

VIRGINIA ELECTRIC AND POWER COMPANY  
RICHMOND, VIRGINIA 23261

February 26, 2003

United States Nuclear Regulatory Commission  
Attention: Document Control Desk  
Washington, DC 20555-0001

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License Nos.: NPF-4  
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Gentlemen:

**VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)**  
**NORTH ANNA POWER STATION UNITS 1 AND 2**  
**ANNUAL STEAM GENERATOR INSERVICE INSPECTION SUMMARY REPORT**

Pursuant to Technical Specification 5.6.7.b for North Anna Power Station Units 1 and 2, Virginia Electric and Power Company (Dominion) is submitting the results of the steam generator tube inservice inspections performed during 2002. The steam generator tube inspections conducted on Unit 2 during the Fall 2002 refueling outage are included in the Attachment. There were no inspections performed on the North Anna Unit 1 Steam Generators.

This letter does not establish any new commitments. Should you have any questions or require additional information, please contact us.

Very truly yours,



C. L. Funderburk  
Director – Nuclear Licensing & Operations Support

Attachment

cc: U. S. Nuclear Regulatory Commission  
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Mr. M. J. Morgan  
NRC Senior Resident Inspector  
North Anna Power Station

A047

**NORTH ANNA POWER STATION**  
**2002 ANNUAL STEAM GENERATOR**  
**INSERVICE INSPECTION SUMMARY REPORT**

**Virginia Electric and Power Company**  
**(Dominion)**

**Virginia Electric and Power Company (Dominion)  
North Anna Unit 2  
Annual Steam Generator Report**

Station	Unit	Outage Date	SG Examined			Date of Report
North Anna	2	September 2002	A			2/20/03

SG Design Information						
SG Model	TSP Type.	TSP Mat'l	# TSP	Baffle Mat'l	AVB Mat'l	# AVB
54F	Quatrefoil	Type 405 SS	7	Type 405 SS	Type 405 SS	3
# Tubes	Tube Dia.	Tube Mat'l	Tube Pitch	Tube Tks	Expansion	Heat X-fer Area
3592	0.875"	Alloy 690TT	1.225"	0.050"	Full Hydraulic	54,500 sq. ft.

Scope of Inspection					
SG	Inspection Program	Planned	Inspected	Inspection Method	Extent
A	Bobbin	2156	2156	Bobbin	TEC - TEH
A	Row 1 U-Bend RPC	98	98	+Point RC	7H - 7C
A	TTSH RPC	719	719	+Point RC	TSH +/- 3"

Indications of Imperfections Detected							
SG	NDE Method	Row	Column	Indication Code	Location	Active Yes/No	Measured Wall Penetration
A	N/A	N/A	N/A	N/A	NONE	No	N/A

Tube Plugging		
SG	Reason/Mechanism	Tubes Plugged
A	Permeability Variation (PV) Noise	1
<b>Total Tubes Plugged</b>		<b>1</b>

Repair Attributions				
SG	Row	Column	Reason/Mechanism	Repair Method
A	9	45	Permeability Signal	Plug

Plugging/Repair Record					
SG	Tubes Plugged	Tubes Repaired (Not Plugged)	Percent Plugged	Percent Repaired (Not Plugged)	Percent Plugged or Repaired
A	1	0	0.03	0	0.03
B	0	0	0	0	0
C	1	0	0.03	0	0.03

## North Anna Unit 2 "A" Steam Generator Inspection

### Summary

The inspection performed on North Anna Unit 2 "A" steam generator was consistent with the Program Plan and the results formed the basis of the condition monitoring and operational assessment performed for this outage. The inspection satisfied the surveillance requirements of North Anna Technical Specification 5.5.8.

No tube degradation was identified during the eddy current inspection program. Secondary side visual evaluations also determined no conditions existed that would compromise the integrity of the steam generator tubing, therefore acceptable tube integrity has been demonstrated. The requirements on burst pressure and accident condition leak rates have been satisfied. The Condition Monitoring and Operational Assessment that was performed followed the requirements of the March 2000 EPRI Steam Generator Integrity Assessment Guidelines: Revision 1 (TR-107621-R1) and the requirements of NEI 97-06.

