

89.1103.0141

PALO VERDE NUCLEAR GENERATING STATION
UNIT 3 STEAM GENERATOR EDDY CURRENT EXAMINATION
1ST REFUELING OUTAGE
APRIL 1989

ARIZONA NUCLEAR POWER PROJECT
P. O. BOX 52034
PHOENIX, AZ 85072

PREPARED BY:

Michael J. Anderson

DATE:

7-11-89

REVIEWED BY:

J. B. Smith

DATE:

7-12-89

APPROVED BY:

J. D. Hume

DATE:

7-18-89

COMMERCIAL SERVICE DATE: 1/8/88

REPORT DATE: 7/11/89

.....

.....
.....
.....

INDEX

1.0 Summary

2.0 Examination Results

3.0 Examination Techniques and Equipment

APPENDIX A - CE Steam Generator Support Reference Drawing

APPENDIX B - Summary Data Sheets

APPENDIX C - Tubesheet Maps

APPENDIX D - Form NIS-1

25



25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

UNIT 3 STEAM GENERATOR EDDY CURRENT EXAMINATION

1.0 Summary

The first refueling outage for Palo Verde - Unit 3 officially began on March 8, 1989. Virtually 100% of the tubing in both steam generators was examined full length with the exception of a small number of Row 1 and 2 tubes which were examined to the extent practical through the U-bend region. The decision to perform a 100% examination was based on several factors including:

- The observance of random wear patterns during a recent Unit 2 refueling outage.
- Long term, low level primary-to-secondary leakage as detected in blowdown sample lines.
- The availability of examination time due to reactor coolant pump maintenance activities.

The overall results of the examinations are encouraging, in that after completion of one fuel cycle, the total number of degraded and/or defective tubes is minimal and no significant wear patterns have been observed.

2.0 Examination Results

Approximately 11,000 tubes were examined in each of the steam generators. The majority of tube degradations were observed in regions where vertical support straps intersect the tubing, (see Appendix A). The total numbers of degraded tubes for this region were 5 and 6, for steam generators 31 and 32, respectively. All indications at vertical support straps were compared with the preservice baseline examinations and while none of these tubes were defective, as defined by the Technical Specifications, those exhibiting indications with a potential for accelerated growth were plugged.

In addition to the vertical strap wear, several tubes with degraded/defective wear indications were observed in small groups of adjacent tubing near the periphery of the tube bundles. These indications occurred approximately 0.5 inches to 1.5 inches above the top of the first support plate (01C), cold leg side. Steam generator 31 (S/G 31) exhibited one affected area, (3 tubes), while two separate areas, (2 tubes each), were observed in steam generator 32 (S/G 32). For purposes of clarity, the affected tubes are grouped as follows:

Tube Numbers/Locations

Row 67, Line 10	
Row 66, Line 11	- Group A (S/G 31)
Row 68, Line 11	
Row 49, Line 06	- Group B (S/G 32)
Row 50, Line 07	
Row 91, Line 170	- Group C (S/G 32)
Row 93, Line 170	

The group B as well as two adjacent tubes, (R51, L06 and R52, L07), produced signals indicative of secondary side possible loose parts (PLP). In addition, leakage was visually observed at the Groups A and C tubesheet areas by use of a remote camera installed in each S/G primary channel-head.

A secondary side visual examination for the tubing in Groups B and C was performed utilizing a fiberoptic technique, with accessibility being provided by cutting a window in adjacent tubes via an electron discharge machining (EDM) operation performed by Combustion Engineering. The visual examination confirmed the eddy current results for Groups B and C, and the final disposition of the secondary side loose part issue was addressed in Engineering Evaluation Request #89-RC-051. All tubing associated with Groups A, B, or C were preventatively staked and/or plugged as necessary.

The remaining indications consisted of a small number of tubes exhibiting < 20% thru-wall signals at various locations. Some minor denting was also evident on several tubes. The majority of these indications were identified during the baseline examination and no significant changes were observed. Sludge profiling was performed during the examination and found to be minimal. Less than 1.0% of the tubing exhibited sludge indications at the top of the tubesheet with the average depth being less than 1.0 inch.

