis. The paired t-Test evaluates the differences for each indication to test if, as hypothesized, the mean change in the ODIGA flaws is zero. In addition to the above general tests on the overall ODIGA distributions, the licensee will perform an extreme value test which focuses on the maximum apparent growth for specific ODIGA indications. If the maximum observed growth is less than the defined critical value, the observation is not considered to be statistically significant. If the results of these tests are unsuccessful in demonstrating that no growth is occurring in the ODIGA indications, the licensee's methodology requires a cycle-specific model of growth for the operational assessment. The cycle-specific growth model will require NRC approval and additional in-situ testing. A cycle-specific testing program, if ever deemed necessary, would be performed in accordance with the sampling methodology described in ANO Engineering Report No. 00-R-1005-01, Revision 1. The sampling plan should be chosen prior to beginning the testing.

The repair criteria rely on the assumption that the ODIGA degradation growth will not occur during the subsequent operating cycle if growth was not detected in the previous operating cycle. Any changes in the size or depth of the flaws will invalidate the results of the leakage assessment. Based on the growth criterion presented in the proposed license amendment, the staff concludes that there is reasonable assurance that indicated growth would be expected to trip the criterion, resulting in additional in-situ pressure tests and licensee development of a cycle-specific model of growth for the operational assessment.

ANO Engineering Report No. 00-R-1005-01, Revision 1, states on page 69 that for large sample sizes above 60, the 95 percent confidence value of the normal distribution (1.645) provides a close approximation of the k-factor. The value of 60 does not correspond to a large sample size in this context. The staff confirmed with the licensee that the value was a typographical error and that the licensee would, as stated in the report, select a k-factor from standard statistical tables in reference books or commercial computer software.

To develop the cycle-specific model of growth, the licensee will follow ANO Engineering Report No. 00-R-1005-01, Revision 1, which is referenced in TS 4.18.3.a.5 and TS 4.18.5.a.7, and re-verify the analyst-to-analyst variability that is applicable to the field data at hand and evaluate the components of variability so that an accurate model of actual growth can be obtained. Any growth analysis performed using the cycle specific growth model described here will require a revision to ANO Engineering Report No. 00-R-1005-01, Revision 1, to include information substantiating the growth conclusions reached and the basis for the conclusions. The revised report will be submitted in a license amendment to the NRC well ahead of the subsequent refueling outage with any actions to address potential growth. The staff concludes that the approach described in ANO Engineering Report No. 00-R-1005-01, Revision 1, is acceptable and that reference to the report in TS 4.18.3.a.5 and TS 4.18.5.a.7 provides the appropriate regulatory controls.

4.0 REQUIREMENTS FOR IMPLEMENTATION OF ODIGA REPAIR CRITERIA

The following summarizes the proposed changes to the ANO-1 TSs to implement the repair criteria for SG tubes degraded with ODIGA degradation:

1. TS 4.18.3.a.5

The referenced report to be used to assess the indications is changed from "topical report BAW-10235P, Revision 1" to "ANO Engineering Report No. 00-R-1005-01."

2. TS 4.18.5.a.7

The restriction of using the ODIGA ARC solely for cycle 16 is removed. The referenced report to be used to assess the indications is changed from "topical report BAW-10235P, Revision 1" to "ANO Engineering Report No. 00-R-1005-01, Rev. 1."

3. TS 4.18.5.b

The second paragraph is being deleted which allowed tube 110/60 to remain in service. This change was approved in Operating License Amendment 203. The amendment was issued to address a flaw indication within the upper tube sheet in tube 110/60 that was discovered to exceed the plugging limit by an analyses of inspection data following the restart of the unit. The allowance for continued operation with the identified exception to the plugging limit for tube 110/60 was granted for a single cycle with the expectation that the tube will be repaired or plugged in the next refueling outage. The removal of the TS is appropriate since it is not applicable after cycle 16.

4. TS Bases

The wording to the second paragraph of the bases is revised to reference the ANO Engineering Report No. 00-R-1005-01, Rev. 1, instead of the previously referenced topical report BAW-10235P, Revision 1.

5.0 SUMMARY

The staff finds that the proposed TS changes will provide reasonable assurance of SG tube integrity. It is, therefore, acceptable to allow tubes with ODIGA indications within the upper tubesheet to remain in service (within the limitations described in ANO Engineering Report No. 00-R-1005-01, Revision 1, which is referenced in TS 4.18.3.a.5 and TS 4.18.5.a.7). The staff has independently assessed the ODIGA inspection results obtained during the past outage (1R15) and concurs with the licensee's finding that the subject ODIGA indications are not experiencing any significant growth. Given the absence of significant growth, the in-situ pressure tests performed during the 1R14 outage indicate that the licensee's estimate of the number of ODIGA indications that may potentially leak during postulated accidents is a conservative upper bound and that the licensee's estimate of total accident-induced leak rate is conservative. Therefore, the proposed changes to the ANO-1 TSs are acceptable to justify allowing tubes with ODIGA indications to remain in service.

The repair criteria rely on the assumption that the ODIGA degradation growth will not occur during the subsequent operating cycle if growth was not detected in the previous operating cycle. Any changes in the size or depth of the flaws will invalidate the results of the leakage assessment. Based on the growth criterion presented in the proposed license amendment, the staff concludes that there is reasonable assurance that indicated growth would be expected to trip the criterion, resulting in additional in-situ pressure tests and licensee development of a cycle-specific model of growth for the operational assessment.

To develop the cycle-specific model of growth, the TS (through the references to ANO Engineering Report oo-R-1005-01, Revision 1) requires that the licensee re-verify the analyst-to-analyst variability that is applicable to the field data at hand and evaluate the components of variability so that an accurate model of actual growth can be obtained. Any growth analysis performed using the cycle specific growth model described here will require a revision to ANO Engineering Report No. 00-R-1005-01, Revision 1, to include information substantiating the growth conclusions reached and the basis for the conclusions. The revised report will be submitted in a license amendment to the NRC well ahead of the subsequent refueling outage with any actions to address potential growth.

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. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (65 FR 77917 published December 13, 2000). The amendment also changes reporting or recordkeeping requirements. Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9) and (c)(10). 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.

Principal Contributors: Louise Lund
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Lee Abramson

Date: March 28, 2001

March 28, 2001

Mr. Craig G. Anderson
Vice President, Operations ANO
Entergy Operations, Inc.
1448 S. R. 333
Russellville, AR 72801

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT NO. 1 - ISSUANCE OF AMENDMENT RE: STEAM GENERATOR TUBES WITH INDICATIONS OF OUTER DIAMETER INTERGRANULAR ATTACK (ODIGA) (TAC NO. MA9879)

Dear Mr. Anderson:

The Commission has issued the enclosed Amendment No. 213 to Facility Operating License No. DPR-51 for Arkansas Nuclear One, Unit No. 1 (ANO-1). The amendment consists of changes to the Technical Specifications (TSs) in response to your application dated August 29, 2000, as supplemented by letter dated March 2, 2001.

The amendment revises the TS to allow steam generator tubes to remain in service with indications of ODIGA in the upper tubesheet region of the steam generators. The surveillance and evaluation methodology is described in ANO Engineering Report No. 00-R-1005-01, Revision 1, "Management Program for Volumetric Outer Diameter Intergranular Attack in the Tubesheets of Once-Through Steam Generators," which is referenced in TS 4.18.5.a.7.

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

Sincerely,
/RA/
William Reckley, Project Manager, Section 1
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-313

Enclosures: 1. Amendment No. 213 to DPR-51
2. Safety Evaluation

cc w/encls: See next page

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