ARKANSAS NUCLEAR ONE - UNIT ONE

STEAM GENERATOR TUBING INSERVICE

INSPECTION REPORT FOR FIFTH REFUELING OUTAGE

INSPECTION SUMMARY

An inservice eddy current inspection was performed on tubes in the Arkansas Nuclear One Unit 1 Once Through Steam Generators (OTSGs) "A" and "B" during the period from 10 December 1983 through 25 February 1983. The previous inservice inspection, conducted in January, 1981, resulted in a forty (40) month inspection interval (per T.S. 4.18.4.b). The 1R5 inspection was completed within the required interval.

The inspection was conducted in accordance with T.S. 4.18.3 and T.S. Table 4.18.2. On 13 December 1982, the "B" OTSG was declared Category C-3 as a result of defects found in and around the lane region (Group A-1 per T.S. 4.18.3.a.3). The "A" OTSG was declared Category C-3 on 29 December 1982 with defects in the same region of the tubesheet. The NRC staff received prompt notification in both these cases with LER followup on 21 December 1982 (LER-82-030, Rev. 0) and 5 January 1983 (LER-82-030, Rev. 1). As a result of these classifications, a 100% inspection of all accessible (non-plugged, non-obstructed) tubes was conducted.

In the "A" OTSG, 15,504 tubes (of the total 15,531 tubes) were inspected full length. Of the remaining twenty-seven (27) tubes, twenty-six (26) tubes had been previously plugged and one (1) tube was sufficiently obstructed to prevent passage of the eddy current probe. In the "B" OTSG, 15,525 tubes were inspected full length. Of the six (6) remaining tubes, three (3) had been previously plugged and three (3) were sufficiently obstructed to prevent passage of the eddy current probe.

The multi-frequency method of eddy current testing was utilized during the inspection to determine tube wall degradation. Details of the inspection equipment and methodology are attached.

INSPECTION RESULTS

Tube wall degradation was observed in both the "A" and "B" OTSGs. In the "A" OTSG, eighty-three (83) defective tubes (i.e. $\geq$ 40% through wall imperfections per T.S. 4.18.5.a.5) were plugged. The one (1) obstructed tube was also plugged. Forty-three (43) defective tubes were plugged in the "B" OTSG. The three (3) obstructed tubes in the generator were also plugged. The plugged tubes were stabilized in accordance with OTSG vendor recommendations.

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Tables 1 and 2, attached, list the defective tubes for the "A" and "B" OTSGs, respectively. Defect location and size (% through-wall) are also listed. Tables 3 and 4 list the remaining reportable indications ($\geq$ 20 but < 40 % through-wall imperfections per T.S. 4.18.5.a.1) in the "A" and "B" OTSGs. Defect location and size are also provided.

These lists complete the reporting requirements of T.S. 4.18.6.

TABLE 1: "A" OTSG TUBE DEFECTS (≥ 40% TW INDICATIONS)

Row-Tube	Location	% TW
6-51	4-5 (1)	53
24-5	14-15	51
24-35	UTSM (2)	42
31-17	UTSM	59
32-95	UTSM	57
37-97	15-UTS	60
37-97	15-UTS	45
37-97	UTSM	45
37-101	LTSM (3)	67
38-57	8-9	75
38-103	UTSM	41
39-15	UTSM	42
42-1	UTSM	53
46-108	UTSM	44
49-111	UTSM	32
49-111	UTSM	49
58-13	UTSM	47
58-13	UTSM	32
58-14	UTSM	52
61-7	UTSM	52
62-10	UTSM	63
62-11	UTSM	53
64-103	13-14	64
65-10	UTSM	70
65-14	UTSM	43
65-16	UTSM	46
65-16	UTSM	25
66-11	UTSM	44
66-11	UTSM	30
67-1	UTSM	62
67-1	UTSM	39
68-12	UTSM	57
68-14	UTSM	50
68-54	UTSM	47
69-1	UTSM	80
69-1	UTSM	41
69-3	UTSM	46
69-5	UTSM	46
69-12	UTSM	53
69-12	UTSM	66
69-48	UTSM	41
69-57	14-15	65
69-57	14-15	34
70-36	UTSM	59
71-5	UTSM	43
71-10	UTSM	59

