ATTACHMENT 1

Steam Generator Examination Program and Results

1986 Refueling Outage

Consolidated Edison Company of New York, Inc.
Indian Point Unit No. 2
Docket No. 50-247

April 1986

Indian Point Unit No. 2
Steam Generator Examination Program and Results
1986 Examination

A. Examination Program Description

By letter from Mr. John D. O'Toole of Con Edison to Mr. Steven A. Varga of the NRC dated December 1, 1985, the details of the steam generator examination program planned for the unit's seventh refueling outage were submitted.

NRC approval of the program was received in a letter from Ms. Marylee Slosson, dated January 9, 1986.

The scope, results and conclusions of the steam generator examination program, as conducted during the seventh refueling outage are discussed below.

B. Scope of the Examination

1. Steam Generator Tube Eddy Current Examination

One hundred percent of the tubes in service in all four steam generators were inspected to the extent feasible.(*)

Selected tubes in the hot and cold legs of Steam Generators 21, 22, 23 and 24 were eddy current examined for both dents and defects. The examination was performed at 100, 200, 400 and 600 KHz.

In addition, all the remaining tubes in both hot and cold legs were eddy current examined for wall thinning in the crevice between the tubes and the tubesheet, and for pitting in the region of the tubes between the tubesheet and the lowest support plate.

A standard 700 mil diameter (or larger) eddy current probe was used to perform the eddy current testing. If any tube did not permit passage of this standard 700 mil probe, the tube was eddy current tested with a 610 mil probe. If any tube did not permit passage of the 610 mil probe, it was plugged. Furthermore, the tubes immediately adjacent to any tube that did not pass the 610 mil probe also were subjected to eddy current examination for dents and defects.

Identification of the hot and cold leg tubes in Steam Generators 21, 22, 23 and 24 which were eddy current examined for dents and defects is given in Table 1, 2, 3 and 4. In Steam Generator 21, more than 543 tubes, or 17.5 percent of all the active tubes in that steam generator, were examined. In Steam Generator 22,

(*) Note: A small number of tubes are not physically accessible. This inspection consisted of eddy current examinations to at least the first support plate.

more than 468 tubes, or 15.3 percent of all the active tubes, were examined. In Steam Generator 23, more than 500 tubes, or 16.0 percent of all the active tubes, were examined. In Steam Generator 24, more than 483 tubes, or 15.7 percent of all the active tubes, were examined.

Examination was conducted from both sides of the channel head. Tubes identified as "hot legs" were examined from the tube sheet, around the U-bend, to the uppermost support plate on the cold leg side. Tubes identified as "cold legs" were examined full length from tubesheet to tubesheet.

In each steam generator, the eddy current examination included tubes in the patch plate and peripheral "hard spot" areas, tubes in rows two and three, and a sample of tubes in the interior section of the bundle. The tubes examined in rows two and three were selected from areas of suspected higher stress concentrations near the flow slots. All the tubes in row one in all four steam generators were plugged during the unit's construction phase.

2. Flow Slot and Lower Support Plate Inspections

Using the hand holes above the tubesheet on all four steam generators, a visual and photographic examination of the flow slots in the lower tube support plates was made.

Using the "hillside" inspection ports in Steam Generators 22 and 23, a visual and photographic examination was made of the flow slots in the uppermost support plates.

3. Secondary Side Examination

A video camera was passed around the annulus between the tube bundle and the shell and down the tube lane between the hot and cold legs to search for foreign objects in all four steam generators.

4. Steam Generators Sludge Analysis

Sludge was removed from the steam generator tube sheets by lancing operations and was sampled and chemically analyzed.

C. Results of the Tube Examination

The numbers of tubes with eddy current indications and the distribution of the indications are listed in Table 5. Tubes with greater than 40% indication were plugged.

Average dent size in the tubes in each steam generator was not substantially different from that measured during previous steam generator examinations.

The numbers of tubes that did not permit passage of a 610 mil diameter probe and their distribution are listed in Table 6. The number of tubes plugged this outage, previously plugged, totals, and the current percentage plugged, are listed in Table 7.

1. Results of Flow Slot and Lower Support Plate Examinations

The photographs taken of the lower support plate flow slots indicated essentially no change in the "hour-glassing" in the flow slots in the lower support plates in all four steam generators.

During previous steam generator examinations, photographs revealed cracks in the tube support plates at some flow slots in the steam generators. The cracks are in the ligaments between the flow slot and the first row tube holes. Examination of these flow slots during the 1986 steam generator examination program indicated essentially no change in the cracks.

