

May 14, 1985

LICENSEE: Northeast Nuclear Energy Company
FACILITY: Millstone Nuclear Power Station, Unit No. 2
SUBJECT: SUMMARY OF MEETING WITH NORTHEAST NUCLEAR ENERGY COMPANY
CONCERNING EDDY CURRENT TEST (ECT) RESULTS ON MILLSTONE UNIT 2

A meeting was held with Northeast Nuclear Energy Company (NNECO) on May 1, 1985 at the Commission's Offices in Bethesda, Maryland. The purpose of the meeting was to convey information about the ECT results before and after chemical cleaning of the steam generator at Millstone 2.

Background

Degradation of steam generator tubes at Millstone 2 has been primarily caused by pitting. The cause of the pitting of the tubes is attributed to the build up of an iron-copper "sludge" on the secondary side. Because sludge lancing has been only partially successful in the removal of this sludge, NNECO chose to use a chemical cleaning process during the current outage to more effectively clean the generators. Chemical cleaning took place during the March - April 1985 time frame.

Prior to the cleaning, NNECO performed ECT on the steam generator tubes and concluded that approximately 600 tubes total would require sleeves (40% through-wall). After the cleaning, additional ECT were performed and the results indicated 2900 tubes would require sleeves. It is because of this significant difference that a meeting was requested to more fully understand the reasons for the differences and the mechanism responsible for tube degradation at Millstone 2.

Because Millstone 2 has already received staff approval during the prior outage ('83) to sleeve tubes, there are no Technical Specification changes associated with these ECT results.

A listing of meeting attendees (Enclosure 1) and slides shown at the meeting (Enclosure 2) are enclosed.

Summary of Presentation

The licensee concluded that:

1. It was not surprising or harmful that ECT detection of smaller volume pits were difficult in the presence of copper "sludge." Significant volume pits were detected by ECT even in the presence of the copper sludge.

2. The reason for finding small volume pits after cleaning is due to reduced noise and improved signal response resulting from copper removal and the use of a larger diameter ECT probe. Furthermore, they concluded that the chemical cleaning did not result in the formation of new defects or in the propagation of old defects.

The inspection of both steam generator has essentially been completed. An estimated 2900 tubes require sleeving. The licensee will sleeve these tubes as permitted by existing Technical Specifications. The estimated radiation dosage for the present sleeving operation is 1100 person-rem.

Details supporting these conclusions are contained in Enclosure 2.

Schedule

Startup has been re-scheduled for July 1985 due to the greater than anticipated number of sleeves required. Although no Technical Specification change is required, the licensee will make a formal submittal of the data along with conclusions in about three weeks.

ORB#3:DL
D0sborne;vr
5/13/85

mk
5/13

MEETING SUMMARY DISTRIBUTION

DCR 016

Licensee: Northeast Utilities

*Copies also sent to those people on service (cc) list for subject plant(s).

Docket File

NRC PDR

L PDR

ORB#3 Rdg

Project Manager - DOsborne

JMiller

BGrimes

OELD

EJordan, IE

ACRS-10

PMorriette

NRC Meeting Participants:

BDLlaw

HConrad

CCheng

FCongel

SBlock

RPichumani

RTurovlin

VBenaroya

FWitt

CMcCracken

GHolahan

EMurphy

MWenger

WJohnston

LIST OF ATTENDEES

Nuclear Regulatory Commission

D. Osborne	DL/ORB#3
J. Miller	DL/ORB#3
B. D. Liaw	DE/MTEB
H. Conrad	DE/MTEB
C. Cheng	DE/MTEB
F. Congel	DSI/RAB
S. Block	DSI/RAB
R. Pichumani	DE/MEB
R. Turovlin	DE/MTEB
V. Benaroya	DE/CHEB
F. Witt	DE/CHEB
C. McCracken	DE/CHEB
G. Holahan	DL/ORAB
E. Murphy	DL/ORAB
M. Wegner	IE/DEPER
W. Johnston	DE

Northeast Utilities

M. Childers
R. Kacich
J. Klisiewicz
J. Fackelmann
J. Benson
J. LaPlatney
J. Ely
J. Kelley

EPRI

S. Brown
C. Wetty

Others

R. Huston	Delian Corp.
L. Connor	NRC Calendar
J. DeRoy	NY Power Authority
J. Bates	INPO
B. Hawkins	Babcock & Wilcox
C. Brinkman	Combustion Engineering
C. Batt	Bechtel Corp.

DOCKET NO. 50-336

MILLSTONE NUCLEAR POWER STATION, UNIT NO. 2

STEAM GENERATOR CHEMICAL CLEANING

STEAM GENERATOR TUBE INSPECTIONS

MAY 1, 1985

INTRODUCTION & PURPOSE

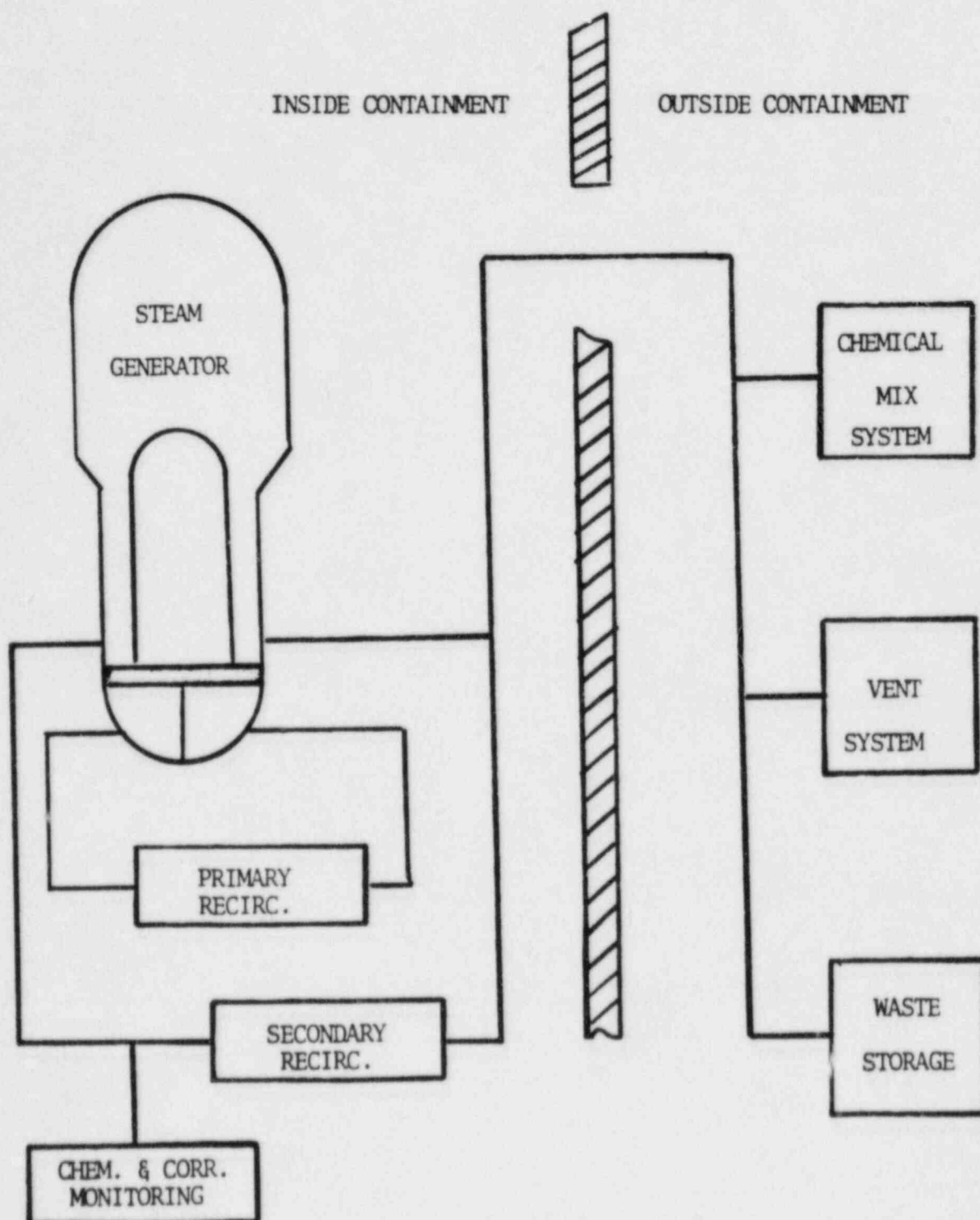
- o DECEMBER 5, 1984 - NRC/NNECO MEETING
CHEMICAL CLEANING PROCESSES
- o PRE-CHEMICAL CLEANING ECT VS. POST-CHEMICAL CLEANING ECT
- o EXPECTED VS. ACTUAL SLUDGE REMOVED
- o CONVEY INFORMATION

MEETING AGENDA

- o INTRODUCTION R. M. KACICH
- o CHEMICAL CLEANING RESULTS J. W. KLISIEWICZ
- o PRE/POST-CHEMICAL CLEANING J. M. FACKELMANN
 - PITTING DETECTABILITY
 - ECT RESULTS
- o DISPOSITION OF PITTING CONCERNS J. M. FACKELMANN
- o SLEEVING PROGRAM J. F. ELY
- o ALARA J. J. LAPLATNEY
- o CONCLUSIONS R. M. KACICH

INDUSTRY COMMUNICATIONS

- o ELECTRIC POWER RESEARCH INSTITUTE (EPRI)
- o INSTITUTE OF NUCLEAR POWER OPERATIONS (INPO)
- o STEAM GENERATOR OWNER'S GROUP (SGOG)



STEAM GENERATOR CHEMICAL CLEANING

MILLSTONE UNIT 2
STEAM GENERATOR TUBESHEET CHEMICAL CLEANING

NOMINAL PROCESS TEMPERATURES

CHECK-OUT RINSE	AMBIENT - 200°F
FE SOLVENT	200°F
FE RINSES (COOLDOWN)	200°F - 100°F
CU SOLVENT	100°F
CU RINSE (HEATUP)	100°F - 200°F
PASSIVATION	200°F

MILLSTONE UNIT 2
STEAM GENERATOR TUBESHEET CHEMICAL CLEANING

PROCESS SEQUENCE

SG1 (2 FE, 6 CU):

R, FE, R, R, CU, CU, CU, CU, R, FE, R, R, CU, CU, R, P, WLU

SG2 (2 FE, 4 CU):

