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UHRIG,R.E. Florida Power & Light Co.
RECIP.NAME RECIPIENT AFFILIATION
EISENHUT,D.G. Division of Operating Reactors

SUBJECT: Forwards results of facility steam generator insps & discusses insp criteria & results. Approval to return facilty to power operation requested. Util will be ready to resume power operation by 800126. Class III fee encl.

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P.O. BOX 529100, MIAMI, FL 33152

FLORIDA POWER & LIGHT COMPANY

January 10, 1980
L-80-8

Office of Nuclear Reactor Regulation
Attention: Mr. Darrell G. Eisenhut, Acting Director
Division of Operating Reactors
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Eisenhut:

Re: Turkey Point Unit 3
Docket No. 50-250
Steam Generator Inspections

The results of the Turkey Point Unit 3 steam generator inspections conducted during the current refueling outage are attached. The inspections, which were performed in accordance with Turkey Point Unit 3 operating license DPR-31, showed no new phenomena and verified that the general pattern of denting in Unit 3 is within predictable limits and consistent with previous inspections of the Turkey Point Units.

The general criteria applied for steam generator inspections and preventive plugging are the same as previously applied to Turkey Point Units 3 and 4, with an additional plugging criterion included to provide more conservatism. The additional plugging criterion leads to the plugging of additional tubes in order to provide for an operating period in excess of 10 months. This approach provides reasonable assurance of steam generator tube integrity such that safe operation of the unit during normal full power operation or during hypothetical accident conditions is assured for an operating period in excess of 10 effective full power months.

Total steam generator tube plugging at the conclusion of the current outage will be approximately 19.3%. This is conservatively bounded by the 25% tube plugging ECCS analysis which has been previously submitted.

The results of this inspection and the preventive tube plugging program have been reviewed by the Turkey Point Plant Nuclear Safety Committee and the Florida Power & Light Company Nuclear Review Board. They have concluded, based on the inspection results, the implemented plugging pattern, and previously submitted analyses, that the return of Turkey Point Unit 3 to full power operation for at least 10 effective full power months does not involve an unreviewed safety question.

A001
S 3/3

w/check
$ 4,000

8001170340

In accordance with condition E4 of operating license DPR-31, Florida Power & Light Company requests NRC approval to return Unit 3 to power operation. Based on our current schedule, we will be ready to resume power operation by January 26, 1980.

We have determined that this submittal involves a Class III fee in accordance with 10 CFR 170. Accordingly, a check for $4,000 is enclosed.

Very truly yours,

J. A. de Mastay
for

Robert E. Uhrig
Vice President
Advanced Systems & Technology

REU/MAS/RJA/ah

Enclosures

cc: Mr. James P. O'Reilly, Region II
Harold F. Reis, Esquire

Turkey Point 3 Steam Generator

Inspection Program

I. Introduction

An extensive inspection program for the Turkey Point Unit 3 steam generators was conducted in December, 1979. The following items were accomplished:

1. gauging of steam generator hot legs and cold legs - all steam generators
2. measurements of visible flow slots in all steam generators
3. eddy current inspection of small radius U-bends in steam generator B
4. Regulatory Guide 1.83 eddy current measurements in the hot legs and cold legs of all steam generators
5. preventive plugging

Table 1 is a summary of the approximate number of steam generator tubes inspected in each category and in each steam generator.

Table 1: Summary of Total Steam Generator Tubes Inspected

	A Hot Leg	A Cold Leg	B Hot Leg	B Cold Leg	C Hot Leg	C Cold Leg
Gauging	1188	248	1074	176	1134	209
U-Bend Rows 2-5	-	-	-	98	-	-
R.G. 1.83	143	67	149	163	149	481

This report summarizes the inspections conducted, the results of these inspections, and preventive plugging programs accomplished.

II. Inspection Programs

A. Gauging Program

The tube gauging program in the tubelane area is based on previously defined regions where significant tube deformation has occurred. These regions are also determined using finite element analysis techniques which yield tube hoop strain contours as a function of plate deformation. The boundary in the peripheral tubelane areas near the three and nine o'clock wedge locations is modified in the analysis to take into account the greater extent of deformation in this region of the plate determined by previous experience. Initially, a 12.5% strain boundary was used in the gauging program when little plant specific data was available. After two initial inspections and three reinspections of the Turkey Point Plants; review of specific information indicated the conservatism of the 12.5% boundary. Consequently, a 15% boundary was adopted and used in the gauging program during the last inspection. With the addition of the information gained from that inspection (now totaling four reinspections), it is apparent that the 15% boundary is also overly conservative and the 17.5% boundary should be used. That is, the majority of the tubes inspected do not restrict the .650 inch probe. In addition, all tubes restricting the .610 inch or .540 inch probe have all fallen well within the inspection boundary. This is significant since the .610 inch and .540 inch restricted tubes form the basis for the plugging patterns in the tubelane region.

Since full closure of the flowslots was observed in Turkey Point 3 steam generators during the December 1977 inspection, Turkey Point 3 is regarded as beyond full closure by approximately 15.5 EFPM's. The tube hoop strain contours estimated for 15.5 EFPM's beyond full closure were utilized to determine the 17.5% boundary for the inspection in the tubelane region. Additional inspection

programs were defined for the periphery, wedge, and patch plate regions. These programs were based on previous tube leakage histories at the Turkey Point and Surry plant sites, as well as previous gauging results at the Surry and Turkey Point sites, as deemed appropriate. Due to the current awareness of the potential for tube deformation on the cold leg side, inspections of all three steam generator cold legs were performed.

The inspection boundary for the January 1979 inspection (Figure 1) is included for reference. The gauging inspection boundaries for the December 1979 inspection are indicated in Figure 2 (typical hot leg) and Figure 3 (typical cold leg).

It should be noted that the cold legs and certain peripheral wedge areas in the hot legs were inspected for the first time in January 1979.

The following additional conservatisms were utilized in determining the Turkey Point 3 inspection boundary:

1. In the tubelane area it is estimated by analysis that the 17.5% strain boundary at 15.5 EFPM beyond full closure extends to approximately the 6th row. The inspection boundary for this inspection extended to the 10th row.

2. If a restricted tube was found close to the inspection boundary, the inspection was expanded in that area.

3. In addition to the specific gauging inspection program, it should be noted that the central portion of the tube bundles from row 14 upward were tested with 700 mil probes, providing early indications on any new deformation which might exist away from the regions usually regarded as active, i.e. the tubelane, patch plate, wedges, and periphery.

4. Tubes restricted in previous inspections, but not adjacent to the areas of predominant activity, were retested if not part of the gauging program laid out generally for the three steam generators.

B. Flow Slot Measurements

Photographs were taken in each steam generator through the secondary handholes. These photographs were then utilized to measure the openings in the visible flow slots. Results are discussed in Section III. Flow slot measurements are utilized in the finite element analysis work and are an indicator of the present status of denting in the steam generators.

C. Other Denting Related Inspections

The U-bends of unplugged tubes in rows 2 thru 5 in steam generator B were examined with 100 KHZ. These inspections are performed to confirm the integrity of the small radius U-bends in low number rows.

D. Regulatory Guide 1.83 (R.G. 1.83) Inspection

The types and extent of inspections required in this area are specified in R.G. 1.83. Typical inspection plans are included (Figures 4 and 5). During the inspections, expansion of the program in steam generators B and C was accomplished as required by R.G. 1.83. Results of the inspection are discussed later in this report (as available).

III. Inspection Results

A. Gauging Programs

Results of the gauging inspections are indicated in Figures 6, 7, 8, 9, 10, and 11 and are summarized in Table 2.

Table 2: Tube Restriction Summary

SG/ Gauge Diameter	Number of Tubes Restricting Passage of Gauge				
	Tubelane		Periphery and Wedge		Patch Plate
	Hot Leg	Cold Leg	Hot Leg	Cold Leg	Hot Leg
SG A					
.650"	31	0	43	0	35
.610"	5	0	3	1	0
.540"	0	0	1	0	0
SG B					
.650"	8	0	19	0	1
.610"	3	1	4	2	0
.540"	0	0	1	0	0
SG C					
.650"	22	0	15	0	2
.610"	5	0	2	0	0
.540"	0	0	2	0	0

Summary comments resulting from the review of this and other data are as follows:

1. Tubes in the tubelane region that restrict the 0.650 inch probe or less lie within the 17.5% strain boundary.

2. There were no tubes in the tubelane region restricting a 0.540" probe (hot leg and cold leg).

3. In steam generators A, B, and C, restricted tubes generally developed adjacent to previous activity or clustered together with other new activity. This was particularly true of tubes that restricted the 0.610" and 0.540" probes. Areas of activity were consistent with past historical data for this and other plants. Areas of note were rows 1-15 and 77-92 near the flow slots which finite element analysis predicts should progress much more rapidly than other flow slot areas. The wedge and tubelane interaction is apparently causing the finite element analysis to over predict this reaction since the activity in this area is consistent with the remainder of the tubelane flow slots. In this and in future inspections, this area will be plugged under the same criteria as the rest of the tubelane area.

4. Tube restrictions were noted in some of the inspected wedge areas (in only the hot legs) of all steam generators and this activity appears consistent with previous experience at this and other units.

5. In this inspection of the cold leg areas, only one tube restriction was noted in the tubelane region (SGB). No activity was noted in the three cold leg wedge areas inspected. However, slight activity was noted adjacent to the inspected wedge area in SGB. The level of activity is consistent with that noted previously in the Turkey Point Unit #4 inspection. The overall level of activity continues to indicate a very low growth rate as compared to the hot leg.