The North Anna Unit 2 steam generators, as indicated by the results of the current condition monitoring evaluation of "A" steam generator and past assessments pertaining to other Unit 2 steam generators, continue to satisfy the safety margin requirements with respect to structural and leakage integrity margin. The operating period for Steam Generator "A" was approximately 49.5 EFPM since its last inspection. The total operating time for the Unit 2 steam generators since replacement is approximately 80.3 EFPM (6.7 EFY). Condition and monitoring assessments for Unit 2 continue to indicate that there is no known existing condition that would exceed structural and leakage margin requirements before the end of next planned operating period. Thus, the Operational Assessment requirements are satisfied.

The inspections conducted during this outage conformed to the North Anna Steam Generator Monitoring and Inspection Program Plan. The pre-outage assessment noted no particular areas of concern. Consistent with the Program Plan, no "Existing" degradation is being monitored and no degradation was observed this outage. Monitoring for the presence of "Relevant" and "Potential" degradation continues to be based on the assessment of prior inspection results, steam generator design features, and industry experience with similar steam generators.

## Inspection Results

The inspection was performed in accordance with the requirements of the EPRI PWR S/G Examination Guidelines, Revision 5. All methods and techniques used for determinations were qualified as required by the above guidelines.

### Primary Side Eddy Current Inspection Results

**Bobbin Inspection:** A total of four (4) tubes were reported with dent (DNT) signals during the bobbin inspection. Two (2) dents were not reported previously because the threshold for reporting dents was lowered from 3.0 volts to 2.0 volts prior to the inspection.

The four (4) DNT locations did not require rotating probe exams in accordance with the site analysis guidelines but were further evaluated using a +Point rotating probe to obtain relevant baseline rotating coil results for future inspections. The + Point examination also confirmed no evidence of degradation existed in the area of the DNT signal. Information derived from the bobbin results is shown below:

Tube	Indication Location	Bobbin Results	
		Volts	Ind.
R5 C19	3C + 10.47 inch	2.00	DNT
R33 C20	AV5 + 6.14 inch	2.73	DNT
R29 C56	2H - 1.94 inch	2.54	DNT
R46 C57	AV1 - 1.34 inch	2.79	DNT

Seventeen (17) tubes were identified with Manufacturing Buff Marks (MBMs). All the signals were resolved by comparing them with baseline inspection results.

**+Point Rotating Probe Inspection:** All of the Row 1 U-bends were inspected from the top of hot leg support to the top of the cold leg support. No evidence of degradation was reported. Noise measurements were performed on a 20 tube random sample to verify that the existing noise was within the limits of the qualified inspection technique (ETSS 96511.1 Rev 10). The results of the noise measurements showed that noise levels were substantially below the required values.

A 20% sample that covered the expansion transition of the hot leg tubes at the top-of-tubesheet was performed with the + Point rotating probe. During this examination, a signal was identified in tube Row 9 Column 45 that was determined to result from a variation in the permeability of the tube (PVN). The signal extended in an axial band over the full length of area inspected with the +Point probe. The bobbin data from this area did not show evidence of the PVN or any evidence of degradation. Unlike the standard + Point probe, the bobbin probe is magnetically biased and therefore tends to suppress permeability variations. The determination that the signal resulted from a permeability variation was based upon the signal characteristics and the absence of a signal at that location in the data collected with a magnetically biased bobbin probe. In addition, re-examination of the area with a magnetically biased + Point probe reduced the signal voltage from 5.99 volts to 1.41 volts. The magnetically biased + Point probe could not completely eliminate the signal due to the insufficient biasing field emitted by the probe.

The technical concern with regard to a permeability variation is that it may prohibit unambiguous interpretation of the + Point data at the expansion transition area. Based on laboratory and field performance of Alloy 690TT material and the negative bobbin results, it is very unlikely that any degradation exists in this area, but due to the potential masking concern the tube was "preventively" plugged.

