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Dominion

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

Serial No. 05-067
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VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
NORTH ANNA POWER STATION UNITS 1 AND 2
ANNUAL STEAM GENERATOR TUBE INSPECTION REPORT

Pursuant to Technical Specification 5.6.7.b for North Anna Power Station Units 1 and 2, Dominion is required to submit an annual steam generator tube inservice inspection report. The attachment to this letter provides the steam generator tube inspection report for North Anna Unit 1. There were no inservice inspections performed on the Unit 2 steam generator tubes during 2004.

This letter does not establish any new commitments. Should you have any questions or require additional information, please contact Mr. Thomas Shaub at (804) 273-2763.

Very truly yours,

C. L. Funderburk, Director
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Dominion Resources Services, Inc.
for Virginia Electric and Power Company

Attachment

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Attachment

Serial No. 05-067

North Anna Unit 1
Annual Steam Generator Tube Inservice Inspection Report

North Anna Power Station
Units 1 and 2
Virginia Electric and Power Company
(Dominion)

Virginia Electric and Power Company (Dominion)
North Anna Unit 1
Annual Steam Generator Tube Inservice Inspection Report

Station	Unit	Outage Date	Generator Examined			Date of Report
North Anna	1	September, 2004		C		11/05/2004

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 Transfer 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**
C	Bobbin (Rows 4–47)	3297	3297	Bobbin	TEC - TEH
C	Bobbin (Rows 2-3)	196	196	Bobbin	7C - TEH
	Bobbin (Rows 1-3)	294	294	Bobbin	TEC - TEH
C	Bobbin (Rows 1)	98	98	Bobbin	7H - TEH
C	Bobbin (Post PLP retrieval)	67	67	Bobbin	TEC - TEH
C	Row 1 U-Bend RPC	122	122	+ Point U-Bend RC	7H – 7C
C	TTSH RPC	719	719	+ Point RC	TSH +/- 3"
C	Special Interest	47	47	+ Point RC	Various

Indications of Imperfections Detected							
SG	**NDE Method**	**Row**	**Column**	**Indication Code**	**Location**	**Active Yes/No**	**Measured Wall Penetration**
C	Bobbin	37	79	NQI	AV6+22.36	No	43%

Tube Plugging		
SG	**Reason/Mechanism**	**Tubes Plugged**
C	Foreign Object/Wear	1
Total Tubes Plugged		1

Plugging Attributions				
SG	**Row**	**Column**	**Reason/Mechanism**	**Plugging Method**
C	37	79	Wear	Mechanical

Repair Attributions				
SG	**Row**	**Column**	**Reason/Mechanism**	**Repair Method**
C	N/A	N/A	N/A	N/A

Plugging/Repair Record					
SG	**Tubes Plugged**	**Tubes Repaired (Not Plugged)**	**Percent Plugged**	**Percent Repaired (Not Plugged)**	**Percent Plugged or Repaired**
A	0	0	0	0	0
B	0	0	0	0	0
C	2	0	0.06	0	0.06

TUBE INTEGRITY ASSESSMENT

1.0 Summary

Overall condition assessments have been delineated in the North Anna Power Station Units 1 and 2 Steam Generator Monitoring and Inspection Plan. Consistent with the NEI 97-06 Rev 1 requirements, a Pre-Outage Assessment (POA) was performed to identify any relevant or potential degradation mechanisms to be considered for the North Anna Unit 1 steam generators and to identify the eddy current inspection scope and probe capabilities.

As required by NEI 97-06, performance criteria are established in this document in three areas:

- Tubing Structural Integrity
- Operational Leakage
- Projected Accident Leakage

The inspection performed on the "C" steam generator was consistent with the inspection plan and the results formed the basis of the condition monitoring and operational assessment performed for this outage. No corrosion mechanisms were identified during the inspection.