6. During the last 6 EFPM of operations, no leakage events occurred.

7. Review of the gauging results for this six month period shows that 75 tubes were reported restricted in the tubelane region; this compares with 214 observed in January, 1979 after 9.5 EFPM. The apparent reduction in the number of restrictions reflects the fact that plugging in February, 1979 was

performed for a 10 month operating period, but only six months of operation actually ensued. Therefore, it appears that the plugging criteria adopted for 10 months operation back in February, 1979 were conservative.

B. Flow Slot Measurements

The results of the flow slot measurements are provided by Fig 12.

C. Other Denting Related Inspections

The U-bends of unplugged tubes in rows 2 thru 5 in steam generator B were examined at 100 KHZ. No indications were noted in these small radius U-bends.

D. Regulatory Guide 1.83 Inspection Results and Evaluation

The regulatory Guide 1.83 inspection results indicate no significant progression of thinning. A total of only seven tubes were plugged based on a 40% wall thinning criterion. The majority of the tubes plugged because of thinning exceeded the 40% criterion by a very small amount (within the tolerance of the Eddy Current method), and the actual thinning of those tubes may have been less than 40%.

IV. Plugging Criteria

A. Gauging Program

The progression of strain contours over the intended operating period is utilized as the basis for preventive plugging of tubes in the tubeland region which are located in rows beyond 0.540" restricted tubes. In earlier inspections the closeness of the strain contour lines prevented identification of the appropriate contour which most reasonably indicated the extent and progression of tubes with greatest deformation. Initially, the 15% strain contour was chosen when limited plant specific data was available and the strain contour lines indicated by finite element analysis fell close together on the plots. A review of the relationship between the most restricted tubes at Turkey Point Units 3 and 4 and the finite element analysis strain contours indicates that the 17.5% strain contour more realistically estimates the boundary of these restricted tubes.

The growth of this contour was evaluated and conservative rate of growth for a ten month operating period was determined; that is, three rows should be plugged over most of the tubelane and up to six rows at the outside columns. Again, it should be pointed out that there have been numerous cases of tubes restricting the 0.540 inch probe for some time and not leaking. In any case the absence of any 0.540 inch restrictions in the tubelane region negates the application of this criterion.

The criterion established for plugging tubes in the region of the patch-plate differs from that used for other regions of the bundle. All leaks in the patchplate region have occurred at the perimeter of the plate or near to the patchplate boundary, where plug welds connect the patchplate to the main body of the tube support plate. All observed data indicate that the phenomenon at the patch plate is local in nature and is not consistent with

the general strained state of the plate, nor can the phenomenon be represented by the finite element model. Due to these factors, the region of the patchplate is inspected and a specific set of plugging criteria applied. Because of the fact that leakers in this region have not always restricted 0.540 inch probes, leakers and tubes that restrict the 0.540 inch probe should be treated alike, and the surrounding tubes about both should be plugged. In addition, tubes that restrict the 0.610 inch probe should be plugged and tubes on either side of the patchplate boundary (plate perimeter on one side the plug welds on the other three sides) that restrict the 0.650 inch probe should be plugged.

Finally, due to the local plate cracking that is believed to occur at the periphery and near wedge locations, tube leaks may occur here at lower levels of tube restriction than in the tubelane. Thus, the wedge areas should have their own inspection program and plugging criteria. The plugging criteria at hot leg wedge locations calls for treating leakers and tubes that restrict the 0.540 inch probe in a similar manner. In addition, tubes that restrict the 0.610 inch probe and peripheral tubes that restrict the 0.650 inch probe should be plugged. Cold leg plugging will be based on the degree of activity noted and rates of progression observed from gauging.

In assessing a 10 month operating period, it was deemed appropriate that more preventive plugging be accomplished beyond that dictated by the above considerations. It was determined that this basis should rely on plant specific information rather than finite element analysis results. Since the proposed 10 month cycle is approximately that for which preventive plugging was performed in February, 1979, an evaluation of tube restriction behavior over the latest period, i.e. the absence of 0.540 inch restrictions in the tubelane, application of the approach adopted in February, 1979 is appropriate. The basis

of the evaluation was the comparison of the .650 inch restricted tubes remaining unplugged from the prior inspection and the gauging results on these tubes during this inspection. The average and conservative estimate of subsequent reduction was calculated to be approximately 70 mils for 10 months. Thus, if a .650" restricted tube is just slightly above .610", it is conservative to assume that in 10 months, this tube could reach .540".

In applying these results, engineering judgement was exercised to choose .650" restricted tubes most likely to be close to .610". In general, tubes restricting a .650" probe located in plugging valleys, those in close proximity to .610" and .540" restricted tubes, and those in areas of current activity were considered for plugging.

The plugging criteria which supports at least ten months of operation are:

1. All tubes which do not pass the 0.540 inch probe will be plugged.
2. Additionally, for in excess of ten (10) months operation, three (3) tubes beyond (i.e., higher row numbers) any tube in columns 1-92 which did not pass the 0.540 inch probe in the tubelane region will be plugged.
3. All tubes which do not pass the 0.610 inch probe will be plugged.
4. The tubes in any column for which plugging under criteria (1) (2), or (3) above is implemented in the tubelane region will also be plugged in the lower row numbered tubes back to the tubelane if not already plugged.
5. As a conservative measure, tubes completely surrounding any known leaking tubes including the diagonally next tube will be plugged if not already covered by the foregoing criteria. Since no leaking tubes were discovered, application of this criterion is not required.
6. In any given column which is surrounded by columns containing tubes with significant tube restrictions or prior plugging, (thereby

creating a "plugging valley" in the pattern) engineering judgement will be used to fill the bottom of the valley. In the peripheral tubelane areas near the three and nine o'clock wedges, tubes surrounded by previously plugged tubes or tubes exhibiting high deformation activity will be plugged based on engineering judgement. Particular attention was paid to .650 restricted tubes relative to the ten month operation period.

7. Additional preventive plugging will be implemented at the hot leg wedge locations. This plugging will include all tubes that:
   a. restrict the 0.540 inch probe
   b. restrict the 0.610 inch probe
   c. restrict the 0.650 inch probe at the periphery
   d. surround leakers and tubes that restrict the 0.540 inch probe including the diagonally next tube.
8. Application of the criteria specified in 7. above, will be made on the basis of engineering judgement for cold leg wedge locations.
9. Additional preventive plugging will be implemented in the patchplate region. This plugging will include all tubes that:
   a. restrict the 0.540 inch probe
   b. restrict the 0.610 inch probe
   c. surround leakers and tubes that restrict the 0.540 inch probe including the diagonally next tube.
   d. lie on either sides of the patchplate boundary (plate perimeter on one side, the plug welds on the other three) and restrict the 0.650 inch probe.

The ten month operating period was also evaluated relative to a postulated main steam line break accident (MSLB). In doing this, the finite element analysis plots for 18 and 24 EFPM beyond closure (Figures 13 and 14 were considered. These are considered to be representative of the

anticipated advanced conditions of the Turkey Point Unit 3 steam generators over the next ten month operating period. It was assumed that the actual boundary of the 17.5% tube loop strain contour in the most advanced steam generator (B) is indicated in the tubelane region by the previous plugging boundary and the present .540" restricted tubes. Using the finite element analysis results above, the advancement of the 17.5% tube loop strain contour over the next ten months was estimated to be 1.9 rows. Using the fact that there are 92 tubes in a row, the total predicted tubes in the tubelane region lying within the 17.5% strain contour at the end of the next ten months is:

1.9 rows in ten months x 92 tubes per row = 175 tubes

Subtracting out the tubes that were preventively plugged in this area in steam generator B this time (14) results in a total of 161 unplugged tubes within the 17.5% strain contour at the end of the ten month operating period. Assuming one intersection involvement per tube and assuming these tubes would leak during a postulated main steam line break, the total resulting leakage from these tubes would be:

$$161 \text{ tubes} \times 0.05 \frac{\text{GPM}}{\text{tube}} = 8.05 \text{ GPM}$$

This added to the 0.3 GPM leakage assumed to be present at the start of a postulated main steam line break (which would increase to approximately 0.7 GPM due to MSLB differential pressures) yield a total leakage less than 10 GPM, which has been determined in previous submittals to be an acceptable level of leakage during a postulated MSLB.

B. Regulatory Guide 1.83

The criteria for plugging tubes in this area are established in the regulatory guide.

C. Preventive Plugging Accomplished

The preventive plugging programs that were implemented are indicated in Figures 15, 16, and 17. Both gauging and Regulatory Guide 1.83 program plugging are indicated. Table 3 summarizes this plugging.

TABLE 3 Summary of Tubes Plugged

	Gauging	R.G. 1.83
SG A	66	0
SG B	43	2
SG C	52	5
	161	7

NOTE: The numbers above are preliminary. Plugging operations are not completed as of this writing, therefore, the final numbers may be slightly different.