#### Eddy Current Screening for Localized Sludge Accumulation:

Data from the +Point probe was used to evaluate 300 tubes on the hot leg side of the steam generator for evidence of localized sludge deposits. Of the tubes evaluated, 249 locations (83%) showed no evidence of sludge accumulation, the remaining locations showed evidence of deposits ranging from 0.5 inch to 3.0 inch. Locations showing sludge accumulation included the baffle plate "cut-out" region and isolated occurrences bounded by an area from column 39 through column 54 extending from row 4 to row 12.

The 100KHZ differential bobbin coil response on selected tube support plate areas showed very minimal signal distortion. This is evidence that no appreciable amount of sludge has accumulated at or within the steam generator support structures. This conclusion is supported by the results of the secondary side 7<sup>th</sup> tube support plate visual inspection.

#### Secondary Side Inspection/Maintenance Results

Routine inspections were conducted on the "A" steam generator consisting of a visual condition evaluation the steam drum area, internal video inspection of the feedwater distribution ring-to-"J" Nozzle interface, UT thickness measurements of selected feedwater distribution ring components, and video inspection of the 7<sup>th</sup> tube support plate. Sludge lancing and top-of-tubesheet video inspections were not conducted at this outage in accordance with the defined program schedule. No conditions were observed that would potentially compromise tube integrity.

## Condition Monitoring Assessment Summary

### Tube Integrity Evaluation

The condition of the North Anna Unit 2 steam generators, as indicated by the results of this inspection, satisfy the requirements for tube integrity with respect to structural and leakage integrity margin for the recently completed operating period.

No indications were observed during the bobbin probe inspection conducted on "A" steam generator. The MBM indications reported during the bobbin inspection were compared to the 1995 baseline results and showed no change from the baseline inspection. The four (4) DNT signals identified during the bobbin inspection were inspected with a + Point probe and showed no degradation. Focused + Point probe inspections at the H/L top of tubesheet and in the Row 1 U-bend area were conducted and showed no evidence of wear or corrosion degradation. No corrosion degradation of Alloy 690TT tubing has been reported in the industry to date.

A permeability variation at the hot leg top of the tubesheet was reported in tube R9C45. This material condition is related to a variation in the response of the material to the eddy current probe and is not related to a "loss" of wall thickness which would be indicative of a flaw. The presence of a permeability variation does not affect the structural integrity of the tube, but potentially could reduce the ability of the eddy current probe to detect actual flaws that could develop in the tube. Hence, this tube was plugged.

### Operational Leakage

The conservative primary-to-secondary leakage response limit from the Technical Specifications that was implemented prior to the replacement of the North Anna generators still exists in Station procedures. The current leak rate limits are conservative relative to the values specified in industry guidance documents. Site procedures reflect the recommended actions levels for shutdown recommended by Revision 2 of the EPRI Primary-to-Secondary Leak Guidelines. Appropriate Technical Specification limits will continue to be followed until the industry Generic Technical Specification is implemented.

During the past operating cycle, no primary-to-secondary leakage was reported. Monitoring continues in accordance with the requirements of Station Procedures. N-16 monitors continue to be used to provide fast response trending of any potential leakage.

### Projected Accident Leakage

There are no inspection findings that indicate leakage would occur during a postulated accident since no operative degradation mechanisms have been identified since unit replacement.

## Tube Integrity Assessment Summary

### Discussion

Based on Dominion management operating cycle information the past operating interval between inspections of the "A" steam generator was 47.6 EFPM. The next projected operating interval is approximately 49.6 EFPM. Since no indications were identified during the current inspection, there is no known condition that would exceed structural and leakage margin requirements before the end of next planned operating interval for Steam Generator "A". Therefore, the Operational Assessment requirements are satisfied. The Program Plan currently specifies general and focused tubing inspections on one steam generator each refueling cycle, the findings of this inspection support maintaining this planned frequency of inspection.