R, FE, R, R, CU, CU, CU, R, FE, R, R, CU, R, WLU

R - RINSE

FE - IRON STEP

CU - COPPER STEP

P - PASSIVATION

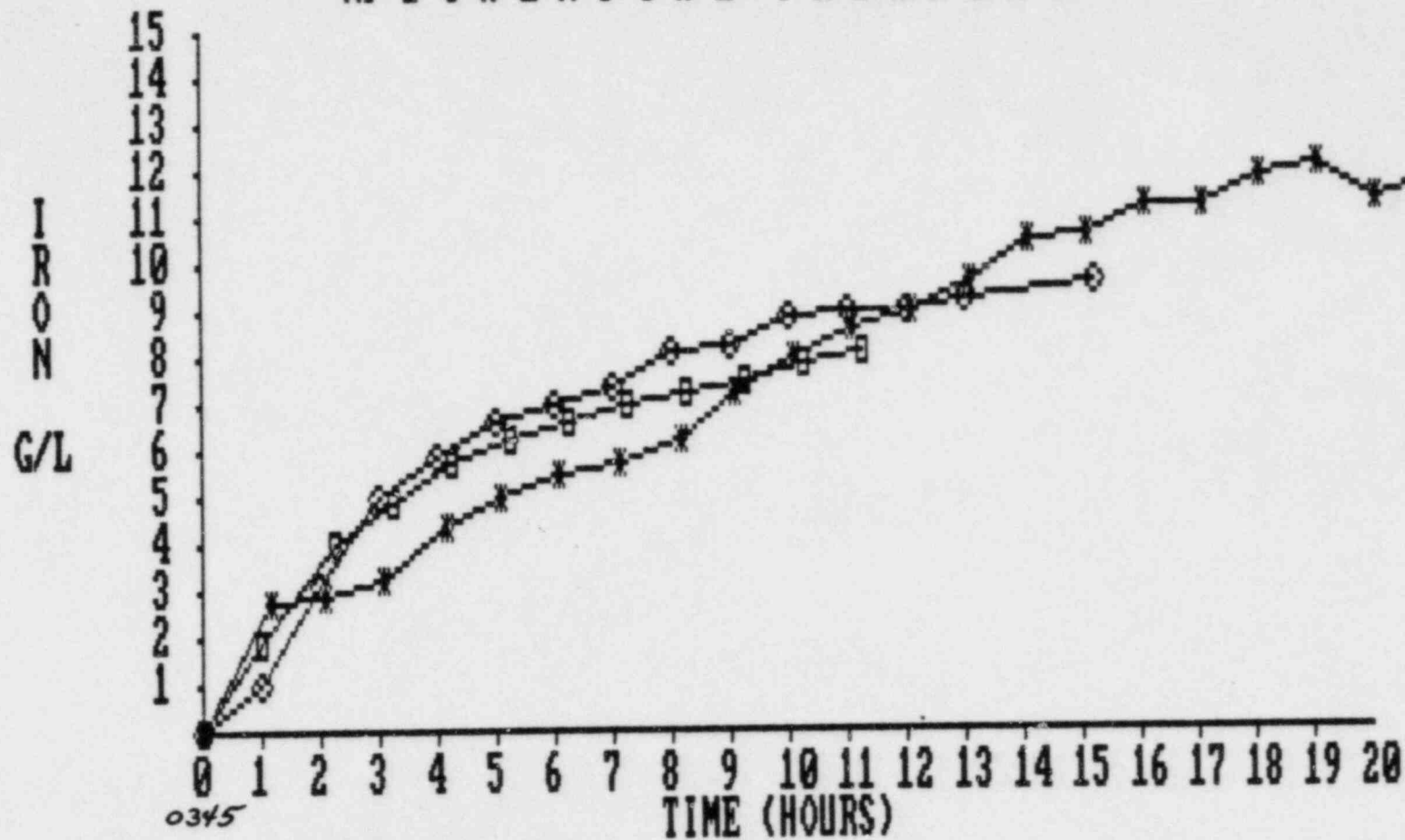
WLU - WET LAYUP

MILLSTONE UNIT 2
STEAM GENERATOR TUBESHEET CHEMICAL CLEANING

NOMINAL PROCESS TIMES (HRS.)

	<u>SG1</u>	<u>SG2</u>
TOTAL FE SOLVENT CONTACT TIMES:	22	15
TOTAL CU SOLVENT CONTACT TIMES:	32	12
TOTAL FE RINSE TIMES:	13	12
TOTAL CU RINSE TIMES:	12	10
CHECKOUT RINSE DURATIONS:	24	12
PASSIVATION RINSE TIMES:	16	12
PASSIVATION TIMES:	8	--
OTHERS (E.G. DELAYS, LEARNING CURVES):	<u>82</u>	<u>30</u>
TOTAL HOURS:	209	103