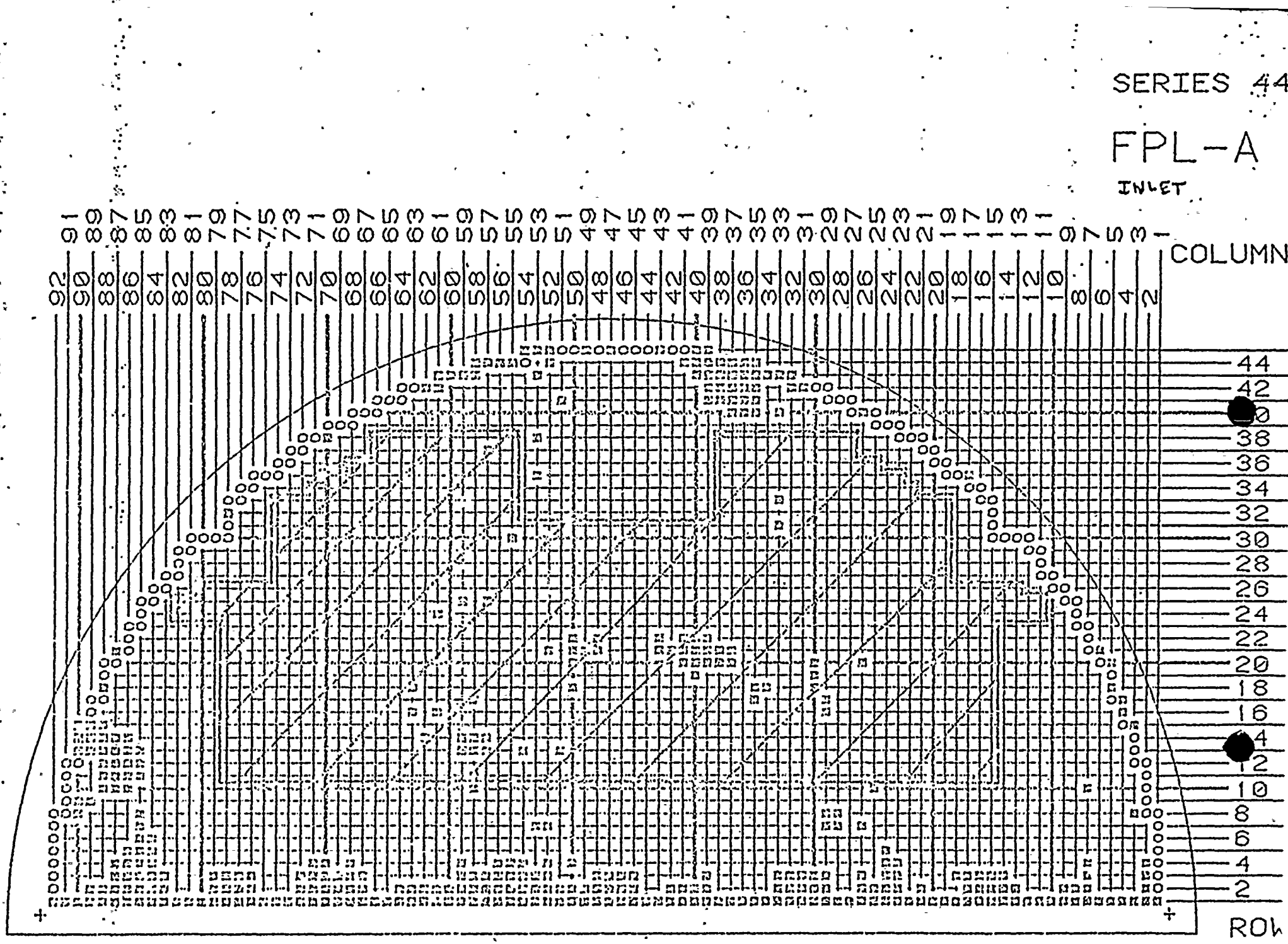

SERIES 44
FPL-A
INLET
COLUMN
ROW
MANWAY
NOZZLE
GAUGE ALL TUBES OUTSIDE SHADED AREA TO TOP SUPPORT
WITH .150, .610 OR .590 PROBES AT 400 KHz
TECH. SUP. 2 - 1399 TUBES
JAN. 1979

