



April 14, 1992

1CAN049208

Mr. Robert Martin
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

Subject: Arkansas Nuclear One - Unit 1
Docket No. 50-313
License No. DPR-5.
Special Report - Once Through Steam Generator
Tubing Surveillance - Category C-3 Results

Dear Mr. Martin:

The steam generator tubing inservice inspection was performed on the Arkansas Nuclear One, Unit 1 (ANO-1) Once Through Steam Generators (OTSGs) during March, 1992 (1R10 refueling outage), using the standard bobbin coil technique. During the planning stages for the 1R10 inspection, it was noted by the eddy current vendor that in previous inspections they had established a threshold signal-to-noise (S/N) ratio of 5:1, below which potential indications were not sized. Based upon recent industry experience where it has been shown that small amplitude signals can represent significant through wall degradation, it was concluded that the S/N screening criterion would no longer be used at ANO-1. This position was previously discussed with the NRC. This, in addition to the fact that the ANO-1 OTSGs had not performed a baseline inspection since 1982, lead to the decision to perform a 100% inspection of both OTSGs during 1R10. All non-plugged tubes in both OTSGs were examined full length.

The results of the inspection revealed that a total of 428 tubes out of the 15296 non-plugged tubes in the "A" OTSG and a total of 316 tubes out of 15423 non-plugged tubes in the "B" OTSG had greater than 40% through wall imperfections or non-quantifiable indications. The distribution of these results place the "A" OTSG in the C-3 category for the A-1 and A-3 groups as defined by ANO-1 Technical Specification 4.18.3.b as well as the remainder of the OTSG. The result of the inspection of the A-2 group of the "A" OTSG was C-2. The results of the inspection of the A-1 and A-3 groups in the "B" OTSG were also C-3. The result of the inspections of the A-2 group of the "B" OTSG and the remainder of the "B" OTSG was C-1 and C-2, respectively.

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Figure 1 provides an upper tube sheet view which identifies the A-1 and A-3 groups. The A-1 group is the three rows on either side of the open inspection lane (row 76) from the periphery to the center of the OTSG. The A-2 group is defined by ANO-1 Technical Specifications as all unplugged tubes with sleeves installed. Group A-3, or the wedge group from the 15th tube support plate and up, is immediately adjacent to the A-1 group.

Note 2 of ANO-1 Technical Specification Table 4.18-2 requires ANO-1 to plug or sleeve all defective tubes and to request NRC approval of remedial action. This note, along with ANO-1 Technical Specifications 4.18.6 and 6.12.5 require a Special Report be submitted prior to resumption of plant operation. This submittal provides the required report.

The defects in both OTSGs were primarily located above the 15th tube support plate with a significant fraction located within the upper tube sheet or at the face. Figure 2 depicts the axial locations of the defects identified during this inspection for the "A" and "B" OTSGs. Figure 3 depicts the axial location of reportable (>20% throughwall) indications identified during the 1R6 through 1R9 inspections for the "A" and "B" OTSGs. The distribution of the defects across the bundle identified during the current outage is shown in Figures 4, 5, 6, and 7 for the "A" and "B" OTSGs. The cumulative results for all previous indications are shown in Figures 8 and 9. Comparing the previous inspection results to those obtained during this outage shows similar distribution of defect locations both axially and across the bundle.

Based upon the similarity between the recently identified defective tubes and past defective tubes from both a radial and axial location standpoint, Entergy Operations concludes that the mechanism causing the observed defects continues to be sulfur-induced intergranular attack (IGA). The sulfur-induced IGA corrosion was determined through the examination of pulled tube sections from 1982 and 1984. This phenomena occurs at relatively low temperatures, provided oxygen is present to allow the IGA to propagate. This process was discussed at length with the NRC in an August 31, 1983, meeting (Summary of the meeting, dated September 27, 1983, 1CNA098305).

Subsequent to the initial identification of this mechanism, ANO-1 instituted the practice of maintaining a nitrogen blanket on the steam generators while the plant is shutdown to prevent oxygen ingress. This action, combined with the tri-bed resin condensate polishing system and the continued use of the B&W/EPRI secondary side chemistry guidelines, has significantly reduced this problem.

In comparison to previous inspections, a greater number of tubes was identified as being defective during this surveillance. This can be attributed to several factors including the magnitude of the inspection (100% full length of both OTSGs) and improved inspection techniques and practices. Specifically, ANO-1 has historically used a frequency of 400 kHz for both detection and sizing of indications. Based on the tube wall

thickness (0.035 inches), the "prime" frequency for sizing is calculated to be 600 kHz. In addition, because of interferences to the signal caused by the tube sheet regions, a tube sheet suppression mix is typically used to enhance the signal response and provide better signal analysis. For 1R10, the data was analyzed using multi-frequency analysis, with sizing of indications being performed at 600 kHz in the freespan areas and at a 600/200 kHz mix at the tube sheet and support plate locations. In addition, high frequency magnetically biased probes were used on 1R10 to provide optimum signal strength and characterization.

Prior to 1R10, ANO-1 utilized a threshold of S/N ratio equal to 5:1. All indications exhibiting a S/N ratio of 5 or less were flagged as "S/N". Most of the S/N indications were relatively low amplitude (< 1 volt), and appeared to exhibit little if any growth. Because of industry concerns over the potential severity of small amplitude indications, the use of S/N was not allowed during 1R10 eddy current testing and will not be used in the future. This resulted in many tubes being repaired, even though there was no apparent change in the eddy current signal.

During 1R10, ANO-1 also implemented the use of "I-Codes" to flag distorted or non-quantifiable indications. All "I-Codes" were required to be further evaluated with a rotating pancake coil (RPC) probe. RPC testing was performed on 224 tubes in the "A" generator and 217 in the "B" generator. All tubes not resolved by RPC or not tested by RPC were either plugged or sleeved. Many of these indications were believed to be manufacturing buff marks (MBMs). ANO-1 permits the use of MBM only if the indication is tested with an RPC probe and has previous history for comparison to reflect no growth. Because there was no recent previous history on several MBM candidates, they were repaired.

