John D. O'Toole
Vice President

Background

Consolidated Edison Company of New York, Inc.
4 Irving Place, New York, NY 10003
Telephone (212) 460-2533

September 20, 1984

Re: Indian Point Unit No. 2
Docket No. 50-247

Director of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

ATTN: Mr. Steven A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing

Dear Mr. Varga:

As required by Indian Point Unit No. 2 Technical Specification 4.13, we conducted a steam generator inspection program during our current Refueling/Maintenance outage now nearing completion. Attachment 1 to this letter sets forth the results of that program. We are providing this report to you in advance of the time specified in the Technical Specification in order to facilitate your review.

Early in our 1984 steam generator inspection program, a decision was made to inspect essentially 100% of the tubes of all four steam generators. This decision was reached by management based upon the type of indication encountered early in the program, and was made independent of the statistical context of Table 4.13-1 of our Technical Specifications. The sequencing and timing of the inspections was established in order to minimize the impact on other outage activities.

As a result of our extensive inspections, we are confident that we have made a complete and thorough assessment of the present condition of the steam generators including data as to the magnitude and specific locations of existing indications. A total of 116 steam generator tubes were identified in all four steam generators with indications greater than 20%. Of these, 84 have been plugged because the indications were greater than 40%. The remaining 32 steam generator tubes with indications between 20% and 40% have been retained in service in accordance with the plugging criteria in our Technical Specifications (Section 4.13.B.1).

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Rec'd for NRC Docketing
6/14/85

The 84 tubes that have been plugged because of indications in excess of 40% constitute less than 0.7% of the total number of active tubes. This is less than the 1% criterion described in Table 4.13-1 of the Technical Specifications. Thus the results of the overall inspection program for all four steam generators indicate that they should be categorized as C-2, prior to plugging.

The steam generator with the most indications was No. 21, which had 38 tubes with indications in excess of 40%. This comprises about 1.2% of the active tubes in Steam Generator No. 21, and results in a C-3 categorization, prior to plugging. Steam Generator No. 21 is the only steam generator which may be characterized as category C-3 in light of the complete inspection results.

Due to the plugging of 84 tubes with significant indications, each of the four steam generators will have been returned to category C-1 in preparation for the start of the next operating cycle.

In summary, we have plugged 84 tubes representing more than 70% of the tubes which have reportable indications. We have inspected essentially 100% of the tubes of all four steam generators. The 32 degraded tubes remaining in service comprise less than 0.3% of the tubes remaining in service, which is substantially less than the 5% criterion for degraded tubes in Category C-1 as described in Table 4.13-1 of our Technical Specifications. The overall results of our inspection program indicate that unit operation for another full cycle is prudent and justified.

Tube denting also continues to receive attention in our steam generator inspection program. An additional 84 tubes were plugged in all four steam generators due to denting. Total tubes plugged in all four steam generators to date is 5.1%. This compares with an already docketed analysis which demonstrates the acceptability of operation with up to 12% of the tubes plugged. The steam generator with the most tubes plugged to date is No. 22 which now has 6.1% of its tubes plugged (still much less than the 12% acceptable plugging).

This report is being submitted to also fulfill the steam generator reporting requirements of our Technical Specifications (Section 4.13.C.2). We request your staff's review and concurrence by October 1st in order not to delay the anticipated restart from the current refueling outage.

Should you or your staff have any questions, please contact us.

Very truly yours,

John D. O'Toole

John D. O'Toole
Vice President

cc: Senior Resident Inspector
U. S. Nuclear Regulatory Commission
P. O. Box 38
Buchanan, New York 10511

ATTACHMENT 1

Steam Generator Examination Program and Results 1984 Refueling and Maintenance Outage

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

September 1984

Indian Point
Unit No. 2

Steam Generator Examination Program and Results
1984 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 April 10, 1984, the details of the steam generator examination program planned for the unit's sixth refueling outage were submitted.

NRC approval of the program was received in a letter from Mr. Varga dated May 30, 1984.