The examination resulted in plugging an additional 7 (seven) tubes in steam generator 31 and 10 (ten) tubes in steam generator 32. Combustion Engineering welded type plugs were used for all tube ends and Engineering Evaluation Requests numbers 89-RC-058 and 89-RC-059 were initiated to track the examination results and subsequent plugging. The tube sheet maps in Appendix C show the total tubes plugged in each steam generator to date. Appendix B contains the summary data sheets which list all tubes in each steam generator with thru-wall indications from 0-100% and possible loose parts (PLP). The NIS-1 form in Appendix D lists each of the tubes, by row and line, plugged as a result of this examination.

3.0 Examination Techniques and Equipment

The eddy current examination was performed by Conam Inspection using Zetec MIZ-18 digital data acquisition and analysis systems. The following frequencies were used for the tube examination(s):

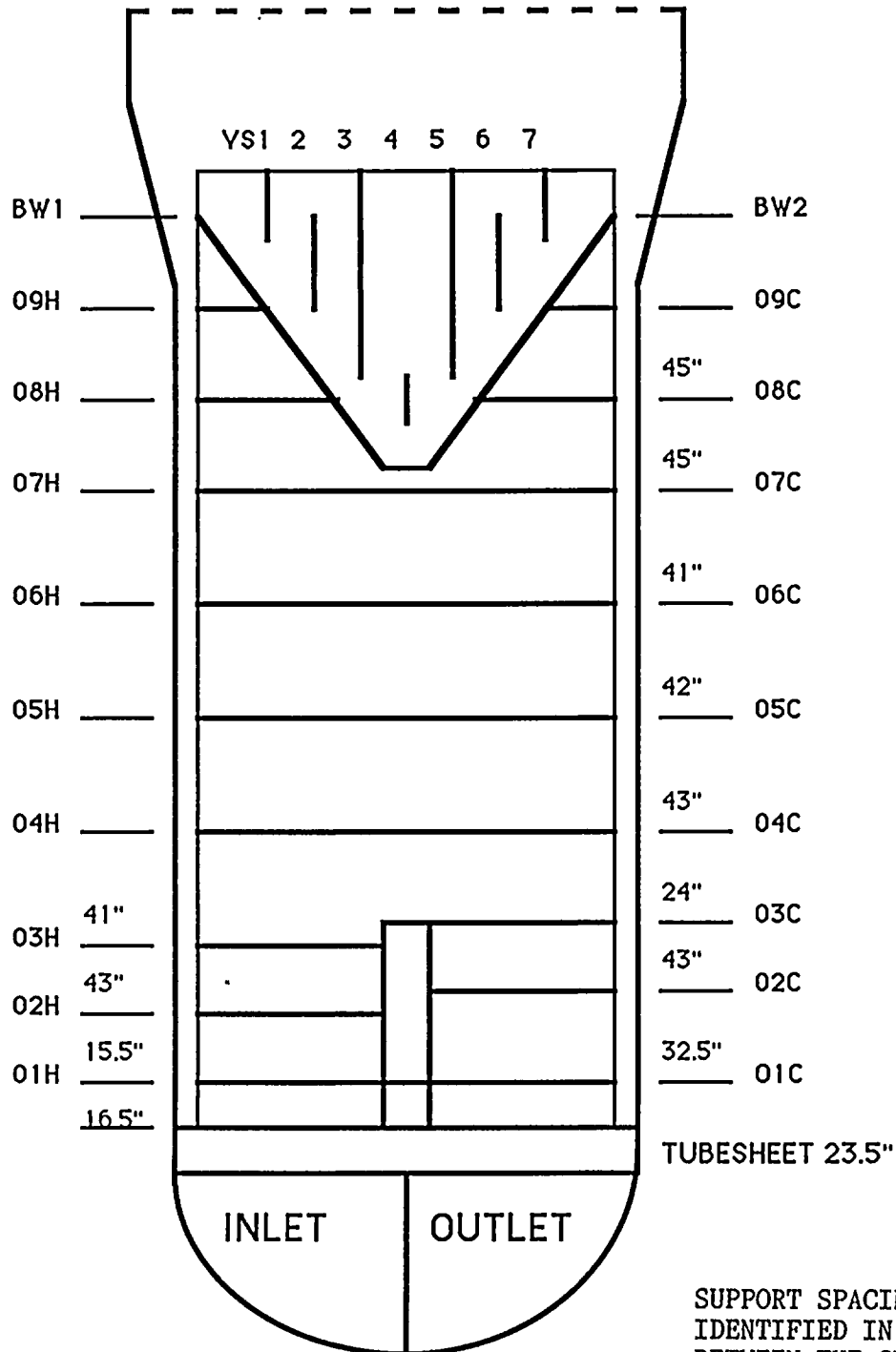
550 KHZ
990 KHZ
100 KHZ
20 KHZ

NOTE: All frequencies were utilized in both differential and absolute modes.

All tubing was tested with standard Zetec manufactured SFM/HF probes. A rotating pancake probe was used to characterize the indications at various locations. Data acquisition was facilitated by using Zetec SM-10 "no entry" probe positioning fixtures in both hot and cold leg S/G plenums.

APPENDIX A

CE SYSTEM 80 STEAM GENERATOR TUBE SUPPORT DIAGRAM



SUPPORT SPACINGS ARE
IDENTIFIED IN INCHES
BETWEEN THE SUPPORT
IDENTIFICATION

APPENDIX B

LEGEND

ROW: Indicates the row number of a given tube.

LIN: Indicates the column number of a given tube.

LEG: Indicates the tube leg from which examination was performed; either the hot (H) leg or cold (C) leg.

EXTENT REQ: Indicates the tube length required to be examined, i.e., F/L - full length, 07H-seventh support on hot leg side.

EXTENT TST: Indicates the tube length actually examined.

REM: Remarks column used for comments relating to examination.
RPI: indicates a plugging limit criteria