MP-2 CHEMICAL CLEANING

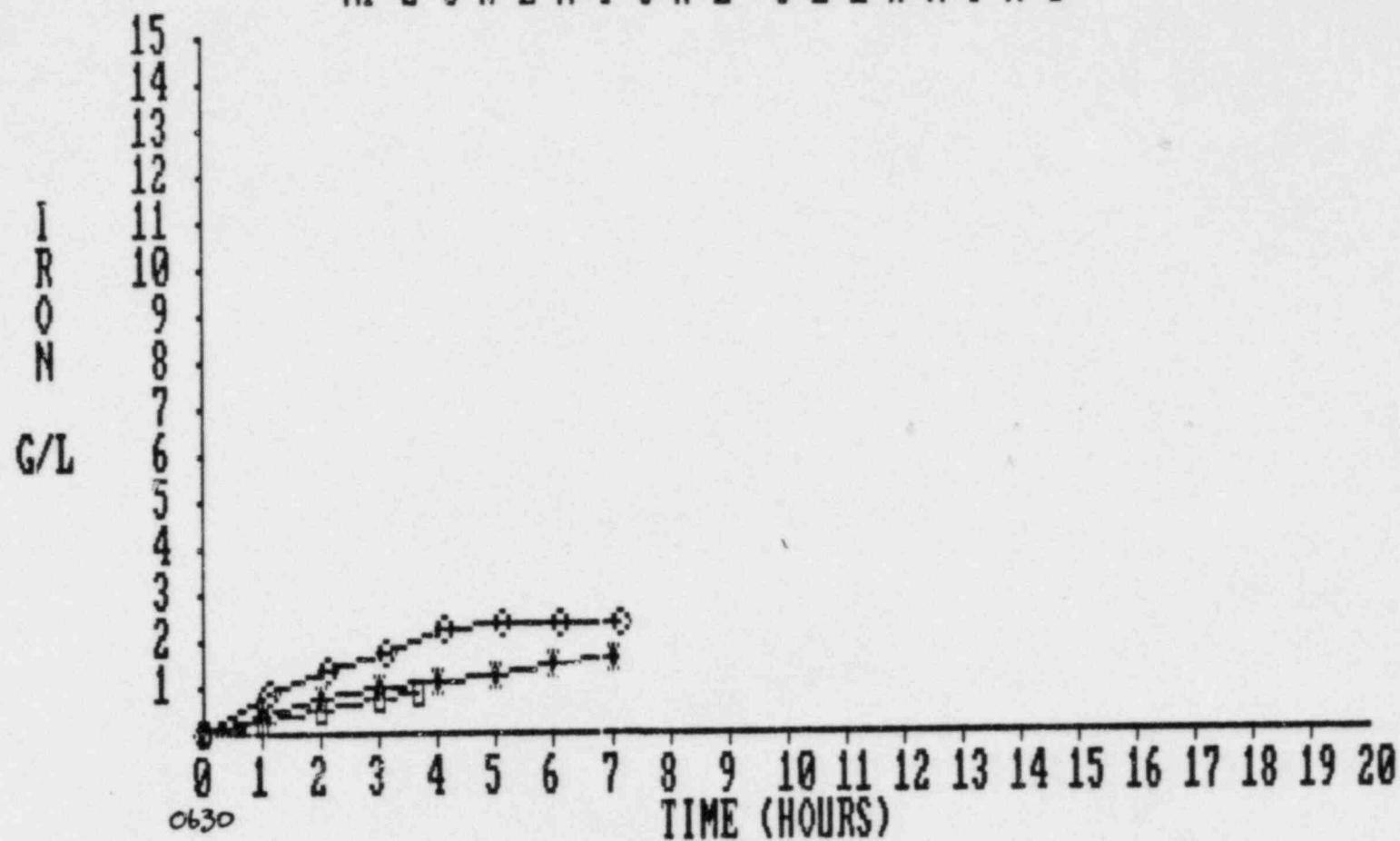


□ = 2-FE-1

* = N27FE1

◇ = FE-1

MP-2 CHEMICAL CLEANING

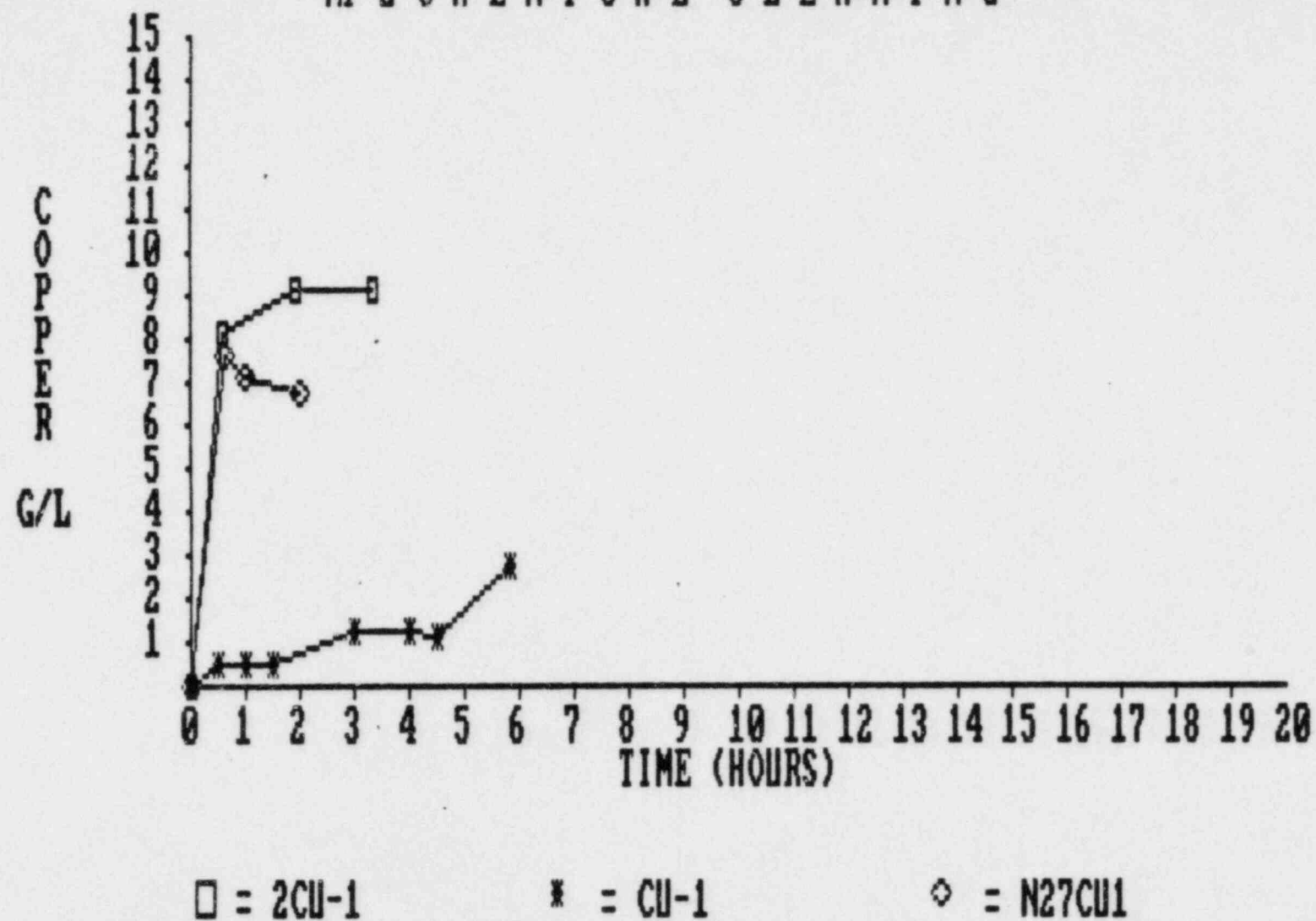


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* = fe-2

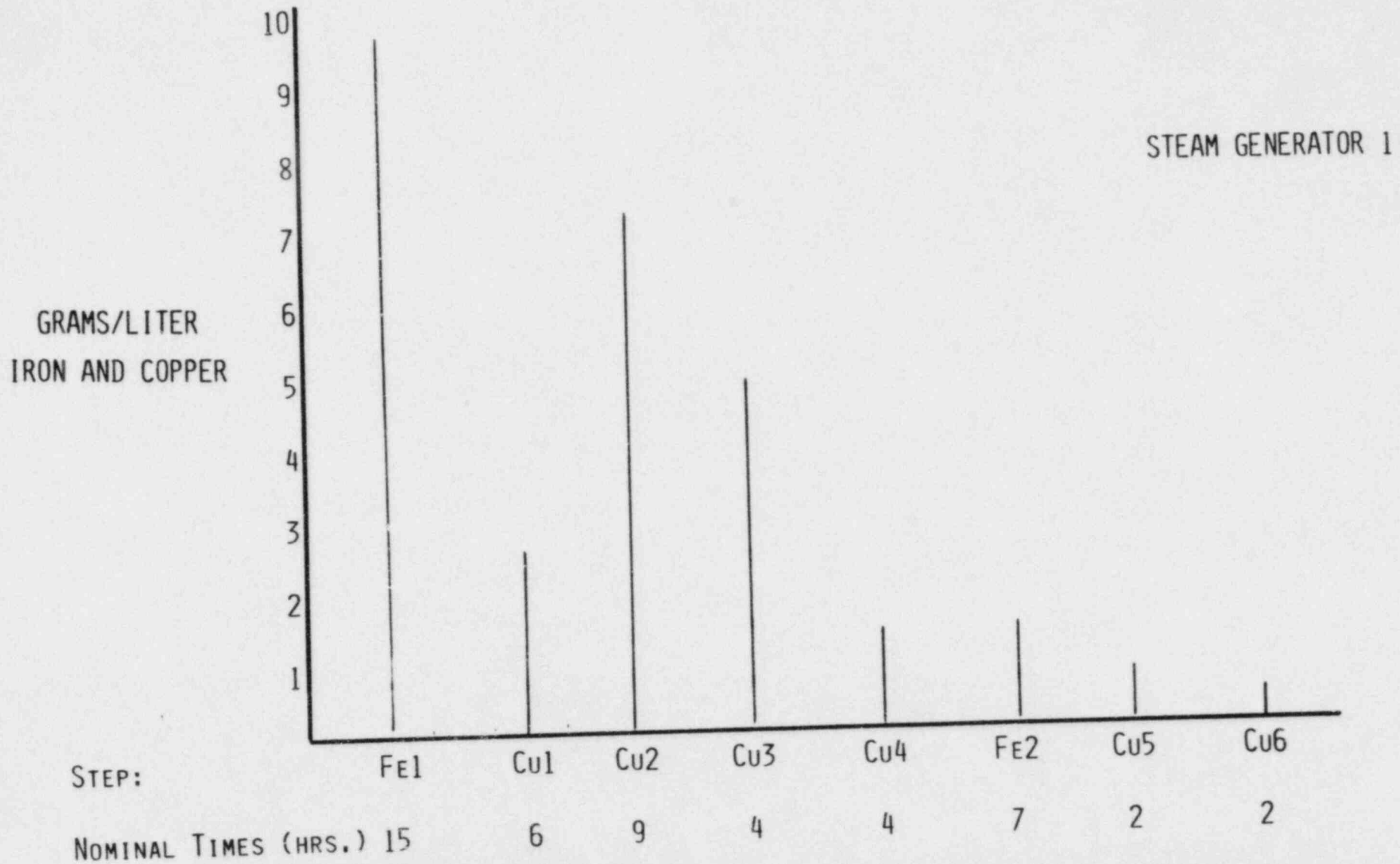
◇ = N27FE7

MP-2 CHEMICAL CLEANING



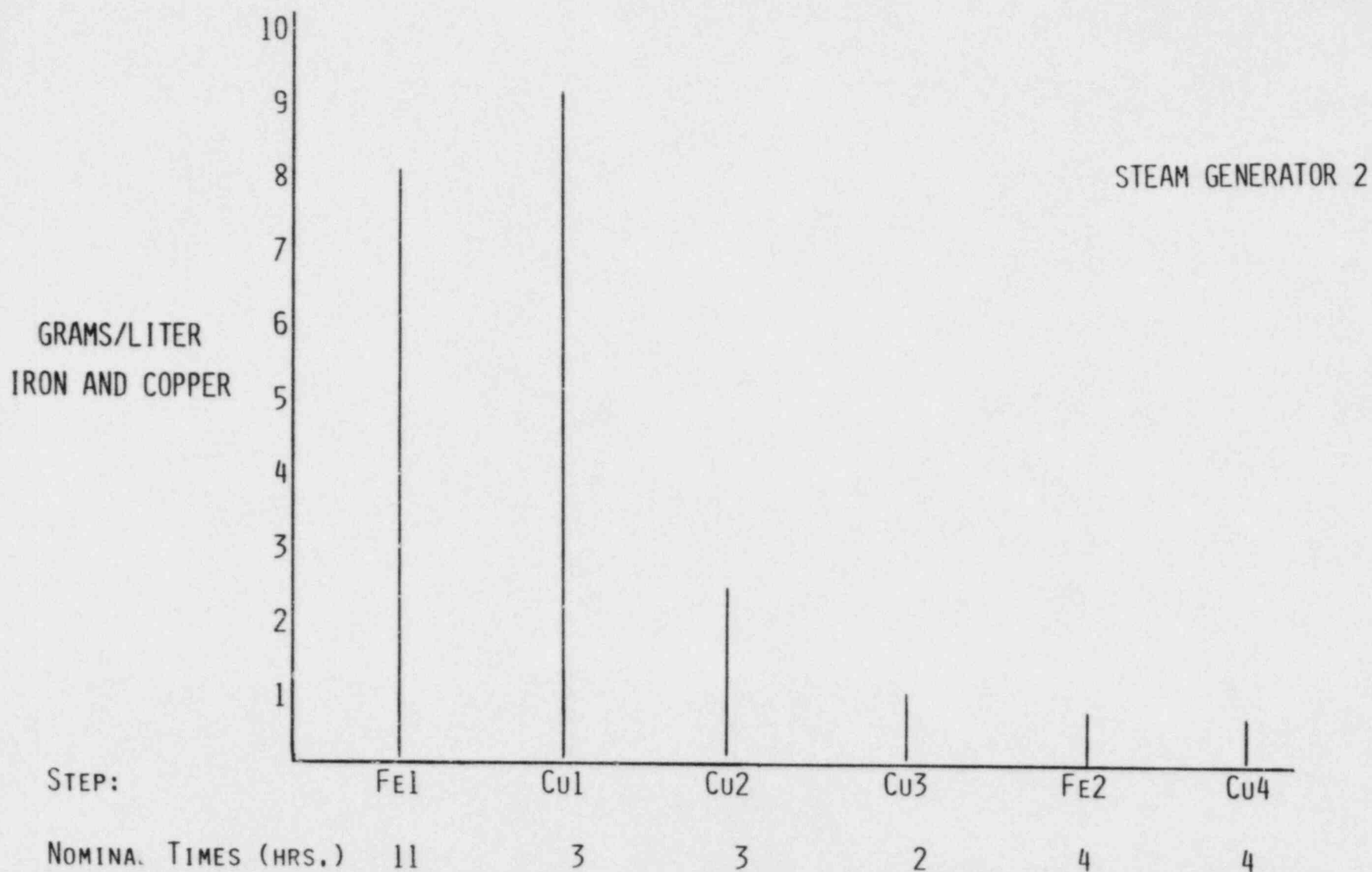
MILLSTONE UNIT 2
STEAM GENERATOR TUBESHEET CHEMICAL CLEANING

IRON AND COPPER PICKUP



MILLSTONE UNIT 2
STEAM GENERATOR TUBESHEET CHEMICAL CLEANING

IRON AND COPPER PICKUP



MILLSTONE UNIT 2
STEAM GENERATOR TUBESHEET CHEMICAL CLEANING

PRELIMINARY SLUDGE REMOVAL DATA

	<u>SG1</u>	<u>SG2</u>
o PRE-CLEANING SLUDGE LANCING (LBS):	300	225
o CHEMICAL CLEANING (LBS):		
DISSOLVED FE (AS Fe_3O_4)	154	119
DISSOLVED CU (AS COPPER)	156	140
DISSOLVED ZN (AS ZnO)	23	21
DISSOLVED NI (AS NiO)	7	7
SUSP. SOLIDS	<u>13</u>	<u>3</u>
CHEMICAL CLEANING SUBTOTAL (LBS):	353	290
o POST CLEANING SLUDGE LANCING (LBS):	40	TO BE COMPLETED
	—	—
TOTAL LBS REMOVED:	693	(515 TO DATE)

MILLSTONE UNIT 2
STEAM GENERATOR TUBESHEET CHEMICAL CLEANING

PRELIMINARY PRE/POST
CHEMICAL CLEANING SLUDGE HEIGHTS
STEAM GENERATOR 1: COLD LEG

<u>LINE</u>	<u>ROW</u>	<u>PRE CLEANING</u> <u>SLUDGE HEIGHT (IN.)</u>	<u>POST CLEANING</u> <u>SLUDGE HEIGHT (IN.)</u>	<u>HEIGHT</u> <u>CHANGE (IN.)</u>
70	58	13.0	4.8	-8.2
69	69	12.5	3.6	-8.9
119	25	12.3	3.4	-8.9
56	18	11.8	1.5	-10.3
130	38	9.9	2.1	-7.8
58	8	9.5	3.5	-6.0
139	17	8.1	2.8	-5.3
127	55	6.9	2.6	-4.3
81	89	5.5	3.1	-2.4
60	116	4.0	1.6	-2.4
128	92	2.4	0.2	-2.2
128	98	1.7	0.3	-1.4
12	40	0.8	0.0	-0.8

MILLSTONE UNIT 2
STEAM GENERATOR TUBESHEET CHEMICAL CLEANING

CORROSION RESULTS

<u>CATEGORY</u>	<u>MP2 LIMITS</u>	<u>QUALIFICATION RESULTS (MILs)</u>	<u>PRELIMINARY DATA* (MILs)</u>	
			<u>SG1</u>	<u>SG2</u>
TUBING	7.0	0.02	0.003	0.003
EGGCRATE	11.0	0.03	0.01	0.04
SECONDARY SHELL	91.2	6.1	2.8	2.4
WELDS	270.0	21.0	3.6	3.4
TUBESHEET	550.0	10.6	3.0	5.9

* MAXIMUM WEIGHT LOSS VALUE FROM EITHER STEAM GENERATOR OR PROCESS
MONITOR CORROSION COUPONS.