During the course of the actual examination, descisions were made independently by Con Edison management to increase the scope of the eddy current examination, and to modify the extent of other examinations. The NRC staff was informed orally of these changes, and their concurrence was obtained.

The scope, results and conclusions of the steam generator examination program, as conducted during the sixth refueling outage, follow:

B. Scope of the Examination

1. Eddy Current Examination

Essentially 100% of the tubes in the hot and cold legs of Steam Generators 22 and 24 received eddy current examination for both dents and defects. Approximately 18% of the tubes in the hot and cold legs of Steam Generators 21 and 23 received eddy current examination for both dents and defects, and 100% of the tubes were examined for defects in the region between the tubesheet and the lowest support plate. The eddy current examination to quantify tube dents was performed nominally at 400KHz and at a reduced gain. The eddy current examination for tube defects was performed using multi-frequencies of 600 KHz, 200 KHz and 100 KHz. In addition, eddy current examination of selected tubes was conducted at 400 KHz absolute for wall thinning in the crevice between the tubes and the tubesheet.

A 740 mil eddy current probe was used to perform the eddy current examination of the tubes in the region between the tubesheet and the lowest support plate. A standard 700 mil eddy current probe was used to perform the eddy current examination of the tubes examined for full length.

If any tube did not permit passage of this standard 700 mil probe, the tube was eddy current examined with a 610 mil probe. In addition, the tubes immediately adjacent to any tube that did not pass the 610 mil probe were also subjected to eddy current examination.

Tubes in which eddy current indicated wall loss equal to or greater than 40% were identified as candidates for plugging.

2. Profilometry Examination

Whenever practicable, tubes that did not pass the 610 mil probe were examined by electro-mechanical profilometry (profil-360), and strain was also calculated. Tubes that did not pass the 610 mil probe were identified as candidates for plugging unless profilometry demonstrated that strain was acceptably low ($\leq$25%).

3. Flow Slot and Lower Support Plate Examinations

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

Using the "hillside" inspection ports in steam generators 22 and 23, the flow slots in the top support plate were visually examined via borescope.

4. Secondary Side Examination

In each steam generator, a fiberscope was passed around the annulus between the tube bundle and the shell to search for foreign objects. In steam generator 23, the J-tubes and the weld between the steam drum and the transition section were reexamined.

5. Sludge Lancing and Analysis

The sludge that was removed from the steam generator tubesheets during two separate lancing operations was weighed, sampled and chemically analyzed.

C. Results of the Examination

1. Results of Eddy Current and Profilometry Examination

Average dent size in the tubes in each steam generator was not substantially different from that measured during previous steam generator examinations. Average dent sizes for each steam generator are shown in Table 1 with comparison data for previous examinations. While the dent measurements are in a random pattern, the magnitudes of the measurements are comparable and do not show significant increase or obvious trend.

The numbers of tubes eddy current examined are listed in Table 2. The numbers of tubes with indications and the distribution of the indications are listed in Table 3.

The numbers of tubes that were plugged as a result of the findings of the eddy current and the profilometry examinations are listed in Table 4. Also listed are the numbers previously plugged, totals, and the current percentage plugged.

The location of tubes plugged in each steam generator bundle are shown in sketches attached.

2. Results of Flow Slot and Lower Support Plate Examinations

The photographs taken of the lower support plate flow slots during the previous examinations indicated that some "hour-glassing" was apparent in the lower flow slots in all four steam generators.

During the 1984 steam generator examination, the flow slots in the lower support plates in all four steam generators were again visually examined and photographed using the hand holes above the tube-sheets. Analysis of the examination results indicates that "hour-glassing" appears to have increased slightly. In Table 5, current average flow slot reduction is tabulated for each steam generator with comparison data for the previous steam generator examinations. The maximum total flow slot reduction observed during the 1984 examination was approximately 2 1/2 inches in Steam Generator 22.

During previous steam generator examinations, photographs revealed cracks in 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 1984 steam generator examination program indicated that the cracks appear to have opened slightly, and additional cracks were observed. Table 6 is a listing of all known flow slot cracks.