FIGURE 1

FPL-A

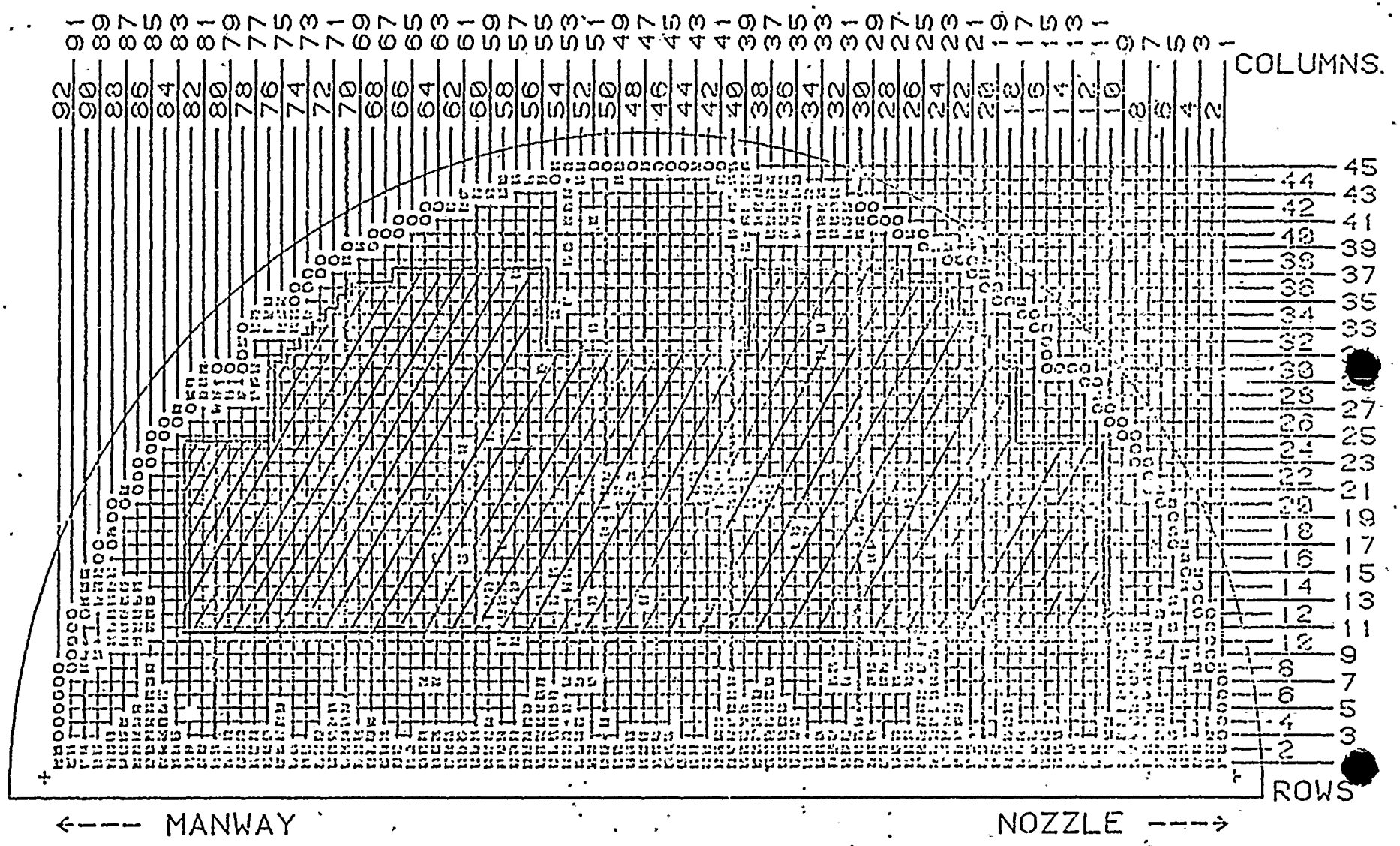


FIGURE 2

TYPICAL GAUGING INSPECTION
BOUNDARY - HOT LEG
DECEMBER 1979 INSPECTION

Test Unshaded Region

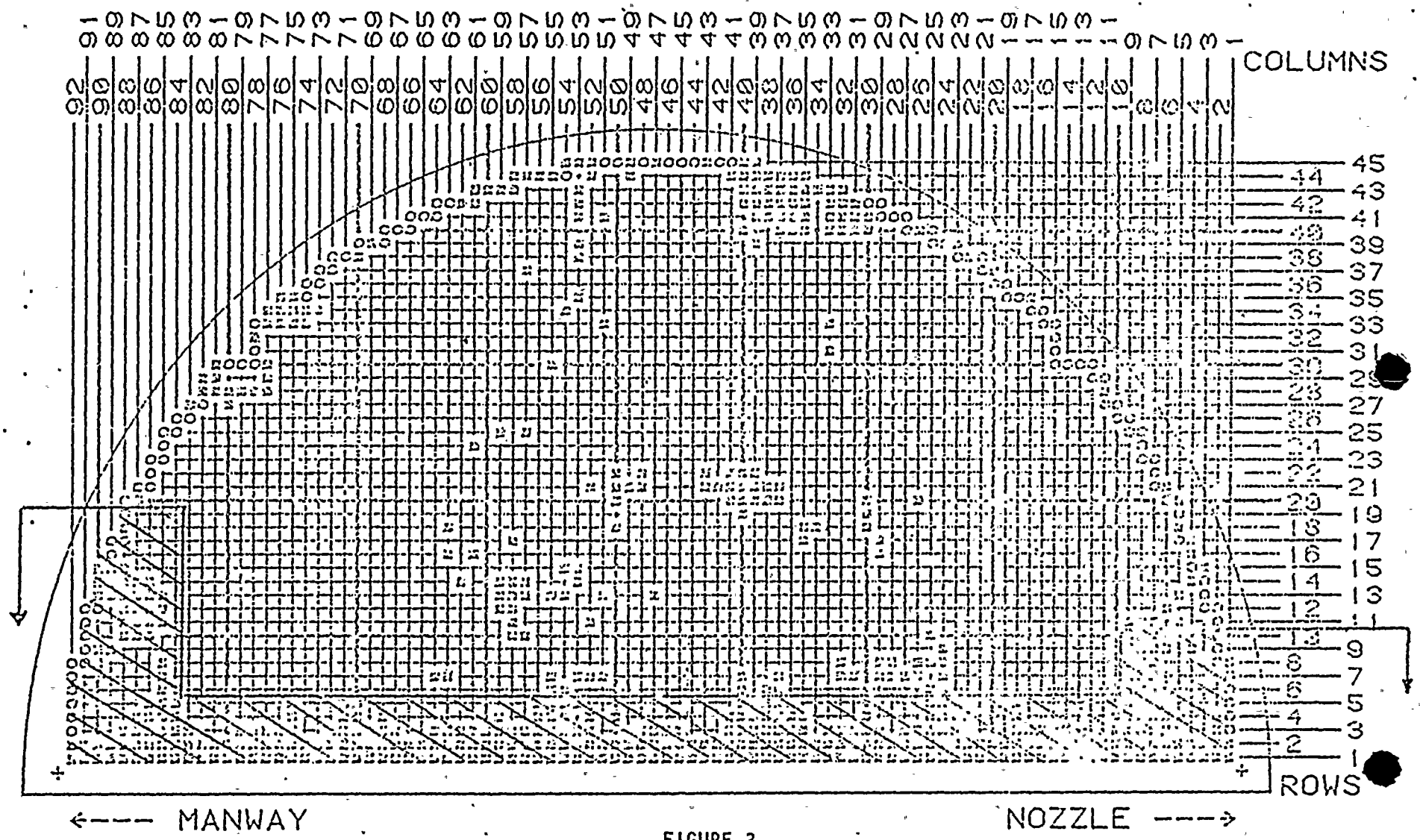


FIGURE 3

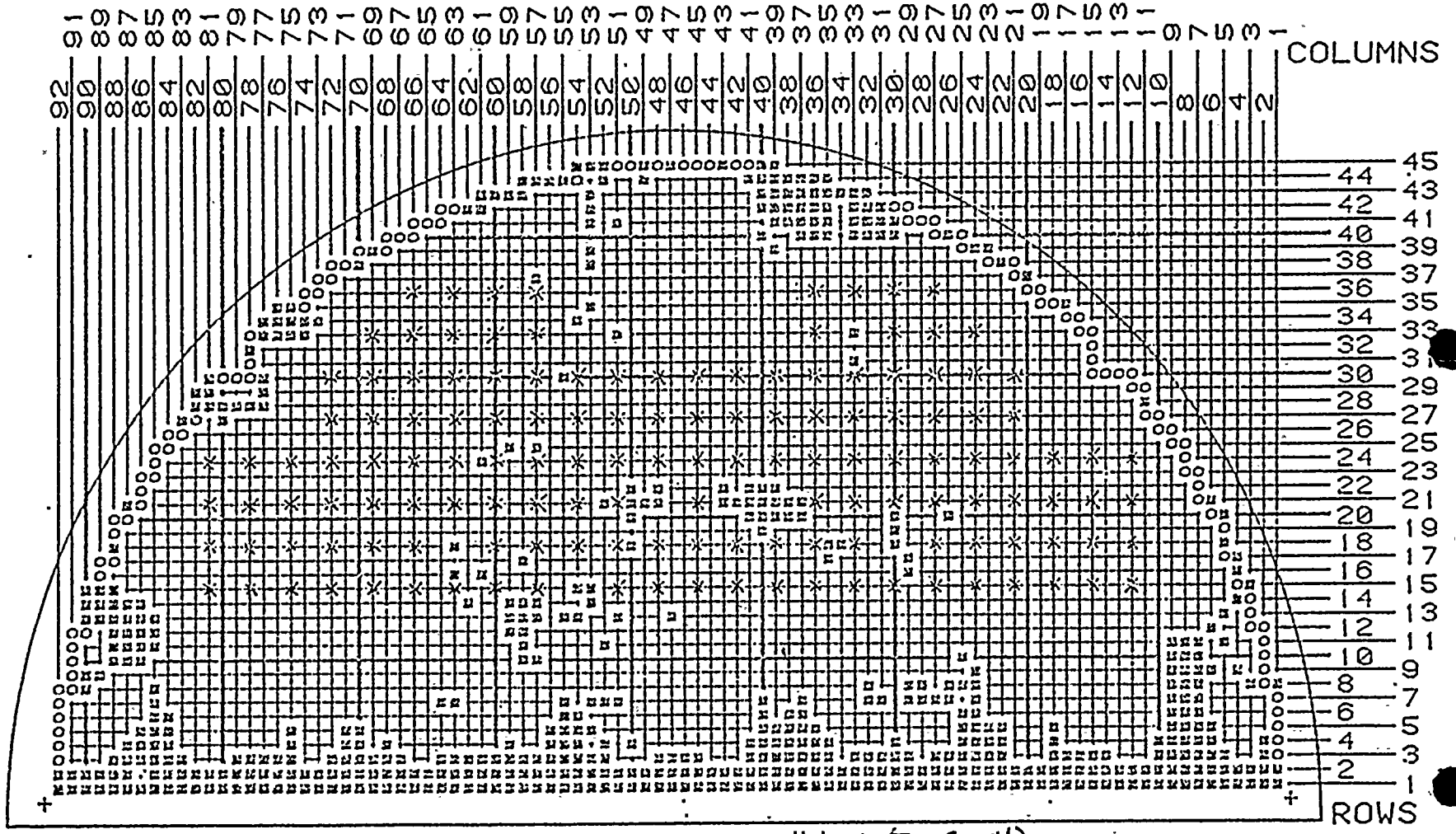
TYPICAL GAUGING INSPECTION
BOUNDARY - COLD LEG
DECEMBER 1979 INSPECTION

Test Blocked-In Region

SERIES 44

FPL-A

INLET



←—— MANWAY Reg. Guide Program – 400 KHz through U-bend (Tech Sup #1) NOZZLE ——→

A 700 SF probe · 143 tubes

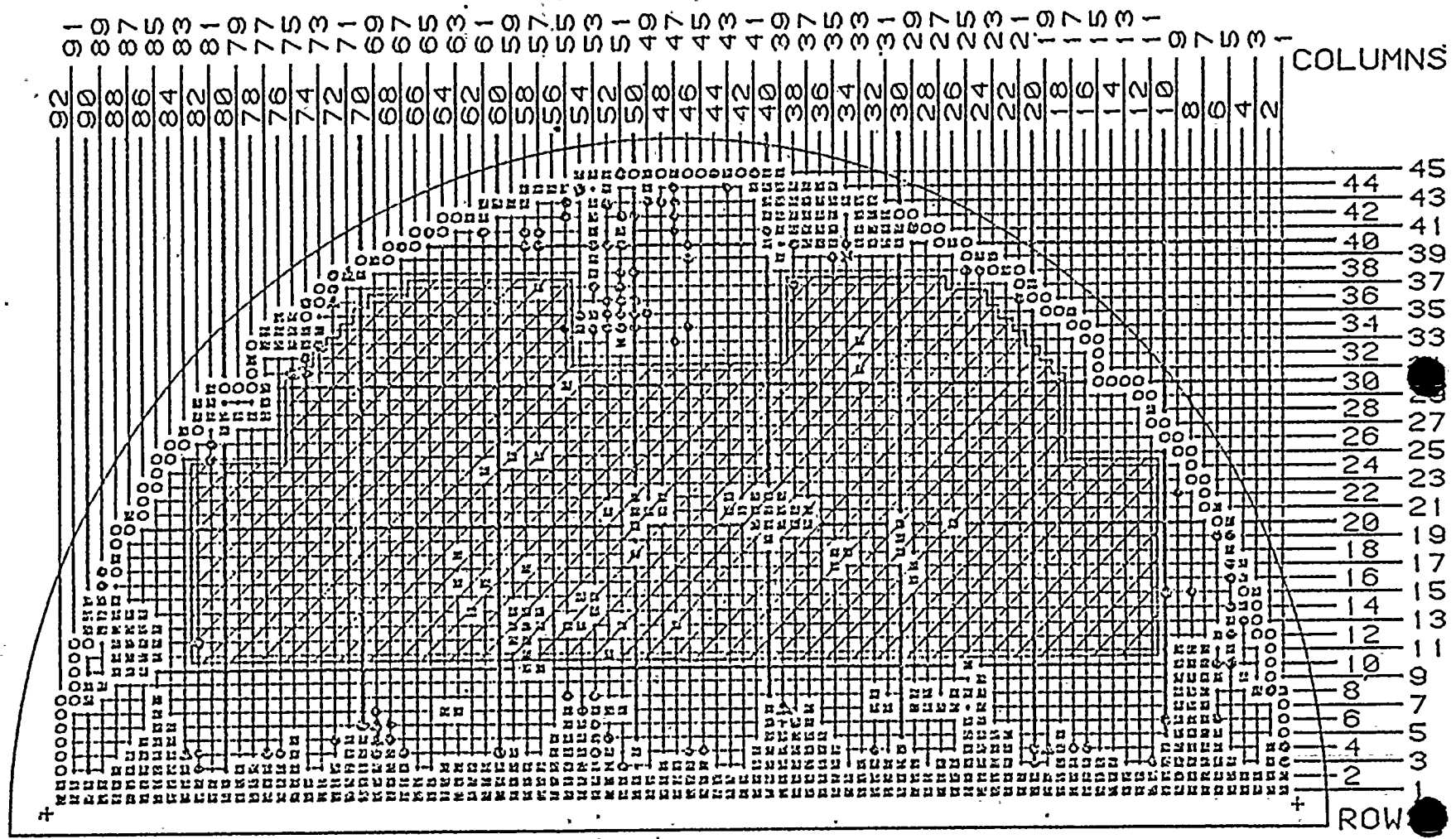
12/79

FIGURE 4

SERIES 44

FPL-A

INLET



←--- MANWAY Gauging Program - 400 KHz through TOP SUPPORT with .650, .610 and .540 probes - Tech. Sup #1 - 1145 Tubes. (Test UNSHADED AREA)