2. Top Support Plate Examination of Steam Generators 22 and 23

The top support plates in Steam Generators 22 and 23 were visually examined as was done in the previous examinations. Examination is accomplished by utilizing a borescope inserted through the one inch diameter (nominal) "hillside port" provided in the two steam generator shells. No "hour-glassing" of the flow slots in the top support plates was observed.

3. Results of Secondary Side Examination

Small foreign objects were observed on the secondary side of the tubesheet in the steam generators. Many of these objects were removed. A safety analysis was performed for the remaining objects which could not be moved. This analysis concluded that Indian Point 2 can safely return to power and operate with the foreign objects remaining in the steam generators until at least the next scheduled refueling outage, at which time the integrity of the steam generator tubes in the vicinity of these objects will be reassessed.

4. Sludge Analysis

Sludge was removed from each of the steam generators by lancing. Quantities of sludge removed are listed in Table 8. The chemical analysis is listed in Table 9.

5. Chemical Soak

The pH of the steam generator lay-up water was raised to 10.5, and a series of cycles of fill, soak and drain was successful in removing significant amounts of copper from each steam generator. The amounts of copper removed from each steam generator by this soak method are listed in Table 10.

D. Conclusions

The 1986 examination demonstrates that the Indian Point Unit #2 steam generators are acceptable for continued service.

Based on the results of this examination, we are scheduling our next steam generator examination during the next refueling outage which is planned for late in 1987.

The proposed schedule for the next examination is justified for the following reasons:

- Our experience with steam generator tubes has been good. Since the initial operation of Indian Point Unit No. 2, there have been only six instances of primary to secondary leakage which in all cases has been very small. One leak occurred in the first quarter of 1975. The leak was in one tube near the tubesheet in Steam Generator 22. The second leak occurred in the fourth quarter of 1976. The leak was in two tubes near the top tube support plate in Steam Generator 24. The third leak occurred in Steam Generator 22 during the second quarter of 1979. Due to its extremely small size (i.e., 0.06 gallons per day), testing did not identify the location of the leak, but the leaky tube was included in those preventively plugged. The fourth leak incident occurred in two tubes on the cold leg in Steam Generator 23 during start-up hydro-testing in April 1981, and the fifth leak occurred in another cold leg tube in Steam Generator 23 after a turbine trip. The sixth leak occurred in a tube on the hot leg in Steam Generator 22 in February 1984.

- Since 1978, our practice has been to plug tubes which did not pass a 610 mil probe. In 1980, profilometry was introduced as an added examination device, and if the maximum strain was found to be acceptable in tubes which did not pass a 610 mil probe, they were continued in serivce. No onset of increased tube degradation accompanied by tube leaks occurred when the unit was returned to service following any of the refueling/maintenance period steam generator examinations.

- During the 1984 examination, tubes in which eddy current signals indicated wall loss equal to or greater than 40%, and tubes which did not pass a 610 mil probe were plugged. No onset of increased tube degradation accompanied by tube leaks is expected to occur during future operation of IP-2.

- Should any tube leak occur, our present Technical Specifications, Section 3.1.F, requires a thorough assessment of its significance and specifies applicable limiting conditions of operation.

TABLE 1-A, HOT LEG TUBES EDDY CURRENT EXAMINED
STEAM GENERATOR NO. 21

ROW	COLUMN	NO. OF TUBES
2	2-7, 9-46, 48-84, 87-92	87
3	1, 11-20, 27-35, 43-49, 56-66, 73-76, 79-82	47
4	77, 78	2
6	51	1
7	1-5, 88, 90, 91, 92	9
8	1-5,88-92	10
9	2-5, 88, 90, 91	8
10	2-5, 89, 90, 91	8
11	2-5, 88, 89,90, 91	8
12	2-5, 51, 88, 90, 91	8
13	3-5, 88-90	6
14	3, 5, 88-90	5
15	6-8, 51, 88, 89	6
16	6-8, 89	4
17	4, 5, 89	3
18	5, 6, 51	3
21	6, 7, 15, 18, 21, 24, 27, 30, 33, 39, 42, 45, 48 51	14
27	10, 11, 51	3
28	11-17, 76-82	18
29	11-17, 76-82	18
30	12-17, 51, 76-81	13
31	15-17, 76-78	6
32	15-17, 39-54, 76-78	22
33	15-17, 39, 54, 76-78	8
34	16, 18, 39, 40, 53, 54, 76	7
35	18, 39, 40, 53, 54, 76	6
36	19, 20, 24, 25, 27-54	32
37	20, 21, 23-54	34
38	21-24, 26-54	33
39	23, 24, 39, 40, 53, 54	6
40	25-27, 39, 40, 53	6
41	27, 39, 40, 53, 54, 62-66	10
42	29-50, 53-64	34
43	32-42, 53-61	20
44	35-40, 42-58	23
45	40-54	15
	Total Number of Hot Leg Tubes	543