The integrity of the tubes adjacent to the observed cracks is not compromised because:

- All row 1 tubes in the four steam generators were plugged during the construction phase when modifications were made to the channel head divider plates. Therefore, all tubes immediately adjacent to the cracks are plugged.

- Flow-induced vibration effects in the steam generators are significant where there is crossflow of the boiler water, as in the region between the tubesheet and the first tube support plate, and in the region above the top tube support plate. In the vicinity of the support plate cracks that were observed, the boiler water flow is essentially parallel to the tube axis. The vibration effects, are therefore, minimal.

- A conservative Westinghouse analysis, forwarded with a Turkey Point Unit #4 (NRC Docket #50-251) submittal dated June 9, 1977 and identified as FPL-77-173, Appendix 3C1, indicates that flow induced vibration and wear only when three or more support plates are missing. This is not the case at Indian Point Unit #2.

3. 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.

4. Results of Secondary Side Examination

The J-tubes and the drum/transition weld were found to be satisfactory. Sludge was observed in all the steam generators. Small foreign objects were observed on the secondary side in all steam generators. Most of these objects were removed. The remaining objects appeared to have been in the steam generators for some time, possibly from the time of final assembly and with one exception, could not be moved. Slight vertical movement of the one object was possible. Stablizing plugs were installed in the tubes adjacent to the object as a precautionary measure. These objects will be reexamined during the next scheduled steam generator examination.

5. Sludge Analysis

Sludge was removed from each of the steam generators by lancing twice. Quantities of sludge removed are listed in Table 7. Chemical analyses are listed in Table 8.

6. Chemical Soak

Eddy current examination of the steam generator tubes indicated the presence of metallic copper on the tubes. 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 to date are listed in Table 9. These fill, soak and drain cycles will continue until the unit is brought above cold shut down.

D. Conclusions

The 1984 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 currently planned for early in 1986.

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

- 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 service. 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 examirations.

- 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 (except those in which profilometry

indicated that the maximum strain was acceptable) were plugged. The risk of onset of increased tube degradation accompanied by tube leaks is considered to be acceptably low during the next cycle of operation of the unit.

- Should any tube leak occur, our present Technical Specifications, Section 3.1F, require a thorough assessment of its significance. The reactor must be brought to a cold shutdown condition within 24 hours if leakage in any steam generator exceeds 0.3 gpm, or if the leakage frequency is two or more tubes within a period of 20 days. Under these circumstances, NRC approval to resume reactor operation must be obtained and Con Edison must inform the NRC before any tube is plugged or repaired.

Table 1
Average Dent Sizes (mils)

	1984	1982	1980	1979
S.G. 21	3.5	3.3	3.5	3.1
S.G 22	2.0	2.9	2.4	2.4
S.G. 23	3.5	3.1	3.1	2.7
S.G. 24	2.7	2.9	2.7	2.3

Table 2
Number of Tubes Eddy Current Examined

Extent of Examination	S/G 21		S/G 22		S/G 23		S/G 24	
	Hot Leg	Cold Leg	Hot Leg	Cold Leg	Hot Leg	Cold Leg	Hot Leg	Cold Leg
Full Length	146	0	0	2981	136	0	146	2594
Tube sheet to Around U-bend	430	0	165	0	411	5	486	4
Tube sheet to Top Support Plate	0	0	8	137	10	0	41	383
Tube sheet to Lowest Support Plate	2581	3159	320	2	2578	3130	343	143
Total Examined	3157	3159	493	3120	3135	3135	1016	3124
Total Active Tubes	3159		3127		3135		3125	

Table 3
Distribution of Tubes with Eddy Current Indications

S/G	Leg	20-29%	30-39%	40-49%	50-59%	60-69%	70-79%	80-89%	<90%
21	Hot	0	1	0	0	2	1	0	0
	Cold	1	3	8	17	8	2	0	0
22	Hot	1	4	0	1	2	0	0	1
	Cold	2	8	7	8	4	4	2	1
23	Hot	0	1	0	0	0	0	0	0
	Cold	0	0	0	1	0	1	0	0
24	Hot	1	0	0	0	2	0	0	0
	Cold	4	6	5	3	3	0	1	0

