

**Florida  
Power**

CORPORATION  
Crystal River Unit 3  
Docket No. 50-302

January 10, 1991  
3F0191-02

U.S. Nuclear Regulatory Commission  
Attention: Document Control Desk  
Washington, D.C. 20555

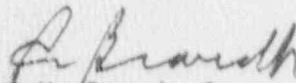
Subject: Eddy Current Testing Summary Report

Reference: FPC to NRC, letter dated June 15, 1990

Florida Power Corporation (FPC) is submitting the attached report on the Eddy Current Testing (ECT) performed at Crystal River Unit 3 (CR-3) during Refuel 7. FPC is providing this supplemental report as a response to a verbal request made by the NRC staff during a telecon held to discuss details of the Steam Generator Tube Plugging report (Reference A). That report was submitted in accordance with the requirements of Technical Specification (TS) Section 4.4.5.5. The report addressed the number, location and percent degradation of tubes plugged during the Refuel 7 Eddy Current Examination.

The supplemental report provides a summary of the inspection results, brief analysis of those results, FPC's future plans to continue to assure the long term integrity of the Once Through Steam Generators (OTSGs) at CR-3, and a brief conclusion. FPC is planning to meet with the NRC staff in January to discuss a variety of current topics including the ECT results and the plans.

Sincerely,

  
P.M. Beard, Jr.  
Senior Vice President  
Nuclear Operations

PMB:LVC

Attachment

xc: Regional Administrator, Region II  
NRR Project Manager  
Senior Resident Inspector

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## EDDY CURRENT TESTING SUMMARY REPORT

### INTRODUCTION

The eddy current testing (ECT) inspection results from the Spring 1990 outage are summarized below. The sample size and technique was based upon the recommendations of the EPRI, "PWR Steam Generator (SG) Examination Guidelines: Revision 2", (EPRI-NP 6201). EPRI, in their guidelines recommends:

- (1) A minimum random sample of 20%. CR-3 inspected 22%.
- (2) The utilization of specialized ECT techniques. CR-3 used 8x1 and Eddy360 (a rotating pancake type coil) probes extensively.
- (3) Examinations on areas known to be generic trouble spots. CR-3 identified several such special interest areas and thoroughly inspected each.

	<u>"A" SG</u>	<u>"B" SG</u>
Number of Tubes Inspected	3795	4154
Total Tube Indications	38	46
1 - 19%	19	18
20 to 39%	11	11
≥ 40%	8	17
Number of Tubes Plugged (Refuel 7)	10	24
Tubes Plugged To-date	20	50

"A" Steam Generator  
Summary of Plugged Tubes

<u>Tube</u>	<u>Defect Type</u>	<u>% Wall Loss</u>	<u>Remarks</u>
77-125	Wear	48%	Not previously inspected
69-130	Wear	43%	Not previously inspected
4-40	OD	38%	Not previously inspected
77-4	Wear	42%	Special interest
77-124	Wear	41%	Special interest
25-91	Wear	38%	Special interest
64-127	Wear	45%	Special interest
63-129	Wear	44%	Special interest
77-3	Wear	55%	Special interest
99-41	OD	45%	Special interest

The inspection of the "A" Steam Generator resulted in plugging ten (10) tubes. Three (3) of the tubes plugged were tubes that had not been inspected before. Seven (7) of the tubes had been identified as special interest tubes. Special interest tubes are defined as tubes containing from 1% to 40% wall loss; tubes three rows either side of the open lane; and, tubes containing indications that were below the threshold of clear signals. These tubes are tracked in the "special interest list", and reinspected for defect growth each time ECT is performed. The defects on these seven (7) tubes had grown to a size where it became necessary to remove them from service.

"B" Steam Generator  
Summary of Plugged Tubes

<u>Tube</u>	<u>Defect Type</u>	<u>% Wall Loss</u>	<u>Remarks</u>
125-9	Wear	42%	Not previously inspected
146-25	Wear	64%	Not previously inspected
27-93	Wear	70%	Not previously inspected
88-39	OD	47%	Not previously inspected
34-61	OD	61%	Not previously inspected
126-9	OD	66%	Not previously inspected
124-9	OD	38%	Special interest
28-93	OD	40%	Special interest
64-114	OD	38%	Special interest
78-49	OD	40%	Special interest
79-37	OD	55%	Special interest
124-39	OD	56%	Special interest
145-11	OD	61%	Special interest
87-59	No defect		Conservatively plugged to correct previous error
47-1	Administrative		Obstructed tube
46-1	Administrative		Surround obstructed tube
47-2	Administrative		Surround obstructed tube
48-1	Administrative		Surround obstructed tube
48-2	Administrative		Surround obstructed tube
96-33	Administrative		Burnish marks
98-28	Administrative		Burnish marks
98-44	Administrative		Burnish marks
109-34	Administrative		Burnish marks
116-46	Administrative		Burnish marks