REEL: Indicates reel number data was recorded on.

PROBE: Indicates probe diameter and style used for examination.

LOCATION: Gives indication location relative to known landmarks such as supports and batwings. Location codes are as follows:

#1 Vertical Support Strap.....VS1
 #1 Bat Wing.....BW1
 #1 Support Plate in Hot Leg.....01H
 #7 Support Plate in Cold Leg.....07C
 Top Tube Sheet Hot Leg.....TSH
 Top Tube Sheet Cold Leg.....TSC
 Tube End Hot Leg.....TEH
 Tube End Cold Leg.....TEC

VOLTS: Indicates the peak-to-peak voltage of a given indication response.

DEG: The measured phase angle of a given indication response.

%: The percent through the tube wall of a given indication based on the measured phase angle/amplitude and the calibration curve established for that particular channel, or analysis comment codes, e.g., PLP = Possible Loose Parts, etc.

CH: Indicates the channel used to measure and evaluate a given indication.

CUMULATIVE REPORT
03/89, ARIZONA PUBLIC SERVICE CO., PALO VERDE, UNIT 3

STEAM GENERATOR: 31
LOCATION: ALL
CRITERIA: 0% TO 100%,PLP

PAGE: 1 OF 1
DATE: 07/02/89
TIME: 09:57:21

ROW	LIN	HEAT#	LEG	EXAM EXTENT		REM	REEL	PROBE	LOCATION	CURRENT				
				PROGRAM	ACTUAL					VOLTS	MIL	DEG	%	CH
P 67	10		C	01C-02C	01C-02C	RPI	188	620ZR	01C+ 1.31	0.4		90	51	1
			C	TEC-TEH	TEC-TEH		027	610SL	01C+ 1.1	1.1		122	44	1
P 66	11		C	01C-02C	01C-02C	RPI	188	620ZR	01C+ 1.09	4.3		42	78	1
			C	TEC-TEH	TEC-TEH		027	610SL	01C+ 1.0	9.2		78	77	1
P 68	11		C	TEC-TEH	TEC-TEH		027	610SL	01C+ 0.8	0.7		110	37	M1
			C	01C-02C	01C-02C	RPI	188	620ZR	01C+ 0.71	0.3		77	57	1
144	59		H	TEH-TEC	TEH-TEC		140	610SM	VS5- 0.8	0.8		0	20	M2
28	73		C	TEC-TEH	TEC-TEH		068	610SM	01C+ 0.7	1.1		164	<20	M4
154	83		H	TEH-TEC	TEH-TEC		159	610SM	VS1+ 0.9	0.5		0	<20	M2
			H	TEH-TEC	TEH-TEC		159	610SM	VS5+ 0.9	1.9		0	32	M2
159	88		H	TEH-TEC	TEH-TEC		165	610SM	VS3+ 0.9	2.7		0	39	M2
153	100		H	TEH-TEC	TEH-TEC		120	610SM	VS3+ 0.9	1.3		0	28	M2
86	133		C	TEC-TEH	TEC-TEH		146	610SM	VS3+ 0.5	2.2		0	37	M2
42	163		H	TEH-TEC	TEH-TEC		052	600SM	02H+ 0.4	0.6		129	21	M1

