

August 22, 2003

U. S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
Mail Stop P1-137  
Washington, DC 20555-0001

Ladies and Gentlemen:

ULNRC-04892  
TAC No: MB 8103



**DOCKET NUMBER 50-483  
CALLAWAY PLANT UNIT 1  
UNION ELECTRIC CO.  
FACILITY OPERATING LICENSE NPF-30  
REQUEST FOR ADDITIONAL INFORMATION  
ON NOVEMBER 2002 STEAM GENERATOR TUBE INSPECTION**

- References: 1) ULNRC-04776 dated 11/19/02  
2) ULNRC-04778 dated 11/19/02  
3) ULNRC-04777 dated 10/21/02  
4) ULNRC-04823 dated 3/17/03  
5) NRC letter to G. L. Randolph dated 6/24/03

Reference 5 transmitted a request for additional information in regard to information transmitted by References 1-4 on the results of the November 2002 steam generator inservice inspections performed at Callaway. The attachment to this letter provides responses to the staff's request.

Please contact Dave Shafer (314) 554-3104 if additional information is needed in this matter.

Very truly yours,

A handwritten signature in cursive script that reads "Keith D. Young".

Keith D. Young  
Manager, Regulatory Affairs

DS/mlo  
Attachments 1: RAI Response  
2: Event Report #39345

A 047

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cc: U. S. Nuclear Regulatory Commission (Original and 1 copy)

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Washington, DC 20555-0001

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REQUEST FOR ADDITIONAL INFORMATION

CALLAWAY PLANT

NOVEMBER 2002 STEAM GENERATOR INSPECTION REPORT

The results of the Callaway Plant 2002 steam generator tube inspections were reported to the NRC in a letters dated November 19 and 21, 2002, and March 17, 2003. In order for the staff to complete its review, responses to the following questions are needed:

1. Thermally treated Alloy 600 tubes were plugged both in Steam Generator A (Row 1, Column 34) and Steam Generator D (Row 5, Column 70). These tubes were plugged as a result of detecting volumetric indications in these tubes. Please discuss the cause and the size (length, depth) of these indications. Address the implications of these findings including the technical basis for your conclusions regarding the cause of the indications (e.g., tube pull results, etc.)

*Answer:*

*Cause:*

*These volumetric indications in thermally treated tubing in Steam Generator A and Steam Generator D are attributed to wear at tube support plate locations caused by vibration of the tube due to thermohydraulic forces acting of the tube. Hydraulic excitation is expected to occur in the steam generators due to high energy steam formation.*

*Size:*

*The volumetric indications found in Steam Generator A Row 1, Column 34, were measured to be 6 and 7% throughwall (TW) and have a length of 0.28 and 0.26 inches, respectively. Steam Generator D Row 5, Column 70, was measured to be 16% TW with a length of 0.29 inches.*

*Implications and technical basis for cause:*

*These indications are similar to each other and to eddy current traces of AVB wear indications found in the u-bend region. These indications also occurred in thermally treated tubing which is much less susceptible to other forms of degradation such as Intergranular Attack (IGA). In addition to bobbin coil detection, these indications were tested with a rotating coil to further evaluate the cause of the degradation. Tube degradation due to AVB wear has been occurring in steam generators for years. Vibration due to high energy steam causes the tube to repeatedly contact the quatrefoil lands and create a wear scar similar to AVB wear. The indications are located at tube support plate intersections. They are centered at quatrefoil lands and the ends of the tube support plates. These indications are shallow in depth, have small growth rates and are much smaller than the structural or leakage limits of the tube. These tubes were conservatively plugged on detection and do not present a challenge to tube integrity.*

*The conclusions for type of degradation are based on eddy current evaluation, expert opinion, and historical findings in Callaway tubing. No tube pulls have been performed at Callaway.*

2. Several mill annealed tubes in SG A were plugged due to the identification of single volumetric indications. Please discuss the cause and the size (length, depth) of these indications. Address the implications of these findings including the technical basis for your conclusions regarding the cause of the indications (e.g., tube pull results, etc.)

*Answer:*

*Cause:*

*The volumetric indications at tube support plate locations are attributed to wear caused by vibration of the tube due to thermohydraulic forces acting of the tube. Hydraulic excitation is expected to occur in the steam generators due to high energy steam formation. The cause of volumetric indications at the top of the tubesheet is attributed to Outside Diameter Intergranular Attack (IGA).*

*Size:*

*This question is assumed to pertain to the following indications:*

SG	Row	Column	Location	Indication	Size %TW	Length (in)
A	12	99	TSH +0.07	SVI	13	0.34
A	15	48	07H +0.26	SVI	18	0.51
A	43	36	TSH +0.03	SVI	11	0.36
A	44	35	TSH +0.09	SVI	28	0.40
A	44	36	TSH +0.13	SVI	10	0.33
A	47	57	FBH +0.07	SVI	10	0.28
A	59	67	02C +0.13	SVI	9	0.36