TABLE 1: "A" OTSG TUBE DEFECTS (≥ 40% TW INDICATIONS)

Row-Tube	Location	% TW
71-12	UTSM	40
71-13	UTSM	45
71-15	UTSM	51
71-22	UTSM	71
71-22	UTSM	35
71-24	UTSM	51
71-24	UTSM	53
71-24	UTSM	79
71-27	UTSM	44
71-33	UTSM	46
71-33	UTSM	54
71-36	UTSM	43
71-36	UTSM	27
72-8	UTSM	48
72-10	UTSM	43
72-10	UTSM	45
72-12	UTSM	55
72-12	UTSM	39
72-12	UTSM	64
72-15	UTSM	58
72-19	UTSM	47
73-68	UTSM	57
73-68	UTSM	23
74-87	UTSM	41
75-4	15	41
75-4	15	27
75-6	15	52
75-10	15	53
75-24	10-11	46
75-32	UTSM	51
75-65	UTSM	44
80-2	UTSM	51
80-7	UTSM	59
80-10	UTSM	47
80-11	UTSM	28
80-11	UTSM	66
80-11	UTSM	72
80-12	UTSM	44
80-12	UTSM	50
80-13	UTSM	54
80-13	UTSM	33
80-17	UTSM	70
80-21	UTSM	40
80-23	UTSM	37
80-23	UTSM	49
80-66	UTSM	40

TABLE 1: "A" OTSG TUBE DEFECTS (≥ 40% TW INDICATIONS)

Row-Tube	Location	% TW
81-2	UTSM	47
81-3	UTSM	44
81-10	UTSM	24
81-10	UTSM	51
81-10	UTSM	27
81-10	UTSM	30
81-13	UTSM	59
82-11	UTSM	57
82-60	1-2	83
83-6	UTSM	68
83-7	UTSM	67
83-10	UTSM	42
85-1	UTSM	42
85-1	UTSM	56
85-1	UTSM	60
86-1	UTSM	73
87-81	12-13	47
91-7	UTSM	44
97-17	UTSM	41
97-125	15-UTS	69
116-111	UTSM	34
116-111	UTSM	41
134-34	NA (4)	Obstructed

(1) Designation for defects/imperfections between tube support plates, in this case between the 4th and 5th tube support plates. A single number designates a defect at the tube support plate.

(2) Defect in the upper tube sheet midspan.

(3) Defect in the lower tube sheet midspan.

(4) Obstruction prevented inspection.

TABLE 2: "B" OTSG TUBE DEFECTS (≥ 40% TW INDICATIONS)

Row-Tube	Location	% TW
29-79	5-6 (1)	40
39-89	6-7	22
39-89	6-7	57
41-96	UTSM	43
42-98	12-13	63
43-99	2-3	57
44-49	3-4	64
68-22	UTSM	45
70-2	UTSM	42
70-2	UTSM	36
70-2	UTSM	41
70-2	UTSM	41
70-4	UTSM	50
70-14	UTSM	59
71-1	UTSM	25
71-1	UTSM	42
71-1	UTSM	37
71-2	UTSM	69
71-2	UTSM	28
71-2	UTSM	51
71-2	UTSM	39
72-5	UTSM	43
72-5	UTSM	28
72-49	UTSM	41
73-8	UTSM	84
73-8	UTSM	36
73-8	UTSM	60
73-8	UTSM	84
73-8	UTSM	84
73-9	UTSM	52
74-5	UTSM	64
74-9	UTSM	57
74-9	UTSM	62
74-12	7-8	43
74-26	UTSM	68
75-2	UTSM	56
75-2	UTSM	46
77-55	UTSM	52
77-63	UTSM	20
77-63	UTSM	40
78-2	UTSM	80
78-2	UTSM	74
78-2	UTSM	40
78-2	UTSM	47

(1) See Table 1 for nomenclature.

