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UNION ELECTRIC

Donald F. Schnell
Senior Vice President
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January 12, 1996

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Washington, D.C. 20555-0001

Gentlemen:

ULNRC-3313
TAC No. M92228

CALLAWAY PLANT
DOCKET NUMBER 50-483
CIRCUMFERENTIAL CRACKING
OF STEAM GENERATOR TUBES

References: 1) NRC Generic Letter 95-03, dated April 28, 1995
2) ULNRC-3226, dated June 27, 1995
3) K. M. Thomas ltr to D. F. Schnell dated December 11, 1995

NRC Generic Letter 95-03 requested information concerning circumferential cracking of steam generator tubes. Our response was transmitted to NRC as Reference 2.

Attached please find additional information as requested by NRC in Reference 3. If you have any questions concerning this response, please contact us.

Very truly yours,

Donald F. Schnell

Donald F. Schnell

TWP/

Attachment

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STATE OF MISSOURI)
) S S
CITY OF ST. LOUIS)

Donald F. Schnell, of lawful age, being first duly sworn upon oath says that he is Senior Vice President-Nuclear and an officer of Union Electric Company; that he has read the foregoing document and knows the content thereof; that he has executed the same for and on behalf of said company with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By Donald F. Schnell
Donald F. Schnell
Senior Vice President
Nuclear

SUBSCRIBED and sworn to before me this Twelfth day of January, 1996.

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MY COMMISSION EXPIRES APRIL 22, 1997
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Union Electric response
to NRC Request for Additional
Information Regarding Generic Letter 95-03

NRC Question 1

The following areas have been identified as being susceptible to circumferential cracking:

a. Expansion transition circumferential cracking
b. Small-radius U-bend circumferential cracking
c. Dented location (including dented TSP) circumferential cracking
d. Sleeve joint circumferential cracking

Areas b, c, and d were not specifically addressed in your response, although you indicated that some tube support plate intersections were inspected. Please provide the requested information for these areas (and any other areas susceptible to circumferential cracking) per Generic Letter (GL) 95-03. The NRC staff realizes that some of these areas may not have been addressed because they may not be applicable to your plant; however, this should be clearly stated with the basis for the statement (e.g., "no sleeves are installed; therefore, the plant is not susceptible to sleeve joint circumferential cracking").

Your response indicated that some tube support plate intersections were inspected. Please clarify whether the locations sampled were dented tube support plate intersections. Describe the criteria for determining which locations were inspected. If a dent voltage threshold was (or will be) used for such a determination, the calibration procedure used (i.e., 2.75 volts peak-to-peak on 4-20 percent through-wall ASME holes at 400/100 mix) should be provided. In addition, clarify the past inspection scope and your future inspection plans for dented locations.

Response to NRC Question 1

At Callaway Plant, the only crack indications found to date have been in the expansion transition region. All tubes affected have been removed from service.

Small Radius U-bend

No indications of circumferential cracking have been found in the small radius U-bends. The first ten rows of tubes in Callaway's steam generators were thermally treated after

bending and prior to installation. Although the EPRI guidelines do not identify U-bend PWSCC as an expected damage mechanism for the Model F steam generator, we periodically inspect the short-radius U-bends with a rotating pancake coil (RPC) probe. The last such inspection was performed in Refuel 5 (3/20/92 to 5/17/92), at which time all row 1 and 2 U-bends were inspected in Steam Generator C. One tube, C-R2C98 (Steam Generator C, Row 2, Column 98) was removed from service due to an undefined indication (UDI). This tube is further described in the response to Question 4. We plan to inspect the Row 1 U-bends in Steam Generator C during our next refueling outage, which is currently scheduled to begin in October 1996.

Dented Locations

No service-induced denting has been identified in the Callaway steam generators. As stated in our response to Generic Letter 95-03, 100% bobbin coil inspection is performed in two steam generators during each outage. This ensures that all tube support plate intersections are examined every 3 years. To date, no damage mechanism has been identified in these areas. This is expected since Callaway's steam generators have stainless steel support plates with quatrafoil tube passages. We will continue to monitor these areas for any indication of damage.

Sleeve joints

No sleeves are installed in the Callaway steam generators. Therefore, the plant is not susceptible to sleeve joint circumferential cracking.