Based on the above, Entergy Operations believes that a significant number of defective tubes are due to changes in improved inspection sensitivity and signal disposition.

Entergy Operations is unaware of any unusual operational events which might have attributed to an increased number of defective tubes in the ANO-1 OTSGs. During the last cycle, the unit remained in compliance with the stringent B&W/EPRI secondary water chemistry guidelines. A detailed evaluation of last cycle's operating history is currently underway.

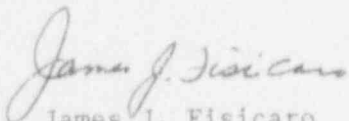
During the last refueling outage (1R9), the secondary side of the OTSGs were chemically cleaned up to the ninth tube support plate. This process was conducted under careful administrative controls. Particular attention was paid to the control of oxygen. The copper removal portion of the cleaning process generated oxygen as a by-product of the chemical reactions. The oxygen was purged from the generator via nitrogen gas over pressure. While some oxygen could have come in contact with the tubing above the ninth support plate, it is not believed to have been a major cause of the damage detected this outage. To accomplish the chemical cleaning, all the secondary handholes and four main feedwater nozzles were removed from each OTSG. This extensive maintenance was carefully controlled, but still resulted in several potential locations for oxygen ingress.

With regard to remedial actions to prevent recurrence, ANO-1 has demonstrated the ability to restrict the IGA phenomena in past cycles by limiting oxygen ingress. ANO Operations and Chemistry personnel are continuing to take steps to preclude oxygen ingress to the steam generators during periods of plant shutdown. During 1R10, no secondary side penetrations were opened in the "A" OTSG. In the "B" OTSG, one main feedwater nozzle was removed for repair but the opening was covered and a nitrogen blanket was on the OTSG during the removal. Additionally, ANO-1 will continue to comply with B&W/F I secondary side chemistry guidelines.

Additional details concerning this outage's internal inspection results from both the "A" and "B" OTSGs will be submitted to the NRC in the 45-day report required by ANO-1 Technical Specification 4.18.6.

This submittal completes the ANO-1 reporting requirements for steam generator tube surveillance with results in the C-3 category. If you have any questions, or require additional information with regards to this submittal, please contact my office.

Very truly yours,


James J. Fisicaro
Director, Licensing

JJF/RWC/sjf
Attachments

cc: U. S. Nuclear Regulatory Commission
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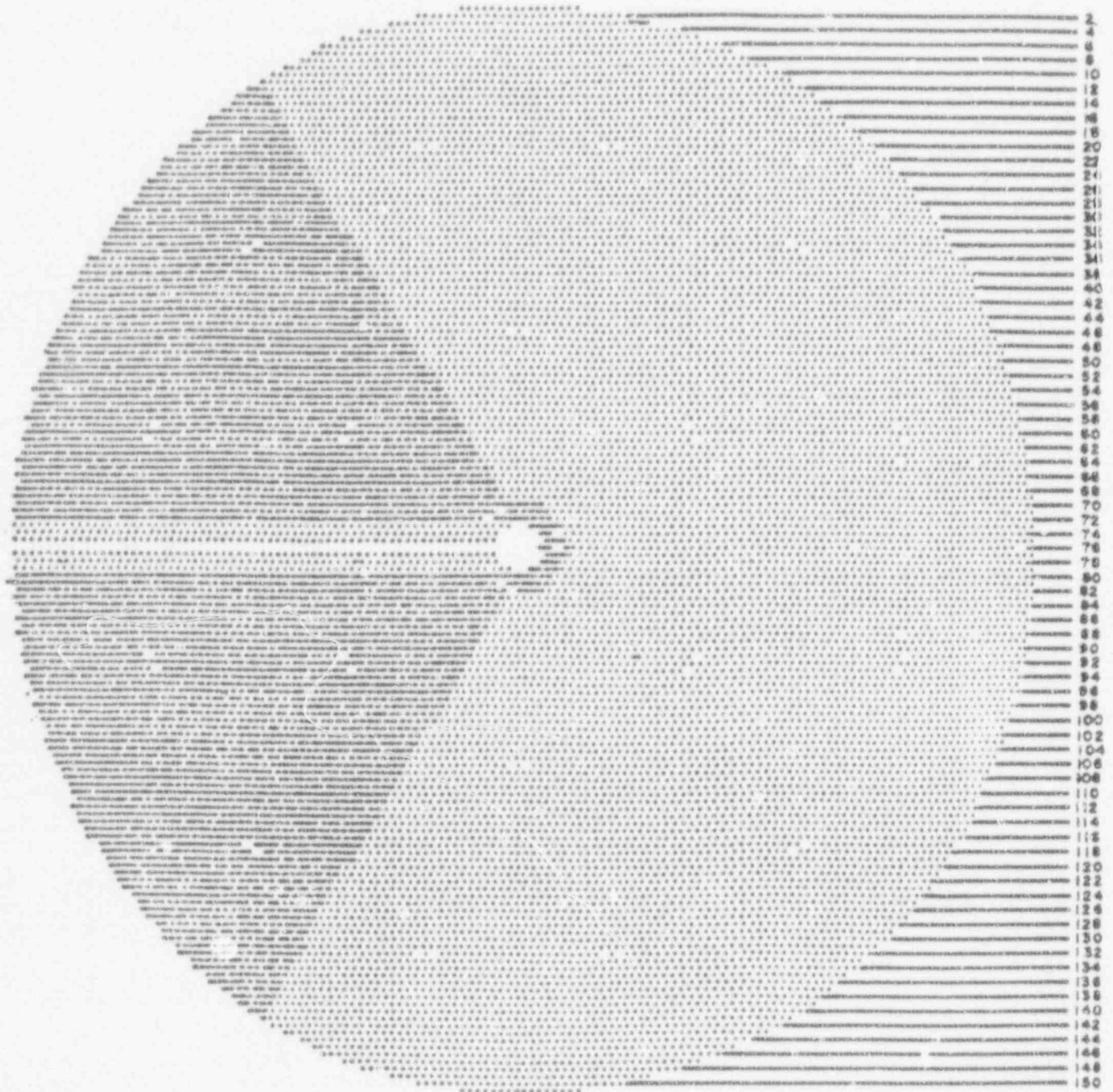
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Upper Tube Sheet View of Wedge Shaped Group (Group A-3) per Specification 4.18.3.a.3