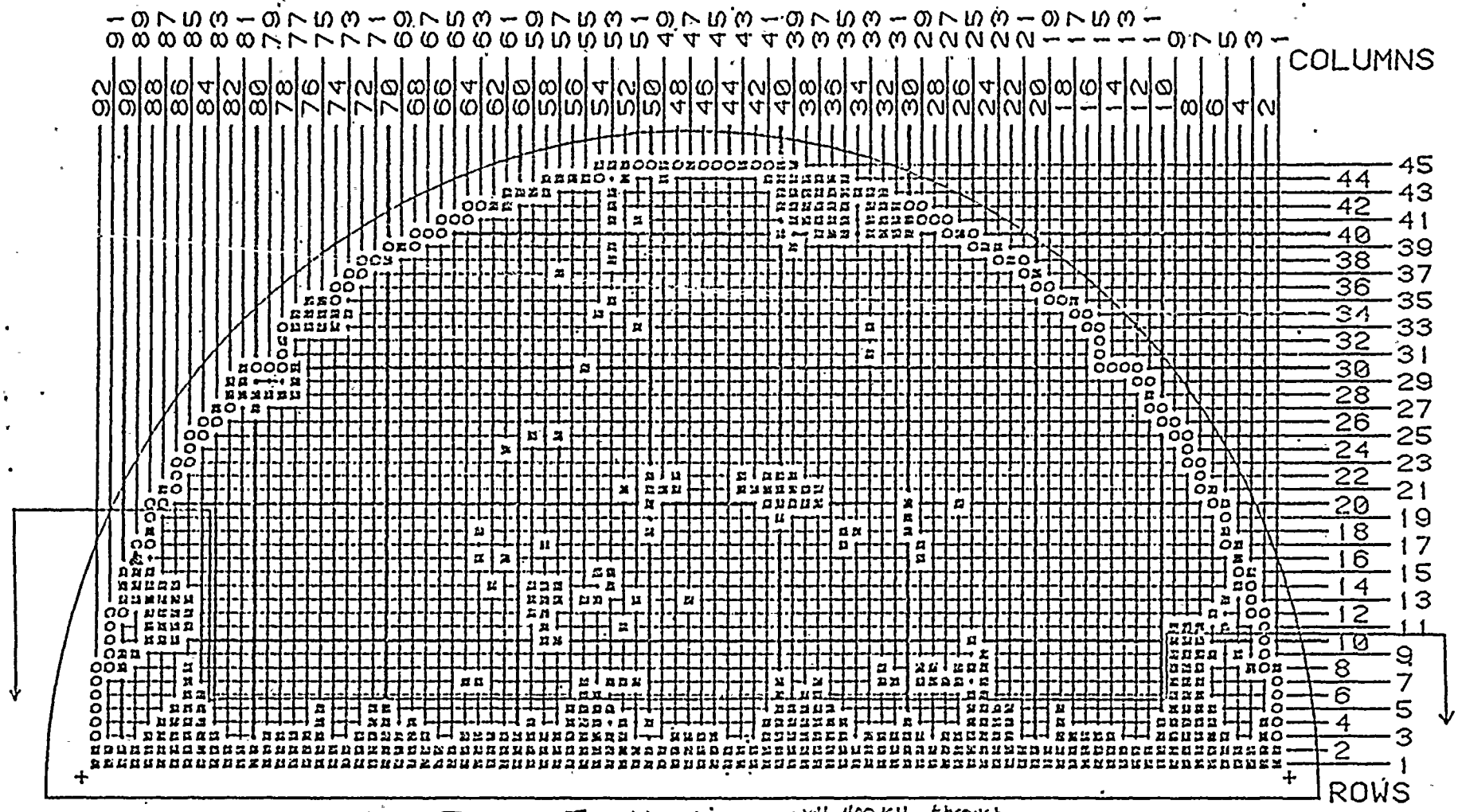
NOZZLE ---→

● 650	112	12/79
▲ 610	7	
X 540	1	

FIGURE 6

SERIES 44

FPL-A
OUTLET



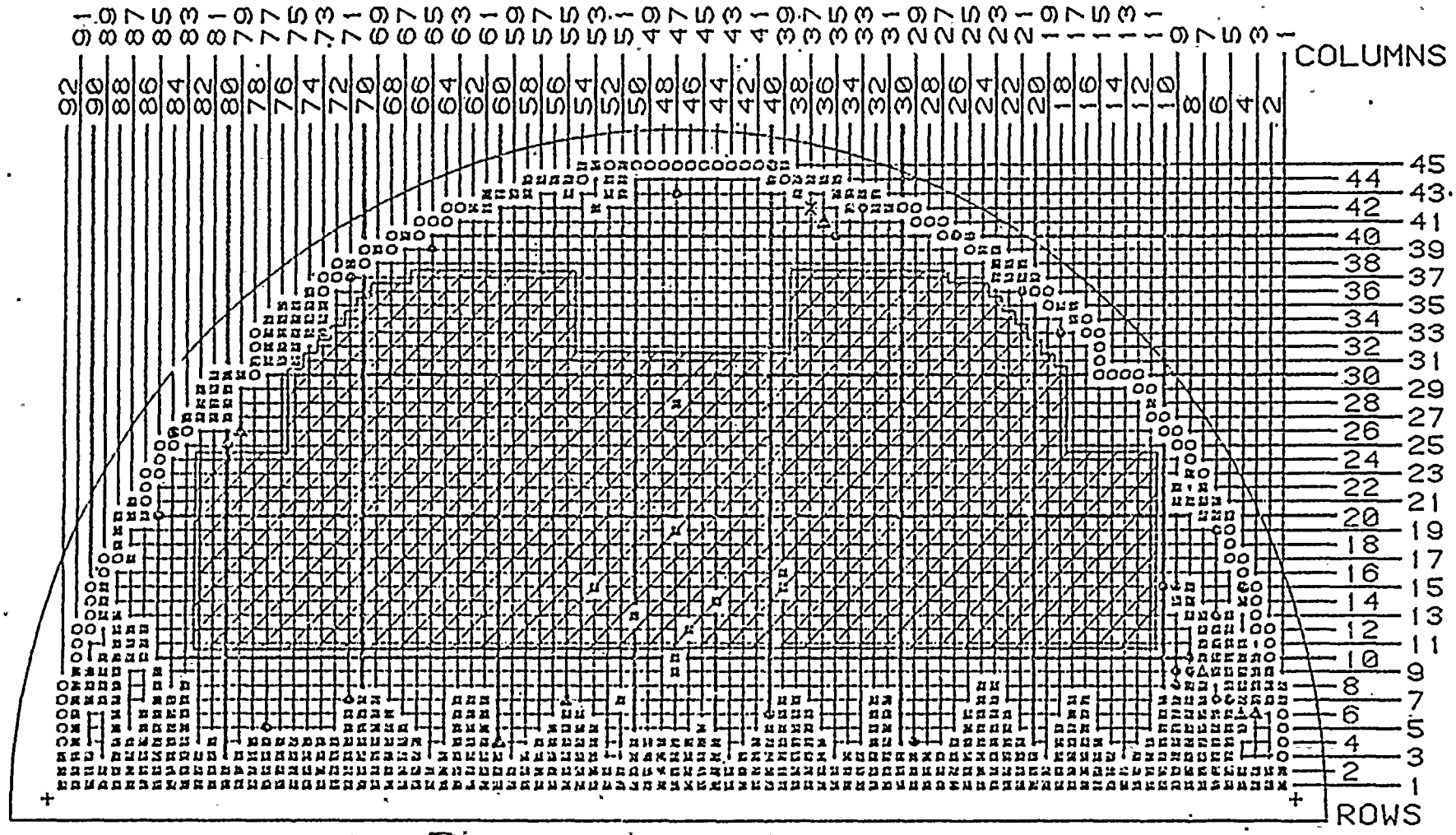
← MANWAY Gauging Program - Test blocked in area with 400 KHz through NOZZLE →
Top Support with .610 and .540 probes
Tech Sup # 1 - 248 tubes
Δ 60 mils - 1 12/79

