Portland General Electric Company

Charles Goodwin Jr. Assistant Vice President

July 11, 1980

Trojan Nuclear Plant
Docket 50-344
License NPF-1

Director of Nuclear Reactor Regulation
ATTN: Mr. Robert A. Clark, Chief
Operating Reactors Branch No. 3
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Sir:

In accordance with your letter of May 22, 1980, please find attached an interim report describing the results of the nondestructive examination of U-bends removed from the Trojan steam generator D. We will attempt to adhere to the schedule for reporting additional interim and final results as requested in your letter although this schedule is more stringent than that originally contemplated in our letter of March 27, 1980. We will inform you of any scheduling problems regarding report submittal as they become evident.

Should you have any questions regarding this report, please contact us as appropriate.

Sincerely,

C. Goodwin, Jr.

C. Goodwin, Jr.
Assistant Vice President
Thermal Plant Operation and
Maintenance

CG/DRS/4sa9A11
Attachment

c: Mr. Lynn Frank, Director
State of Oregon
Department of Energy

Mr. R. H. Engelken, Director
U. S. Nuclear Regulatory Commission
Region V

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STATUS REPORT
NONDESTRUCTIVE EXAMINATION RESULTS OF U-BENDS REMOVED FROM TROJAN STEAM GENERATOR D
JULY 1980

INTRODUCTION

A total of 29 U-bends have been removed from steam generator D for nondestructive and destructive examination with the objective of determining the cause and resolution of Row 1 U-bend leakage. The selected U-bends were Row 1-Column 1 through 26 and Row 2-Column 1 through 3. These include one leaking tube (R1C6), and one tube (R1C26) which was identified by previous Plant eddy current (ET) examination during the Fall 1979 outage as containing an indication. The other 27 U-bend sections removed did not display ET indications during the Fall 1979 inspection.

This report presents the preliminary findings of the various nondestructive tests performed to date by Westinghouse. (Upon completion of this phase, selected bends will be retained by Westinghouse for destructive examination and a number will be sent to Battelle Northwest for additional nondestructive and destructive examination.)

The nondestructive examination (NDE) reported herein consists of the following:

1. Measurement of leg spacing of each bend taken in situ below the tangent points before the bends were cut. The measurement of the cut bend at the same location was made in the laboratory.
2. Ovality measurements taken on each removed bend at the apex and at the cold and hot leg tangent points and more detailed ovalities measured on selected tubes.
3. Visual examination of each bend.
4. Double wall radiography of each bend.
5. Eddy current examination of each bend.

In addition, Silastic molds were taken of the inner diameters of three tubes (R1C6, R1C10 and R1C22) at the hot- and cold-leg tangent points and will be retained for detailed measurements, if required, since these bends will be destructively evaluated. Finally, wall thickness traverses are currently being made by ultrasonic gaging on selected bends; these results will be reported subsequently.

NONDESTRUCTIVE EXAMINATION RESULTS

1. Dimensional Measurements

   Table 1 presents the leg spacing, before and after cutting of each Row 1 bend and the maximum ovality measured, after removal, at the apex of the bends and at the hot- and cold-leg tangent points. Also included are the NDE findings.

It should be noted that there is an uncertainty associated with the pre- and post-leg spacing values due both to the difficulties inherent in making the measurements in the steam generator prior to cutting and in duplicating the location for the laboratory measurements afterward.

With regard to ovality, there does not appear at this time to be a correlation between the maximum ovality measured and the incidence of cracking.

More detailed ovality measurements, taken at 1/4-in. axial increments above and below the hot- and cold-leg tangent points, have been developed on the three bends with indications of cracking (R1C6, R1C7 and R1C26) and have been compared with similar measurements taken on three tubes with no obvious cracking (R1C4, R1C13 and R1C18). Again, there does not appear to be any correlation between the maximum value of ovality and cracking. In fact, as shown in Table 1, the ovalities at the particular tangent points which are cracked, the cold leg in each of these three cases, are essentially equal or less than the ovalities at the corresponding hot-leg tangent points which are not believed to be cracked, and are well below the ovalities observed in many of the other tubes which are apparently uncracked. There does appear to be a characteristic shape to the ovality plots, however, as shown in Figure 1, which compares one of the tangent locations in two bends, arbitrarily called the "smooth" transition (because of the even contour of the bend in the transition from the straight portion) with the "opposite" transition (which does not have quite as smooth a transition). All of the cracks reported in Table 1 are believed to be located in the "opposite" transition, but as shown in Figure 1, there does not appear to be an obvious distinction in this region between cracked and uncracked bends. Additional effort is underway, to be supplemented with the destructive examination results, to evaluate these characteristics.

2. Visual Examination

All U-bend tubes were examined visually upon arrival. Several were further examined at magnifications up to 30X in an attempt to correlate crack locations and patterns with those indicated by radiography.

All U-bends were covered with a tenacious black scale. This scale is typical for tube samples removed from steam generators at other plants. The scale was judged to be intact before sample removal; but due to removal operations and subsequent handling, some scale flaked off at several locations.