NUMBER OF TUBES SELECTED FROM CURRENT OUTAGE: 10

NO TREND ANALYSIS REQUESTED

CONAM, INSPECTION

CUMULATIVE REPORT
03/89, ARIZONA PUBLIC SERVICE CO., PALO VERDE, UNIT 3

STEAM GENERATOR: 32
LOCATION: ALL
CRITERIA: 0% TO 100%, PLP

PAGE: 1 OF 1
DATE: 07/02/89
TIME: 10:10:19

ROW	LIN	HEAT#	LEG	EXAM PROGRAM	EXTENT ACTUAL	REMARKS	REEL	PROBE	LOCATION	VOLTS	CURRENT MIL	DEG	%	CH
47	6		C	TEC-TEH	TEC-TEH		004	610SL	VS4- 0.8	0.6		0	<20	M2
			C	TEC-TEH	TEC-TEH		004	610SL	VS4+ 0.8	0.9		0	<20	M2
B 49	6		C	01C-02C	01C-02C	RPI	192	620ZR	01C+ 0.59TO+ 1.61	10.4		0	PLP	5
			C	TEC-TEH	TEC-TEH		004	610SL	01C+ 1.3	0.7		133	35	1
			C	01C-02C	01C-02C		192	620ZR	01C+ 1.27	0.3		112	32	1
			C	TEC-TEH	TEC-TEH		004	610SL	01C+ 1.2	0.1		259	PLP	08
51	6		C	01C-02C	01C-02C	RPI	192	620ZR	01C+ 0.60TO+ 1.58	2.1		0	PLP	5
			C	TEC-TEH	TEC-TEH		004	610SL	01C+ 0.9 TO+ 0.0	3.7		288	PLP	08
0 50	7		C	01C-02C	01C-02C	RPI	192	620ZR	01C+ 0.73TO+ 1.85	3.0		0	PLP	5
			C	TEC-TEH	TEC-TEH		005	610SL	01C+ 1.6				PLP	8
			C	TEC-TEH	TEC-TEH		005	610SL	01C+ 1.5	1.2		140	28	1
			C	01C-02C	01C-02C		192	620ZR	01C+ 1.12	0.3		113	31	1
52	7		C	01C-02C	01C-02C	RPI	192	620ZR	01C+ 1.17TO+ 2.00	0.9		0	PLP	5
			C	TEC-TEH	TEC-TEH		005	610SL	01C+ 1.9 TO+ 0.0				PLP	8
43	18		C	TEC-TEH	TEC-TEH		008	610SL	01C+ 0.3	0.6		128	<20	M1
2	25		C	TEC-TEH	TEC-TEH		003	590SM	02C- 0.5	0.6		0	<20	M2
85	46		C	TEC-TEH	TEC-TEH		033	610SL	VS5+ 0.8	0.7		0	<20	M2
99	52		C	TEC-TEH	TEC-TEH		035	610SL	VS2- 0.5	0.6		0	<20	M2
75	70		C	TEC-TEH	TEC-TEH		063	600SM	07C- 0.6	0.8		144	<20	M1
74	85		C	TEC-TEH	TEC-TEH		081	600SM	BW1+ 10.7	1.2		152	<20	M4
- 159	96		H	TEH-TEC	TEH-TEC		117	610SM	VS1+ 0.0	0.7		0	21	M2
- 36	103		H	TEH-TEC	TEH-TEC		166	610SM	VS4- 0.6	0.6		0	20	M2
- 99	106		H	TEH-TEC	TEH-TEC		162	610SM	VS2+ 11.9	1.1		126	39	1
- 150	127		H	TEH-TEC	TEH-TEC		091	610SM	VS5+ 1.7	0.7		133	32	1
- 76	143		H	TEH-TEC	TEH-TEC		078	610SM	BW2+ 0.9	1.7		180	<20	M1
- 100	151		H	TEH-TEC	TEH-TEC		069	610SL	VS2+ 2.8	1.0		121	38	1
- 106	159		H	TEH-TEC	TEH-TEC	RPI	051	610SL	VS3- 0.7	1.3		101	47	M1
C 91	170		C	TEC-TEH	TEC-TEH		050	600SM	01C+ 1.1	7.9		65	86	1
			C	01C-02C	01C-02C	RPI	191	620ZR	01C+ 0.97	2.4		35	83	1
C 93	170		C	01C-02C	01C-02C	RPI	191	620ZR	01C+ 0.75	0.5		68	58	1
			C	TEC-TEH	TEC-TEH		107	590SM	01C+ 0.6	1.9		86	66	M1
74	173		C	TEC-TEH	TEC-TEH		105	590SM	VS5+ 0.6	0.8		157	<20	M4
49	184		C	TEC-TEH	TEC-TEH		095	610SM	VS4+ 0.8	0.8		0	<20	M2