Table 4
Tubes Plugged

	S/G 21	S/G 22	S/G 23	S/G 24
Plugged because of Indications	38	29	2	15
Plugged because of Restrictions	10	38	9	27
Total Plugged 1984	48	67	11	42
Total Previously Plugged	101	133	125	137
Total Plugged at End of Outage	149	200	136	179
% Plugged at End of Outage	4.6%	6.1%	4.2%	5.5%

Table 5
Average Flow Slot Closure (Inches)

	1984	1982	1980	1979
S.G.21	0.77	0.54	0.70	0.65
S.G 22	1.04	0.90	0.72	0.57
s.G 23	0.93	0.78	1.01	0.78
S.G.24	0.67	0.44	0.61	0.47

Table 6
Support Plate Flow Slot Cracks

S.G. 21	S.P.3, Flow Slot M3
S.G. 22	S.P.1, Flow slots N1, N2, N3, M3
S.G. 23	S.P.1, Flow slot N1, N2, N3 S.P.2, Flow slot N2, N3, M3 S.P.3, Flow slot N2, M2 S.P.4, Flow slot N2
S.G 24	S.P.2, Flow slot N1, N2, N3, M1, M3

Table 7
Total Sludge Removal

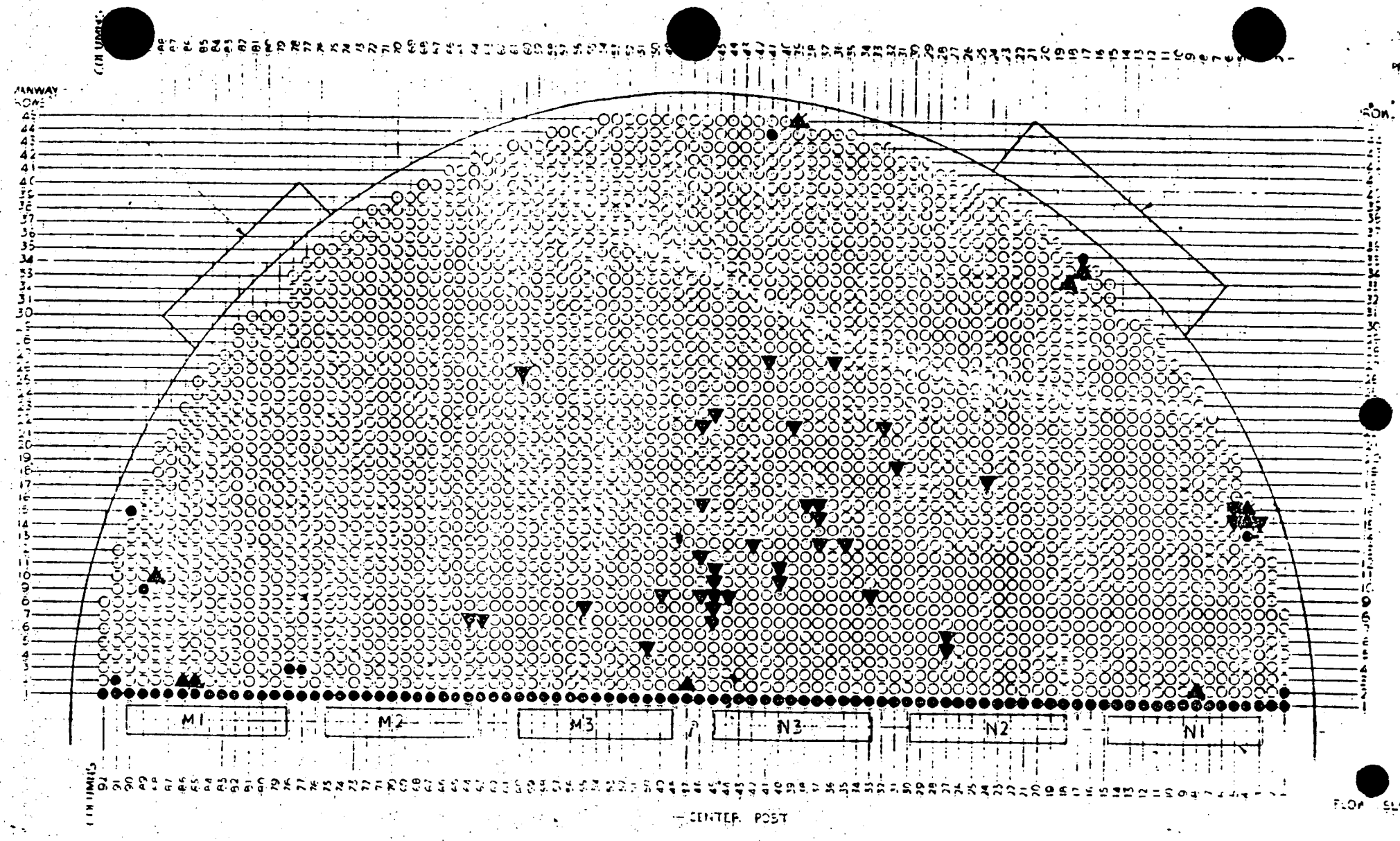
S/G 21	363 lbs.
S/G 22	543 lbs.
S/G 23	217 lbs.
S/G 24	270 lbs.