Tube R1C6 revealed a crack-like indication on the OD in the vicinity of the radiographic indication. The area was

covered by a thin oxide layer which made exact visual examination questionable. Looking at the tube ID, however, two or possibly three distinct longitudinal "crack-like" indications were visible.

Similar examinations were carried out on R1C7 and R1C26. Neither bend exhibited any indication on the tube OD. Examinations on the ID of the tube R1C7 revealed one possible indication. It was difficult to assess positively if this was the indication seen on the radiograph due to oxide deposits on the ID and the short length of the indication. No obvious indications were found on the inside of R1C26. The IDs of these U-bends will be further examined and documented later.

3. Radiography

Each U-bend was radiographed after removal, using the double-wall technique[a] with shots taken at 0 degrees and 90 degrees at the apex of each bend and at 0 degrees, 45 degrees, 90 degrees and 135 degrees at both hot- and cold-leg transitions. A total of 303 radiographs were taken. Axial cracks were observed in three U-bends (R1C6, R1C7, and R1C26) as described in Table 2.

4. Laboratory Eddy Current Testing

Each U-bend was examined after removal utilizing the inservice inspection probe, Zetec 0.650" BF. Test frequencies were 400 kHz and 100 kHz differential and also 100 kHz absolute. The ET results are presented in Table 2.

SUMMARY

Nondestructive examination by radiography and eddy current testing detected axial cracks in the cold-leg transition, at or near the extrados surface in three of the 29 Row 1 and Row 2 U-bends removed from steam generator D of the Trojan plant; these were R1C6, R1C7 and R1C26. The crack discovered in R1C7 during this inspection is not discernible in tapes from the Fall 1979 inspection.

Maximum ovality measurements do not coincide with the reported crack locations, but the relationship, if any, between the crack locations and the smoothness of the transition from the straight legs will be investigated.

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[a] Voltage: 200 kV initially; 150 kV for verification
Amperage: 5mA
Time: 129 sec.
Film: Type M Double Film
Source to film distance: 60 in.

TABLE 1

STEAM GENERATOR TUBE DIMENSIONAL
MEASUREMENTS AND NDE RESULTS

Tube Number	Leg Spacing (Inches)			Percent Ovality (Maximum)			NDE Results
	Pre	Post	Δ	CL	Apex	HL	
R1-C1	3.505	3.457	-.048	4.8	2.06	1.71	OK
R1-C2	3.481	3.480	-.001	4.23	1.37	2.40	OK
R1-C3	3.483	3.566	+.083	1.71	3.54	4.57	OK
R1-C4	3.483	3.479	-.004	1.26	2.06	0.57	OK
R1-C5	3.476	3.489	+.013	2.17	2.74	4.11	OK
R1-C6	3.447	3.495	+.048	3.66	1.60	4.80	Crack in cold-leg transition per RT and ET
R1-C7	3.452	3.474	+.022	2.17	2.40	2.06	Crack in cold-leg transition per RT and ET
R1-C8	3.465	3.435	-.030	2.06	2.97	2.40	OK
R1-C9	3.473	3.466	-.007	1.23	2.29	3.20	OK
R1-C10	3.501	3.450	-.015	2.06	1.71	4.57	OK
R1-C11	3.493	3.478	-.051	4.80	2.97	2.17	OK
R1-C12	3.479	3.466	-.013	2.51	1.37	2.97	OK
R1-C13	3.481	3.463	-.018	2.06	1.71	5.14	OK
R1-C14	3.497	3.480	-.017	4.91	2.74	1.37	OK
R1-C15	3.481	3.420	-.061	4.11	2.17	2.40	OK
R1-C16	3.478	3.470	-.008	3.31	2.17	3.09	OK
R1-C17	3.471	3.417	-.054	2.74	2.06	3.54	OK
R1-C18	3.513	3.535	+.022	4.34	3.26	1.66	OK
R1-C19	3.483	3.450	-.033	3.09	2.06	1.14	OK
R1-C20	3.503	3.556	+.053	4.91	2.97	2.51	OK
R1-C21	3.506	3.534	+.028	4.69	3.20	1.26	OK
R1-C22	3.507	3.510	+.003	4.69	3.77	1.26	OK
R1-C23	3.502	3.535	+.033	2.86	3.31	0.97	OK
R1-C24	3.503	3.542	+.059	4.23	3.09	1.03	OK
R1-C25	3.495	3.466	-.029	2.17	2.51	5.37	OK
R1-C26	3.503	3.509	+.006	2.63	2.40	2.57	Crack in cold-leg transition per RT and ET