The examination of the "B" steam generator resulted in plugging 24 tubes. Six (6) tubes that had never previously been inspected were plugged. Seven (7) tubes plugged had been identified as special interest tubes. Special interest tubes are defined as tubes containing from 1% to 40% wall loss; tubes three rows either side of the open lane; and, tubes containing indications that were below the threshold of clear signals. These tubes are tracked in the "special interest list", and reinspected for defect growth each time ECT is performed. The defects on these seven (7) tubes had grown to a size where it became necessary to remove them from service.

One (1) tube was plugged to correct a plugging error.

Five (5) tubes were plugged due to finding manufacturing burnish marks on the tube outer surface.

Five (5) additional tubes were plugged due to locating an obstruction approximately 39 inches from the top of one tube. This obstruction was lodged in a tube where high steam flow conditions exist (between the 15th tube support plate and the upper tube sheet). If that obstruction had developed into a through-wall defect causing the tube to sever, the severed tube could have damaged the surrounding tubes. Normal practice is to stabilize and plug a tube with defects in this sensitive cross flow area, but due to the obstruction, the tube could not be stabilized. Therefore, the four (4) surrounding tubes which contained no indications, were stabilized and plugged to capture the one tube containing the obstruction.

## ANALYSIS

The defects that required plugging in the "A" and "B" steam generators were generally found to be of two types: wear and OD defects. See Figures 1A, 1B, 2A and 2B for defect locations. OD indications were found generally distributed through-out both steam generators. Of the 12 tubes that were removed from service due to OD indications, none were located in a group or cluster of tubes. In addition, for each tube that was removed from service, all surrounding tubes were inspected (ECT) to determine if a localized degradation phenomena was starting. No other tubes required plugging. Therefore, it does not appear that there is any localized degradation occurring within the tube bundle.

Eleven (11) tubes were removed from service due to wear indications. Wear indications have predominantly been located between the 7th and 10th tube support plates in both steam generators. The practice to ECT all surrounding tubes of a plugged tube was also applied to tubes removed from service due to wear indications. In some cases one or two "plugged" tubes were clustered together but no localized degradation mechanism appears to be present. Refuel 7 was the first time ECT had been expanded to utilize the Eddy360 technique to look for wear. In addition, this outage was the first time CR-3 utilized wear calibration standards to be used by the Bobbin Coil and Eddy360 probes. CR-3 has in the past utilized some of these probe techniques in limited applications to look for wear but never to the extent employed during Refuel 7.

Additional analysis on the burnish marks that were found in the lower tube sheet area of the "B" steam generator, has started. This analysis is to review old ECT tapes from previous outages to determine if the burnish marks were identified and noted. This work will be completed within the next few months.

## FUTURE PLANS

To continue ensuring the integrity of the CR-3 Once Through Steam Generators (OTSG), FPC intends to achieve the following actions during Refuels 8 and 9 as noted below.

1. Expand Scope of ECT
  - ° ECT all tubes in "A" SG that have not been previously inspected (43%). This will be accomplished during Refuel 8.
  - ° ECT half (31%) of the tubes in "B" SG which have not been previously inspected. This will be completed during Refuel 8. The remaining tubes (31%) will be inspected during Refuel 9.
  - ° ECT all tubes (approximately 3% in each SG) in special interest areas during Refuels 8 and 9.
2. Contingent upon the results of the analysis on the burnish marks, the removal of tubes from the "B" SG may be necessary. Destructive analysis will be performed on the removed tubes to determine cause of degradation.
3. Prepare to sleeve tubes in "A" and "B" SGs (Refuels 8 and 9)
  - ° Sleeve defects.
  - ° Preventive sleeving along the lane.