EPRI/STEAM GENERATOR OWNERS
GROUP (SGOG) AND NU DATA ADDRESSING
ALLOY 600 SMALL VOLUME DEFECTS

o FULL FILL STEAM GENERATOR CHEMICAL CLEANING:

20% EDTA, pH 6, PROCESS TIME:
260 HOURS (225 HOURS @ 250°F) PLUS A 45 DAY
RESIDUAL EFFECTS TEST

- NO INDICATIONS OF TUBE SURFACE CORROSION
- NO MORPHOLOGICAL CHANGES OF PRE-PITTED SPECIMENS
OBSERVED.

o CHEMICAL CLEANING TEST UTILIZING ACTUAL MILLSTONE UNIT 2
PITS:

15% EDTA, pH 7, PROCESS TIME:
45 HOURS (33 HOURS @ 200°F) PLUS A 10 DAY RESIDUAL
EFFECTS TEST

- NO MORPHOLOGICAL CHANGES OBSERVED

o MILLSTONE UNIT 2 SITE SPECIFIC QUALIFICATION TEST:

15% EDTA, pH 7, PROCESS TIME:
253 HOURS (107 HOURS @ 200°F) PLUS A
30 DAY RESIDUAL EFFECTS TEST

- NO INDICATIONS OF TUBE SURFACE CORROSION
- NO OBSERVABLE EFFECTS ON PRE-DAMAGED SPECIMENS

EPRI/STEAM GENERATOR OWNERS
GROUP (SGOG) AND NU DATA ADDRESSING
ALLOY 600 SMALL VOLUME DEFECTS

o MILLSTONE UNIT 2 TUBESHEET CHEMICAL CLEANING:

15% EDTA, pH 7 PROCESS TIMES:

SG1 209 HOURS (22 HOURS @ 200°F)

SG2 103 HOURS (15 HOURS @ 200°F)

- NO INDICATIONS OF TUBE SURFACE CORROSION

SUPPLEMENTAL DATA
ALLOY 600 SMALL VOLUME DEFECTS (PITTING)

TEMPERATURE EFFECT

o EPRI (RPS308-1) REPORT SUMMARY; DATED MARCH 15, 1985:

"PITTING CORROSION OF ALLOY 600 STEAM GENERATOR TUBING:
RESULTS OF A LABORATORY SCOPING STUDY," CONTRACTOR-BATTELLE,
COLUMBUS LABORATORIES.

- STEAM GENERATOR PITTING, A MID-TO-HIGH TEMPERATURE PHENOMENON
- IN THE LABORATORY, PITS OF THE APPROPRIATE MORPHOLOGY OCCUR ONLY AT
TEMPERATURES EXCEEDING APPROXIMATELY 150°C (302°F)

CONCLUSIONS

- o CURRENT DATA INDICATES THAT TUBESHEET SLUDGE INVENTORIES OF BOTH MILLSTONE UNIT 2 STEAM GENERATORS HAVE BEEN ESSENTIALLY REMOVED.
- o TUBESHEET CHEMICAL CLEANING DID NOT RESULT IN THE FORMATION OF NEW DEFECTS ON HEAT TRANSFER TUBING.
- o TUBESHEET CHEMICAL CLEANING DID NOT RESULT IN THE PROPAGATION OF OLD DEFECTS ON HEAT TRANSFER TUBING.

MILLSTONE 2 STEAM GENERATOR
EDDY CURRENT TESTING
1985 REFUELING OUTAGE

- o TECHNIQUE/QUALIFICATION/TESTING
- o RESULTS PRE, POST CLEANING
- o CONCLUSIONS

ELECTRONICS 1985 EXAMINATION

MIZ-18 DIGITAL EDDY CURRENT TESTER SYSTEM

- o 16 CHANNELS
- o 8 MIXES
- o MULTIFREQUENCY
- o MULTICOIL
- o HP 9836 COMPUTER

DDA-4 DIGITAL DATA ANALYSIS SYSTEM

- o COMPATABLE WITH MIZ-18
- o HP9836 COMPUTER
- o SIGNAL ISOLATION
- o DYNAMIC RANGE COMPENSATION

PROBES

<u>INSPECTION</u>	<u>DIA., IN.</u>	<u>DESCRIPTION</u>
SLUDGE	540	STANDARD
FULL LENGTH	560	HIGH FREQUENCY MAGNETIC SATURATION NARROW FOCUS
FIRST EGGRATE PRECLEANING	580	HIGH FREQUENCY MAGNETIC SATURATION NARROW FOCUS
POSTCLEANING	580	HIGH FREQUENCY MAGNETIC SATURATION NARROW FOCUS (HOT LEG)
	600	HIGH FREQUENCY NARROW FOCUS (COLD LEG)
ROW 1	540	JOINTED FLEX
SLEEVES	520	DUAL CROSS WOUND DUAL BOBBIN COMBINATION
TOP OF TUBESHEET		EIGHT PANCAKE COIL ARRAY SURFACE RIDING

POTENTIAL FORMS OF DEGRADATION

PITTING

- o PIT DETECTION QUALIFIED FOR DIAMETERS ≥ 0.075 INCH IN THE PRESENCE OF MILS COPPER. (HIGH FREQUENCY PROBE DEVELOPMENT)
- o PITS DETECTED POSTCHEMICAL CLEANING APPEARS TO BE < 0.050 INCH DIAMETER BASED ON SIGNAL AMPLITUDE.
- o SIZING ACCURACY ESTABLISHED BY 1981 TUBE REMOVAL.

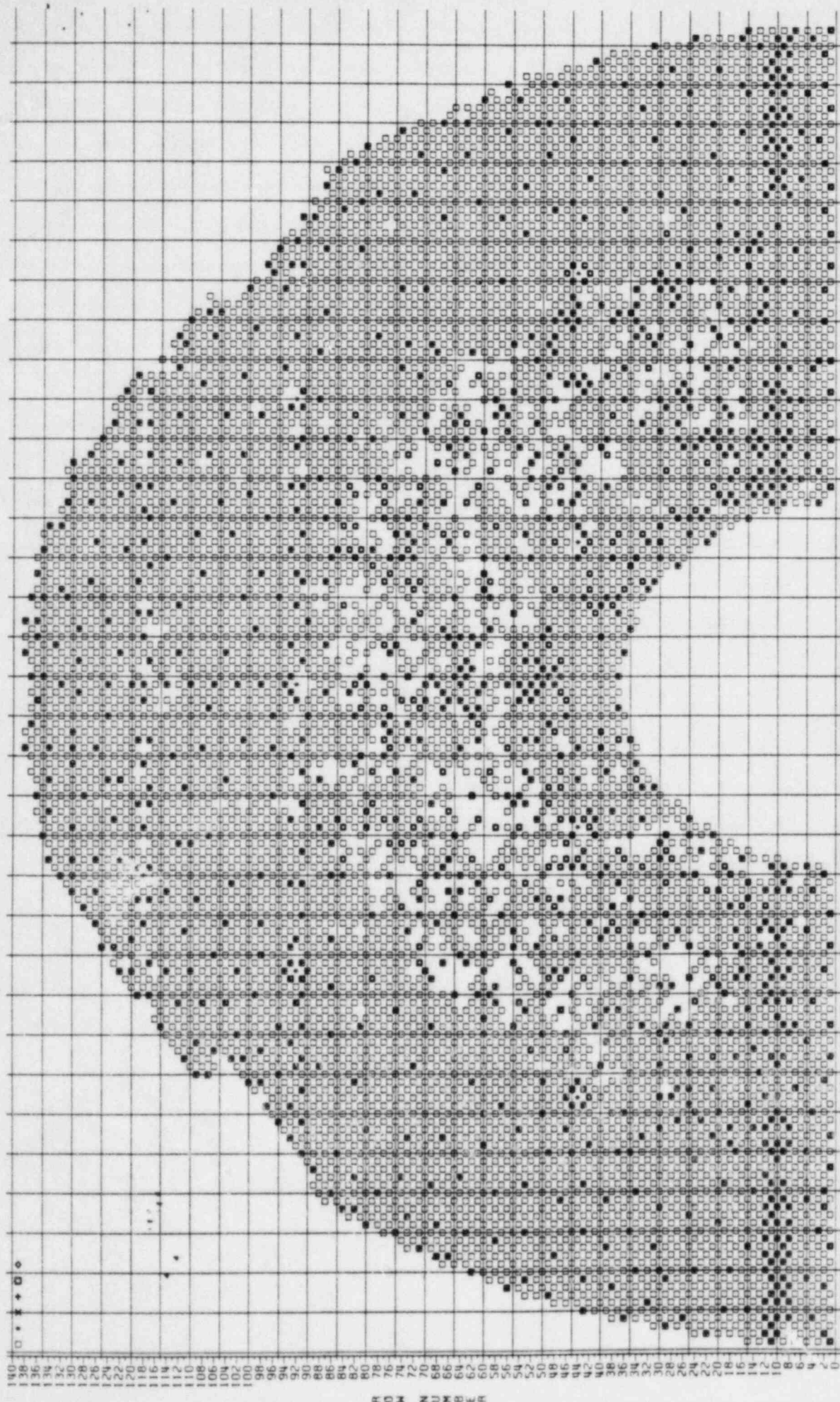
WASTAGE/WEAR

- o ASME CALIBRATION STANDARD ADEQUATE REPRESENTATION.

IGA/SCC

- o SURFACE RIDING PANCAKE ARRAY PROBES. SCC AND IGA IN THE PRESENCE OF DENTING.