Even though no AVB wear indications have been identified in any of the North Anna steam generators to date, experience dictates that it should be expected to occur over the long term. AVB wear is reported during bobbin testing. Typically, indications begin to be reported at approximately 10% through wall and, in general, are slow growing. Industry experience on steam generators of similar design to those at North Anna has reported no appreciable AVB wear. Typical growth rates of 2% to 5% through wall have been experienced at Surry. The performance of the North Anna generators is expected to exceed that of Surry based upon their performance to date and the improved fabrication techniques that were used during manufacturing.

Using a conservative projected wear rate the tube wear depth of any potentially undetected AVB wear indication is well below the bounding structural limit depth of 58% based on the uniform wall thinning degradation model. No structural integrity concern is identified for the next planned operating interval (49.6 EFPM's) of the North Anna Unit 2 "A" steam generator. No inspection findings were noted for the "A" steam generator that would not support satisfactory operation of the "B" and "C" and steam generators to their next scheduled inspections.

### Conclusion

The operational assessment of the North Anna Unit 2 steam generators for the next operating cycle satisfies the structural integrity and leakage performance criteria. If other issues are identified on the North Anna steam generators in ensuing inspections or other relevant industry findings are noted during the inspection of similar model steam generators, a review of planned inspection intervals will be conducted in accordance with the requirements of the Program Plan.

Results of secondary side inspections continue to demonstrate reliable operation. Continuing diligence on chemistry and FME control will support long term performance. Evaluation and monitoring will continue as detailed in the Monitoring and Inspection Program Plan. Continuing awareness of any related industry issues will be considered when planning future inspections.

**Corrective Actions Planned**

None

**Evaluation (If SG condition does not meet previous cycle operational assessment)**

Not Applicable

**ATTACHMENTS:**

Attachment 1 – Three Letter Codes

Attachment 2 – Series 54F Steam Generator - Sketches

## ATTACHMENT 1 Three Letter Codes

### General Codes

**ANF - ANOMALY NOT FOUND** - Indicates that a previously reported anomaly cannot be found within .50" of the location where the anomaly was previously called.

**ANR - ANOMALY NOT REPORTABLE** - Indicates that a previously reported anomaly does not meet the present reporting criteria.

**BDA - BAD DATA (retest)** – Indicates that the data for the specified tube is not acceptable for analysis due to poor signal quality. The tube will be re-tested to the required extent

**INF - INDICATION NOT FOUND** - Indicates that a previously reported INDICATION has not been found in the data being analyzed or that a tube/signal is being re-tested for positive identification (PID) and no signal is present in the retest data.

**INR - INDICATION NOT REPORTABLE** - Indication called in previous inspections that are still detectable but fall below current reporting criteria

**NDD - NO DETECTABLE DISCONTINUITY** – The recorded data has no signal responses meeting the criteria established in the Site Specific Analysis Guidelines for degradation, damage precursors or anomalies.

**NT - NO TEST (re-test)** – Indicates that the tube ROW, COLUMN was encoded on the tape; however, no inspection data was recorded for analysis.

**OBS - OBSTRUCTED** – Blockage of a tube that prevents passage of a defined minimum size probe through the tube.

**PID - POSITIVE IDENTIFICATION** - Verification of a signal at the same reported ROW/COL and at the same reported tube location.

**PLG - PLUG** – Indicates that the tube at the specified location has been plugged.

**PVN - PERMEABILITY VARIATION** – Condition where the test coil impedance changes due to a change in the tubing materials inherent tendency to conduct magnetic flux lines.

**PLP – POSSIBLE LOOSE PART** – Indicates the possible presence of a loose part in the generator.

**RST - RESTRICTED** - Blockage of a tube that prevents passage of a probe beyond a specified location within the tube.

**TIU - TUBE I.D. UNCERTAIN (re-test)** - Indicates that the ROW and/or COL identifier for a given tube is in doubt.

### BOBBIN CODES

**BLG - BULGE** - An area along the tube where the diameter of the tube has been abruptly deformed in an outward direction as compared to the nominal tube diameter.

**CUD - COPPER DEPOSIT** - The presence of copper deposits on the outside of the tube.

**DNT - DENT** – An area along the tube where the diameter of the tube has been abruptly reduced compared to the nominal tube diameter.

