

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1) Oconee Nuclear Station, Unit 1	DOCKET NUMBER (2) 05000 269	PAGE (3) 1 of 1
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TITLE (4) Steam Generator Tube ECT Indications Not Repaired due to Inadequate Guidance Results in Operation Prohibited by Technical Specifications

EVENT DATE (5)				LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER(S)	
06	02	98	98	08	00	07	02	98	Unit 3	05000 287	
										05000	

OPERATING MODE (9) N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR (Check one or more of the following) (11)									
POWER LEVEL (10) 100	<input type="checkbox"/>	20.402(b)	<input type="checkbox"/>	20.405(c)	<input type="checkbox"/>	50.73(a)(2)(iv)	<input type="checkbox"/>	73.71(b)		
	<input type="checkbox"/>	20.405(a)(1)(i)	<input type="checkbox"/>	50.36(c)(1)	<input type="checkbox"/>	50.73(a)(2)(v)	<input type="checkbox"/>	73.71(c)		
	<input type="checkbox"/>	20.405(a)(1)(ii)	<input type="checkbox"/>	50.36(c)(2)	<input type="checkbox"/>	50.73(a)(2)(vii)	<input type="checkbox"/>	OTHER (Specify in		
	<input type="checkbox"/>	20.405(a)(1)(iii)	<input checked="" type="checkbox"/>	50.73(a)(2)(i)(B)	<input type="checkbox"/>	50.73(a)(2)(viii)(A)	<input type="checkbox"/>	Abstract below and		
	<input type="checkbox"/>	20.405(a)(1)(iv)	<input type="checkbox"/>	50.73(a)(2)(ii)	<input type="checkbox"/>	50.73(a)(2)(viii)(B)	<input type="checkbox"/>	in Text, NRC Form		
<input type="checkbox"/>	20.405(a)(1)(v)	<input type="checkbox"/>	50.73(a)(2)(iii)	<input type="checkbox"/>	50.73(a)(2)(x)	<input type="checkbox"/>	366A)			

LICENSEE CONTACT FOR THIS LER (12)						TELEPHONE NUMBER					
NAME J.E. Burchfield, Regulatory Compliance Manager						AREA CODE (864)			885-3292		

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)										
CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	

SUPPLEMENTAL REPORT EXPECTED (14)				EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (f yes, complete EXPECTED SUBMISSION DATE)				<input checked="" type="checkbox"/> NO			

ABSTRACT (Limit to 1400 spaces, i.e. approximately fifteen single-space typewritten lines) (16)

On June 2, 1998, Oconee Units 1 and 3 were operating at 100% full power. As a result of operating experience reports from another site, Oconee had reanalyzed Eddy Current Testing data from each Unit's latest refueling outage for indications classified as Tube End Anomalies (TEAs). It was determined that some data analysts had misclassified some indications as TEAs outside the pressure boundary which were actually inside the pressure boundary and should have been repaired. Therefore, the affected tubes were not repaired or removed from service as required by Technical Specification 4.17.2. At 1715 hours, Oconee management concluded that Units 1 and 3 were operating in a condition prohibited by Technical Specifications. An operability evaluation showed that predicted leakage was within previous accident analysis assumptions. Oconee requested and received a Notice of Enforcement Discretion. The root cause was inadequate guidance for consistent classification. New guidance has been provided. Repairs will be made during the next refueling outage or cold shutdown exceeding 7 days.

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EVALUATION:

Background

Oconee Nuclear Station uses the Babcock and Wilcox (B&W) Nuclear Steam Supply System [EIIS:AC], which includes two Once Through Steam Generators (OTSGs) [EIIS:SG], for primary to secondary heat transfer. The B&W OTSG is a vertical, straight tube heat exchanger. Inside the OTSG shell, there is an upper tube sheet, 15 tube support plates, a lower tube sheet, and 15531 tubes per steam generator. See Attachment A.

The tube sheets are two feet thick and the tubes are nominally 0.625 inches in diameter. During construction, the tube sheets were drilled, individual tubes were inserted in one tube sheet, passed through openings in the tube support plates, through the other tube sheet, and then rolled in place and seal welded. They were manufactured in Barberton, Ohio, by B&W. Framatome Technologies Inc. subsequently acquired this division of B&W.

Technical Specification 4.17.5.f defines a repair limit for a steam generator tubes as follows:

"Repair Limit means the imperfection depth beyond which the tube shall be either removed from service by plugging or repaired by sleeving or rerolling because it may become unserviceable prior to the next inspection; it is equal to 40% of the nominal tube or sleeve wall thickness."