FOR MP2 STEAM GENERATOR #1, 1985 OUTAGE

[illegible]

LINE NUMBER

X = U-BEND

* = FULL LENGTH
X = U-BEND

$$\text{SQUARE} = \text{FIRST EGG RATE}$$

DIAMOND = TESTED TO TOP OF SLEEVE
 SQUARE = FIRST LOCUS ONLY

ANGLE = RESTRICTED OR INCOMPLETE

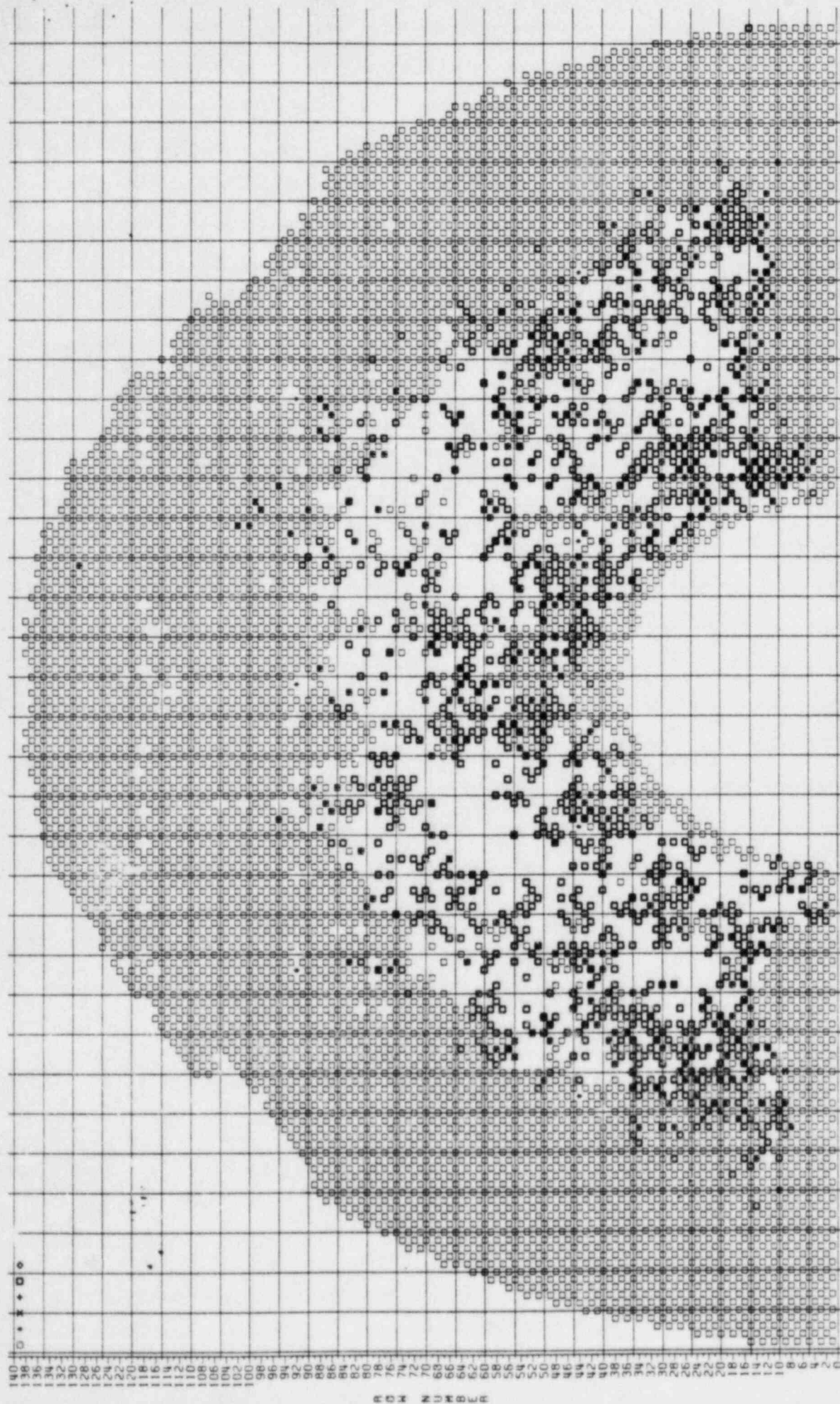
BLANK = PREVIOUSLY PLUGGED

MP2 STEAM GENERATOR TUBE FLAW PROGRESSION
JUNE 1983 TO MARCH 1985 (PRE CLEANING)
FOR FLAWS $\geq 20\%$ THROUGH WALL IN SG1 AND SG2

	<u>COLD SIDE</u> PROGRESSION			<u>HOT SIDE</u> PROGRESSION		
	NUMBER	AVERAGE	DEVIATION	NUMBER	AVERAGE	DEVIATION
TUBE FLAW ELEVATION						
TS (0" TO 1")	26	4	14	24	3	7
ATS (> 1")	25	20	16	.	.	.

	<u>TOTAL</u> PROGRESSION		
	<u>NUMBER</u>	<u>AVERAGE</u>	<u>DEVIATION</u>
TUBE FLAW ELEVATION			
TS (0" TO 1")	50	3	11
ATS (> 1")	25	20	16

STEAM GENERATOR #1, COLO SIDE, 1985 OUTAGE

[illegible]

LINE NUMBER

 $x = \text{FLAW} > 0\% \text{ AND } < 20\%$

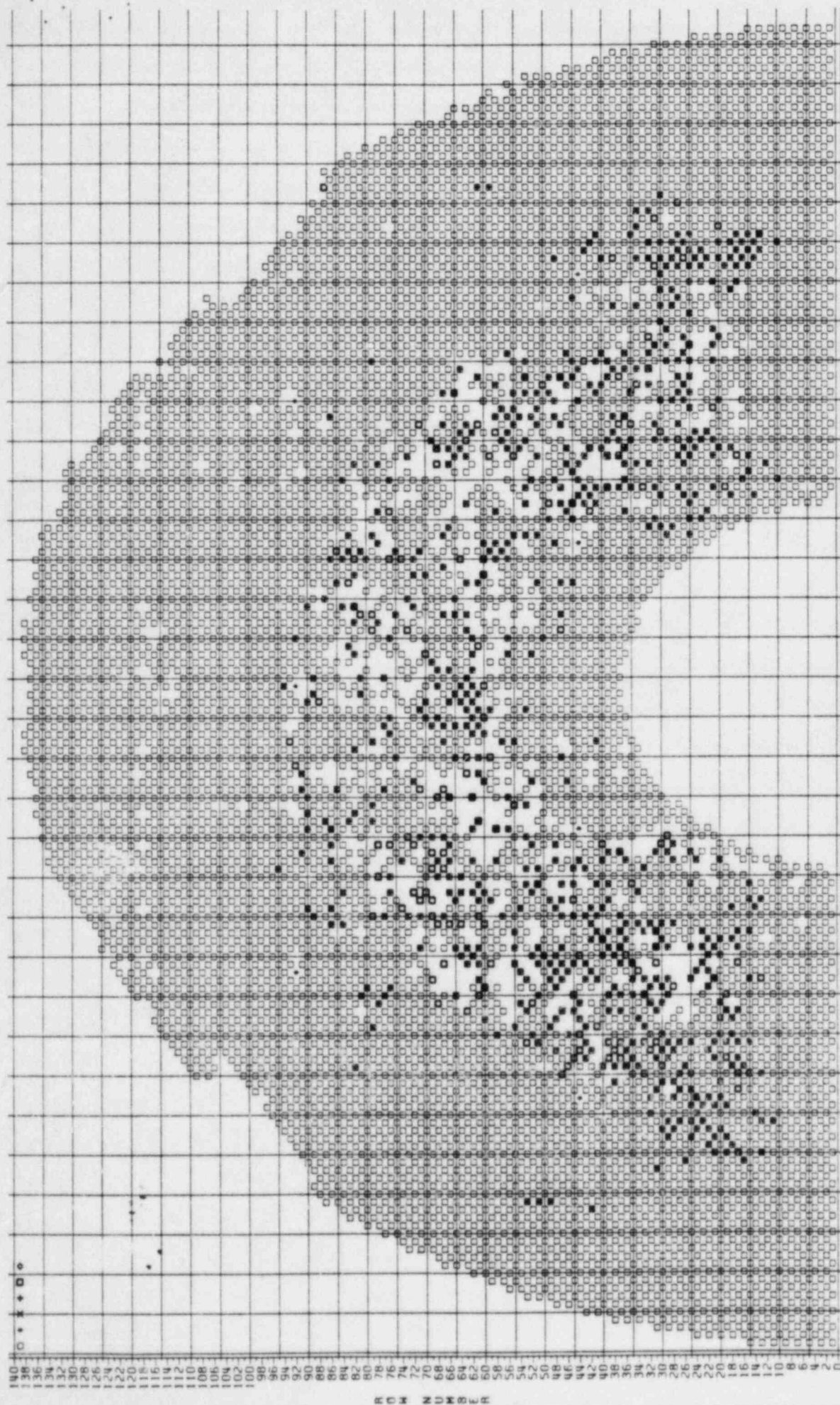
* = FLAW $\geq 20\%$ AND $\leq 40\%$

SQUARE = FLAW > 40%
FLAW > 40% AND < 40%
FLAW < 40%

SOURCE = FLANK 40%
BLANK = PREVIOUSLY PLUGGED

BLANK = PREVIOUSLY PLUGGED
BLANK = PREVIOUSLY PLUGGED OR SLEEVED

STEAM GENERATOR #1, HOT SIDE, 1985 OUTAGE

[illegible]

LINE NUMBER

X = FLAW >0% AND <20%
+ = FLAW >=20% AND <40%
SQUARE = FLAW >40%
BLANK = PREVIOUSLY PLUGGED

PRELIMINARY
MP-2 STEAM GENERATOR ECT INSPECTION SUMMARY*
(DATA THROUGH APRIL 21, 1985)

SG1 - AFTER CHEMICAL CLEANING

<u>DESCRIPTION</u>	<u>HOT SIDE</u>	<u>COLD SIDE</u>	<u>HOT & COLD SIDE</u>
1.0 NUMBER TUBE SIDES TESTED	7562	6680	14242
2.0 NUMBER TUBE SIDES WITH FLAWS			
2.1 > 0%	785	1310	2095
2.2 > = 40%	155	1107	1262
3.0 NUMBER TUBE SIDE WITH DISTORTED INDICATIONS	402	23	425
4.0 NUMBER OF FLAWS (SOME TUBES HAVE MORE THAN ONE FLAW)			
3.1 0-1"	673	242	915
3.2 1"-13"	243	1828	2071
3.3 13"-28"	7	6	13
3.4 OTHER	3	0	3
3.5 TOTAL	926	2076	3002
5.0 NUMBER PLUGGABLE RESTRICTIONS	0	1	1

*APPROXIMATELY 99% COMPLETE

PRELIMINARY
MP-2 STEAM GENERATOR ECT INSPECTION SUMMARY*
(DATA THROUGH APRIL 21, 1985)