FIGURE 7

SERIES 44

FPL-B

INLET



← MANWAY Gauging Program - Test UNSHADED AREA at 400 KHz through NOZZLE →

TOP SUPPORT with .650, .610 and .540 probes

Tech Sup #1 1068 tubes

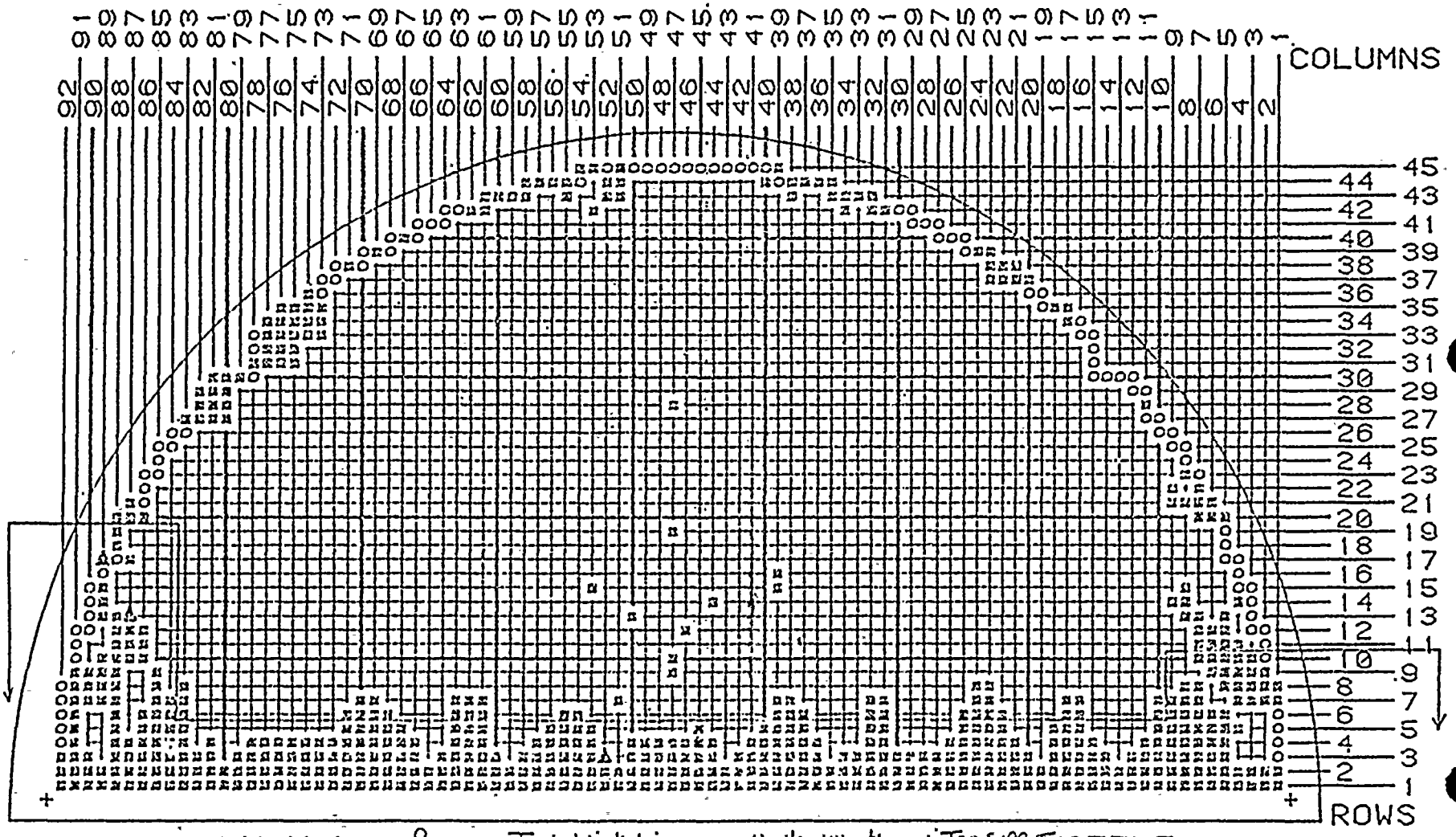
		HL
o	650	28
Δ	610	7
X	540	1

12/79

FIGURE 8

SERIES 44

FPL-B
OUTLET



Gauging Program - Test blocked in area with 400 KHz through Top Support with .610 and .510 probes - Tech Sup #L - 176 Tubes

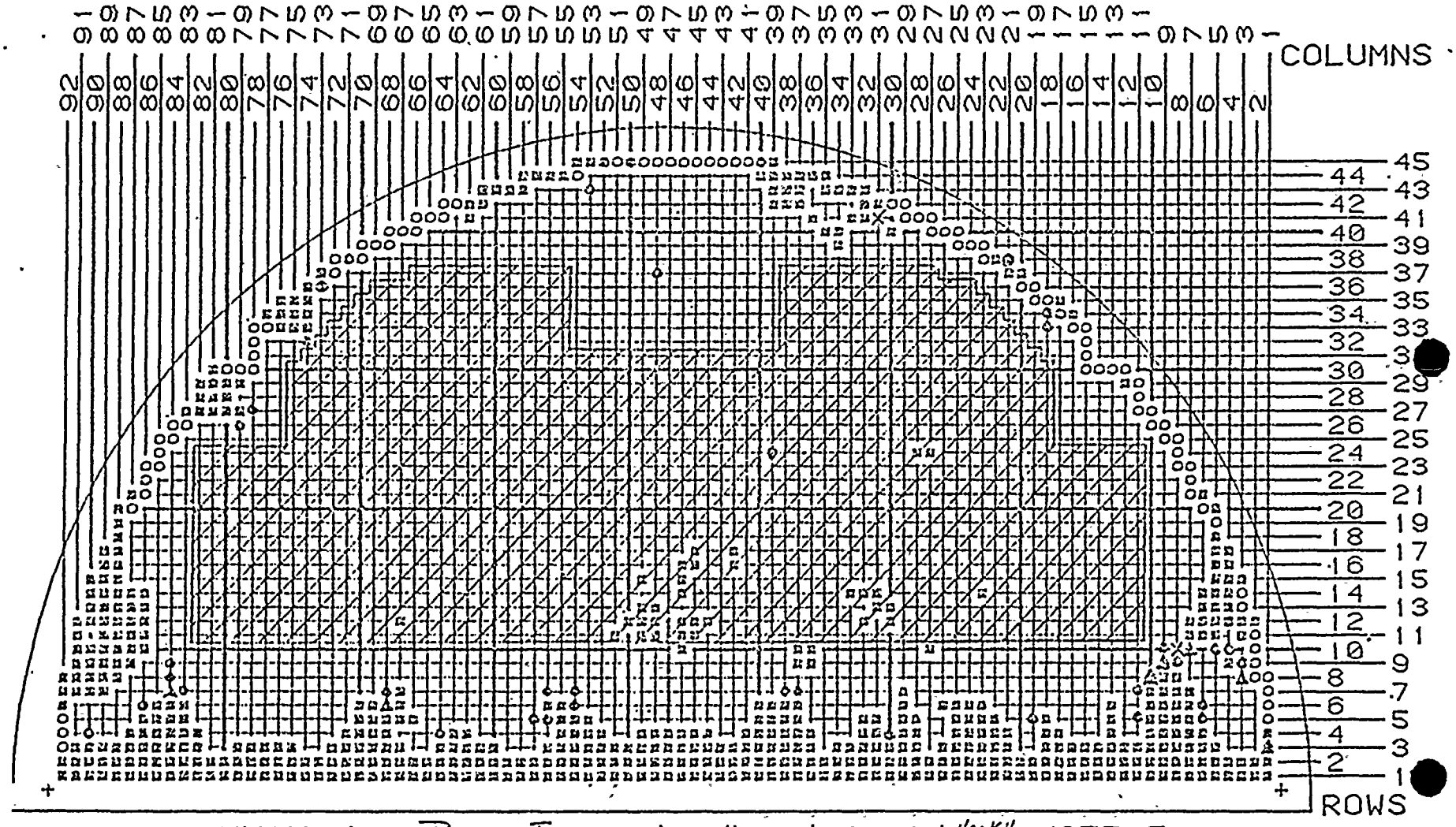
A 610 with 3 12/79

FIGURE 9

SERIES 44

FPL-C

INLET



←--- MANWAY Gauging Program - Test unshaded area through top support at 400KHz NOZZLE ---→

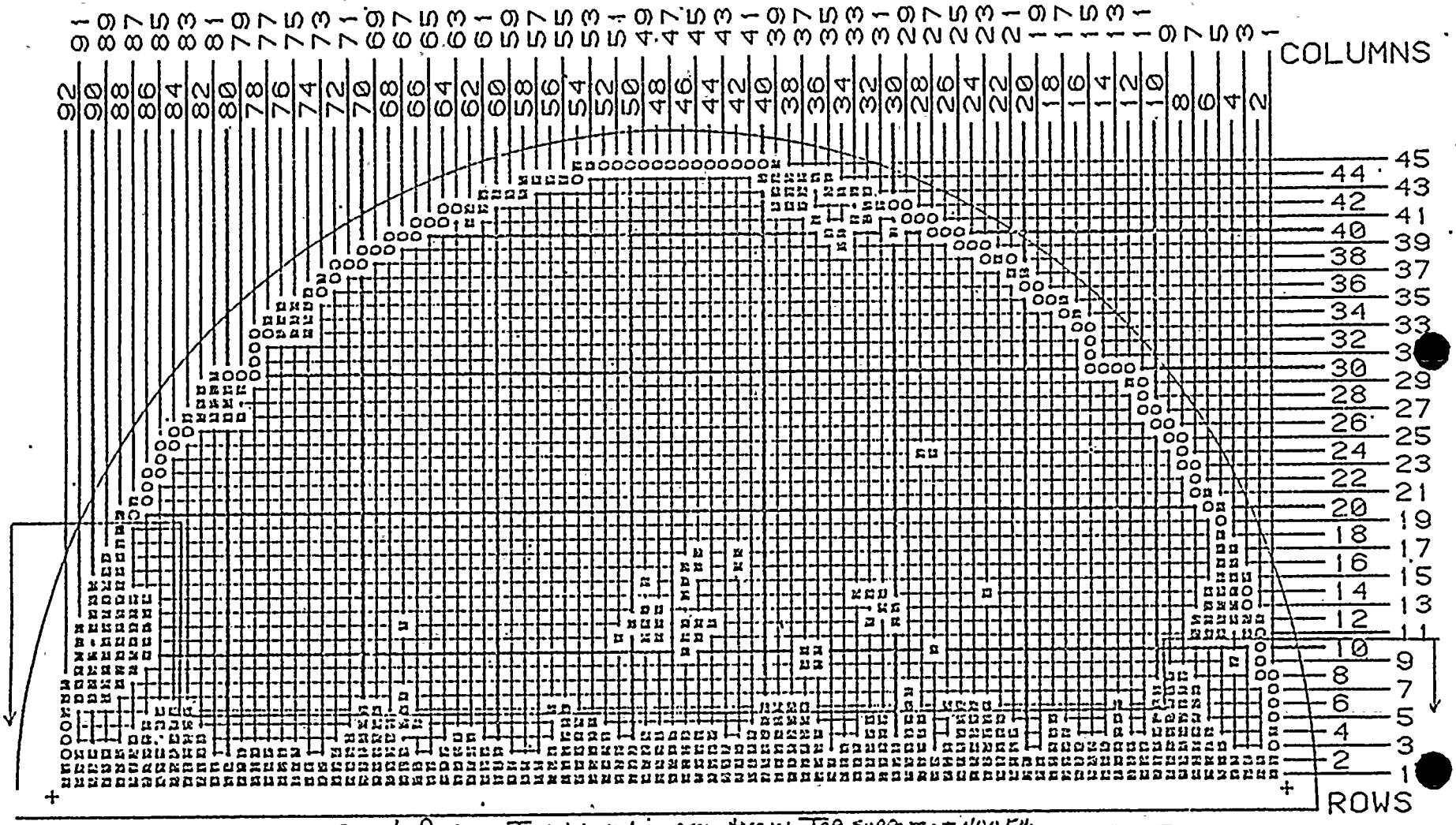
with .650, .610 and .540 probes. Tech Sup #1 - 1131 Tubes

○	650	39
△	610	7
×	540	2

FIGURE 10

SERIES 44.