NUMBER OF TUBES SELECTED FROM CURRENT OUTAGE: 22

NO TREND ANALYSIS REQUESTED

CONAM INSPECTION

APPENDIX C

100-100000

100-100000

100-100000

100-100000

100-100000

100-100000

100-100000

100-100000

100-100000

100-100000

07/89, ARIZONA PUBLIC SERVICE CO., PALO VERDE, UNIT 3

STEAM GENERATOR: 31

DATE: 07/02/89

LOCATION: ALL

TIME: 09:54:11

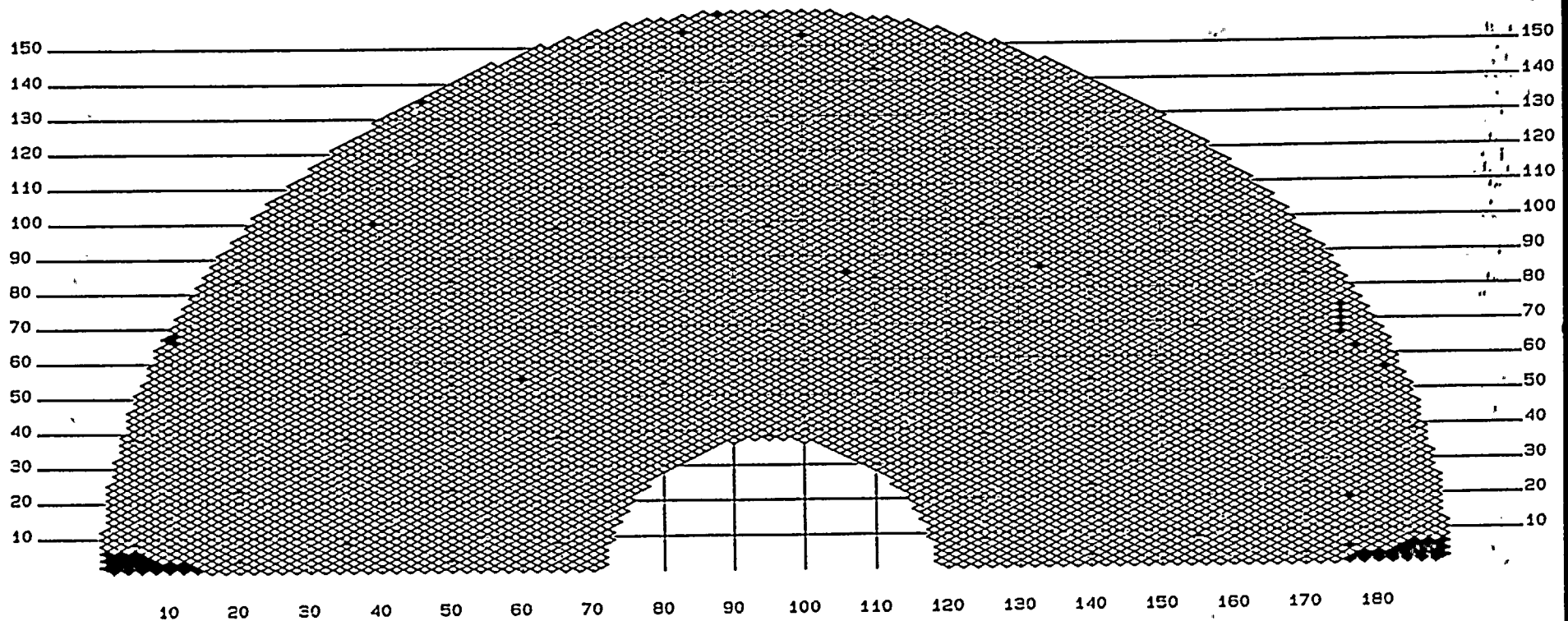
CRITERIA: PLG

PLG

80

STAYS

▲



CCNAM INSPECTION

07/89, ARIZONA PUBLIC SERVICE CO., PALO VERDE, UNIT 3

STEAM GENERATOR: 32

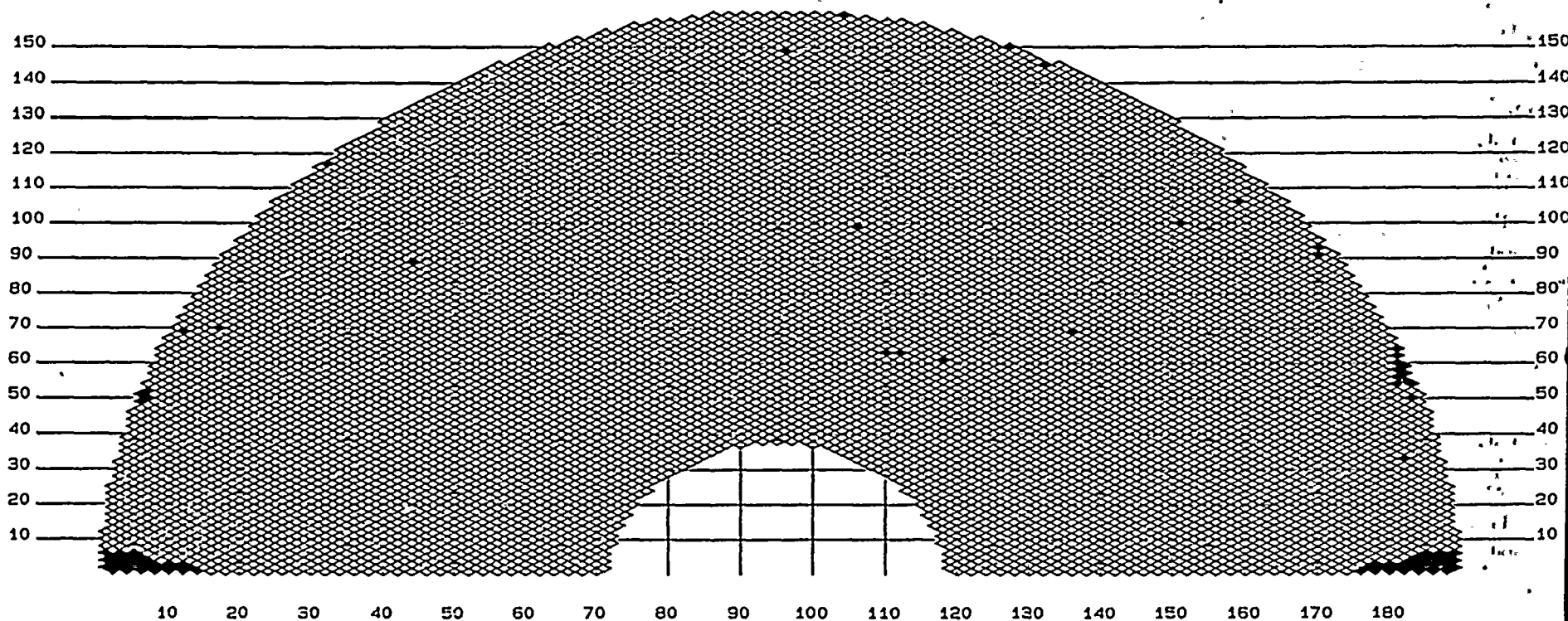
LOCATION: ALL
CRITERIA: PLG

DATE: 07/02/89
TIME: 09:12:00

STAYS

PLG

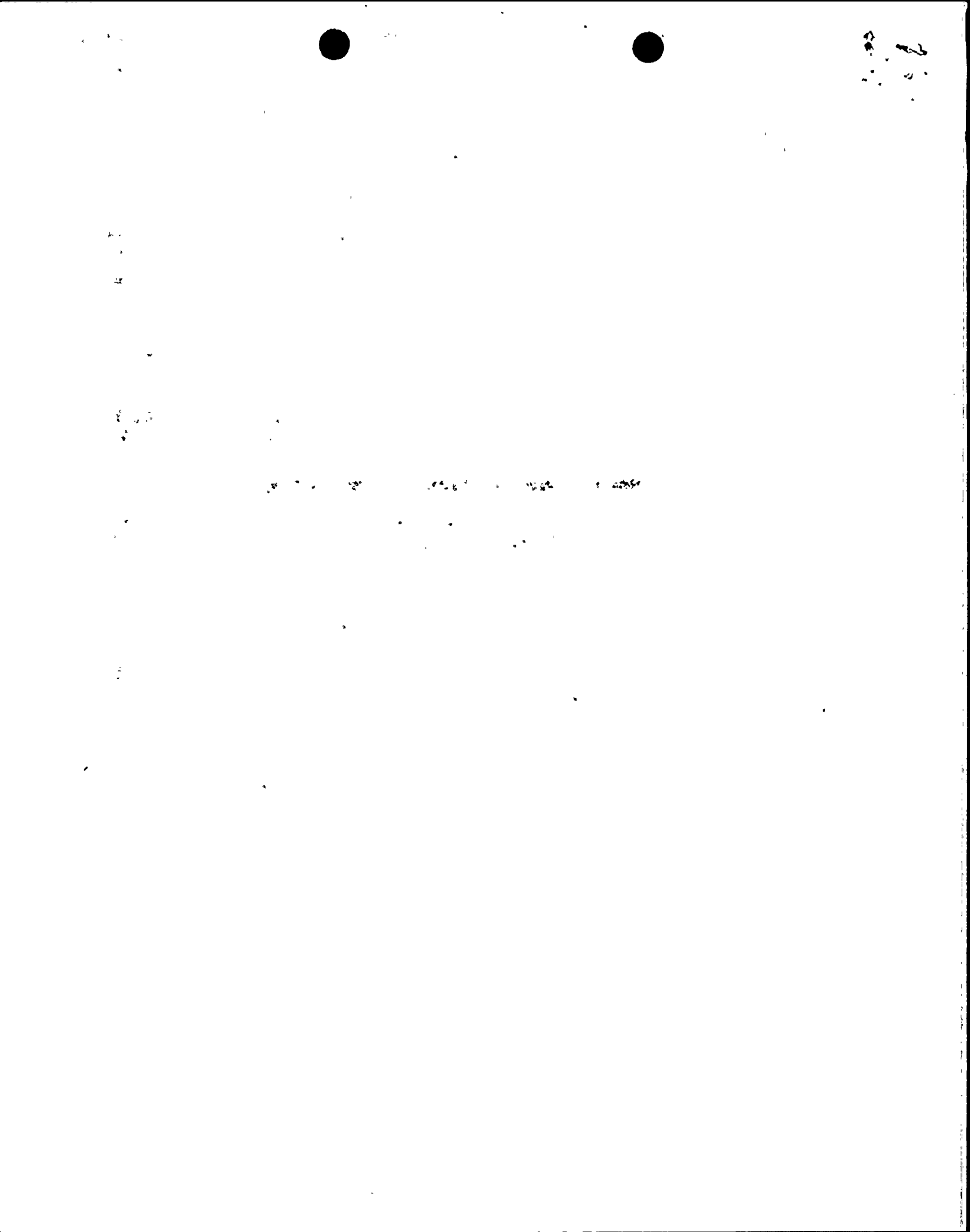
93



CONAM INSPECTION

12-11-61

APPENDIX D



ANPP

NIS-1 FORM

OWNERS' DATA REPORT FOR INSERVICE INSPECTIONS

1. OWNER ARIZONA PUBLIC SERVICE COMPANY, ET AL