*Technical Basis for Cause and Implications:*

*The support plate indications are similar to each other, to the indications found in the thermally treated tubing, and to eddy current traces of AVB wear indications found in the u-bend region. Tube degradation due to AVB wear has been occurring in steam generators for years. Vibration due to high energy steam causes the tube to repeatedly contact the quatrefoil lands and create a wear scar similar to AVB wear. The indications are located at tube support plate intersections. They are centered at quatrefoil lands and the ends of the tube support plates. These indications are shallow in depth, have small growth rates and are much smaller than the structural or leakage limits of the tube. These tubes were conservatively plugged on detection and do not present a challenge to tube. In addition, these indications were tested with a rotating coil to further evaluate the cause of the degradation.*

*The other indications are located at the tubesheet expansion transition. Steam Generator A Row 12 Column 99 has a phase considered ID. However, this indication looks more like a dent at the top-of-tubesheet than IGA. The indication could possibly be OD IGA being influenced by*

*the dent causing it to be ID in phase. The other volumetric indications at TSH are all OD. This is typically attributed to Intergranular Attack (IGA). Stress Corrosion Cracking and IGA have been occurring in Callaway mill annealed tubing for several cycles and is an anticipated form of degradation. All indications are shallow in depth. These tubes are plugged on detection and pose no challenge to tube integrity. Callaway performs a 100% expansion transition inspection in each steam generator each outage to identify this type of degradation and repair the tubing prior to exceeding tube leakage or structural limits.*

*The conclusions for type of degradation are based on eddy current evaluation, expert opinion, and historical findings in Callaway tubing. No tube pulls have been performed at Callaway.*

3. The March 12, 2003 letter (page 7) indicates that 5 tubes were repaired because of tube support plate wear at various locations. Provide more details about the location of the degradation and the size of the degradation including your basis for concluding that the indications were attributed to wear.

*Answer:*

*This question is assumed to pertain to the following indications:*

SG	Row	Column	Location	Indication	Size %TW	Length (in)
A	1	34	01C -0.45	MVI	6	0.28
			01C -0.47		8	0.26
A	15	48	07H +0.26	SVI	18	0.51
A	47	57	FBH +0.07	SVI	10	0.28
A	59	67	02C +0.13	SVI	9	0.36
D	5	70	03C +0.50	SVI	16	0.29

#### *Technical Basis for Cause*

*These indications are similar to each other and to eddy current traces of AVB wear indications found in the u-bend region. Two of these indications also occurred in thermally treated tubing which is much less susceptible to other forms of degradation such as IGA. In addition to bobbin coil detection, these indications were tested with a rotating coil to further evaluate the cause of the degradation. Tube degradation due to AVB wear has been occurring in steam generators for years. Vibration due to high energy steam causes the tube to repeatedly contact the quatrefoil lands and create a wear scar similar to AVB wear. The indications are located at tube support plate intersections. They are centered at quatrefoil lands and the ends of the tube support plates. These indications are shallow in depth, have small growth rates and are much smaller than the structural or leakage limits of the tube. These tubes were conservatively plugged on detection and do not present a challenge to tube integrity.*

*The conclusions for type of degradation are based on eddy current evaluation, expert opinion, and historical findings in Callaway tubing. No tube pulls have been performed at Callaway.*

4. A tube in SG A (Row 25, Column 71) was plugged due to multiple circumferential indications near a Westinghouse laser welded sleeve. Page 5 of Attachment 1 to the March 17, 2003 letter states, in part, that there was no degradation detected in the sleeves. Clarify the location of the indication in tube R25C71 with respect to the sleeve including the possible relationship between the indication and the sleeve. Discuss whether this indication was service-induced degradation and the basis for this conclusion. If not service-induced, discuss the cause of the indication. Also address the implications of these findings.

*Answer:*

*The location of the multiple circumferential indications were recorded between 2.03 and 2.07 inches below the bottom of the sleeve. The bottom of the Laser Welded Sleeve was hydraulically expanded then rolled to the inside diameter of the tube. The indications were well below the bottom of the sleeve.*

*The flaws were most likely service induced due to high localized stress in the expanded region of the tube in combination with high temperature service. A number of locations (41) below other installed sleeves were tested to the same extent and no flaws were detected. The flaws exhibit the same characteristics as others discovered in the tubesheet in the most recent outage. The existence or absence of Laser Welded Sleeves does not contribute to the location of flaws found in the tubesheet. These indications did not challenge the integrity of the installed sleeve or the tube.*

*This type of degradation has been occurring for several cycles in the steam generators. A 100% hot leg tubesheet examination is performed each outage to identify the degradation and remove it from service.*

5. The rotating probe inspection scope included examination of 20% of the dents and dings within bobbin coil signals above 2 volts. Please explain how tubes with dent and ding signals greater than 2 volts were selected for rotating probe testing. For example, were all dents and dings greater than 5 volts selected? If not, why not? Discuss whether any cracks were found associated with dents/dings. If any were selected, discuss the size of the indications and of the dent/ding.