DESCRIPTION

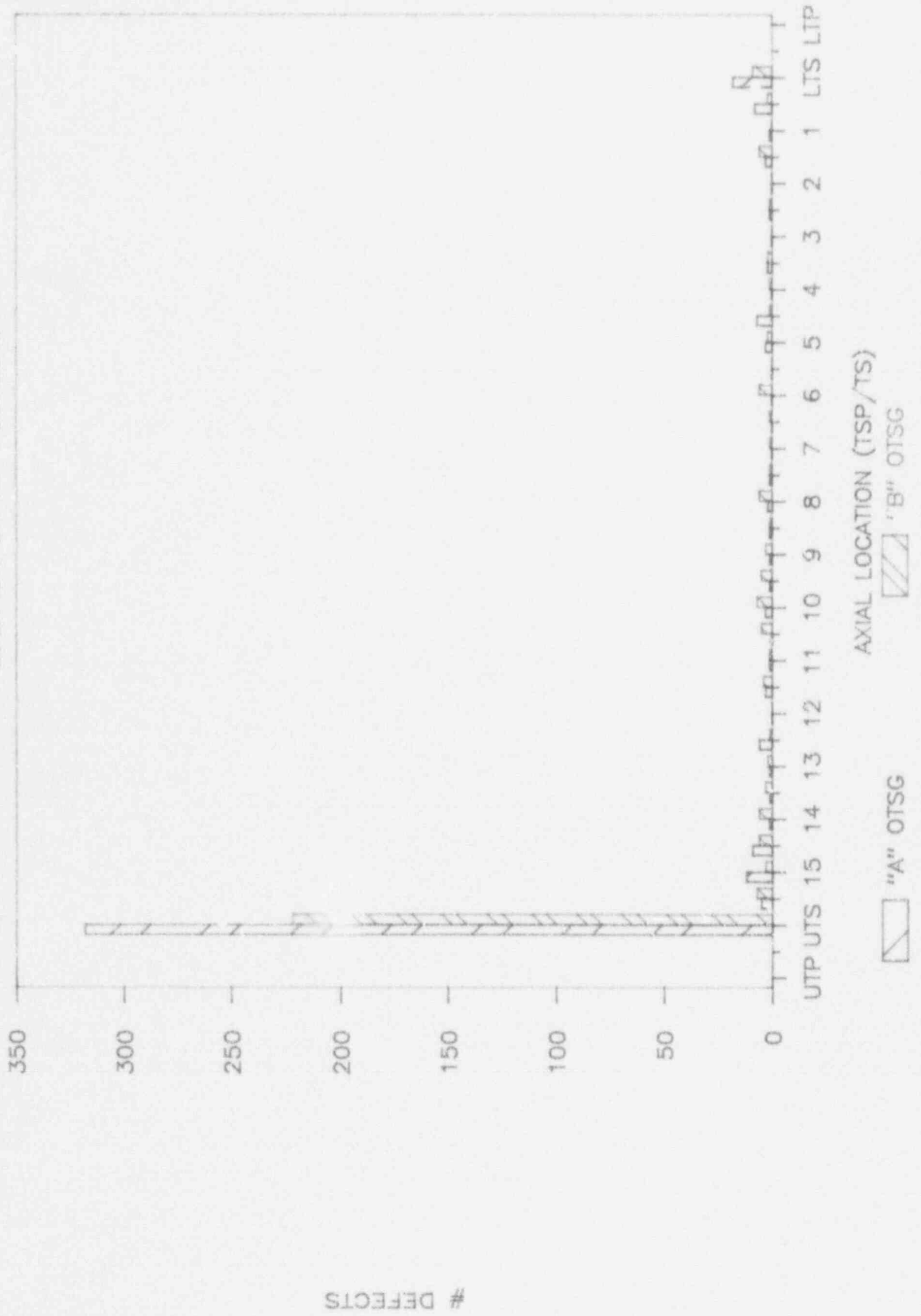
GROUP A - 1: Lane region
tubes as defined in
4.18.3.a.3(1)