ADDRESS P.O. BOX 53999 PHOENIX, ARIZONA

2. PLANT PALO VERDE NUCLEAR GENERATING PLANT

ADDRESS 4 MILES SOUTH WINTERSBURG, ARIZONA

3. UNIT NUMBER: 3

4. OWNERS CERTIFICATE OF AUTHORIZATION NONE

5. COMMERCIAL SERVICE DATE: 1/8/88

6. COMPONENTS INSPECTED:

COMPONENT OR APPURTENANCE	MANUFACTURER OR INSTALLER	SERIAL NUMBER	STATE OR PROVINCE	NATIONAL BOARD NO
3MRCEE01A STEAM GENERATOR 31 TUBING	COMBUSTION ENGINEERING	79273-1	N/A	22478
3MRCEE01B STEAM GENERATOR 32 TUBING	COMBUSTION ENGINEERING	79273-2	N/A	22479

ANPP

NIS-1 BACK

OWNERS' DATA REPORT FOR INSERVICE INSPECTIONS

7. EXAM DATES 4/8/89 TO 5/12/89
8. INSPECTION INTERVAL FROM 1/08/88 TO 3/17/97 *
9. ABSTRACT OF EXAMINATIONS. INCLUDE A LIST OF EXAMINATIONS AND A STATEMENT CONCERNING STATUS OF WORK REQUIRED FOR CURRENT INTERVAL.