TABLE 2: "B" OTSG TUBE DEFECTS (≥ 40% TW INDICATIONS)

Row-Tube	Location	% TW
78-6	UTSM	54
78-21	UTSM	51
80-1	UTSM	80
80-1	UTSM	68
80-1	UTSM	56
80-1	UTSM	63
80-1	UTSM	22
80-2	UTSM	42
80-2	UTSM	46
80-5	UTSM	41
80-62	UTSM	63
81-2	UTSM	46
81-2	UTSM	96
81-2	UTSM	69
81-2	UTSM	69
81-2	UTSM	50
81-2	UTSM	89
81-2	UTSM	24
81-4	UTSM	71
81-6	UTSM	57
81-6	UTSM	76
82-2	UTSM	80
82-24	UTSM	42
85-28	UTSM	45
88-30	UTSM	36
88-30	UTSM	48
88-30	UTSM	40
89-2	UTSM	48
89-54	LTS-1	48
92-117	8-9	53
92-117	13-14	23
94-44	7-8	51
105-27	UTSM	22
105-27	UTSM	30
105-27	UTSM	43
108-22	UTSM	43
108-22	UTSM	32
108-22	UTSM	30
112-19	14-15	63
138-37	LTS-1	85
27-39	NA	Obstructed
31-101	NA	Obstructed
65-5	NA	Obstructed

TABLE 3: "A" OTSG DEGRADED TUBES

(≥ 20% TW BUT < 40% TW INDICATIONS)

Row-Tube	Location	% TW
10-31	UTSM (1)	26
12-46	UTSM	25
21-55	UTSM	36
26-55	UTSM	24
29-49	15-UTS	26
31-13	UTSM	34
39-13	UTSM	31
39-18	UTSM	24
48-15	UTSM	25
50-22	UTSM	39
51-111	1-2	36
52-9	UTSM	39
57-9	UTSM	38
57-29	UTSM	36
61-75	UTSM	38
61-117	UTSM	20
65-1	UTSM	38
65-11	UTSM	21
65-80	10-11	31
66-24	UTSM	31
68-2	UTSM	33
68-11	UTSM	37
69-13	UTSM	37
71-11	UTSM	36
71-25	UTSM	26
71-34	UTSM	24
71-55	UTSM	23
71-61	UTSM	22
72-5	UTSM	23
72-7	UTSM	39
72-7	UTSM	24
72-7	UTSM	20
72-18	UTSM	37
72-106	UTSM	20
72-130	10	24
73-6	UTSM	23
75-5	14	27
75-14	UTSM	34
75-14	UTSM	31
75-64	12-13	39
77-11	UTSM	36

(1) See Table 1 for nomenclature.

TABLE 3: "A" OTSG DEGRADED TUBES

(≥ 20% TW BUT < 40% TW INDICATIONS)

Row-Tube	Location	% TW
79-123	12-13	21
81-12	UTSM	33
81-14	10-11	26
81-19	UTSM	35
81-54	UTSM	31
81-63	13-14	20
82-59	UTSM	27
82-62	UTSM	32
83-11	UTSM	35
84-11	UTSM	36
84-12	LTSM	28
85-2	UTSM	35
86-12	UTSM	34
87-1	UTSM	29
87-11	UTSM	34
88-4	9-10	38
90-9	UTSM	27
96-120	UTSM	21
100-62	5	24
102-81	8-9	35
103-120	UTSM	36
104-2	UTSM	21
105-121	UTSM	25
107-13	UTSM	28
117-100	UTSM	30
119-13	UTSM	36
119-92	UTSM	27
126-97	UTSM	32
127-49	9-10	39