GROUP A - 3: Wedge shaped
group depicted by darkened
region of figure

FIGURE 2

ARKANSAS NUCLEAR ONE

LOCATION OF 1R10 DEFECTS



ARKANSAS NUCLEAR ONE

LOCATION OF 1R5-1R9 INDICATIONS

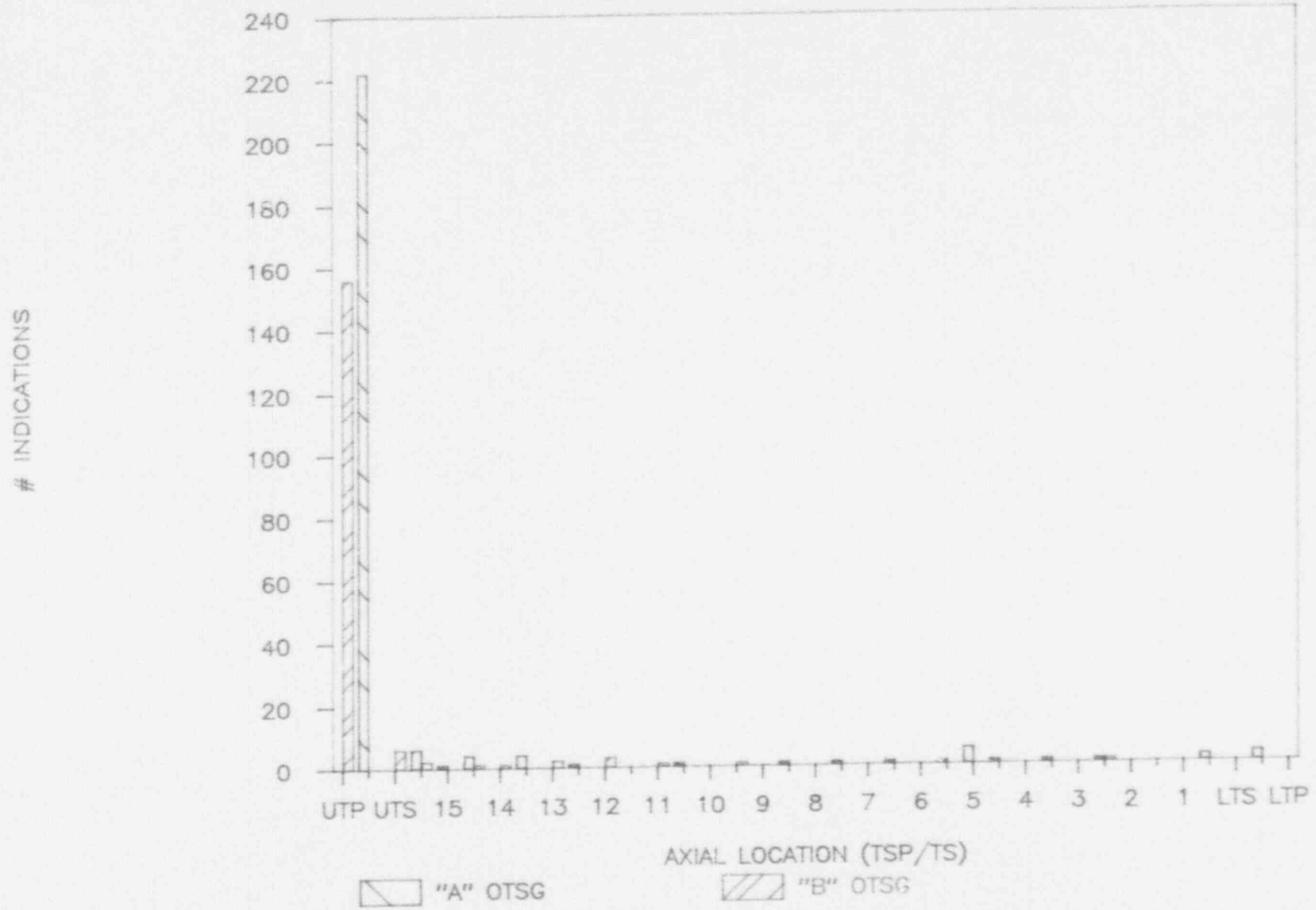


FIGURE 3

FIGURE 4

TUBES TO BE PLUGGED DURING 03/92 RFO

PLANT: ARKANSAS UNIT 1

GENERATOR: A

● = TUBES TO BE PLUGGED DURING 1910 (234)