One hundred percent of the tubing in each steam generator was examined. Several degraded/defective tubes were observed. These are documented in Appendix B of this report.

The following tubes were plugged and/or staked as a result of this examination:

S/G 31: R67L10, R66L11, R68L11, R154L83, R159L88, R153L100, R86L133.
S/G 32: R49L06, R51L06, R50L07, R52L07, R99L106, R150L127, R100L151, R106L159, R91L170, R93L170

* Common Interval Date

WE CERTIFY THAT THE STATEMENTS MADE IN THIS REPORT ARE CORRECT AND THE EXAMINATIONS AND CORRECTIVE MEASURES TAKEN CONFORM TO THE RULES OF THE ASME CODE, SECTION XI.

DATE 7-18-89 SIGNED: ARIZONA PUBLIC SERVICE COMPANY BY [Signature]

CERTIFICATE OF INSERVICE INSPECTION

I, THE UNDERSIGNED, HOLDING A VALID COMMISSION ISSUED BY THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS AND THE STATE OF PROVINCE OF ARIZONA EMPLOYED BY KEMPER GROUP OF LONG GROVE, ILLINOIS HAVE INSPECTED THE COMPONENTS DESCRIBED IN THIS OWNERS REPORT DURING THE PERIOD 4/89 TO 5/89, AND STATE THAT TO THE BEST OF MY KNOWLEDGE AND BELIEF, THE OWNER HAS PERFORMED EXAMINATIONS AND TAKEN CORRECTIVE MEASURES DESCRIBED IN THIS OWNERS REPORT IN ACCORDANCE WITH THE REQUIREMENTS OF THE ASME CODE, SECTION XI. BY SIGNING THIS CERTIFICATE NEITHER THE INSPECTOR NOR HIS EMPLOYER MAKES ANY WARRANTY, EXPRESSED OR IMPLIED, CONCERNING THE EXAMINATIONS AND CORRECTIVE MEASURES DESCRIBED IN THIS OWNERS REPORT. FURTHERMORE, NEITHER THE INSPECTOR NOR HIS EMPLOYER SHALL BE LIABLE IN ANY MANNER FOR ANY PERSONAL INJURY OR PROPERTY DAMAGE OR A LOSS OF ANY KIND ARISING FROM OR CONNECTED WITH THIS INSPECTION.

INSPECTOR [Signature] COMMISSIONS NB6153/1252
DATE 7/19/89 NAT'L BOARD, STATE, PROVINCE