TABLE 1-B, COLD TUBES EDDY CURRENT EXAMINED
STEAM GENERATOR NO. 21

ROW	COLUMN	NO. OF TUBES
7	1-5, 88, 90, 91, 92	9
8	5, 88, 91, 92	4
9	5, 88	2
10	2, 3, 5, 90, 91	5
11	2, 3, 5, 89, 90, 91	6
12	90, 91	2
18	6	1
29	13	1
31	16	1
33	16, 39	2
36	24, 25, 27, 28, 29, 30, 31, 35, 36, 37, 38, 39, 42, 43, 44, 45, 48, 49, 50, 51, 52	20
37	24-27, 30, 32, 34-44, 46, 48-52	23
38	24, 26-30, 36-46, 49-52	21
39	23, 40, 53, 54	4
40	27, 39, 40, 53	4
41	27, 40, 53	3
42	32-35, 39, 40, 53, 54, 57-61, 64	14
43	32, 34, 36,37, 39, 40,56-60	11
44	35, 36, 54, 57, 58	5
45	50, 54	2
	Total Number of Cold Leg Tubes	140

TABLE 2-A, HOT LEG TUBES EDDY CURRENT EXAMINED
STEAM GENERATOR NO. 22

ROW	COLUMN	NO. OF TUBES
2	4, 6, 8, 11-13, 18, 21, 22, 24-28, 34-41, 52-57, 62-74, 76, 78, 80-92	57
3	1, 5, 12-14, 17-22, 24-26, 28-30, 33-37, 42-45, 48, 49, 57-60, 62-67, 74-83	42
4	31, 32, 61	3
6	51	1
7	90	1
8	2-5, 88, 89, 91	7
9	3-5, 51, 88, 91	6
10	2-5, 88-91	8
11	2-5, 89-91	7
12	3-5, 51, 88-91	8
13	4-6, 88-90	6
14	4-6, 90	4
15	4, 5, 51, 88, 90	5
16	5, 88, 89	3
17	5	1
18	6, 51	2
21	7, 13, 15, 18, 21, 27, 28, 30, 36, 39, 42, 45, 48, 51	14
22	8	1
23	8	1
24	9, 51	2
25	9	1
26	10	1
27	11,51, 81-83	5
28	12-18, 77-81	12
29	12-17, 77-82	12
30	13-17, 51, 78-81	10
31	15-20, 77, 78	8
32	16-18, 20, 39-54, 77,78	22
33	15-17, 19, 39-54, 77, 78	22
34	18, 19, 39, 40, 53, 54, 77	7
35	17, 18, 39, 40, 53, 54	6
36	19, 20, 39, 40, 53, 54	6
37	20, 21, 23-54	34
38	21-54	34
39	23, 24, 39, 40, 53, 54	6
40	25, 26, 27, 39, 40, 41, 53, 54	8
41	28-40, 54-66	26
42	30-32, 34-41, 53-64	23
43	33-37, 40-41, 52-61	17
44	36-39, 41-53	17
45	39-50	12
	Total Number of Hot Leg Tubes	468

TABLE 2-B, COLD LEG TUBES EDDY CURRENT EXAMINED
STEAM GENERATOR NO. 22

ROW	COLUMN	NO. OF TUBES
3	58, 59, 60, 63	4
8	2-5, 88, 89	6
9	3, 4, 5, 51, 88, 91	6
10	2-5, 88, 90, 91	7
11	2-5, 90, 91	6
12	3, 4, 5, 51, 89, 90, 91	7
13	51	1
18	51	1
21	15, 18	2
35	17	1
36	19	1
37	23-52	30
38	23-52	30
39	23, 39, 40, 53	4
40	27, 39, 40, 41, 54	5
41	29, 30, 32-40, 55, 56, 59-66	21
42	30-32, 34-41, 53, 55-64	22
43	33-35, 37, 40, 55-61	12
44	37-39, 43, 47-50	8
45	44, 47, 48, 50	4
	Total Number of Cold Leg Tubes	179