TOTAL TUBES : 15531
SUPPORT RODS () : 48

TOTAL TUBES ASSIGNED : 234
OUT OF SERVICE (/) : 235

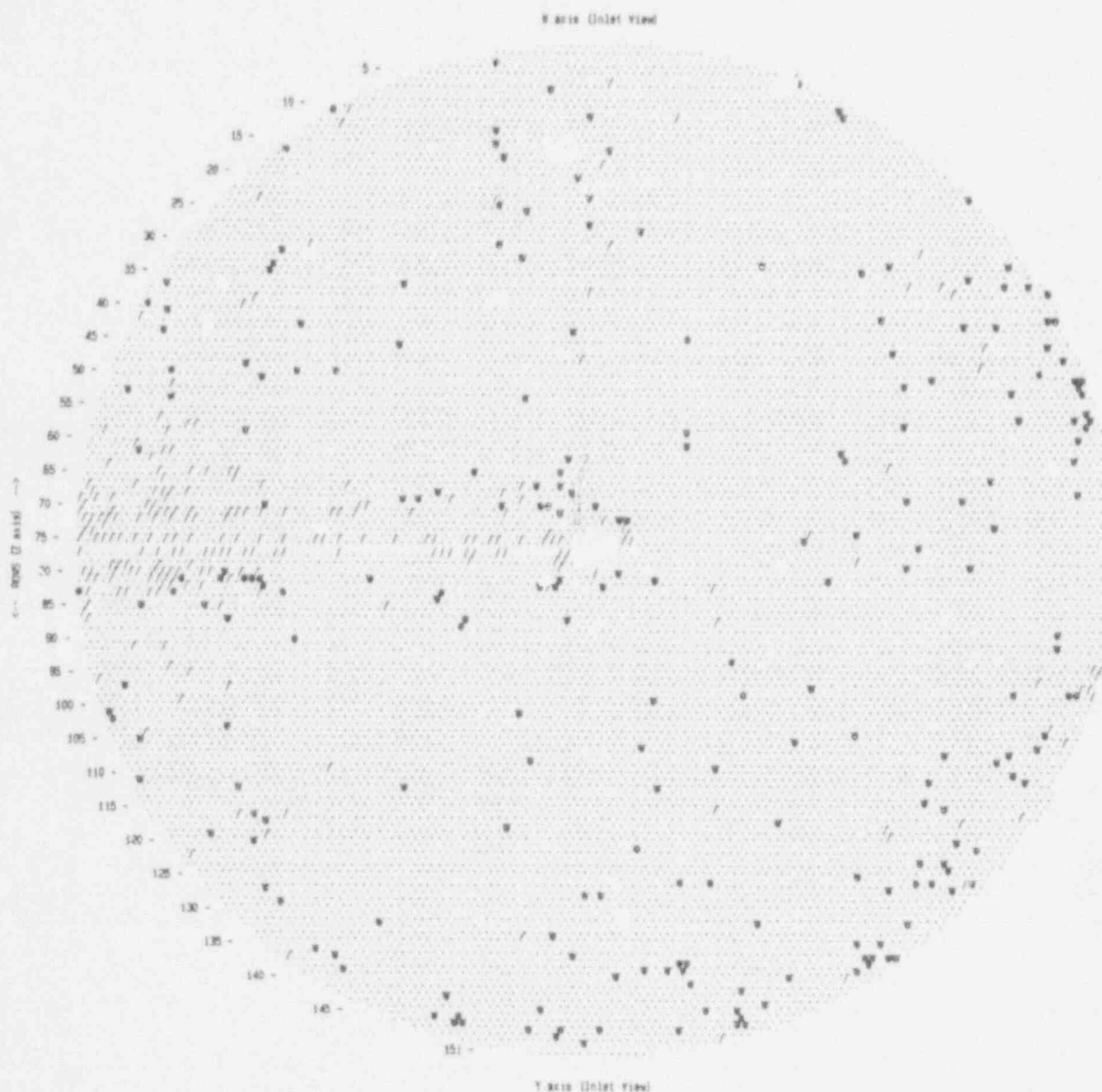


FIGURE 5

TUBES SLEEVED DURING 03/92 RFO - 31" AND 80" SLEEVES

PLANT: ARKANSAS UNIT 1

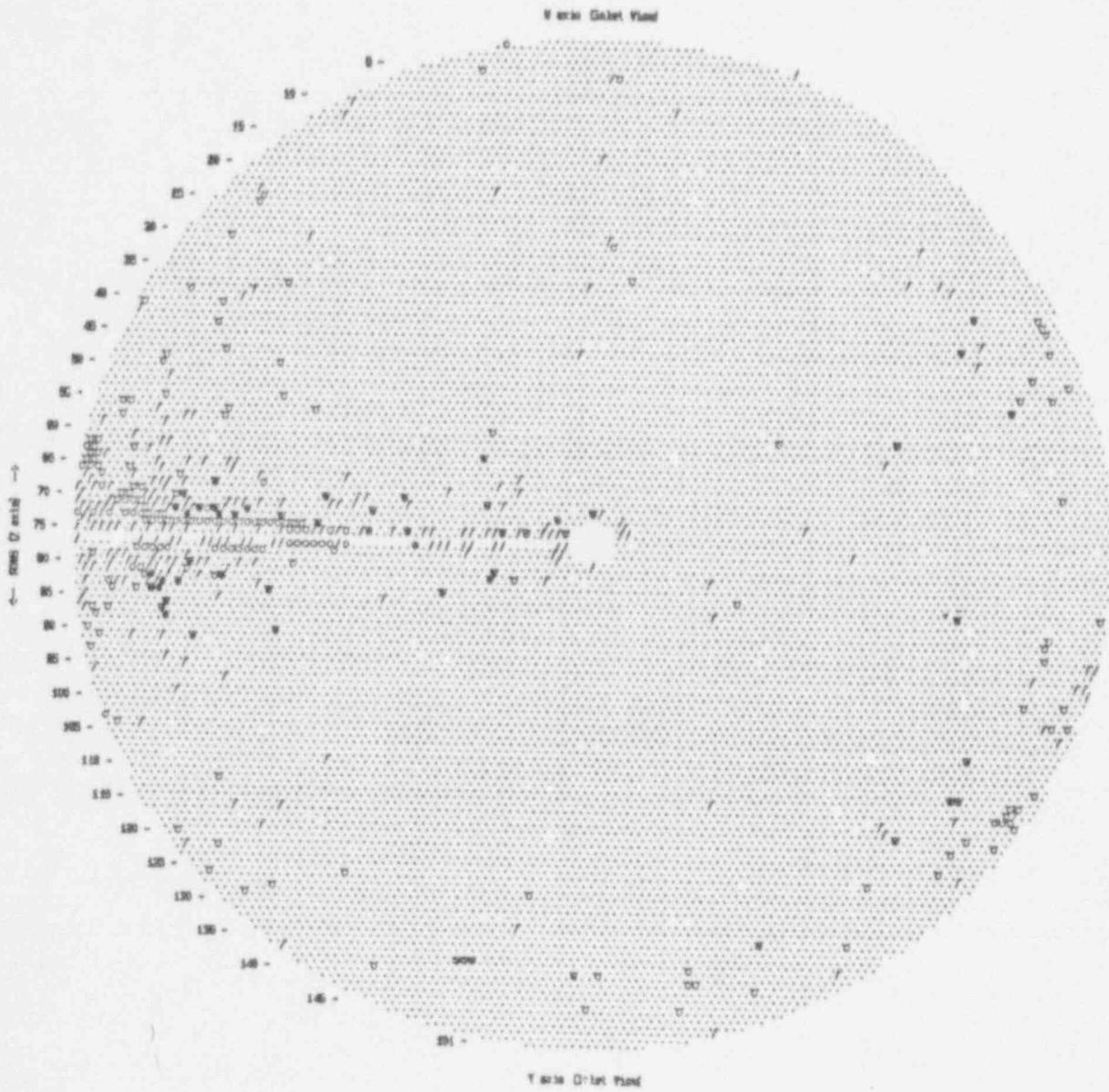
GENERATOR: A

● = TUBES WITH 31" SLEEVES (54)

○ = TUBES WITH 80" SLEEVES (177)

TOTAL TUBES : 15531
SUPPORT RODS () : 48

TOTAL TUBES ASSIGNED : 231
OUT OF SERVICE (/) : 235



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FIGURE 6

TUBES TO BE PLUGGED DURING THE 03/92 RFD

PLANT: ARKANSAS UNIT 1

GENERATOR: B

● = TUBES TO BE PLUGGED - 03/92 RFD (68)