Technical Specification 4.17.2 requires, in part:

"All tubes examined exceeding the repair limit shall be repaired by sleeving or rerolling or removed from service (e.g., plugged, stabilized)."

However, in all cases discussed in this report, Duke applies a repair on detection criteria for defects within the pressure boundary.

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Description of Event

In late April, 1998, Oconee personnel were informed of events at Arkansas Nuclear One (ANO) related to primary-to-secondary leakage near the ends of certain steam generator tubes. These tubes had previously shown eddy current testing (ECT) indications which had been termed "tube end anomalies" (TEAs). TEA indications can only be identified when the upper tubesheet roll joints are inspected with a rotating pancake coil (RPC) eddy current probe or a plus-point eddy current probe. TEAs are characterized as ECT indications at the end of the tube outside of the pressure boundary, and, therefore, not subject to the Technical Specification repair limit. The observation of leakage at ANO indicated that some indications classified as TEAs at ANO were actually in the pressure boundary area.

Subsequent evaluation of the ANO data by Duke analysts indicated that analysis guidelines previously in use for Duke were not specific in identifying the landmarks that should be used to determine if indications were in or out of the pressure boundary. It was determined that some, but not all, ECT resolution analysts were incorrectly identifying the lower edge of the tube sheet cladding as part of the tube end and therefore outside the pressure boundary. The pressure boundary is defined as the roll expanded area to the primary face (upper edge) of the tube sheet cladding. At this time, Oconee Unit 2 was in a refueling outage (2EOC16). A review of Unit 2 ECT data taken during the outage identified some indications that were reclassified from TEAs to repairable indications. All of the Unit 2 TEAs that were reclassified as indications exceeding the repair criteria were repaired by re-rolling on Unit 2 during the EOC-16 outage.

On May 6, 1998, a Problem Investigation Process (PIP) report was initiated. Engineering began to assess the operability implications for this information with respect to Units 1 and 3 which were at 100% Full Power.

An evaluation of steam generator ECT results from the previous outages on Units 1 and 3 indicated there were 2,951 TEAs on Unit 1 and 66 TEAs on Unit 3 that had not been repaired during those respective outages. An operability evaluation was performed, which conservatively assumed that all of the TEAs were in the pressure boundary region and would result in leakage at rates determined by previous measurements on mockups performed

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by Framatome Technologies. The operability evaluation, completed on May 9, 1998, analyzed for tube burst and tube leakage considerations under accident conditions and concluded that the predicted leakage was well below the leakage assumed in design basis steam line break accident analyses.

An action plan was identified to initiate a reanalysis of the Units 1 and 3 data obtained during the previous outages to establish the extent of the TEA indications. The action plan used the operating experience of the ANO indications and the results of the steam generator indications during the recent Unit 2 refueling outage. The controlling activity for completing the data review was completion of a detailed mock up of the upper tube sheet and clad with tubes installed with geometry identical to the ONS steam generators. Machined defects were included in identified areas. This mockup was used to verify that revised ECT analysis guidelines were appropriate and comprehensive. The data analysts were trained and tested on the new guidelines and began the actual reanalysis of Unit 1 and 3 data using the new guidelines.

Prior to the completion of the analysis, some indications were identified which extended beyond the upper (primary) surface of the tube sheet clad. These indications would have met the Duke criteria for repair by reroll during the past outages if they had been recognized as being inside the pressure boundary. These tubes had not been repaired or removed from service as required by Technical Specification 4.17.2. Therefore, on June 2, 1998, at 1715 hours, Duke concluded that Units 1 and 3 were operating in a condition prohibited by Technical Specifications.

On June 3, 1998, Duke requested and received a Notice of Enforcement Discretion. On June 4, 1998, a follow-up license amendment was submitted which will allow continued operation of Units 1 and 3 until the next refueling outage on each unit or until plant conditions result in an extended cold shutdown of greater than seven days.

The reanalysis reclassified 372 indications out of 2,951 TEAs not previously repaired on Unit 1, and 61 of 66 TEAs not previously repaired on Unit 3. These reclassified indications extend beyond the primary surface of the tube sheet clad and therefore meet the repair criteria.

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Conclusion

Tube End Anomalies (TEAs) are, by definition, outside the pressure boundary. Eddy Current Test (ECT) indications in this region of the tube may be degradation caused by pressurized water stress corrosion cracking, ID scratch marks, or anomalous eddy current indications caused by tube end deformation.

