

December 16, 2002

U.S. Nuclear Regulatory Commission
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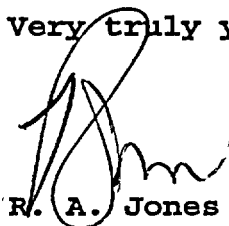
Subject: Oconee Nuclear Station
Docket Nos. 50-270
Licensee Event Report 270/2002-03, Revision 0
Problem Investigation Process No.: O-02-6118

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report 270/2002-03, Revision 0, concerning a Steam Generator tube which failed an in-situ pressure test.

This report is being submitted as a voluntary Licensee Event Report. This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,



R. A. Jones

Attachment

IE22

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cc: Mr. Luis A. Reyes
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Washington, D.C. 20555

Mr. M. C. Shannon
NRC Senior Resident Inspector
Oconee Nuclear Station

INPO (via E-mail)

NRC FORM 366 (7-2001)		U.S. NUCLEAR REGULATORY COMMISSION		APPROVED BY OMB NO. 3150-0104 EXPIRES 7-31-2004				
LICENSEE EVENT REPORT (LER) (See reverse for required number of digits/characters for each block)						Estimated burden per response to comply with this mandatory information collection request 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.		
1 FACILITY NAME Oconee Nuclear Station, Unit 2				2. DOCKET NUMBER 050- 0270		3. PAGE 1 OF 7		
4 TITLE Steam Generator Tube Leak During In-Situ Pressure Test								
5 EVENT DATE			6. LER NUMBER		7. REPORT DATE		8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR
10	31	2002	2002	- 03	- 0	12	16	2002
9. OPERATING MODE None			11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR § (Check all that apply)					
10. POWER LEVEL 0			20 2201(b)		20.2203(a)(3)(ii)		50.73(a)(2)(ii)(B)	
			20 2201(d)		20.2203(a)(4)		50.73(a)(2)(iii)	
			20 2203(a)(1)		50.36(c)(1)(i)(A)		50.73(a)(2)(iv)(A)	
			20 2203(a)(2)(i)		50.36(c)(1)(ii)(A)		50.73(a)(2)(v)(A)	
			20 2203(a)(2)(ii)		50.36(c)(2)		50.73(a)(2)(v)(B) <input checked="" type="checkbox"/>	
			20 2203(a)(2)(iii)		50 46(a)(3)(ii)		50.73(a)(2)(v)(C)	
			20 2203(a)(2)(iv)		50 73(a)(2)(i)(A)		50.73(a)(2)(v)(D)	
			20 2203(a)(2)(v)		50.73(a)(2)(i)(B)		50.73(a)(2)(vi)	
20 2203(a)(2)(vi)		50.73(a)(2)(i)(C)		50.73(a)(2)(vii)(A)		OTHER Specify in Abstract below or in NRC Form 366A		
20 2203(a)(3)(i)		50 73(a)(2)(ii)(A)		50 73(a)(2)(viii)(B)				
12. LICENSEE CONTACT FOR THIS LER								
NAME L.E. Nicholson, Regulatory Compliance Manager						TELEPHONE NUMBER (Include Area Code) (864) 885-3292		
13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT								
CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER
A	AC	SGI	B015	Y				
14. SUPPLEMENTAL REPORT EXPECTED						15. EXPECTED SUBMISSION DATE		
YES (If yes, complete EXPECTED SUBMISSION DATE).				X	NO		MONTH	DAY
								YEAR
16. ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)								
<p>On 10-31-02, Unit 2 was defueled in No Mode for a Refueling outage. During in-situ pressure testing, Steam Generator (SG) "B" Tube 37-27 began to leak at approximately 3900 psig. This did not meet the "3 times normal operating delta-p pressure" (4250 psig) test criterion. The failure was at an axially oriented indication in a dent with manufacture burnish marks (MBM) superimposed over the dent. The tube was removed from service by plugging. Axial indications have been seen in dents in the past and are anticipated in the ONS SGs. Existing test data was reviewed. Unit 2 had 28 indications of dents and MBM that overlapped and were preventatively plugged. Unit 3 had no similar indications. Unit 1 found 13 such indications but had no indication of cracking.</p> <p>The root cause of this event is human error (i.e. guidance document not followed correctly) due to a difficulty associated with interpreting eddy current test results. During previous inspections, the combination of signals from the overlapping indications resulted in masking the defect. Additional guidance for eddy current analysis will be provided so that this type of complex indication that potentially could mask degradation shall be considered for plugging. This event is considered to have no significance with respect to the health and safety of the public.</p>								

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NARRATIVE (If more space is required, use additional copies of NRC Form 366A) (17)

EVALUATION:

BACKGROUND

Duke Power provides this report as a voluntary Licensee Event Report.