TOTAL TUBES : 15531
SUPPORT RODS () : 48

TOTAL TUBES ASSIGNED : 68
OUT OF SERVICE (/) : 108

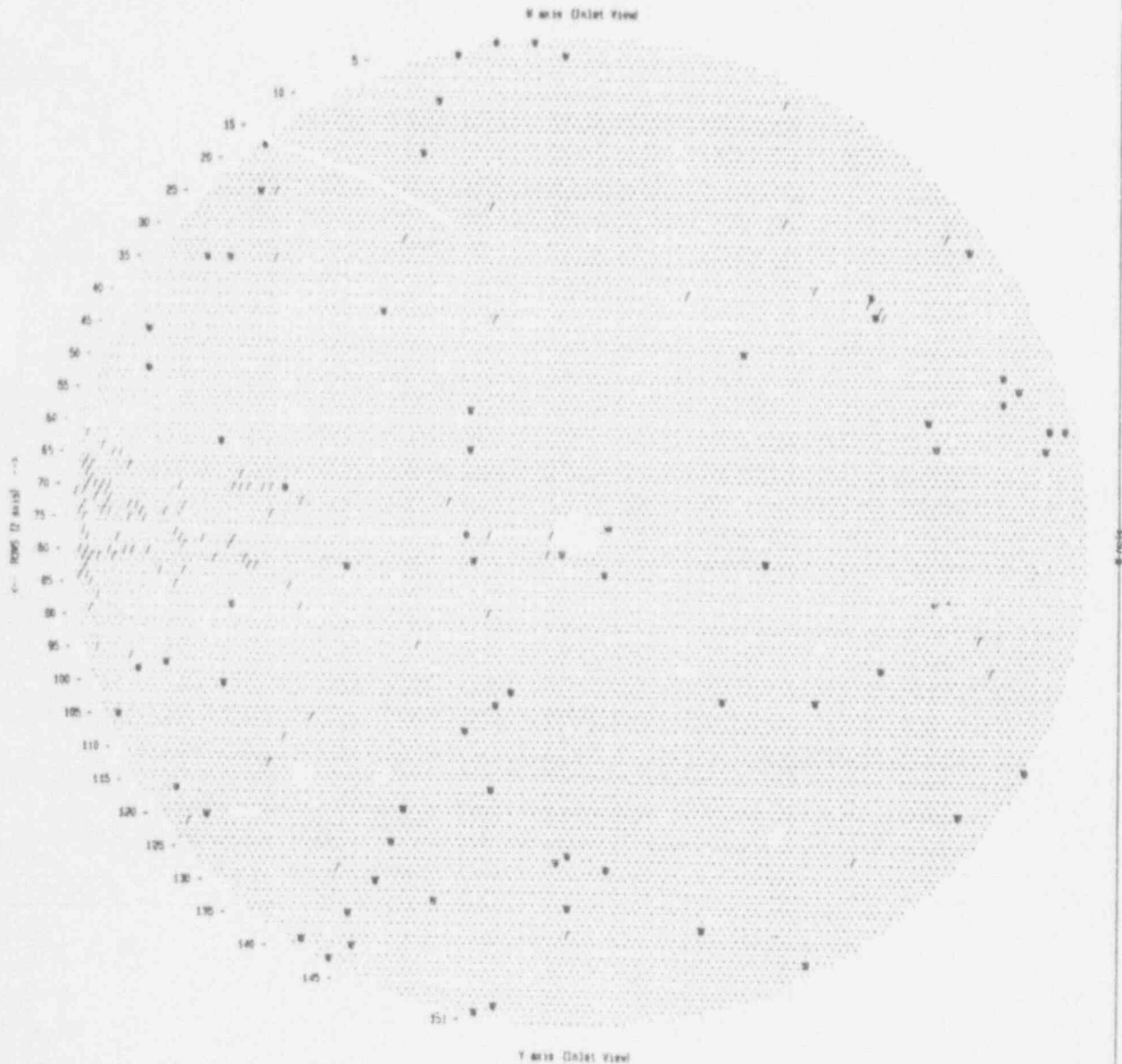


FIGURE 7

TUBES SLEEVED DURING 03/92 RFO - 31" AND 80" SLEEVES

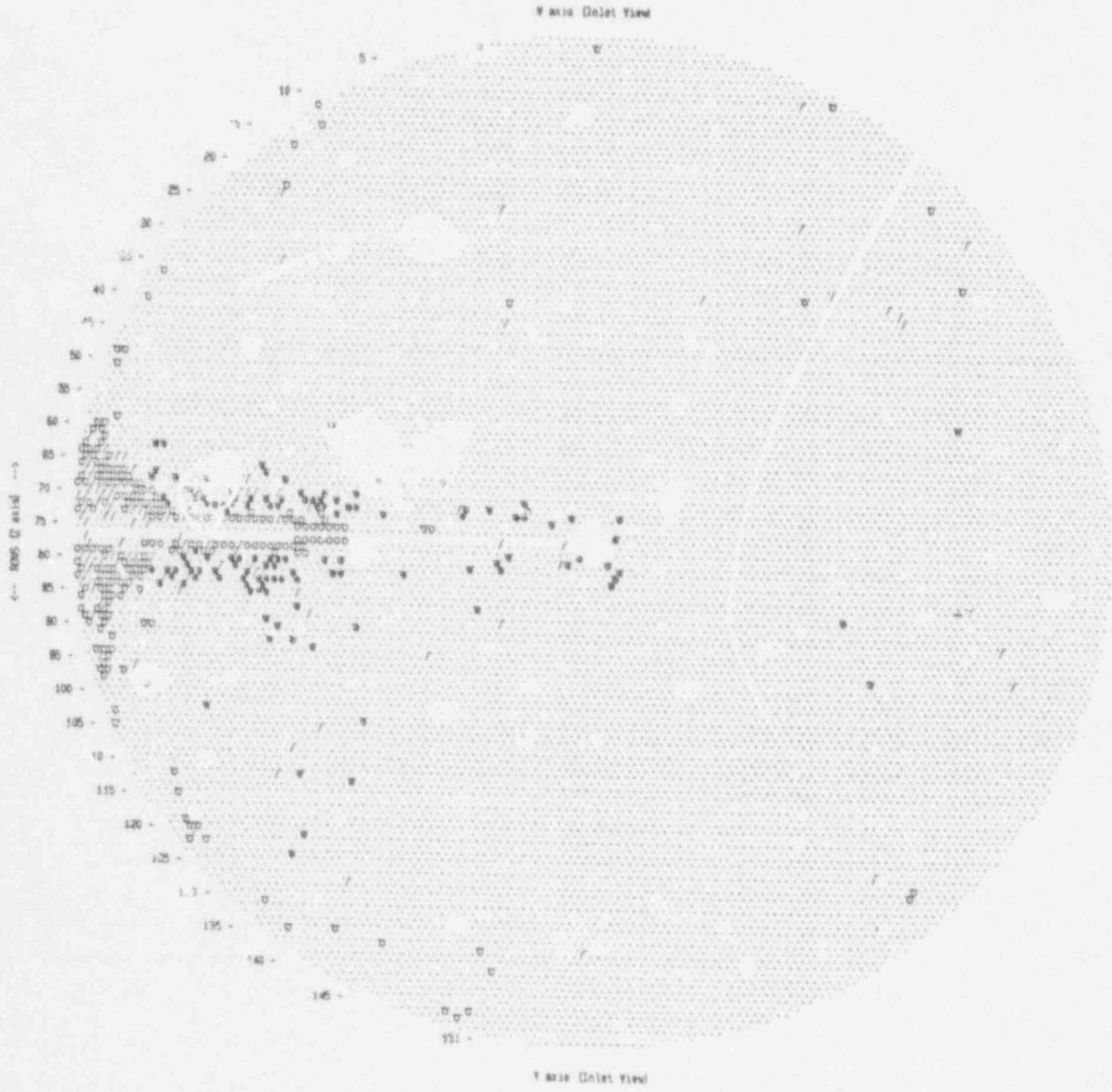
UNIT: A - ANSAS UNIT 1

GENERATOR: B

● = TUBES WITH 31" SLEEVES (124)

○ = TUBES WITH 80" SLEEVES (220)

TOTAL TUBES AFFECTED: 344
OUT OF SERVICE (V): 108



100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 2600 2700 2800 2900 3000 3100 3200 3300 3400 3500 3600 3700 3800 3900 4000 4100 4200 4300 4400 4500 4600 4700 4800 4900 5000 5100 5200 5300 5400 5500 5600 5700 5800 5900 6000 6100 6200 6300 6400 6500 6600 6700 6800 6900 7000 7100 7200 7300 7400 7500 7600 7700 7800 7900 8000 8100 8200 8300 8400 8500 8600 8700 8800 8900 9000 9100 9200 9300 9400 9500 9600 9700 9800 9900 10000

FIGURE 8

SLEEVES AND PLUGS EXISTING PRIOR TO THE 03/92 RFO

PLANT: ARKANSAS UNIT 1

GENERATOR: A

X = TUBES PLUGGED THROUGH 10/90 RFO (236)

◆ = TUBES SLEEVED THROUGH 10/90 RFO (176)