SG2 - AFTER CHEMICAL CLEANING

<u>DESCRIPTION</u>	<u>HOT SIDE</u>	<u>COLD SIDE</u>	<u>HOT & COLD SIDE</u>
1.0 NUMBER TUBE SIDES TESTED	4314	3421	7735
2.0 NUMBER TUBE SIDES WITH FLAWS			
2.1 > 0%	338	842	1180
2.2 > = 40%	90	669	759
3.0 NUMBER OF TUBE SIDES WITH DISTORTED INDICATIONS	123	17	140
4.0 NUMBER OF FLAWS			
3.1 0 - 1"	210	37	247
3.2 1"-13"	172	1119	1291
3.3 13"-28"	5	4	9
3.4 OTHER	0	0	0
3.5 TOTAL	387	1160	1547
5.0 NUMBER PLUGGABLE RESTRICTIONS	0	0	0

*APPROXIMATELY 54% COMPLETE

MILLSTONE 2 POST CHEMICAL CLEANING
SUMMARY OF TUBE SLEEVING OR PLUGGING REQUIREMENTS
(AS OF APRIL 21, 1985)

SLEEVING CANDIDATES

<u>DESCRIPTION</u>	<u>STEAM GENERATOR 1</u>		<u>TOTAL</u>
	<u>COLD SIDE</u>	<u>HOT SIDE</u>	
1. DEFECTS \geq 40 PERCENT	1101	154	1255
2. DISTORTED INDICATIONS	14	392	<u>406</u>
			1661

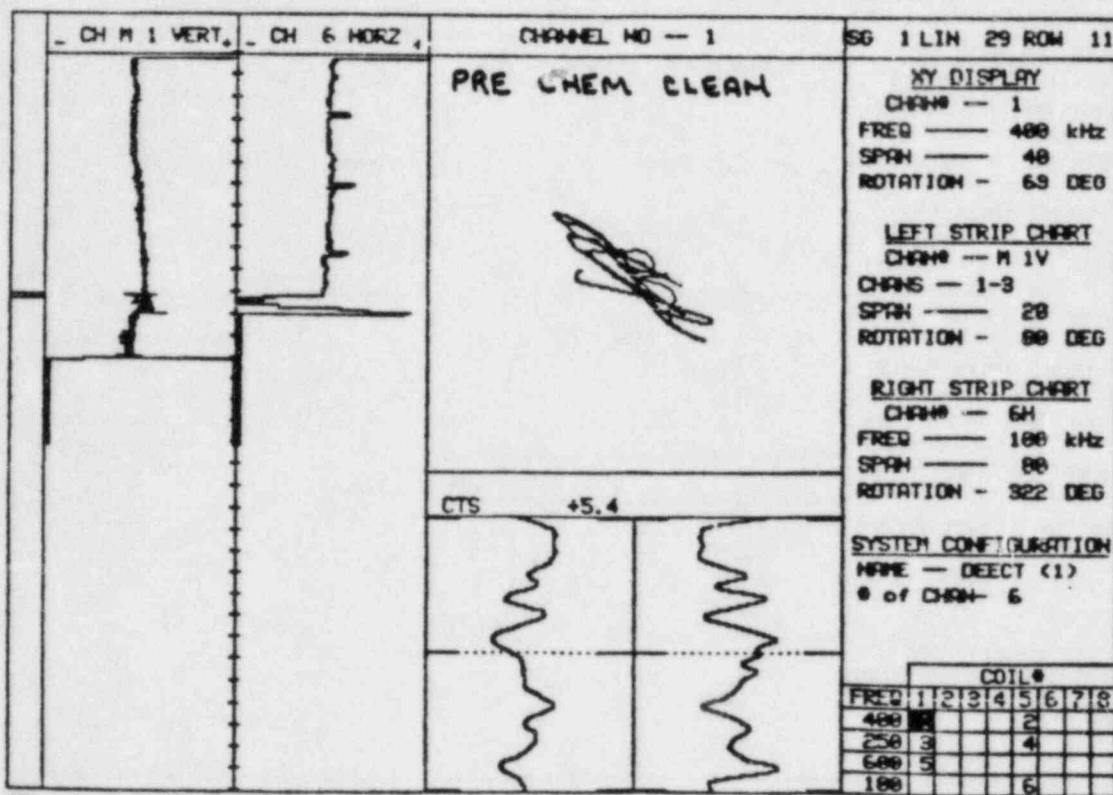
SLEEVING CANDIDATES

<u>DESCRIPTION</u>	<u>STEAM GENERATOR 2</u>		<u>TOTAL</u>
	<u>COLD SIDE</u>	<u>HOT SIDE</u>	
1. DEFECTS \geq 40 PERCENT	666	89	755
2. DISTORTED INDICATIONS	13	119	<u>132</u>
			887*

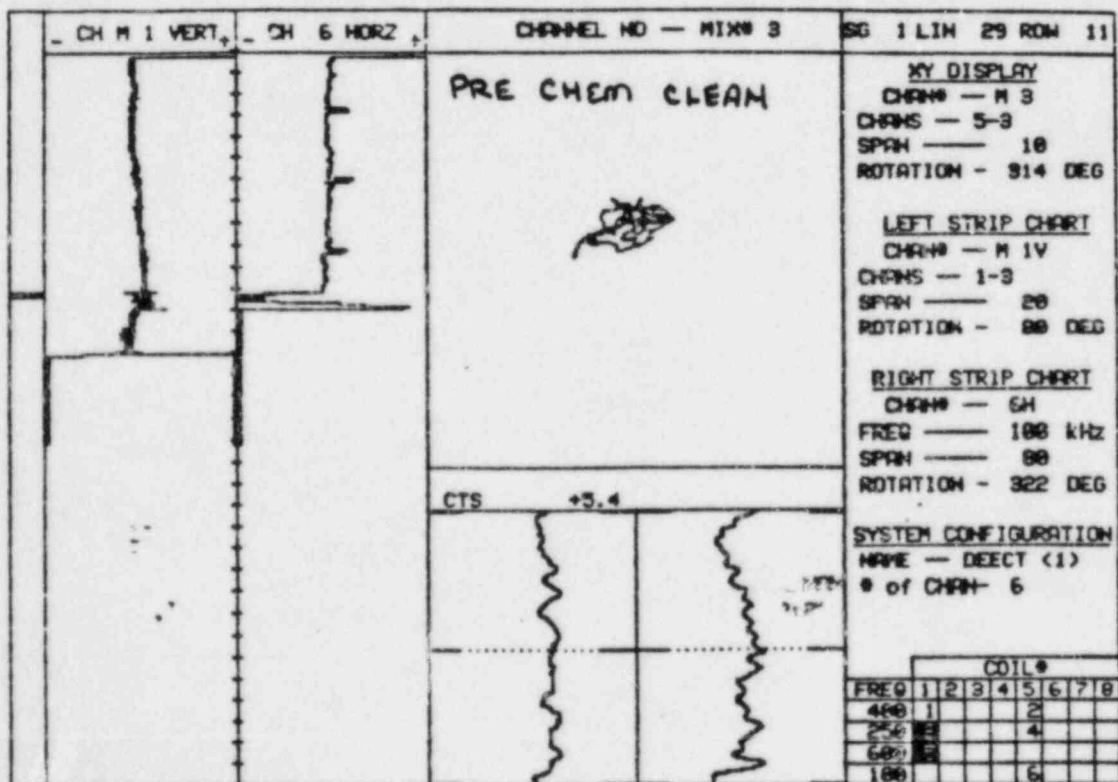
PLUGGING CANDIDATES

	<u>STEAM GENERATOR 1</u>	<u>STEAM GENERATOR 2</u>
1. DEFECTS \geq 40 PERCENT	6	4
2. DISTORTED INDICATIONS	0	0
3. SLEEVE INDICATIONS	4	2
4. PLUGGING RESTRICTIONS	<u>2</u>	<u>0</u>
(INCLUDING SLEEVES)	12	6