Oconee Nuclear Station (ONS) uses the Babcock and Wilcox (B&W) Nuclear Steam Supply System [EIIS:AC], which includes two Once Through Steam Generators (SGs) [EIIS:SGI], for primary to secondary heat transfer per unit. Each SG is a vertical, straight tube heat exchanger. Inside the SG shell, there is an upper tube sheet, 15 tube support plates, a lower tube sheet, and 15531 tubes per steam generator. The tubes are nominally 0.625 inches in outside diameter. During manufacture of the tubes, minor dents and manufacture burnish marks were considered acceptable. However these are now recognized as potential stress concentration points which can contribute to expected tube degradation due to age.

During each refueling outage, in-situ pressure testing is conducted on selected SG tubes as part of the SG In-Service Inspection. The tubes are selected for this test based on eddy current indications observed during the current outage inspections. By normal practice, any tube selected for in-situ pressure testing will be removed from service by plugging regardless of the test result. The acceptance criteria are that the tubes should not burst at either 3.0 times normal steady state pressure for full power operation or 1.4 times the transient pressure during a limiting design basis accident concurrent with a safe shutdown earthquake.

For ONS the procedural limiting value, corrected for test conditions and instrument issues, is 4250 psi. The test is conducted using a test pump with a nominal 3 gpm capacity.

Prior to this event, Unit 2 was defueled during a Refueling outage (No Mode) with no safety systems or components out of service that would have contributed to this event.

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EVENT DESCRIPTION

During October 2002, in-situ pressure testing of SG tubes was conducted as part of the Oconee Unit 2 refueling outage (EOC 19) In-Service Inspection. A total of 21 tubes were tested (ten tubes in SG "A" and eleven tubes in SG "B"). All ten of the SG "A" tubes and ten of the eleven SG "B" tubes showed no leakage during the pressure testing. However, one SG "B" tube began to leak prior to reaching the highest test pressure.

Specifically, eddy current testing of SG "B" Tube 37-27 had shown a defect measured as a 2" long single axial indication, 95% through wall (maximum depth), in a dent located just above the 15th support plate. Therefore the tube was selected for in-situ testing. During in-situ pressure testing conducted on 10-31-02, SG "B" Tube 37-27 began to indicate leakage at approximately 3900 psig. The tube did not reach the full 3 times normal operating delta-p pressure (4250 psig) and thus did not meet the test criterion. The leak rate equaled or exceeded the capacity of the test pump, approximately 3 gpm, such that pressure could not be maintained. The test was aborted and appropriate personnel, including Operations, were notified.

Additional eddy current testing and video inspections were conducted to evaluate the leak. The leak was found to be at the defect mentioned above. SG "B" Tube 37-27 was subsequently removed from service by plugging.

Following the evaluation of the leak and eddy current data from the current outage, data from prior outage inspections on Unit 2 were re-evaluated. This review found that recordable volumetric and dent indications had been observed at this location as far back as 1993. However, the indications were not interpreted as indicative of a crack. Reviewing the data in retrospect, it appears that as early as 1998 the data was ambiguous and could reasonably be interpreted either as indicative of a manufacture burnish mark (MBM) superimposed on a dent, to be resolved accordingly, or as degradation associated with the dent.

After this conclusion was reached, data from this outage on Unit 2 and the most recent outages on Oconee Units 1 and 3 were re-evaluated. The review for Unit 2 found 28 additional tubes with locations where dent and MBM indications overlapped. These tubes

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were preventatively plugged. The review for Unit 1 found 13 locations where dent and MBM indications overlapped but none appeared to contain possible defects as was seen on SG 2B tube 37-27. Unit 3 revealed no similar overlapping dent/MBM indications.

CAUSAL FACTORS

The immediate cause mechanism was determined to be expected component aging. Axial indications have been seen in dents in the past and are anticipated in the ONS SGs. Therefore the root cause of this event is related to the failure to properly analyze the flaw and remove it from service sooner. The root cause of the event was evaluated by knowledgeable individuals and reviewed by outside consultants from EPRI and the industry.