NRC Question 2

Clarify the extent (percentage of tubes sampled) of the rotating pancake coil (RPC) examinations performed in the thermally-treated alloy 600 tubes at the expansion transition location.

Response to NRC Question 2

Callaway has a total of 4856 (4 x 1214) thermally-treated tubes which comprise the first ten rows in each steam generator. During Refuel 7 (3/25/95 to 5/11/95), 405 thermally-treated tubes were inspected with the RPC at the expansion transitions. This represents an overall sample of about 8.3%. However, the examination concentrated on the sludge deposition zones of generators A and C where most of the crack indications were found in the mill-annealed tubing and where thermally-treated

tubing would most likely be affected. No indications were identified in thermally-treated tubing.

NRC Question 3

Provide the size of the indications detected at the expansion transition region along with an assessment of their structural integrity. Discuss any other techniques used to assess their structural integrity (e.g., UT, in situ pressure tests, tube pulls).

Response to NRC Question 3

Table 1 lists all of the expansion transition indications found during Refuel 7. Westinghouse evaluated tube A-R18C54, which had the greatest mixed mode degradation. Their analysis determined that this tube satisfied Regulatory Guide 1.121 requirements and bounded the remaining degraded tubes. No other techniques were used to assess structural integrity.

NRC Question 4

Please clarify the following titles in Table 1 of your Generic Letter 95-03 response: "Undefined Defect Indication" and "Unknown Axial Crack."

Response to NRC Question 4

In Table 1 of ULNRC-3226 (Reference 2), "Undefined Defect Indication" refers to an indication found in tube C-R2C98 during Refuel 5. This indication, not detected by bobbin coil, was found by RPC and was located just above the 7th cold leg support plate. As noted in our response to Question 1, all row 1 and 2 U-bends in generator C were inspected with RPC during Refuel 5 with no other indications detected. Since no degradation mechanism has been identified in this region, we considered this to be an anomalous indication. Our level III analyst judged this indication to be a distorted signal caused by its location in the U-bend transition. Nonetheless, we conservatively plugged the tube.

The term "Unknown Axial Crack" means we could not determine whether crack initiation was OD or ID.

NRC Question 5

During the Maine Yankee outage in July/August 1994, several weaknesses were identified in their eddy current program, as detailed in NRC Information Notice 94-88, "Inservice Inspection Deficiencies Result in Severely Degraded Steam Generator

Tubes." In Information Notice 94-88, the staff observed that several circumferential indications could be traced back to earlier inspections when the data was reanalyzed using terrain plots. These terrain plots had not been generated as part of the original field analysis for these tubes. For the rotating pancake coil (RPC) examinations performed at your plant at locations susceptible to circumferential cracking during the previous inspection (i.e., the previous inspection per your Generic Letter 95-03 response), discuss the extent terrain plots were used to analyze the eddy current data. If terrain plots were not routinely used at locations susceptible to circumferential cracking, state whether the RPC eddy current data has been reanalyzed using terrain mapping of the data. If terrain plots were not routinely used during the outage and your data has not been reanalyzed with terrain mapping of the data, discuss your basis for not reanalyzing your previous RPC data in light of the findings at Maine Yankee.

Response to NRC Question 5

Terrain plots are used at Callaway for every tube examined with the RPC probe. During future inspections, terrain plots will continue to be used for analyses of tube sections inspected with the RPC probe.

Union Electric reviewed pertinent historical data for tubes with expansion transition indications. This work was performed during Refuel 7 by a third party Level III analyst. The review included any available bobbin or RPC data for a particular tube. Eight possible precursor signals were identified. None of the precursor signals were significant enough to be considered a "missed" call. Table 2 (attached) provides this information.