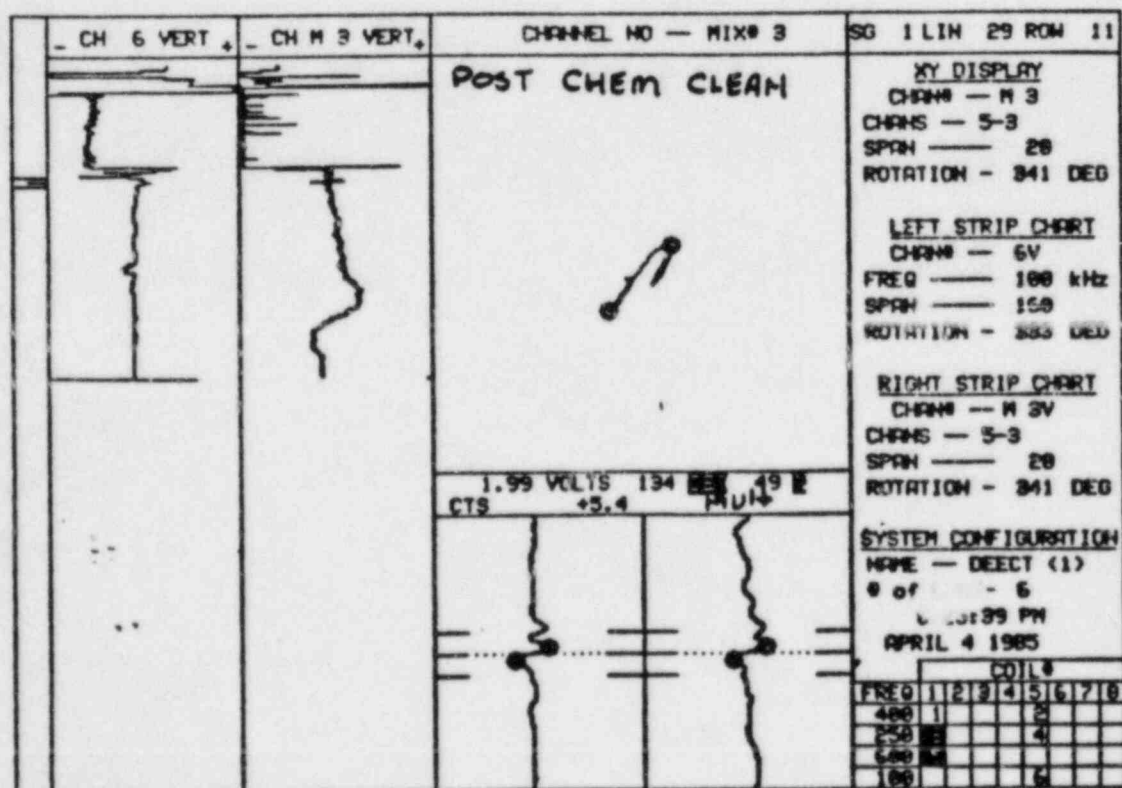
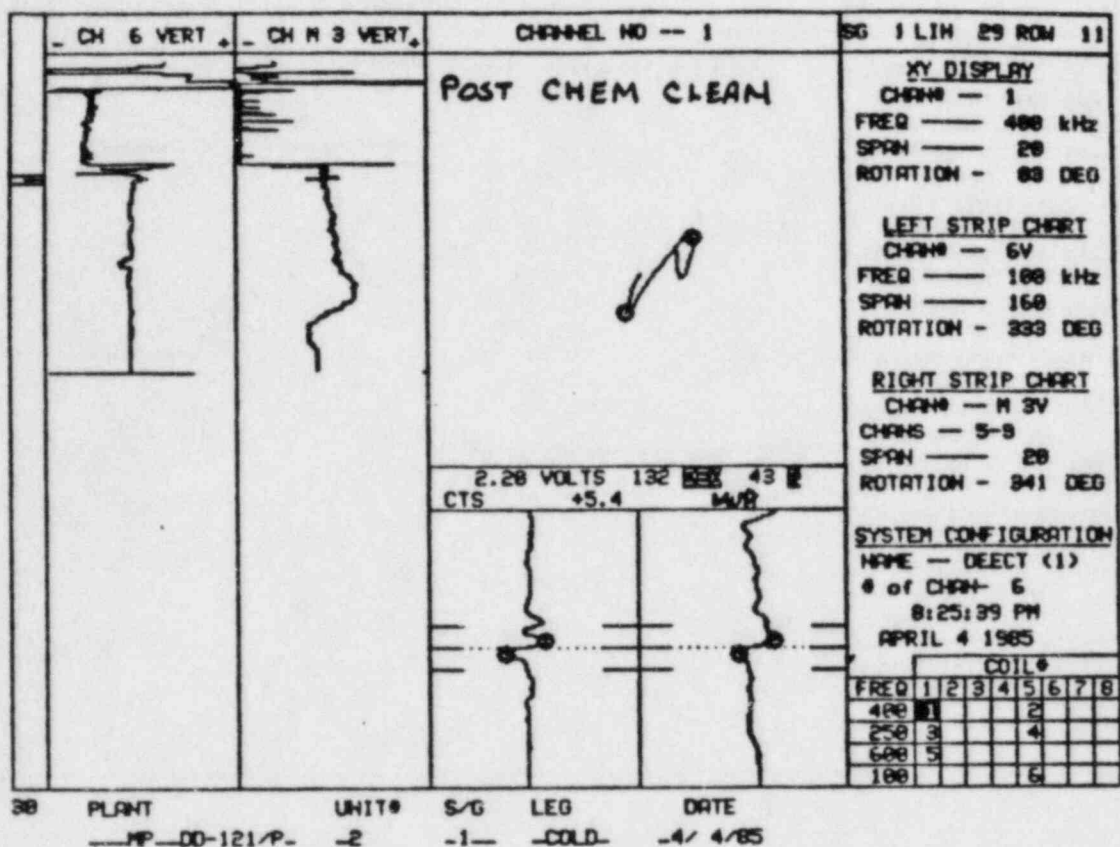
*ADDITIONAL 233 TUBES REQUIRING REPAIR WERE SLEEVED
PRIOR TO CHEMICAL CLEANING



40



40



REASON FOR NEWLY DETECTED DEFECTS
AFTER CHEMICAL CLEANING

- o STRONG ELECTRONIC NOISE (COPPER) GREATLY REDUCED BY CHEMICAL CLEANING (COPPER REMOVAL)
- o INCREASED EDDY CURRENT SIGNAL RESPONSE FROM COPPER REMOVAL (SHOWN IN LABORATORY).
- o NEW FLAWS SMALL IN VOLUME, BELOW ECT THRESHOLD OF DETECTABILITY IN PRESENCE OF COPPER
- o LARGER PROBE DIAMETER AFTER CLEANING

COMPARISON OF PRE/POST CHEMICAL CLEANING
ECT INSPECTION RESULTS FOR TUBES TESTED WITH
IDENTICAL PROBES BOTH BEFORE AND AFTER
CHEMICAL CLEANING

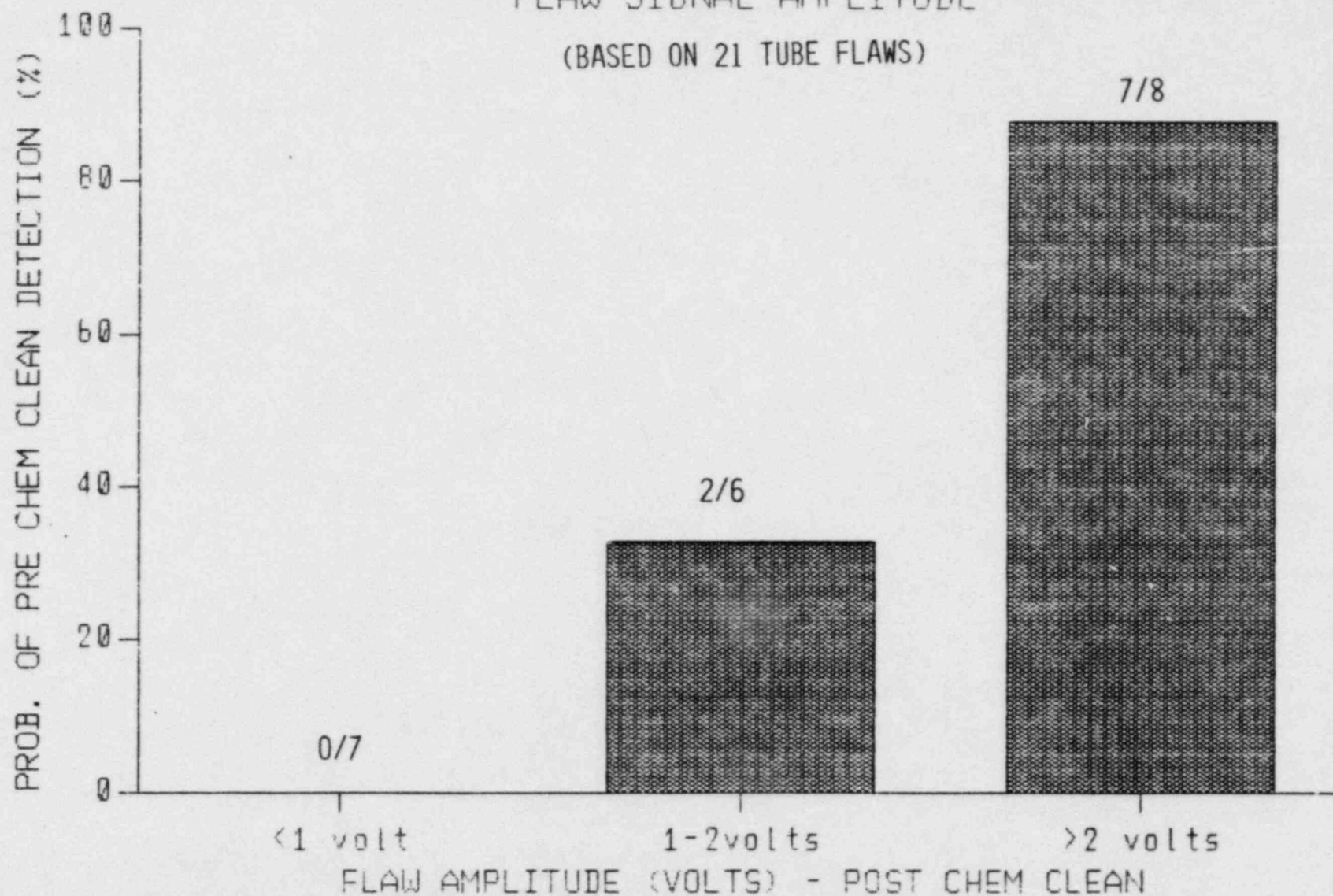
	SG1 (HL & CL)*		SG2 (HL)**		SG1 & SG2	
	PRE	POST	PRE	POST	PRE	POST
# TUBE ENDS TESTED BEFORE & AFTER CC	383	383	1369	1369	1752	1752
# TUBE ENDS $\geq 40\%$	37	75	15	84	52	159
% TUBE ENDS $\geq 40\%$	10%	20%	1%	6%	3%	9%

* SG1 - 560 HF BOBBIN PROBE

** SG2 - (HL) - 580 HF BOBBIN PROBE

PROBABILITY OF PRE CHEMICAL CLEANING FLAW DETECTION
VS.
FLAW SIGNAL AMPLITUDE

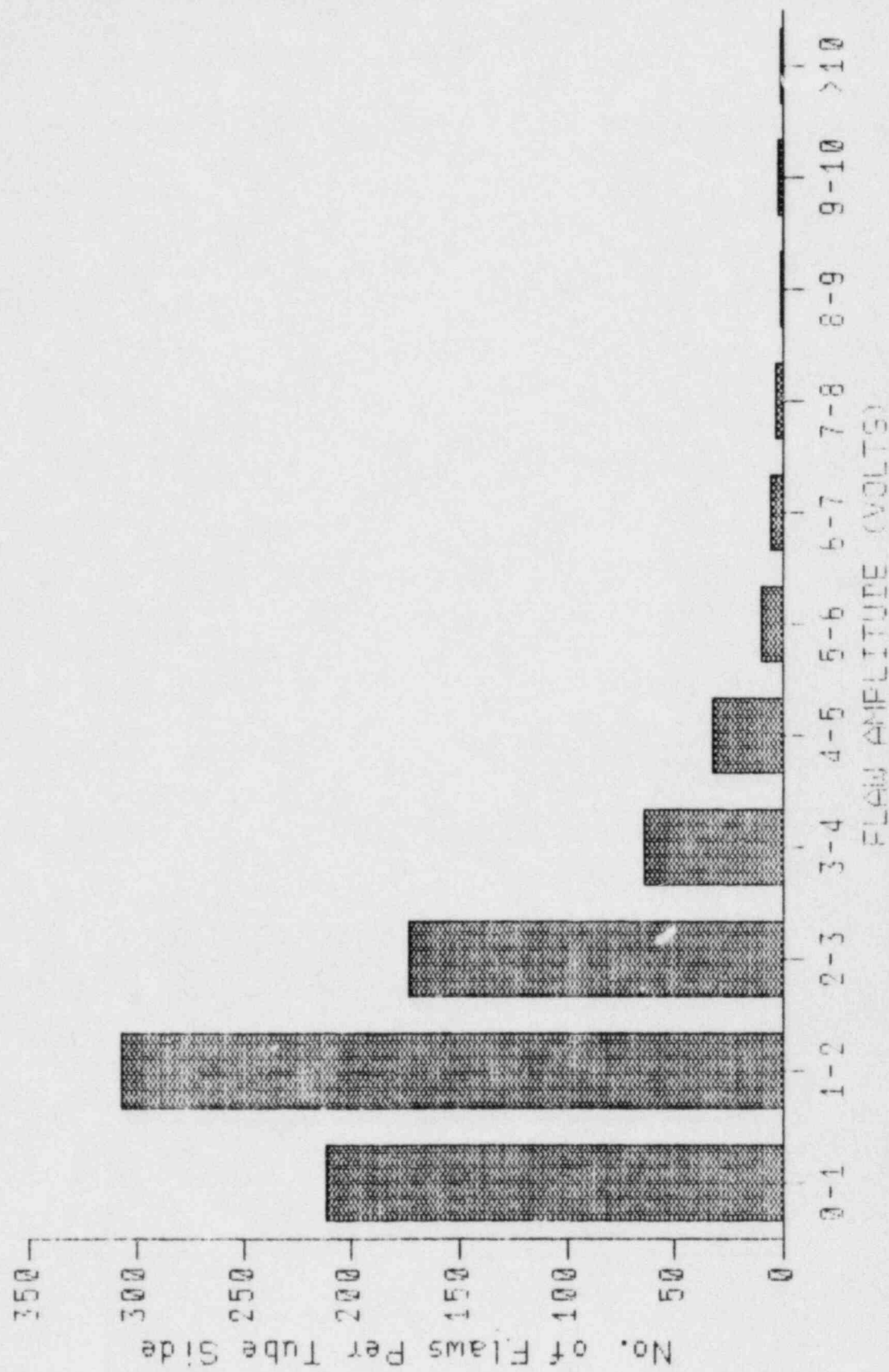
(BASED ON 21 TUBE FLAWS)