The root cause of this event is human error (i.e. guidance document not followed correctly) due to the difficulty associated with interpreting eddy current test results during prior inspections. While it is reasonable, in retrospect, to state that previous inspections provide evidence of the presence of degradation, the combination of signals (MBM and dent) resulted in masking the defect.

Investigation and detailed examination of the leaking tube found that there was a dent at 5.41 inches above the 15th tube support plate. The dent had axial length. Also there is a volumetric flaw superimposed over the end of the dent at this location. The volumetric flaw is believed to be a manufacture burnish mark. The axial flaw was essentially a crack inside the dent and the area of the MBM. This was the point where the structural failure occurred during the in-situ pressure test.

A review of prior eddy current test data shows that the bobbin data has not changed since 1993, which indicates that the dent is unchanged. However, rotating coil data is more capable of detecting a crack. The review of rotating coil data found that an axial indication that was marginally detectable in 1998 has been slowly degrading since then. The current analysis guidelines were reviewed and determined to be adequate to have identified the axial indication during the outages since 1998. Therefore, in hindsight, it appears that the axial flaw could have been detected earlier. However, because these flaws were in essentially the same location

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as the dent, the potential for small cracks at this location was masked, making interpretation of indications from earlier inspections difficult.

As a result of this finding, guidance will be clarified so that all indication of dents and volumetric flaws in close proximity to each other will be considered a precursor signal and masking combination that affects detectability of potential flaws. Oconee will revise criteria so that, for the current ONS Steam Generators, any tubes displaying this combination of signals in the future will be removed from service as a preventative measure. All three ONS units will undergo SG replacement, expected to begin during with the next Unit 1 refueling outage.

CORRECTIVE ACTIONS

Immediate:

1. The affected tube was removed from service by plugging.

Subsequent:

1. Test data from this Unit 2 outage and the preceding outages on Units 1 and 3 were reviewed for similar indications. As a result, 28 additional tubes were preventatively plugged on Unit 2. Thirteen overlapping dent and MBM indications on Unit 1 were found and dispositioned as having no indication of cracking. Unit 3 revealed no similar overlapping dent and MBM indications.

Planned:

1. Revise analyst guidelines to include specific guidance on dents with complex indications that potentially could mask degradation.
2. Revise dispositioning guidelines for the current ONS Steam Generators so that any dent indication with evidence that other signals could be present shall be plugged since it could be masking more serious degradation.
3. Indications similar to the pre-2002 eddy current results for B 37-27 indication shall be included in future analyst training

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and testing. Verification that analyst are sensitive to complex signals contained at dented locations shall be demonstrated.

None of these corrective actions are considered NRC Commitment items. There are no other NRC Commitment items contained in this LER.

SAFETY ANALYSIS

The in situ pressure test indicated the axial flaw met the limiting pressure requirements for normal operation and worst case accident conditions. The SG tube did have a loss of required margin, but there is no presumption that the tube would have failed during an actual event. Therefore this event does not represent significant SG tube degradation that would have a safety concern or operability issue for operation in the previous cycle. For that reason, this event is not considered a safety system functional failure.

However, per NEI 97-06 rev 1 guidance, maintaining the required margin is a maintenance rule function. Since the required margin was not maintained, this event is a maintenance rule functional failure and is considered reportable under the Equipment Performance and Information Exchange (EPIX) program. The affected component was the 2B Steam Generator [EIIS:SGI], manufactured by Babcock and Wilcox [manufacturer's code: B015].

Due to previous operational assessments, the ONS units are limited to only one cycle of operation between required 100% inspections which insures that other potentially significant degradation in this geometry will be detected prior to exceeding the safety requirements for protection against burst and/or leakage due to most limiting accident condition and during normal operation.

Therefore, there was no actual impact on the health and safety of the public due to this event.

ADDITIONAL INFORMATION

There have not been any previous indications of dents with flaws that have approached structural limits. Therefore this event is not a recurring event. Since 1997, several hundred axial

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indications have been in-situ pressure tested with no problems; though of these, only a few have been associated with a dent. This indicates that there has not been a generic problem with detectability or growth rate of defects contained within dented locations. There have not been any indications of volumetric flaws approaching structural limits and therefore the detectability of MBM indications is not in question.

There were no releases of radioactive materials, radiation exposures or personnel injuries associated with this event.