**LGV - LOCAL GEOMETRIC VARIATION** - A local reduction in tube diameter usually associated with a localized change in conductivity of the tube. LGV signals are caused by dings introduced during manufacturing/installation process and do not represent a discernible wall loss. The signals must be verified by history review to be called with bobbin (See rotating probe DNG code).

**MBM - MANUFACTURING BURNISH MARK** – A tubing condition where localized tubing imperfections were removed by buffing and are detectable due to the effects of cold working and minor localized wall thinning. The signal must be verified by history review to be called with bobbin.

**MMB - MULTIPLE MANUFACTURING BUFF MARK** - Multiple MBM signals in close proximity over a length of tube. The signals must be verified by history review to be called with bobbin

**NQI – NON-QUANTIFIABLE INDICATION** – A bobbin signal requiring rotating coil examination for disposition.

**NQN – NON-QUANTIFIABLE NONDEGRADED** – A bobbin signal which was formally classified as NQI but has been determined to be anomalous or of a type which does not represent degradation.

**PDS - POSTIVE DRIFT SIGNAL** –Long (several inches to several feet) drift signals evident on absolute channels caused by variations in tube concentricity associated with the pilgring process. The signals may be located at random elevations and are generally only in one leg of the tube

## **ROTATING PROBE CODES**

**DNG - DING** – A localized inward displacement of the tube caused by a mechanical impact on the OD surface.

**MAA - MULTIPLE AXIAL ANOMALY** - Multiple axially oriented signals located at the top of the tube sheet that the rotating coil data shows to result from an anomalous condition in the tube.

**MCA - MULTIPLE CIRCUMFERENTIALLY ORIENTED ANOMALY** - Multiple circumferentially oriented signals located at the top of the tube sheet that the rotating coil data shows to result from an anomalous condition in the tube.

**MAI - MULTIPLE AXIAL INDICATION** - Multiple axially oriented signals that the rotating coil data shows to result from flaws in the tube.

**MBM - MANUFACTURING BURNISH MARK** – A tubing condition where localized tubing imperfections were removed by buffing and are detectable due to the effects of cold working and minor localized wall thinning

**MCI - MULTIPLE CIRCUMFERENTIALLY ORIENTED INDICATION** - Multiple circumferentially oriented signals reported from rotating probe data that the rotating coil data shows to result from flaws in the tube.

**MMB - MULTIPLE MANUFACTURING BUFF MARK** - Multiple MBM signals in close proximity over a length of tube

**NDF - NO DEGRADATION FOUND** - For special interest exams. No visible signal found at the location of interest.

**NQN – NON-QUANTIFIABLE NONDEGRADED** – A bobbin NQI signal which is determined to be anomalous or not to represent degradation.

**PIT - PIT** – Localized attack on tubing resulting from non-uniform corrosion rates caused by the formation of local corrosion cells. At NAPS, the condition refers to small volumetric indications with approximately the same axial and circumferential extent.

**SAA - SINGLE AXIAL ANOMALY** – A single axially oriented signal located at the top of the tube sheet that the rotating coil data shows to result from an anomalous condition in the tube.

**SCA - SINGLE CIRCUMFERENTIALLY ORIENTED ANOMALY** – A single circumferentially oriented signal located at the top of the tube sheet that the rotating coil data shows to result from an anomalous condition in the tube.