Table 8
Sludge Analysis

Metals, %	21 S/G	22 S/G	23 S/G	24 S/G
Ni	1.40	1.66	1.18	1.05
NiO	1.85	2.18	1.78	1.79
Zn	3.48	3.79	3.31	3.14
ZnO	4.33	4.72	4.12	3.91
Fe	51.52	45.21	43.86	43.97
Fe O	74.16	64.65	62.72	62.88
Cu	8.43	7.53	10.88	10.31
B	0.05	0.04	<0.01	<0.01
Ca	0.26	0.18	0.11	0.36
CaO	0.36	0.25	0.15	0.50
Mg	0.08	0.05	0.06	0.09
MgO	0.13	0.08	0.10	0.15
K	<0.01	<0.01	<0.01	<0.01
Cr	0.40	0.44	0.24	0.18
Cr O	0.92	1.14	0.80	0.74
Na	0.05	0.06	0.02	0.04
Na O	0.08	0.10	0.03	0.07
SiO	0.62	0.32	0.47	1.16

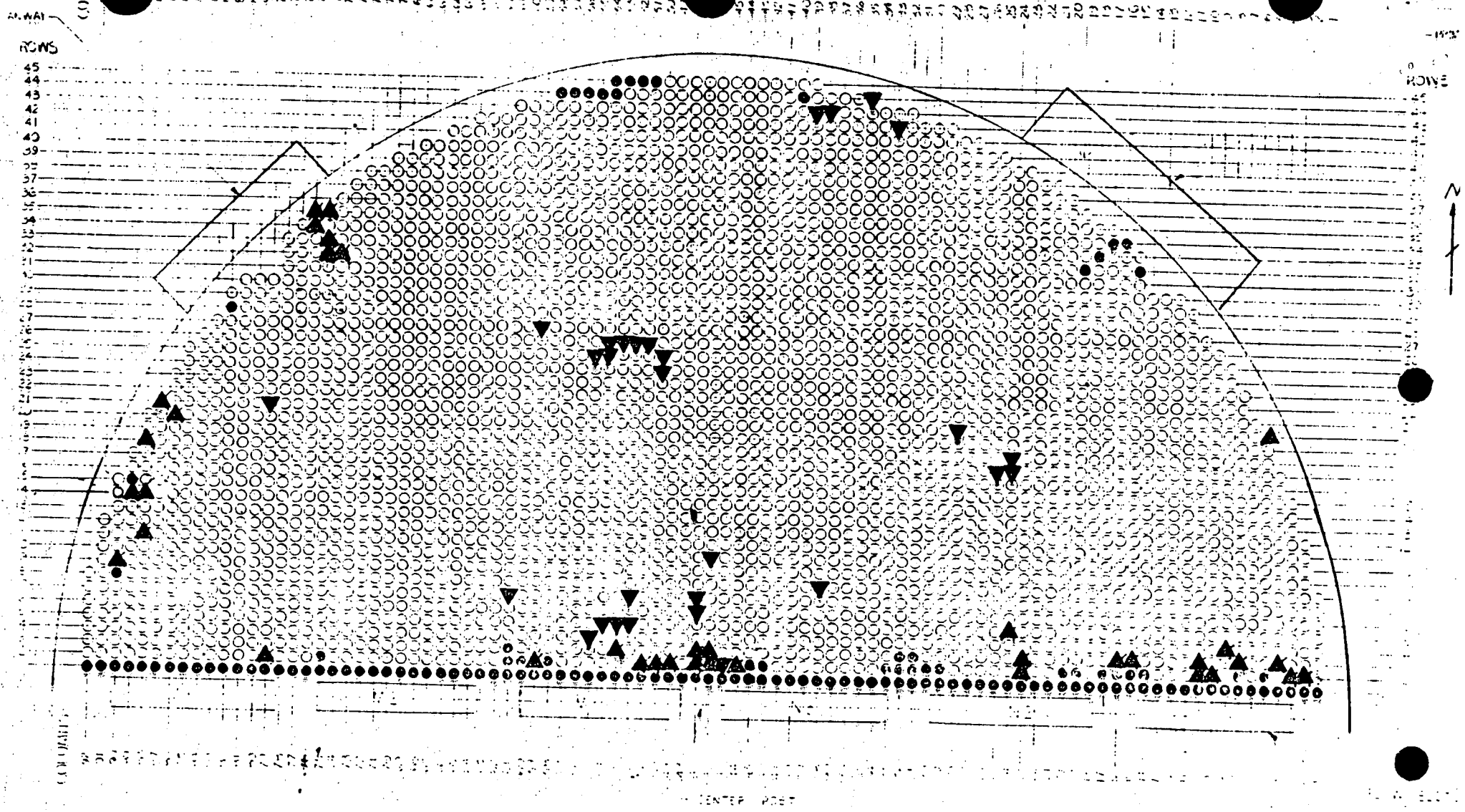
Table 9
Copper Removal by Chemical Soak
(as of 9/10/84)

S/G 21	35 lbs.
S/G 22	38 lbs.
S/G 23	26 lbs.
S/G 24	24 lbs.