POST CHEMICAL CLEANING TUBE FLAW AMPLITUDES

FOR POST CHEM CLEAN FLAWS $\geq 40\%$

WHICH WERE NOT IDENTIFIED IN PRE CHEM CLEAN TESTING



1985 MP2 STEAM GENERATOR TUBE EDDY CURRENT INSPECTION
TUBE FLAW SIZING DIFFERENCES BEFORE AND AFTER CHEMICAL CLEANING
USING A .560 INCH DIAMETER NARROW COIL BOBBIN PROBE

	<u>COLD SIDE</u>			<u>HOT SIDE</u>		
		AVERAGE CHANGE	STD. DEV.		AVERAGE CHANGE	STD. DEV.
TUBE FLAW ELEVATION	NUMBER	IN SIZE (%)		NUMBER	IN SIZE (%)	
TS (0" TO 1")	17	0	4	34	0	6
ATS (> 1")	16	11	14	1	-11	.

	<u>TOTAL</u>		
		AVERAGE CHANGE	STD. DEV.
TUBE FLAW ELEVATION	NUMBER	IN SIZE (%)	
TS (0" TO 1")	51	0	5
ATS (> 1")	17	10	14

NOTE - FLAWS < 20% OR DTS INDICATIONS ARE NOT INCLUDED IN
THIS COMPARISON

SUMMARY

- o OVER 99% OF ALL FLAWS LOCATED IN 13 INCH BAND ABOVE TUBESHEET.
(DEFECTS PRIMARILY CL SIDE, DTS PRIMARILY HL SIDE)
- o PIT PROGRESSION RATE FOR CYCLE 6 ABOUT 20% THROUGH WALL
(PRE CLEANING DATA)
- o WHERE FLAWS IDENTIFIED PRE CLEANING, POSSIBLE SMALL INCREASE
IN AVERAGE FLAW DEPTH ESTIMATE AFTER CLEANING (0-10%)
- o IMPROVED DETECTABLE THRESHOLD POST CLEANING. DEFECT RATE
INCREASE FROM 3% OF TUBES TESTED "PRE", TO 9% POST CLEANING.
- o TUBES IDENTIFIED FOR CORRECTIVE ACTIONS (PRELIMINARY)

- 1661 /12	SLEEVE/PLUG	SG1 (99%)
- 1120 /6	SLEEVE/PLUG	SG2 (54%)

CONCLUSION

- o ECT DETECTION OF SMALLER VOLUME PITS DIFFICULT IN PRESENCE OF COPPER "SLUDGE". NOT SURPRISING OR HARMFUL.
- o FINDING OF SMALLER VOLUME PITS AT MP2 AFTER CLEANING, RESULT OF IMPROVED SIGNAL RESPONSE, AND REDUCED "NOISE", RESULTING FROM COPPER REMOVAL AND LARGER PROBE.
- o SIGNIFICANT PITS DETECTABLE BY ECT EVEN WITH COPPER PRESENT.

MILLSTONE UNIT II

SLEEVING PROGRAM

OBJECTIVE

- o REPAIR ALL DEFECTIVE (\geq 40% THRU WALL) TUBES TO MAINTAIN OPERATIONAL MARGINS
- o PLUG ONLY THOSE TUBES WHICH CANNOT BE SLEEVED
 - o OUTSIDE OF 40" 'CONTOUR' LINE OF CHANNEL HEAD BOWL (2 IN #1)
 - o DEFECTS ABOVE ($>$ 13") SLEEVE EFFECTIVE REGION (6 IN #1, 5 IN #2)
 - o PROBE RESTRICTIONS GREATER THAN .540" (1 IN #1)

STATUS START OF CYCLE 6

- o 2022 SLEEVES INSTALLED - COLD LEG ONLY
 - o STG #1 - 894, STG #2-1128
- o APPROXIMATELY 1700 EFFECTIVE PLUGGED TUBES VERSUS 2500 ALLOWABLE STG #1-997, STG #2-825

MILLSTONE UNIT II

SLEEVING PROGRAM

STATUS - 1985 RFO PROGRAM (ESTIMATED)

- o STG #1 SLEEVES CL-1110 PLUGS - 40
HL-540
- o EFFECTIVE PLUGS, START OF CYCLE 7 = 1134
- o STG #2 SLEEVES CL-950* PLUGS - 40
HL-240
- o EFFECTIVE PLUGS START OF CYCLE 7 = 935
- o TOTAL ESTIMATED EFFECTIVE PLUGGED TUBES START OF
CYCLE 7 = 2069
- o AUTOMATED INSTALLATION IN COLD LEGS
- o CHANNEL HEAD DECONTAMINATION AND MANUAL INSTALLATION
IN HOT LEGS
- o EXPECTED TOTAL MAN-REM EXPOSURE IS MINIMIZED.
- o MANUAL INSTALLATION IN LOW ($\leq 8R$) FIELDS IS FASTER
THAN ROSA INSTALLATION
- o ROSA SOFTWARE WAS NOT QUALIFIED FOR HOT LEG
INSTALLATION, IN ADDITION THERE ARE LOADING
INTERFERENCES

* 100 SLEEVES IN 20-39% DEFECTS (PRIOR TO CHEMICAL CLEANING)
WHEN TOTAL PROGRAM WAS EXPECTED TO BE APPROXIMATELY 700 TUBES.

ROSA - REMOTE OPERATED SERVICE ARM

MILLSTONE II

SLEEVING PROGRAM

SUMMARY

- o SLEEVING IS AN EFFICIENT MEANS OF REPAIRING STEAM GENERATORS TUBES TO PRESERVE OPERATING MARGINS
- o 1985 PROGRAM WILL NOT IMPACT CURRENTLY ANALYZED CONDITIONS.
2069 (Est) vs. 2500 ALLOWABLE PLUGGED TUBES
- o PRIMARY FLOW WILL BE MEASURED DURING STARTUP

CHEMICAL CLEANING OF MILLSTONE 11
STEAM GENERATORS (SECONDARY SIDE)

ALARA IMPLICATIONS

- o INCREASED WORK SCOPE IN CHANNEL HEADS (BETTER ECT DETECTABILITY)
- o ALARA EFFORT
- o EXPECTED CUMULATIVE EXPOSURES

INCREASED WORK SCOPE IN CHANNEL HEADS

ORIGINAL ESTIMATE: 250-300 MAN-REM

- o COLD LEG SLEEVING USING ROSA (APPROXIMATELY 2300 SLEEVES)
- o NO HOT LEG SLEEVING

POST CHEMICAL CLEANING

- o 800 MANUAL HOT LEG SLEEVES (20 R/HR)
- o 2000 ROSA COLD LEG SLEEVES
- o OPTION 1 - USE NO ADDITIONAL ALARA MEASURES
 - 3000 - 3200 MAN-REM
- o OPTION 2 - CHEMICALLY DECONTAMINATE CHANNEL HEADS
 - 1000 - 1300 MAN-REM
- o CHOOSE OPTION 2 FOR APPROXIMATELY 2000 MAN-REM SAVINGS

ROSA - REMOTE OPERATED SERVICE ARM

ALARA EFFORT

- o 100% MOCKUP TRAINING
- o EXTENSIVE SHIELDING IN LOOP AREAS
- o EXTENSIVE SHIELDING FOR DECONTAMINATION
- o USE OF ROSA IN COLD LEGS
- o CHEMICAL DECONTAMINATION OF STEAM GENERATORS
 - 3 R/HR COLD LEGS; 5 R/HR HOT LEGS
 - DF APPROXIMATELY 4

EXPECTED CUMULATIVE EXPOSURES

- o EVEN WITH MEASURES TAKEN, BEST ESTIMATE OF OUTAGE TOTAL EXPOSURE IS 1800 MAN REM
- o STEAM GENERATOR SLEEVING ESTIMATED AT 1100 MAN REM

SUMMARY

CHEMICAL CLEANING

- o CURRENT DATA INDICATES THAT TUBESHEET SLUDGE INVENTORIES OF BOTH MILLSTONE UNIT 2 STEAM GENERATORS HAVE BEEN ESSENTIALLY REMOVED.
- o TUBESHEET CHEMICAL CLEANING DID NOT RESULT IN THE FORMATION OF NEW DEFECTS ON HEAT TRANSFER TUBING.
- o TUBESHEET CHEMICAL CLEANING DID NOT RESULT IN THE PROPAGATION OF OLD DEFECTS ON HEAT TRANSFER TUBING.

SUMMARY

ECT RESULTS

- o ECT SIGNAL RESPONSE IMPROVED AS A RESULT OF COPPER REMOVAL, RESULTING IN GREATER DETECTABILITY OF SMALL VOLUME FLAWS.
- o SIGNIFICANT DEFECTS WERE DETECTED EVEN WITH COPPER PRESENT.

SUMMARY

SLEEVING PROGRAM

- o SLEEVING PER MILLSTONE UNIT 2 TECHNICAL SPECIFICATIONS IS AN EFFECTIVE MEANS OF REPAIRING THE MILLSTONE UNIT 2 STEAM GENERATORS.
- o THE SLEEVING EFFORT WILL NOT IMPACT CURRENTLY ANALYZED CONDITIONS (2009-EST vs 2500 ALLOWABLE PLUG EQUIVALENTS)

MILLSTONE UNIT 2
CHEMICAL CLEANING AND TUBE INSPECTIONS

SUMMARY

- o ALARA - 1100 MAN REM ESTIMATE FOR SLEEVING PROGRAM
- o INDUSTRY AWARENESS