TABLE 3-A, HOT LEG TUBES EDDY CURRENT EXAMINED
STEAM GENERATOR NO. 23

ROW	COLUMN	NO. OF TUBES
2	14-17, 19-30, 33-43, 45, 48-52, 54-60, 64-80, 82, 84, 85, 87-92	66
3	1-20, 27-31, 33-35, 43-49, 58-66, 73-81	53
4	1-14	14
7	90-92	3
8	1-4, 6, 88, 89, 91, 92	9
9	2-6, 46, 88, 90, 91	9
10	2-6, 87, 90, 91	8
11	2-6, 86, 89-91	9
12	2-7, 46, 89, 90, 91	10
13	3-6, 88-90	7
14	3-6, 88-90	7
15	3-6, 46, 88-90	8
18	46	1
21	16, 19, 22, 25, 28, 31, 34, 37, 40, 43, 46	11
24	46	1
27	46	1
28	11-16, 77-82	12
29	11-13, 15-17, 77-82	12
30	12-17, 46, 77-81	12
31	15-17, 77, 78	5
32	15-17, 39-54, 77, 78	21
33	15-17, 34,39-54, 77, 78	22
34	16, 17, 39, 40, 53, 54, 77	7
35	39, 40, 53, 54	4
36	39, 40, 53, 54	4
37	23-54	32
38	23-54	32
39	33, 35, 36, 39, 40, 53, 54	7
40	31-34, 36, 37, 40, 53, 54	9
41	27-31, 33-35, 37-40, 53-66	26
42	29-36, 38-40, 53-64	23
43	32-37, 39, 40, 53-61	17
44	35-51, 53-58	23
45	39-53	15
	Total Number of Hot Leg Tubes	500

TABLE 3-B, COLD LEG TUBES EDDY CURRENT EXAMINED
STEAM GENERATOR NO. 23

ROW	COLUMN	NO. OF TUBES
8	1,2, 4, 6, 88, 89	6
9	2,3,5, 46, 88, 90, 91	7
10	2-6, 90, 91	7
11	2-6, 90, 91	7
37	23-54	32
38	23-52	30
39	35, 36, 39, 40, 53, 54	6
40	31, 32, 34, 37	4
41	27-30, 35, 38, 64, 65, 66	9
42	29, 32, 34, 35, 36, 40, 53, 57, 58,64	10
43	34-37, 40, 53, 54, 56-60	12
44	41, 43, 46, 57, 58	5
	Total Number of Cold Leg Tubes	135

TABLE 4-A, HOT LEG TUBES EDDY CURRENT EXAMINED
STEAM GENERATOR NO. 24

ROW	COLUMN	NO. OF TUBES
2	1, 3-7, 10-16, 18-24, 26-33, 43 44, 45, 47-52, 58, 60-67, 69-77, 80-81, 85, 87-92	64
3	2, 10-20, 26-31, 34-49, 54, 57-64, 66, 68, 73-84	57
7	1-5	5
8	4, 5, 88, 89, 90, 91, 92	7
9	2, 3, 5, 6, 88, 89, 90, 91	8
10	2, 3, 4, 6, 88, 89, 90, 91	8
11	2-5, 88-91	8
12	2-5, 46, 88-91	9
13	3, 4, 88-90	5
14	3, 5, 88-90	5
15	4, 5, 46, 88-90	6
18	46	1
21	13, 16, 19, 22, 25, 28, 31, 34, 37, 40, 43, 46	12
24	46	1
26	10, 12	2
27	12-17, 46	7
28	14-17, 77-82	10
29	12-17, 76-82	13
30	12, 13, 16, 17, 46, 76-81	11
31	15-17, 76-78	6
32	15-19, 39-54, 76-78	24
33	15-17, 20, 39-54, 76-78	23
34	16, 19, 39, 40, 53, 54, 76, 77	8
35	19, 39, 40, 53, 54, 75, 76	7
36	23, 24, 39, 40, 52-54	7
37	23-54	32
38	23-54	32
39	39, 40, 52, 53, 54	5
40	39, 40, 52, 54, 60	5
41	27-40, 52, 53, 54, 56-59, 61-64, 66	26
42	29-40, 53-60, 62-63	22
43	32-37, 39-40, 53-61	17
44	35, 39-46, 48-52, 57, 58	16
45	41-53	13
	Total Number of Hot Leg Tubes	483