TOTAL TUBES : 15531
SUPPORT RODS () : 48

TOTAL TUBES ASSIGNED : 411

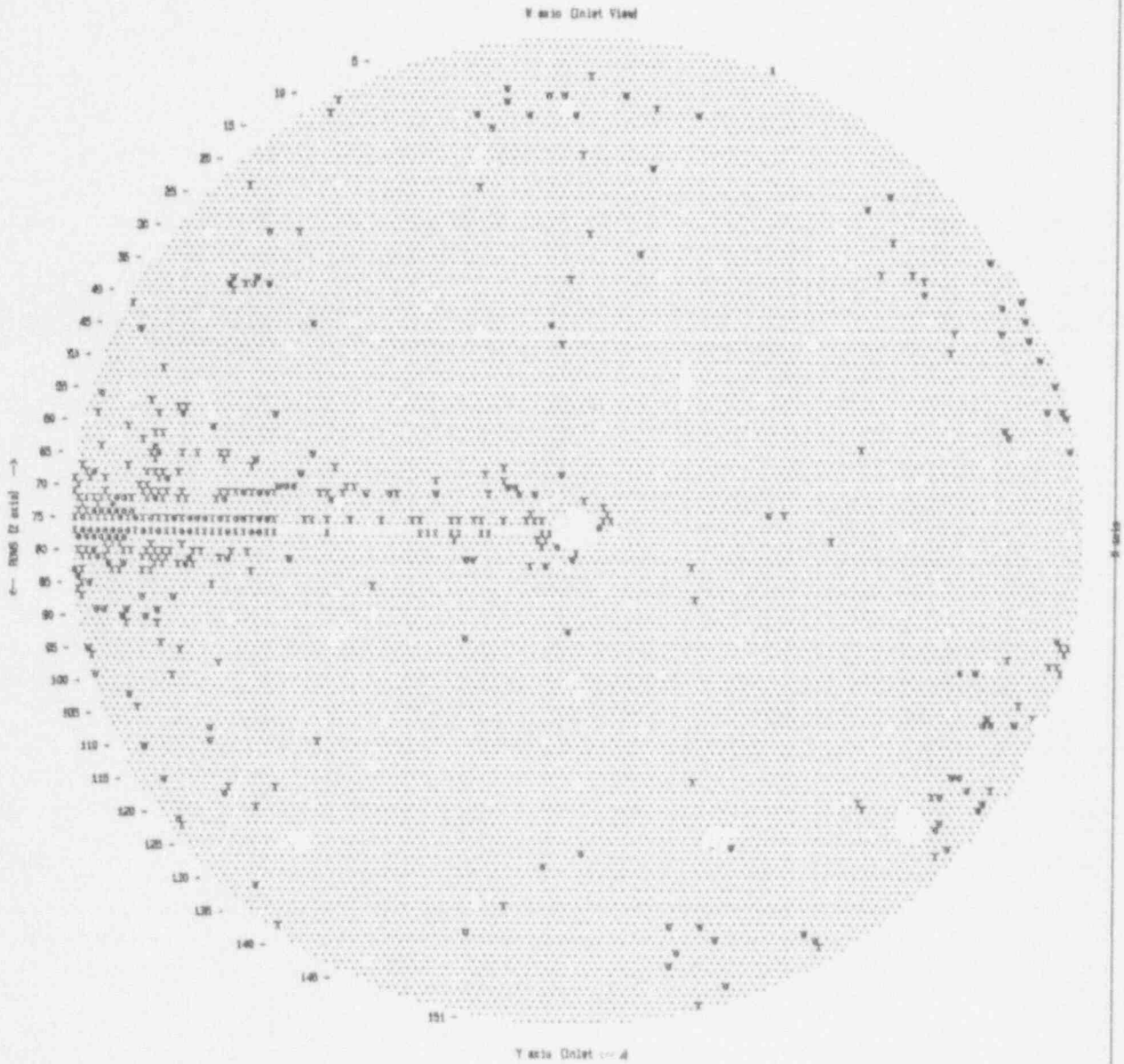


FIGURE 9

SLEEVES AND PLUGS EXISTING PRIOR TO THE 03/92 RFO

PLANT: ARKANSAS UNIT 1

GENERATOR: B

X = TUBES PLUGGED THROUGH 10/90 RFO (108)

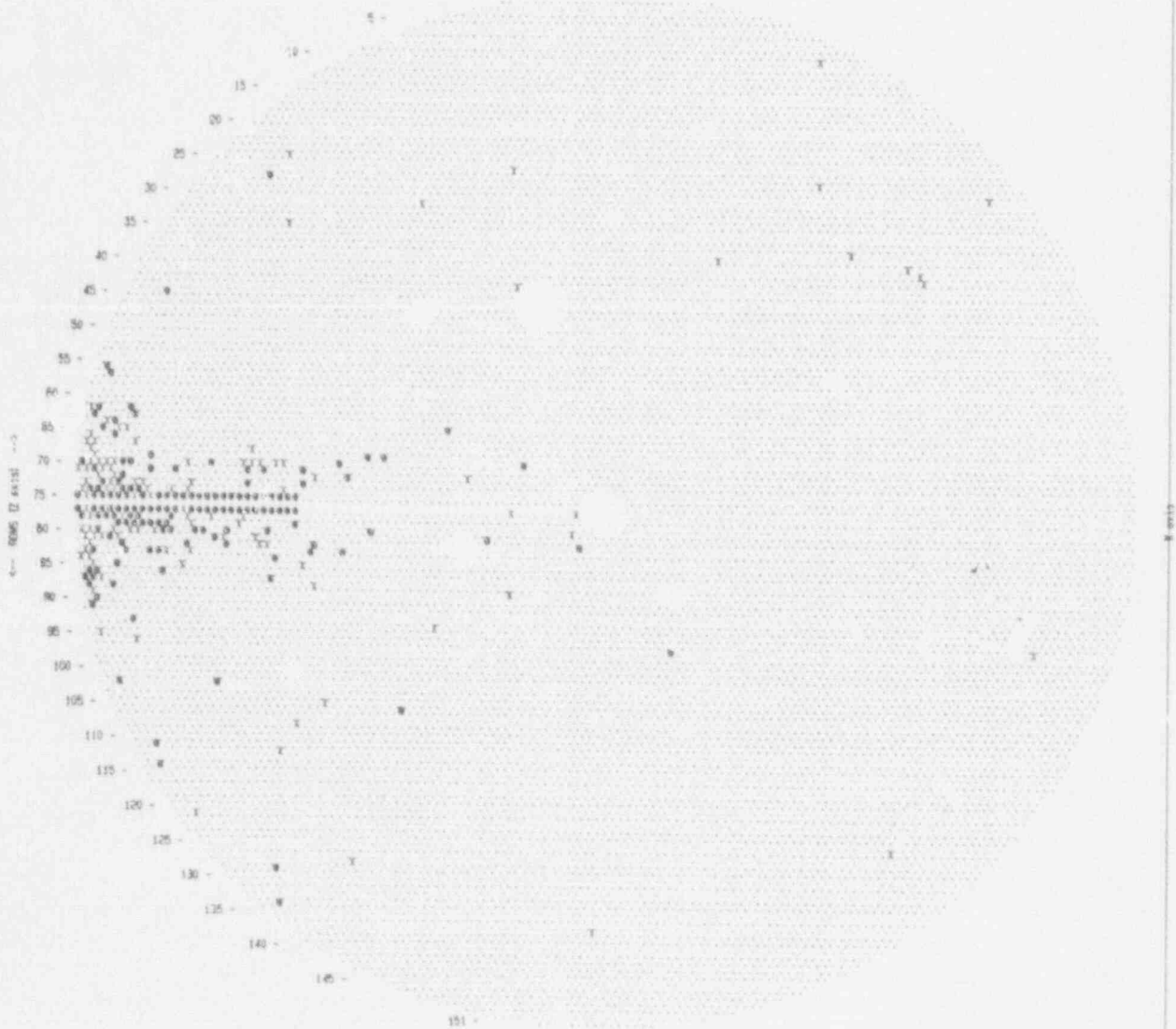
● = TUBES SLEEVED THROUGH 10/90 RFO (147)

TOTAL TUBES : 155

SUPPORT RODS () : 48

TOTAL TUBES ASSIGNED : 255

X axis Inlet View



Y axis Inlet View