## CONCLUSION

It appears that the CR-3 OTSGs are starting to experience in very limited instances, tube degradation in the forms of wear and OD indications similar to what has been experienced by other OTSGs. The table below presents a comparison of the total number of tubes plugged at CR-3 to other OTSGs.

<u>Plant</u>	<u>Total Tubes Plugged</u>	<u>Total Tubes Sleeved</u>	<u>Percent of SG ECT</u>
Davis Besse	61	0	43
CR-3	70	0	48
Oconee-2	124	258	78
Rancho Seco	223	508	51
Oconee-3	330	247	100
ANO-1	343	330	100
Oconee-1	676	450	100
TMI-1	1638	0	100

Figures 1A, 2A, 1B and 2B, reveal no groups or clusters of tubes which had been removed from service. A pattern would be evident if control of a critical operational or chemical parameter had been lost. Therefore, based on the data presented it can be concluded that the steam generators at Crystal River 3 are in good health, both operationally and chemically.



# TUBE PLUG STATUS - POST 4/90 OUTAGE

PLANT: CRYSTAL RIVER 3

GENERATOR: A

o = PLUGGED PRIOR TO 4/90 OUTAGE (10)

x = PLUGGED DURING 4/90 OUTAGE (10)

TOTAL TUBES : 15531  
SUPPORT RODS ( ) : 48

TOTAL TUBES ASSIGNED : 20

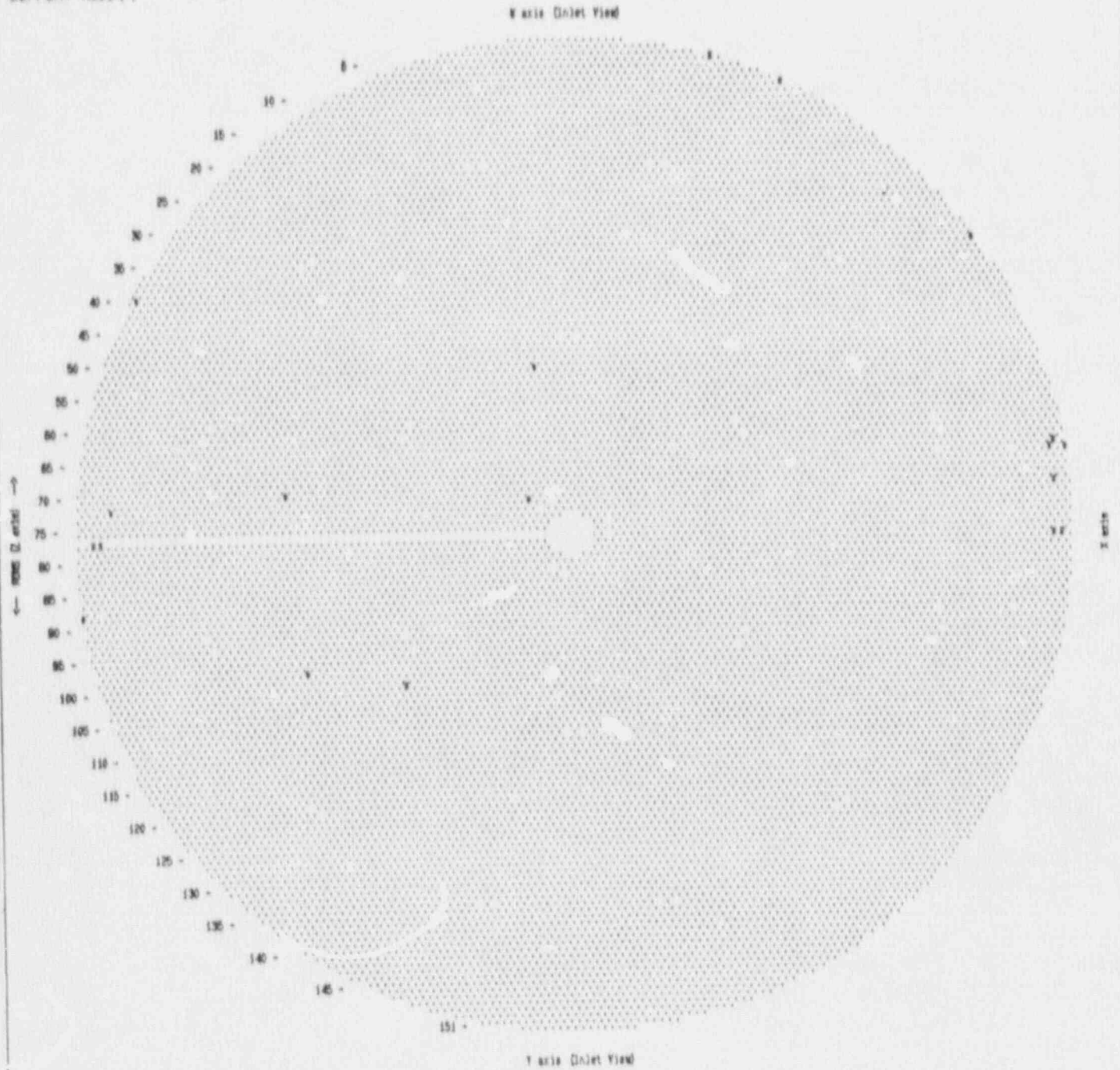


FIGURE 1A

# TUBE PLUG STATUS - POST 4/90 OUTAGE

PLANT: CRYSTAL RIVER 3

GENERATOR: B

0 = PLUGGED PRIOR TO 4/90 OUTAGE (26)

1 = PLUGGED DURING 4/90 OUTAGE (23)

2 = PLUG UTS ONLY & ITS PREVIOUS PLUG (1)