TABLE 4-B, COLD LEG TUBES EDDY CURRENT EXAMINED
STEAM GENERATOR NO. 24

ROW	COLUMN	NO. OF TUBES
7	3-5	3
8	4, 5, 88, 89, 91	5
9	2, 3, 88, 90, 91	5
10	2,3, 4, 88, 90, 91	6
11	2, 3, 4, 89, 90, 91	6
12	2-5, 46, 88-91	9
36	24, 27-34	9
37	26-30, 33, 34, 37-51	22
38	25-28, 30, 31, 38, 40, 42-51	18
39	39, 40, 52, 53, 54	5
40	39, 54	2
41	35, 40, 52-54, 56-58	8
42	29, 30, 34-36, 39, 40, 53-58, 60, 62, 63	16
43	32-37, 39, 53, 54, 56-60	14
44	35, 40, 42-6, 48, 57, 58	10
45	46, 48	2
	Total Number of Cold Leg Tubes	141

Table 5
Distribution of Eddy Current Indications
(Percent Wall Thinning)

S/G	Leg	20-29%	30-39%	40-49%	50-59%	60-69%	>70%
21	hot	0	0	0	0	0	0
	cold	12	20	9	7	2	0
22	hot	3	6	8	1	0	0
	cold	25	25	12	8	6	3
23	hot	2	3	0	0	0	0
	cold	0	4	0	1	1	1
24	hot	2	1	0	0	0	0
	cold	6	16	12	3	2	0

Table 6
Distribution of Constricted Tubes

S.G. 21	10
S.G. 22	8
S.G. 23	10
S.G. 24	5

Table 7
Plugged Tubes

SG	Plugged in 1986	Previously Plugged	Total	Percent
21	28	149	177	5.4
22	49	200	249	7.6
23	13	136	149	4.6
24	22	179	201	6.2

Table 8
Sludge Removed in 1986

S.G. 21	38 lbs.
S.G. 22	108 lbs.
S.G. 23	75 lbs.
S.G. 24	98 lbs.

Table 9

Iron, as Magnetic Iron Oxide	51.5
Copper, as Elemental Copper	26.2
Zinc, as Zinc Oxide	4.2
Nickel, as Nickel Oxide	1.7
Aluminum, as Aluminum Oxide	0.8
Potassium, as Potassium Oxide	0.6
Carbon	0.2
Calcium, as Calcium Oxide	0.1

Table 10
Copper Removed in 1986

S.G. 21	5 lbs.
S.G. 22	5 lbs.
S.G. 23	9 lbs.
S.G. 24	7 lbs.

DISTRIBUTION
Docket File w/o encl.
PAD-3 Rdg. w/o encl.
C. Vogan w/o encl.
M. Slosson w/o encl.

April 16, 1986

DOCKET NO(S). 50-247
Mr. John D. O'Toole - Vice President
Nuclear Engineering and Quality
Assurance
Consolidated Edison Company of New York, Inc.
4 Irving Place
New York, New York 10003
SUBJECT: INDIAN POINT 2

The following documents concerning our review of the subject facility are transmitted for your information.

☐ Notice of Receipt of Application, dated _____.

☐ Draft/Final Environmental Statment, dated _____.

☐ Notice of Availability of Draft/Final Environmental Statement, dated _____.

☐ Safety Evaluation Report, or Supplement No. _____, dated _____.

☐ Notice of Hearing on Application for Construction Permit, dated _____.

☐ Notice of Consideration of Issuance of Facility Operating License, dated _____.

☐ Monthly Notice; Applications and Amendments to Operating Licenses Involving no Significant Hazards Considerations, dated _____.

☐ Application and Safety Analysis Report, Volume _____.

☐ Amendment No. _____ to Application/SAR dated _____.

☐ Construction Permit No. CPPR- _____, Amendment No. _____ dated _____.

☐ Facility Operating License No. _____, Amendment No. _____, dated _____.

☐ Order Extending Construction Completion Date, dated _____.

☐ Other *(Specify)* Bi-weekly Notice covering period April 9, 1986. Expiration date for hearing requests and comments May 9, 1986.

Division of PWR Licensing-A
Office of Nuclear Reactor Regulation

Enclosures:
As stated

cc:

OFFICE	PAD-3						
SURNAME	C. Vogan:bs						
DATE	04/17/84						

NRC FORM 318 (1/84) NRCM 0240