FPL-C
OUTLET



Gauging Program - Test blocked-in area through TOP SUPPORT at 400 KN/3
with .610 and .540 probes. Tech Sup. #1 209 tubes

12/29

No Restrictions to .610 mil probes

FIGURE 11

FIGURE 12

FLOW SLOT WIDTH VERSUS EFPH FOR TURKEY POINT #3 STEAM GENERATORS A, B, AND C

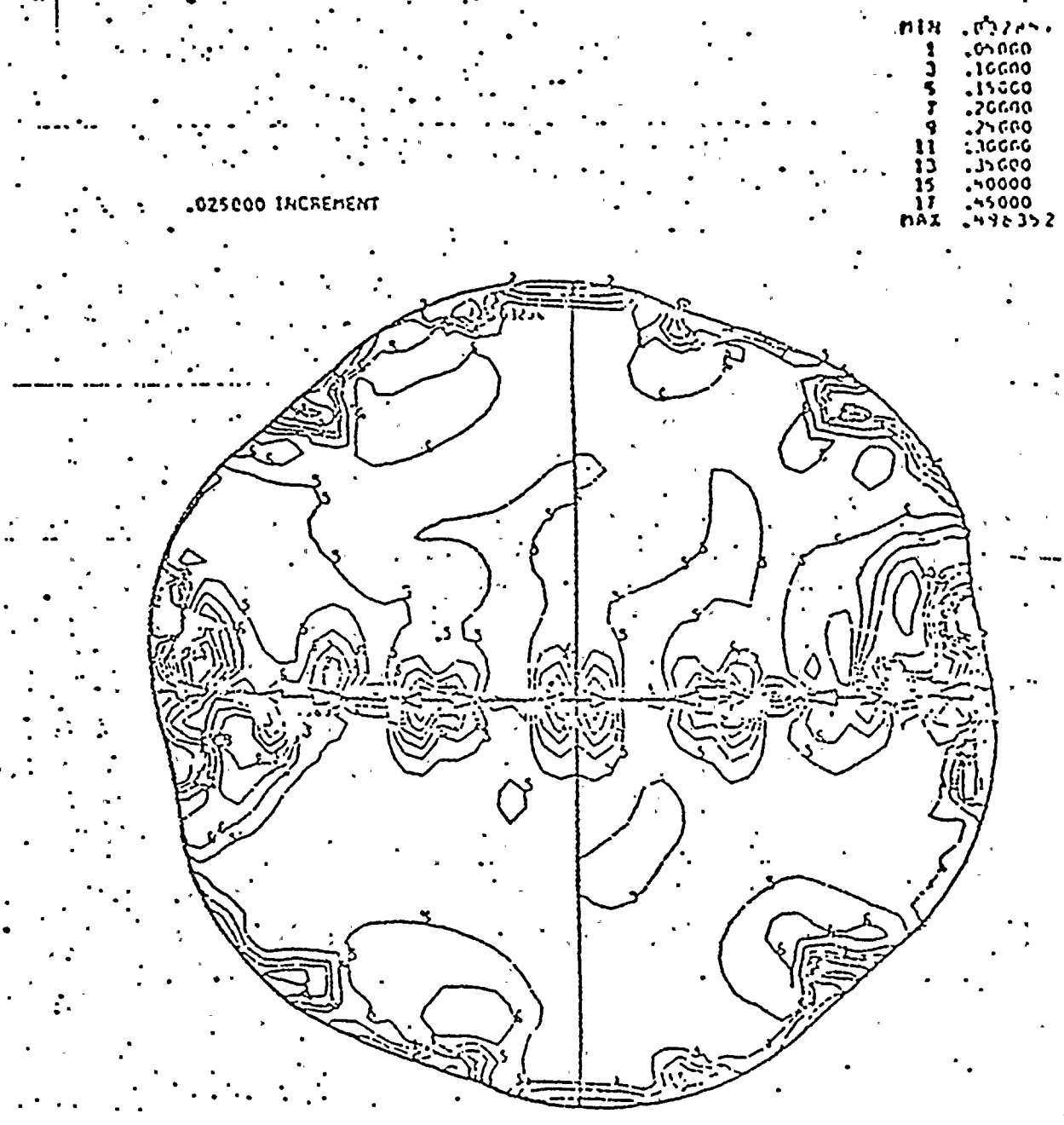


FIGURE 13 - TUBE HOOP STRAIN AT 18 EFPM's BEYOND FULL CLOSURE

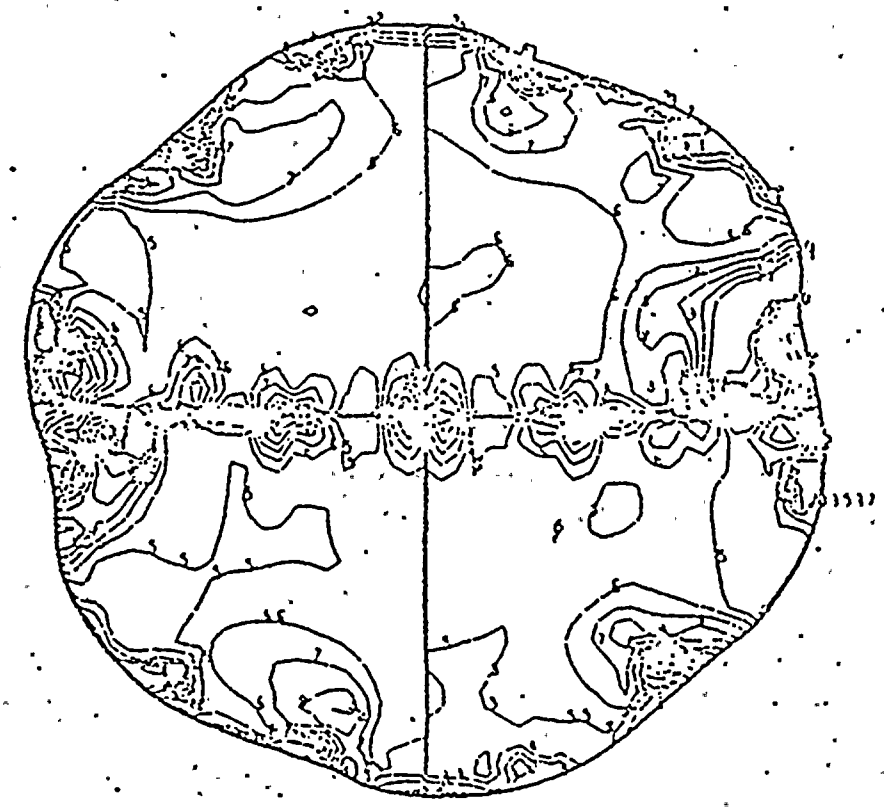


FIGURE 14 TUBE HOOP STRAIN
AT 24 EFPM'S BEYOND FULL CLOSURE

SERIES 44