The classification of ECT results as TEAs, rather than defects exceeding the repair criteria, was due to insufficient guidance on landmarks to use in assessing if indications were outside the pressure boundary and in the tube ends. Therefore, the root cause of this event is inadequate guidance.

It was noted that the use of the rotating pancake coil and/or plus-point eddy current testing (ECT) probes to inspect these regions of the steam generator tubes is relatively new and has only been performed during the last refueling outage on each unit. This portion of ECT was initiated due to operating experience reports from Davis Besse of indications in the upper roll transition area. Therefore, this issue was only recently recognized.

LER 270/98-01 reported the operation of Oconee Unit 2 with ECT indications exceeding the repair criteria. However, that condition was caused by a manufacturing defect which "rotated" tubes such that one end was not in the expected location. Therefore, when the indications were identified, one end of the tube was plugged, the other end remained open, and one end of an adjacent tube was inadvertently plugged. Although corrective actions from that event included enhancements of the eddy current testing process, those corrective actions could not have prevented this event.

This event was discovered due to prompt use of operating experience information.

There were no equipment failures, over exposures, radioactive releases, or personnel injuries associated with this event.

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CORRECTIVE ACTION:

Immediate

1. New analysis guidelines were developed and validated on a mock-up. Personnel were trained on the new guidelines.
2. An operability evaluation was performed to assess the impact of operation with defects classified as Tube End Anomalies (TEAs) in the Steam Generator pressure boundary.
3. The Unit 1 and 3 Eddy Current Testing (ECT) data from the most recent outages was re-analyzed.
4. When the re-analysis indicated that indications exceeding the repair criteria existed in the pressure boundary on Unit 1 and 3, Duke requested and received a Notice of Enforcement Discretion.

Subsequent

1. Duke requested and received a license amendment to permit operation of Unit 1 and 3 until their next scheduled refueling outages or a cold shutdown of greater than seven days.
2. Unit 2 TEAs which were reclassified as indications in the pressure boundary were repaired by rerolling during the refueling outage.

Planned

1. Unit 1 and Unit 3 reclassified TEAs in the pressure boundary will be repaired during the next scheduled refueling outage on each unit or a cold shutdown of greater than seven days.
2. Additional training on assessing these indications will be given to data analysts prior to Eddy Current Testing in the next outage.

Planned corrective action 1 is considered to be an NRC Commitment Item. This is the only NRC Commitment item contained in this LER.

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SAFETY ANALYSIS:

The steam generators serve as part of the Reactor Coolant System pressure boundary and must meet the leakage requirements of the Oconee Technical Specifications. Tube End Anomalies (TEAs) are characterized as axial eddy current testing indications at the end of the tube outside of the pressure boundary. Reanalysis determined that 372 indications misclassified as TEA in Unit 1 steam generators, and 61 in Unit 3, actually extended into the pressure boundary area and meet the criteria as needing repair.

An evaluation was performed with respect to the design basis function of the steam generator tubes as a pressure boundary. All misclassified TEAs are in the area that is in contact with the tubesheet by the roll expansion. The tubesheet provides reinforcement to any indication. Therefore, the tubes will not burst under normal and accident conditions and tube integrity requirements are satisfied.

Another consideration is tube leakage, with main steam line break (MSLB) loading conditions representing the worst case. Analysis of the observed flaw sizes, measured leak rates from in situ pressure tests for indications in the tubesheet area, and an allowance for potential leakage of tubes previously rerolled, resulted in a total predicted tube leakage of 0.023 gpm for Unit 1 following a MSLB. The off-site dose analysis assumes 0.7 gpm at room temperature for each unit. Since Unit 1 is bounding (due to the number of tube indications above the repair criteria), both units meet the MSLB leakage requirements for steam generator integrity.

There is no direct data on growth of TEAs. However, the analysis assumed that all detectable indications exceeded the repair limit. Circumferential indications were assumed to be 360 degree indications. Mixed mode indications were assumed to be circumferential. Two axial indications were observed in the carbon steel region of the tube sheet. These indications are not expected to grow to a point of concern with an industry growth rate of 0.03 inches/EFY.

Since the expected leakage for the worst case accident is still within assumptions previously used in safety analyses, this event had no impact on the health and safety of the public.

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Attachment A

Oconee OTSG

Vertical Cross Section