TABLE 4: "B" OTSG DEGRADED TUBES

(≥ 20% TW BUT < 40% TW INDICATIONS)

Row-Tube	Location	% TW
7-13	9 (1)	24
11-16	14-15	30
14-66	2-3	26
21-72	6-7	24
21-72	8-9	26
22-28	13-14	31
35-37	6-7	22
38-16	2-3	25
41-2	UTSM	28
51-47	11-12	26
60-11	UTSM	25
60-32	UTSM	26
64-4	UTSM	23
67-7	UTSM	38
67-17	15-UTS	35
70-26	UTSM	23
70-90	8-9	20
71-5	UTSM	28
72-20	UTSM	28
72-30	UTSM	32
73-15	UTSM	38
74-4	UTSM	35
74-8	UTSM	31
74-8	UTSM	29
77-14	UTSM	38
79-7	8	37
79-26	UTSM	22
79-41	8-9	30
80-8	UTSM	36
81-10	UTSM	21
82-10	UTSM	23
83-2	UTSM	29
83-2	UTSM	36
84-2	UTSM	31
85-39	5	29
87-24	UTSM	32
96-6	UTSM	22
96-42	14-15	32
103-25	UTSM	28
107-120	UTSM	28
110-87	7-8	30
121-3	15-UTS	32
123-2	14-15	22
123-56	11-12	35
131-6	2-3	22
139-64	1-2	25
149-3	6	36
149-3	11-12	39

(1) See Table 1 for nomenclature.

ATTACHMENT

EQUIPMENT AND METHODOLOGY

The inspection program satisfied the requirements of the USNRC Regulatory Guide 1.83, Revision 1 (July, 1975), "Inservice Inspection of Pressurized Water Reactor Steam Generator Tubes." The program was conducted in accordance with approved vendor-supplied procedures and the ANO-1 Technical Specifications.

The inspection program utilized multi-frequency eddy current techniques to collect defect and debris/sludge data. The following frequencies were used:

Channel 1 - 400 kHz - Defect Analysis

Channel 2 - 200 kHz - Defect Analysis

Channel 3 - 600 kHz - Defect Analysis

Channel 4 - 35 kHz - Debris/Sludge Analysis

Differential eddy current probes were used to examine the OTSG tubing from the primary side of the lower tube sheet to the primary side of the upper tube sheet. A 0.500" OD probe was used for the inspection. A 0.460" probe was used for tubes where denting or obstructions prevented passage of the larger probe. The probes were attached to nylon tubing to allow insertion and withdrawal. The instrument leads and a safety wire passed through the nylon tube. A ZETEC Model 2-D probe driver was used to insert and withdraw the eddy current probe at constant speed.

Eddy current calibration standards were manufactured from Inconel-600 0.625" OD tubing having nominal 0.037" wall thickness. Artifical defects were machined into the tube surface in accordance with Regulatory Guide 1.83, Revision 1.

The B&W Eddy Current Manipulator and associated control equipment was used for remote positioning of the probe at the desired tube location. A closed circuit television system mounted on the manipulator arm was used to observe probe movement and to verify probe position.

An MIZ-12 multi-frequency eddy current tester was used to generate the eddy current test signals and to monitor the return signals to determine the conductivity and/or permeability of the tube being tested. A change in conductivity is related to a discontinuity (imperfections) in the tube wall material. A "time-sharing" technique was used to test up to four (4) eddy current frequencies simultaneously. The MIZ-12 contains mixing circuits which allow the eddy current analyst to subtract out undesirable data (i.e., noise support signals, etc.). A CRT display was used to view the mixer output as well as the test signals.

EQUIPMENT AND METHODOLOGY

The MIZ-12 output signals were recorded on a strip charts and eight channel magnetic tape. The magnetic tape signals were subsequently analyzed by Level II or Level III eddy current examiners to locate and characterize tube defects. Standard eddy current analysis techniques were used. Original strip charts and magnetic tapes produced in the examination will be maintained at ANO.