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TABLE 2

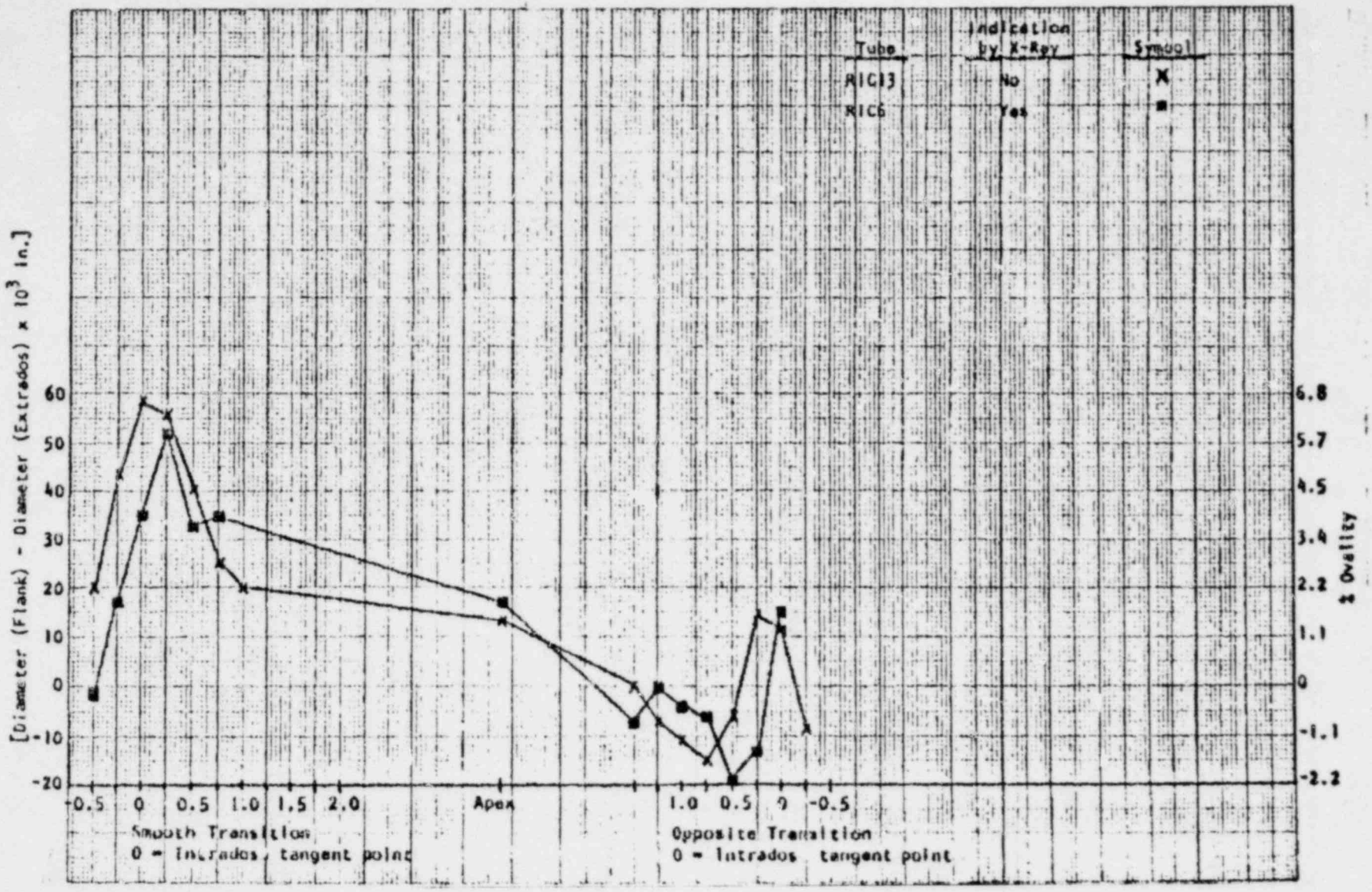
NONDESTRUCTIVE EVALUATION OF
STEAM GENERATOR D TUBE U-BEND SECTIONS

Tube Number	Visual Examination	Radiography[a]	Eddy Current Examination[b]
R1C1	No indications (NI)	No discontinuity (ND)	No indications (NI)
R1C2	NI	ND	NI
R1C3	NI	ND	NI
R1C4	NI	ND	NI
R1C5	NI	ND	Indication - hot leg
R1C6	1 indication - OD 3 indications - ID	One axial crack (3 segments) at cold-leg transition on extrados, total length 0.75-in.	Large indication - cold leg
R1C7	No indication - OD 1 indication - ID	One axial crack at cold-leg transition near extrados, total length 0.5 to 0.625-in.	Indication - cold leg
R1C8	NI	ND	NI
R1C9	NI	ND	NI
R1C10	NI	ND	NI
R1C11	NI	ND	NI
R1C12	NI	ND	NI
R1C13	NI	ND	NI
R1C14	NI	ND	NI
R1C15	NI	ND	NI
R1C16	NI	ND	NI
R1C17	NI	ND	NI

[a] W RT analysis at 150 kV (6-26-80)
[b] W ET analysis with Zetec probe (6-12-80)

Tube Number	Visual Examination	Radiography[a]	Eddy Current Examination[b]
R1C18	NI	ND	NI
R1C19	NI	ND	NI
R1C20	NI	ND	NI
R1C21	NI	ND	NI
R1C22	NI	ND	NI
R1C23	NI	ND	NI
R1C24	NI	ND	NI
R1C25	NI	ND	NI
R1C26	NI	Two axial cracks at cold-leg transition on extrados, total length 0.625-in.	Indication - cold leg
R2C1	NI	ND	NI
R2C2	NI	ND	NI
R2C3	NI	ND	NI

FIGURE 1



(in inches)