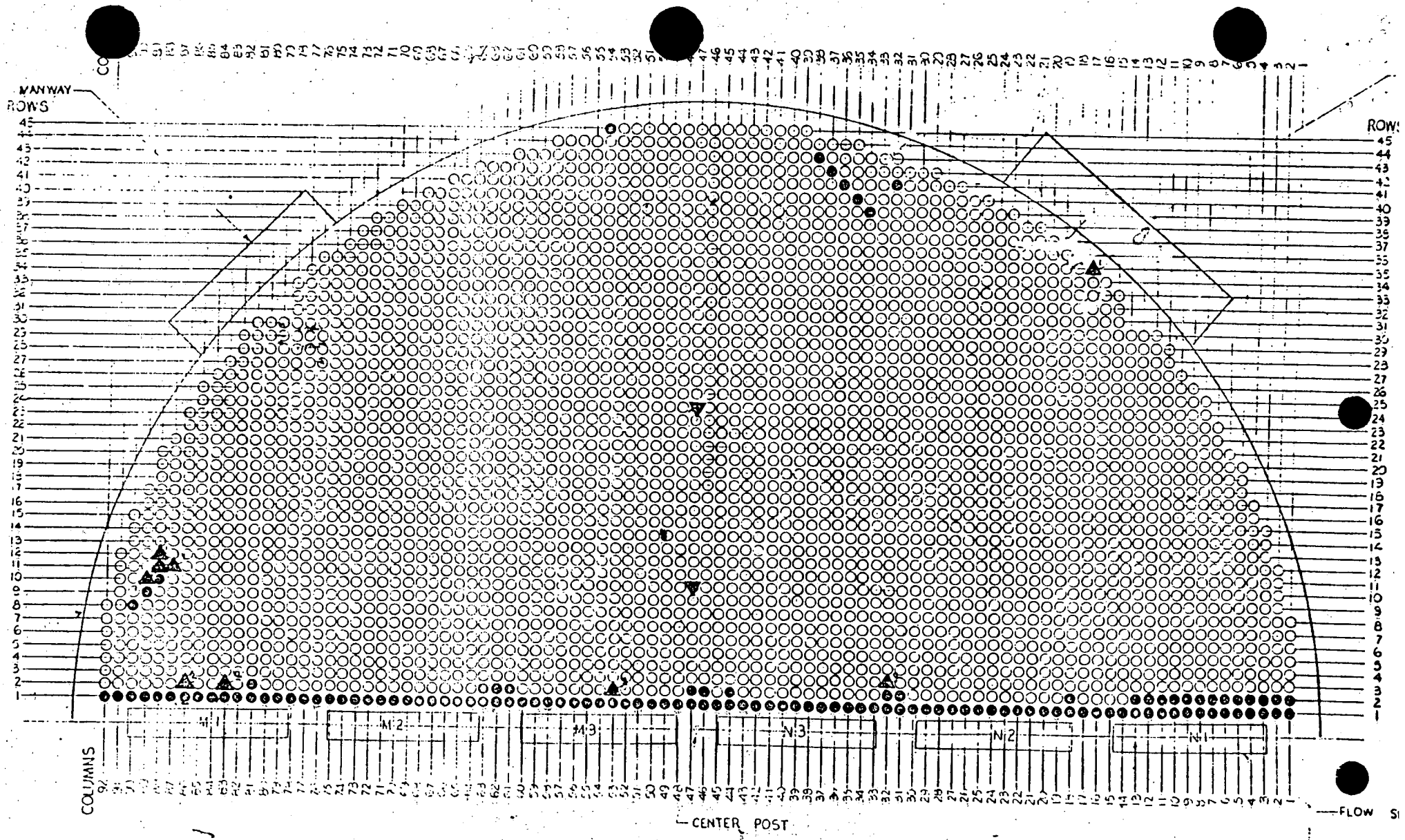
*21 STEAM GENERATOR TUBE IDENTIFICATION LAYOUT

- o UNPLUGGED TUBE
- ● PREVIOUSLY PLUGGED TUBE
- ▲ TUBE PLUGGED IN 1984 DUE TO RESTRICTION
- ▼ TUBE PLUGGED IN 1984 DUE TO EDDY CURRENT INDICATION