TABLE 1

TOP OF TUBESHEET INDICATIONS - REFUEL 7 (APRIL 1995)

S/G	Row	Col	Indication	Location	Circ Extent or Axial Length	Initiation Side (ID, OD, or UN)	Repair method (Plug or stake/plug)
A	21	47	SCI	TSH -1.05	108 degrees	ID	Stake/plug
A	11	50	SAI	TSH - 0.16	0.30 inches	UN	Plug
A	12	51	SAI	TSH + 0.10	0.22 inches	ID	Plug
A	18	54	SAI	TSH - 0.05	0.32 inches	ID	See Below
-	-	-	MCI	TSH - 0.21	333 degrees	OD	Stake/plug
A	13	55	SCI	TSH - 0.18	0.17 inches	OD	Stake/plug
A	32	58	MAI	TSH - 0.01	0.40 inches	ID	Plug
A	12	61	MAI	TSH - 0.08	0.24 inches	ID	Plug
A	12	69	SCI	TSH - 0.13	136 degrees	ID	Stake/plug
A	14	69	SCI	TSH - 0.22	63 degrees	ID	Stake/plug
A	19	80	SCI	TSH - 2.62	116 degrees	ID	Stake/plug
A	34	100	SAI	TSH + 0.02	0.57 inches	ID	Plug
C	14	41	MAI	TSH - 0.04	0.40 inches	OD	Plug
C	36	43	SAI	TSH + 0.17	0.36 inches	ID	Plug
C	12	55	MAI	TSH + 0.42	0.64 inches	OD	Plug
C	14	56	SVI	TSH + 0.01	0.54 inches	OD	Plug
C	13	57	SVI	TSH + 0.20	0.40 inches	OD	Plug
C	14	57	SVI	TSH - 0.08	0.39 inches	OD	Plug
C	14	58	SVI	TSH + 0.01	0.36 inches	OD	Plug
C	15	58	SCI	TSH - 0.09	139 degrees	OD	Stake/plug

TABLE 1 (cont.)

S/G	Row	Col	Indication	Location	Circ Extent or Axial Length	Initiation Side (ID, OD, or UN)	Repair method (Plug or stake/plug)
C	13	59	SVI	TSH + 0.49	0.55 inches	OD	Plug
C	15	60	SCI	TSH - 0.26	83 degrees	OD	Stake/plug
C	13	61	SAI	TSH + 0.28	0.36 inches	OD	Plug
C	14	61	SCI	TSH - 0.08	190 degrees	OD	Stake/plug
-	-	-	SAI	TSH +0.05	0.39 inches	UN	See above
C	43	80	MAI	TSH - 0.19	0.35 inches	ID	Plug
C	24	88	SAI	TSH - 0.16	0.48 inches	UN	Plug
C	14	100	SAI	TSH - 0.01	0.26 inches	OD	Plug
D	33	56	SAI	TSH - 0.05	0.22 inches	ID	Plug
D	16	61	SCI	TSH - 0.06	142 degrees	OD	Stake/plug
D	17	108	SVI	TSH - 0.06	0.40 inches	OD	Plug

SAI Single Axial Indication
MAI Multiple Axial Indication
SCI Single Circumferential Indication
MCI Multiple Axial Indication
SVI Single Volumetric Indication

TABLE 2

HISTORICAL DATA REVIEW

Steam Generator A

Row	Col	1995 MRPC	1993 Bobbin	1990 MRPC
21	47	SCI	No	No data
11	50	SAI	No	No data
* 12	51	SAI	Yes	No
18	54	SAI/MCI	No	No
* 13	55	SCI	No	Possible SCI
32	58	MAI	No	No data
12	61	MAI	No	No
12	69	SCI	No	No
14	69	SCI	No	No
19	80	SCI	No	No data
* 34	100	SAI	Possible	No data

Steam Generator C

Row	Col	1995 MRPC	1995 Bobbin	1992 Bobbin
* 14	41	MAI	Yes	Yes
36	43	SAI	No	Not reviewed
12	55	MAI	No	Not reviewed
* 14	56	SVI	Yes	Possible
* 13	57	SVI	Yes	Yes
* 14	57	SVI	Yes	Possible
* 14	58	SVI	Yes	Yes
15	58	SCI	No	Not reviewed
13	59	SVI	Yes	No
15	60	SCI	No	Not reviewed
13	61	SAI	Yes	No
14	61	SAI/SCI	No	Not reviewed
43	80	MAI	Yes	No
24	88	SAI	No	Not reviewed
14	100	SAI	No	Not reviewed

Steam Generator D

Row	Col	1995 MRPC	1993 Bobbin
33	56	SAI	No
16	61	SCI	No
17	108	SVI	No

* - Possible precursor signals