TOTAL TUBES : 15531

TOTAL TUBES ASSIGNED : 50

SUPPORT RODS ( ) : 48

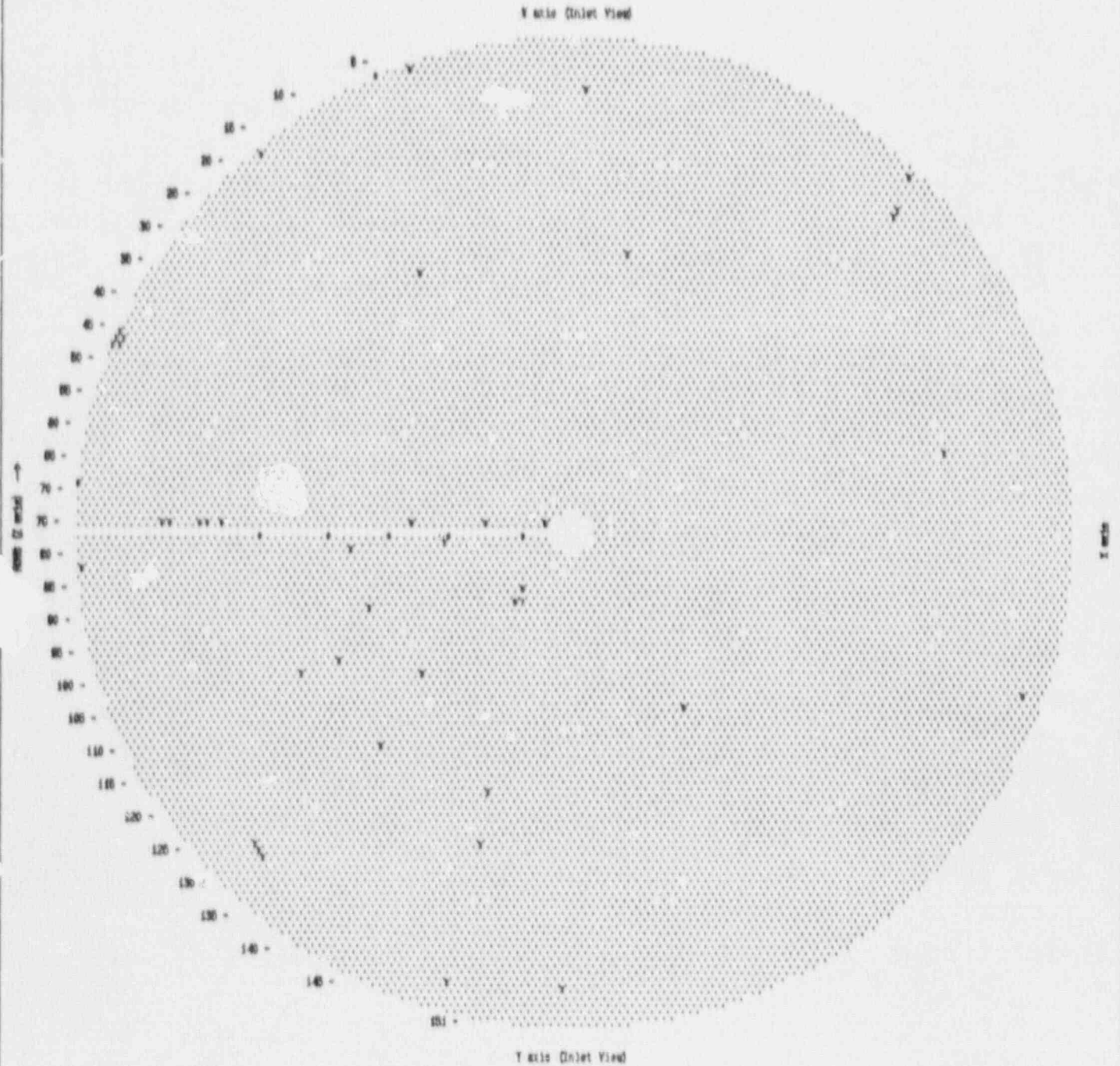
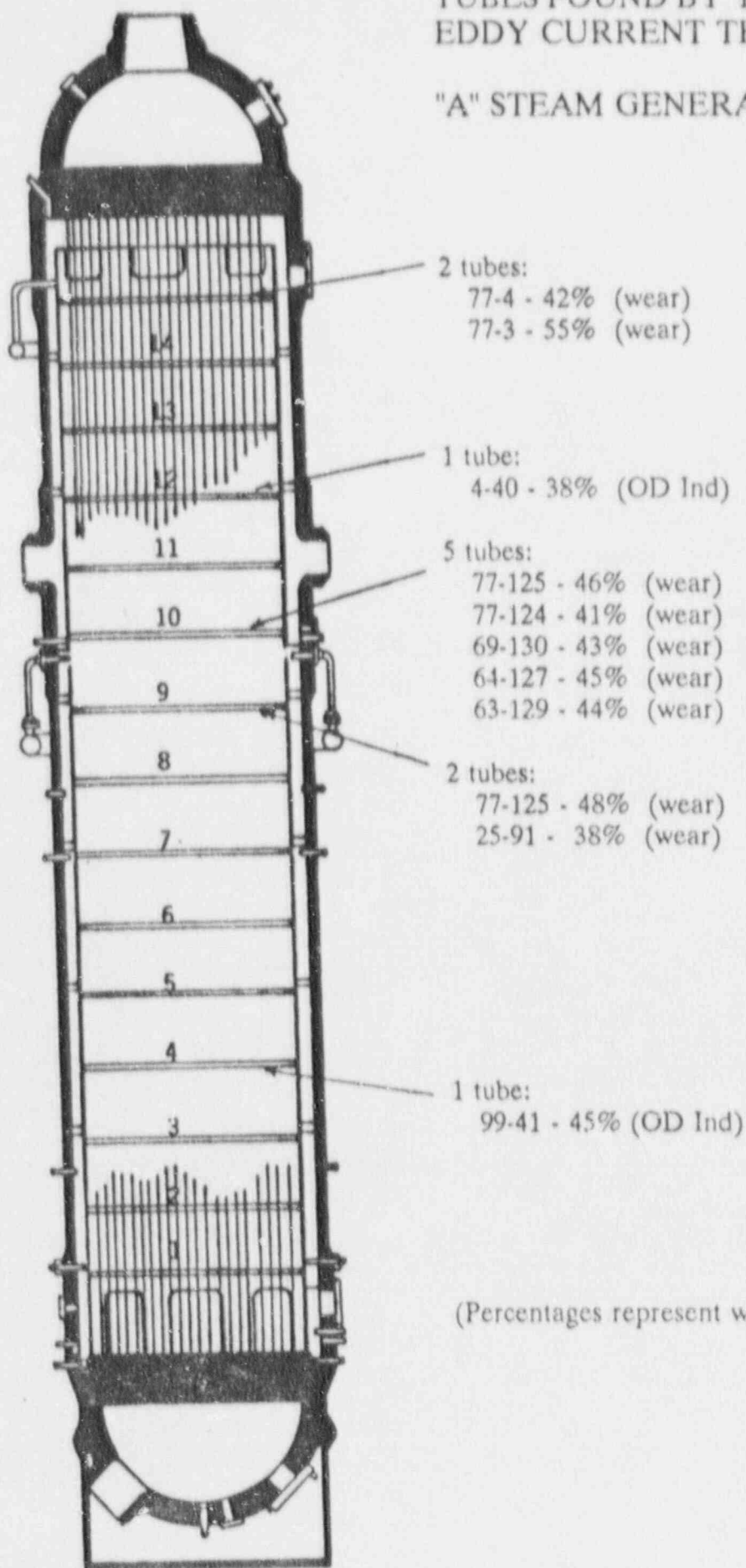