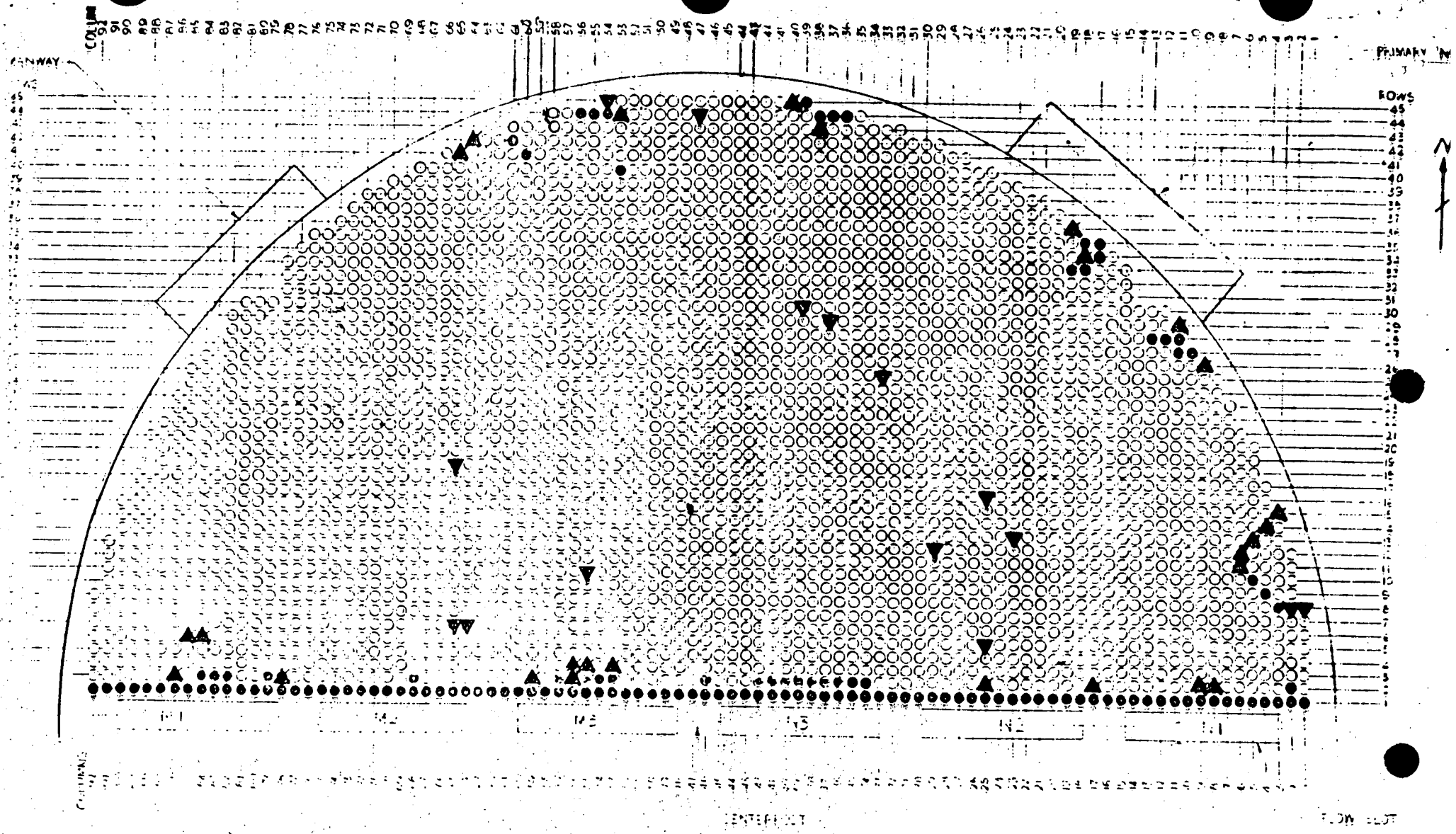
#22 STEAM GENERATOR TUBE IDENTIFICATION LAYOUT

- o UNPLUGGED TUBE
- ● PREVIOUSLY PLUGGED TUBE
- ▲ TUBE PLUGGED IN 1984 DUE TO RESTRICTION
- ▼ TUBE PLUGGED IN 1984 DUE TO EDDY CURRENT INDICATION



#23 STEAM GENERATOR TUBE IDENTIFICATION LAYOUT

- o UNPLUGGED TUBE
- ● PREVIOUSLY PLUGGED TUBE
- △ TUBE PLUGGED IN 1984 DUE TO RESTRICTION
- ▽ TUBE PLUGGED IN 1984 DUE TO EDDY CURRENT INDICATION



#2 STEAM GENERATOR TUBE IDENTIFICATION LAYOUT

- o UNPLUGGED TUBE
- ● PREVIOUSLY PLUGGED TUBE
- ▲ TUBE PLUGGED IN 1984 DUE TO RESTRICTION
- ▼ TUBE PLUGGED IN 1984 DUE TO EDDY CURRENT INDICATION