FPL-A

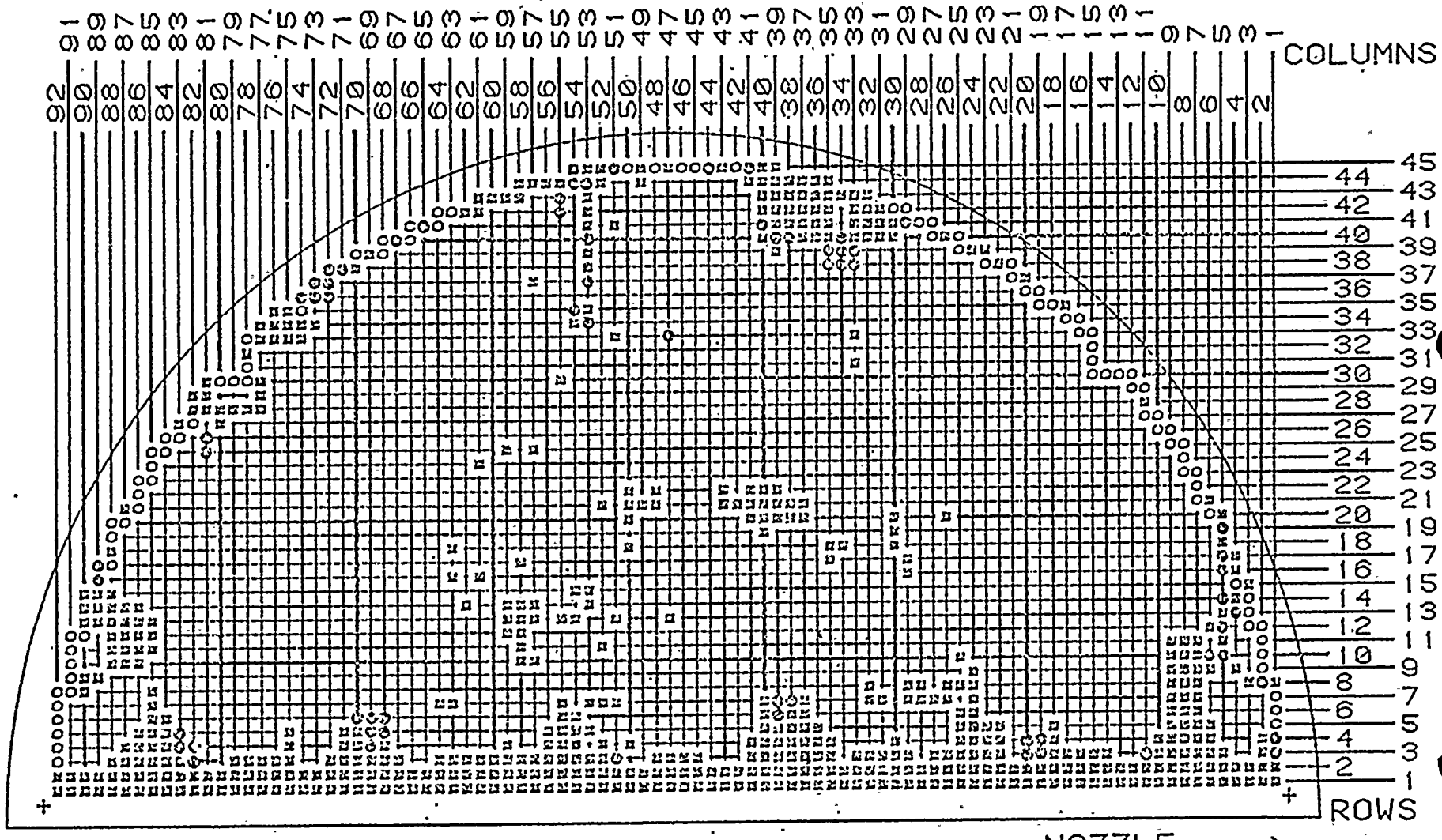


FIGURE 15 STEAM GENERATOR A
PREVENTIVE PLUGGING PATTERN

○ GAUGING PLUGGING
⊠ PREVIOUSLY PLUGGED

⊗ DRAGTIP PLUGGING
X R.G. 1.83 PLUGGING
⊠ PREVIOUSLY PLUGGED

SERIES 44

FPL-C

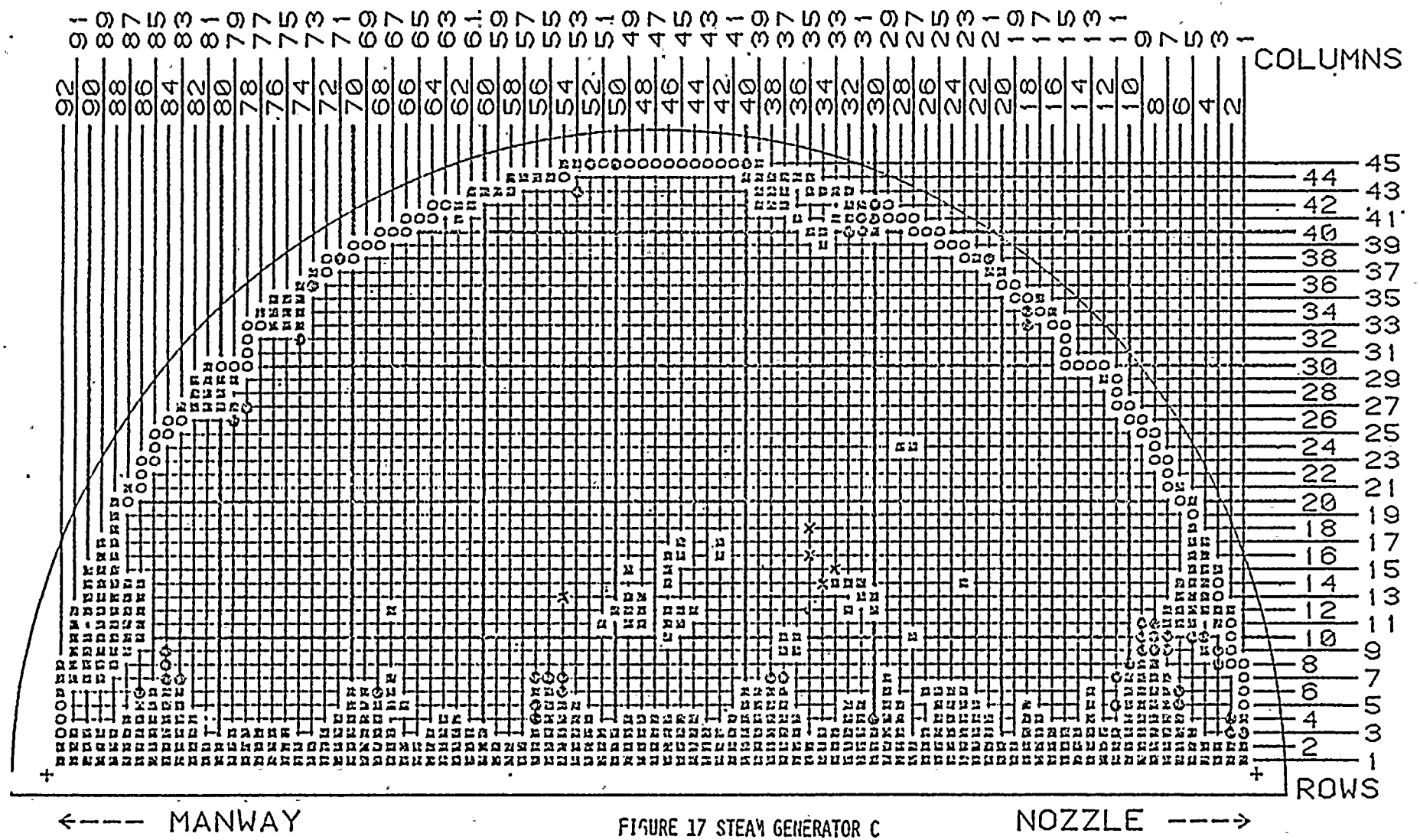


FIGURE 17 STEAM GENERATOR C
PREVENTIVE PLUGGING PATTERN

SERIES 44

FPL-B

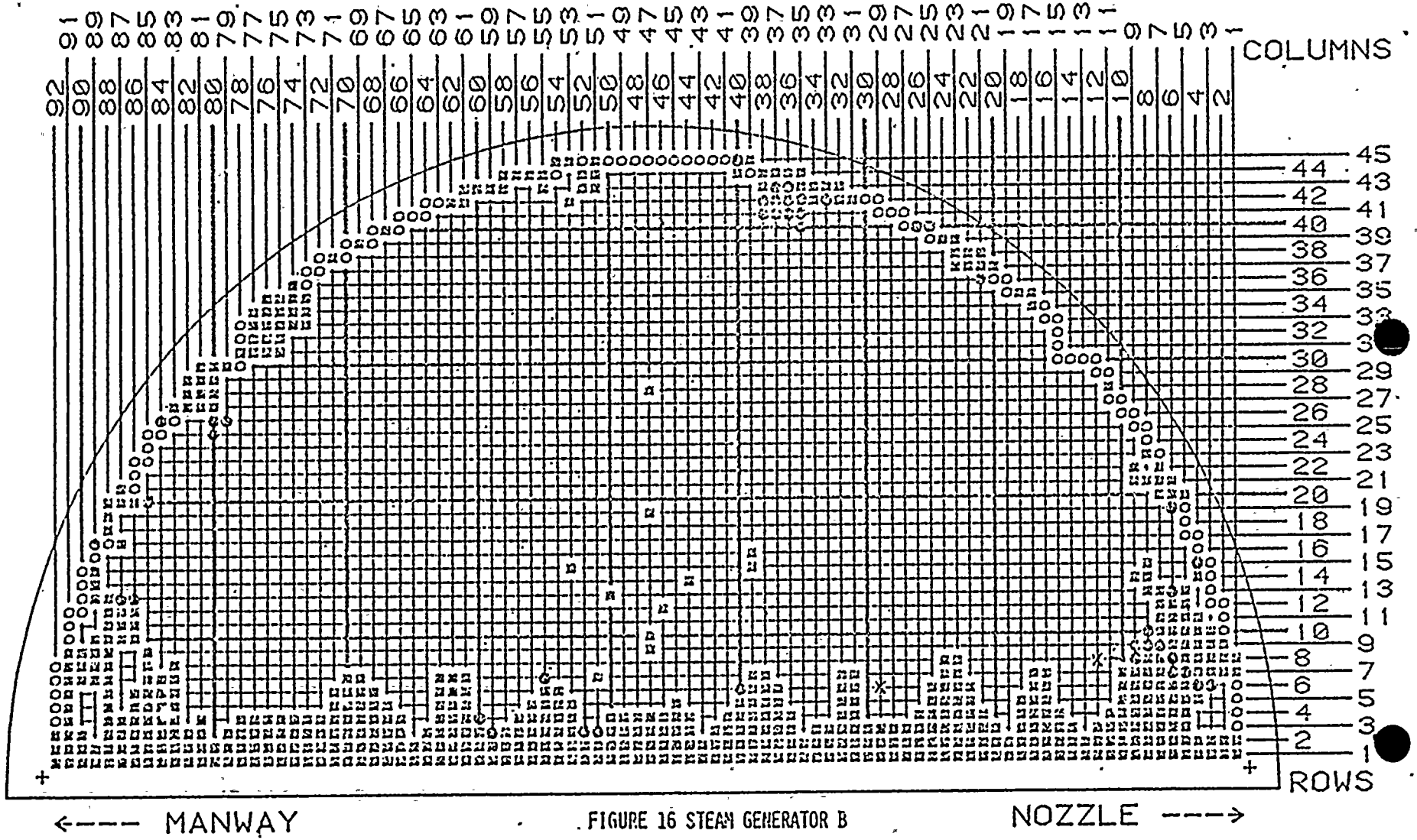


FIGURE 16 STEAM GENERATOR B
PREVENTIVE PLUGGING PATTERN

○ GAUGING PLUGGING
X R.G. 1.83 PLUGGING
▣ PREVIOUSLY PLUGGED