FIGURE 1B

LOCATION OF DEFECTIVE  
TUBES FOUND BY REFUEL 7  
EDDY CURRENT TESTING

"A" STEAM GENERATOR

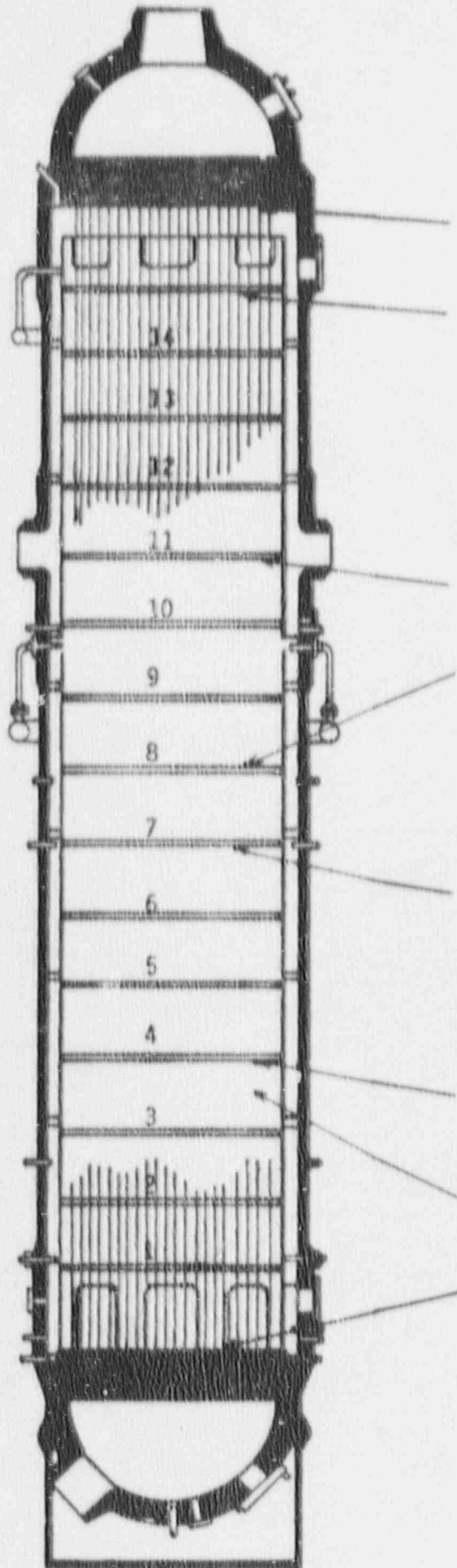


(Percentages represent wall loss)

FIGURE 2A

LOCATION OF DEFECTIVE  
TUBES FOUND BY REFUEL 7  
EDDY CURRENT TESTING

"B" STEAM GENERATOR



- 2 tubes:
  - 34-61 - 61% (OD Ind)
  - 78-49 - 40% (OD Ind)
- 1 tube obstructed  
(5 tubes plugged)
- 1 tube:
  - 79-37 - 55% (OD Ind)
- 5 tubes:
  - 27-93 - 67% (wear)
  - 28-93 - 40% (OD Ind)
  - 126-9 - 66% (OD Ind)
  - 125-9 - 42% (wear)
  - 146-25 - 64% (wear)
- 3 tubes:
  - 27-93 - 70% (wear)
  - 88-39 - 47% (OD Ind)
  - 124-39 - 56% (OD Ind)
  - 145-11 - 61% (OD Ind)
- 1 tube:
  - 64-114 - 38% (OD Ind)
- 1 tube:
  - 124-9 - 38% (OD Ind)
- 5 tubes:
  - 96-33 - 65% (Burnish mark)
  - 98-28 - 66% (Burnish mark)
  - 98-44 - 43% (Burnish mark)
  - 109-34 - 53% (Burnish mark)
  - 116-46 - 54% (Burnish mark)

Figure 2B