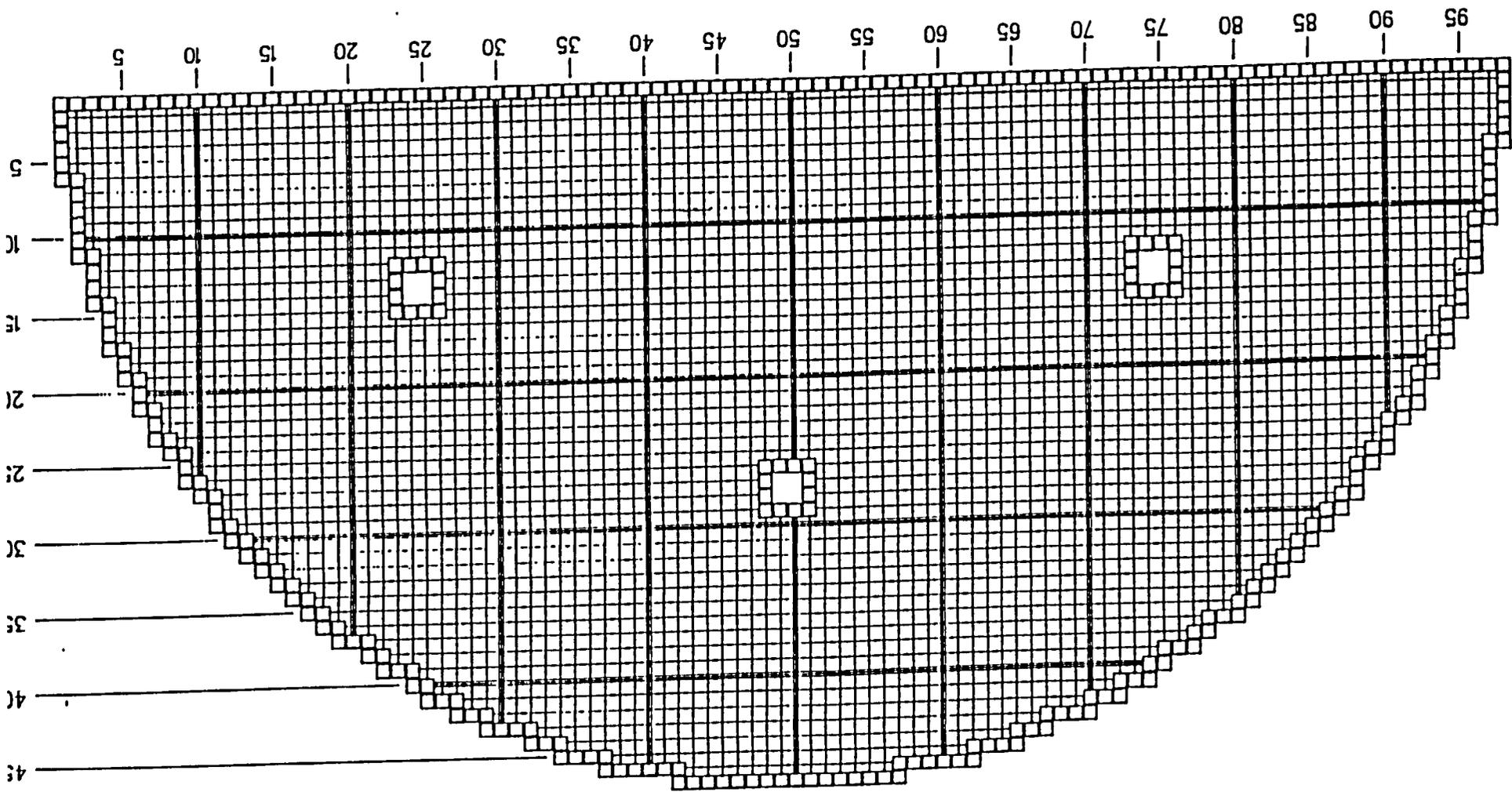
**SAI - SINGLE AXIAL INDICATION** – A single axially oriented signal that the rotating coil data shows to result from a flaw in the tube.

**SCI - SINGLE CIRCUMFERENTIALLY ORIENTED INDICATION** – A single circumferentially oriented signal that the rotating coil data shows to result from a flaw in the tube.

**VOL – VOLUMETRIC** – Indications of volumetric wall loss indicative of general localized thinning, wear or impingement.

**SVI/MVI – SINGLE VOLUMETRIC INDICATION/MULTIPLE VOLUMETRIC INDICATIONS** – Indications of volumetric wall loss indicative of general local inter-granular attack (IGA or IGA/SCC).

**Series 54F Steam Generator  
Sketches**



SERIES 54F

[REDACTED]

BOTDIA VIEW