*Answer:*

*The dent/ding signals  $\geq 2$  volts were split into 3 categories, Hot Leg, Cold Leg, and U-bend regions. 20% of all dents and 20% of all dings in all three categories were then tested with RPC. This is a random selection of indications. The only screening criteria is a 2 volt threshold. This is the only screening criteria used because Callaway has not experienced cracking at dent/ding locations. The 20% sample is in accordance with the EPRI Steam Generator Examination Guidelines. No crack like indications have been identified at dent/ding locations at Callaway. Dent and ding indications at Callaway are not due to active degradation, rather, most of the indications were identified in pre-service inspections and are due to manufacturing or shipment. History reviews of these indications show little or no change in the signals.*

6. Clarify the statement on page 7 of Attachment 1 to the March 17, 2003 letter which indicates that "since through wall tearing and burst will not occur at 3ΔP, leakage integrity at an SLB differential pressure of 2560 psi is also demonstrated."

*Answer:*

*The statement applies to the determination that AVB wear indications measured in the most current inspection met the leakage and structural criteria for the past cycle of operation. Callaway uses a pressure of 3 times normal operating  $\Delta P$ , which exceeds 3600 psi, to demonstrate structural and leakage integrity of indications found in the steam generators. 3600 psi is much greater than the steam line break differential pressure of 2560 psi, and is therefore bounding.  $3\Delta P$  demonstrates tube integrity at the lower bound differential pressure.*

7. Licensee Event Report 2002-011-00, submitted November 19, 2002, states that the classification of Steam Generator A inspection results as C-3 was reported in Event Notification #39345 on November 5, 2002. Since this latter report cannot be found in ADAMS, please provide a copy of Event Notification #39345.

*Answer:*

*Event Notification #39345 is provided as Attachment 2 and can also be found on NRC's website at:  
<http://www.nrc.gov/reading-rm/doc-collections/event-status/event/2002/20021106en.html>*

Power Reactor		Event Number: 39345	
FACILITY: CALLAWAY		REGION: 4	NOTIFICATION DATE: 11/05/2002
UNIT: [1] [] []		STATE: MO	NOTIFICATION TIME: 15:19[EST]
RXTYPE: [1] W-4-LP			EVENT DATE: 11/05/2002
			EVENT TIME: 11:10[CST]
NRC NOTIFIED BY: E. HENSON		LAST UPDATE DATE: 11/11/2002	
HQ OPS OFFICER: MIKE RIPLEY			
EMERGENCY CLASS: NON EMERGENCY		PERSON	ORGANIZATION
10 CFR SECTION:		CHARLES MARSHALL	R4
ADEG 50.72(b)(3)(ii)(A) DEGRADED CONDITION			

UNIT	SCRAM CODE	RX CRIT	INIT PWR	INIT RX MODE	CURR PWR	CURR RX MODE
1	N	N	0	Refueling	0	Refueling

#### EVENT TEXT

##### DEFECTIVE STEAM GENERATOR TUBES DISCOVERED DURING INSPECTION

"During refueling outage RF12, interim results of "A" Steam Generator tube inspections indicate 62 tubes out of 5431 tubes (i.e., > 1%) have been found to be defective. This steam generator tube inspection result for the "A" Steam Generator is classified as category C-3 in accordance with Technical Specification 5.5.9, Table 5.5.9-2. All defective tubes will be plugged before the steam generator is returned to service. There were no adverse safety consequences or implications as a result of this event. This event did not adversely affect the safe operation of the plant or the health and safety of the public."

The licensee notified the NRC Resident Inspector.

\* \* \* UPDATE ON 11/11/02 @ 1653 BY HENSON TO GOULD \* \* \*

"This initial notification was reported under 10CFR50.72(b)(3)(ii)(A) as a Degraded Condition, however, under NUREG 1022, section 3.2.4, discussion (A) 3, the present C-3 classification of the 'A' Steam Generator tubes does not meet the listed criteria for serious steam generator tube degradation. This notification is to amend initial notification, EN #39345, to reflect that this report was made per requirements of Technical Specification 5.5.9, Table 5.5.9-2 only. This C-3 condition does not meet the criteria for serious steam generator tube degradation and thus is not a degraded or unanalyzed condition."

The Licensee will notify the NRC Resident Inspector. Notified R4DO (Pruett).