Based on the results of the fall 2004 "C" steam generator tube inspection, a condition monitoring evaluation of the steam generator tubes was perfromed to ensure compliance with the current licensing basis. If detected during the inspection, structurally significant indications are evaluated to confirm that the safety margins against leakage and burst are not exceeded at the end of this operating cycle using a bounding assessment structural limit prediction. The results of the condition monitoring evaluation were used as a basis for the operational assessment and demonstrated prospectively that the anticipated performance of the steam generators will likewise not exceed the safety margins against leakage and tube burst during the ensuing operating period. The results were in compliance with plant licensing basis.

One tube was plugged due to wear attributed to a foreign object during the EOC17 (replacement cycle EOC8) Refueling Outage in September 2004. Acceptable tube integrity at the end of that cycle was demonstrated. The condition monitoring and operational assessment for tube integrity follow 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 condition of the North Anna Unit 1 steam generators, as indicated by the results of the current Condition Monitoring Evaluation and past Operational Assessments, satisfy the safety margin requirements with respect to structural and leakage integrity margin. The recently completed operating interval, i.e., time between the last steam generator "C" inspection, was approximately 65 effective full power months (EFPM). The expected operating interval before the next inspection of steam generator "C" is three

cycles (nominally 48 EFPM). There is no known condition that would exceed structural and leakage margin requirements before the end of the next planned operating interval for steam generator "C". Thus, the Operational Assessment requirements are satisfied.

Satisfactory operation of "A" and "B" steam generators, which were not inspected during fall 2004 inspection, is acceptable based on the assessment projections and may operate up to 72 EFPM from their last inspection ("A" fall 2001 and "B" spring 2000). This is consistent with the requirements in the EPRI Rev. 6 Examination Guideline. It is based on past satisfactory inspections of these generators and no active damage mechanisms detected in the current inspection of the "C" steam generator that would compromise these previous assessment results. However, it is noted that pending NRC action on a generic technical specification for steam generator examinations may require shorter intervals.

2.0 Condition Monitoring (CM): Tube Integrity Evaluation

The condition of the North Anna Unit 1 steam generators, as indicated by the results of the planned inspection performed on the "C" steam generator, satisfies the structural and leakage integrity requirements for the recently completed inspection. No corrosion related degradation was observed during the inspection of the subject generator. A summary discussion of the inspection results and the evaluations performed is provided in the following sections.

2.1 Tubing Inspections

One of the damage mechanisms identified in the POA as having a reasonable potential to occur was foreign object induced tube wear. This is the only damage mechanism that was identified during the inspection, and it was identified in only one tube. No indication of tube wear at anti-vibration bar (AVB) locations was observed. This continues to demonstrate excellent performance of the replacement generators with respect to this relevant degradation mode since the unit has operated 10.5 EFPY without any observed AVB wear.

As identified above, extensive bobbin probe and rotating probe examinations were performed. The bobbin probe inspections identified various ambiguous indications, some of which were subjected to further testing with rotating probes (i.e., special interest exams) and found to be benign. Tracking of manufacturing related anomalies continued with no concerns identified. Within this population all dent indications 2.0 volts and greater were reported with history resolution being required for those. Only three tubes required rotating exam based on guideline requirements. However, an additional 28 signals were examined with rotating coil probes to provide a 20% sample inspection population. No indications were observed from the rotating coil exam.

The bobbin probe inspection did reveal indications of significance requiring additional investigation. One tube, SGC R37 C79, contained a possible loose part (PLP) indication approximately 4" above the 7th tube support plate (TSP) on the cold side.

Tube degradation associated with the PLP was also detected in the tube. A neighboring tube, SGC R38 C78, also contained a PLP indication caused by the same object; however, no damage occurred to this tube.

Visual examinations performed from the 7th tube support plate hand hole confirmed that a foreign object was present around the R37 C79 tube location. The secondary side inspection team successfully removed the object that was a 14.2" long 3/32" diameter steel wire. A precautionary bobbin re-probing of tubes in the two columns surrounding the exit path was also conducted to ensure that no damage had occurred during the retrieval process. None was observed. A reanalysis of 1998 eddy current data revealed a signal that could be consistent with an object adjacent to the tube. The reanalysis confirmed that no damage was present at this tube location in 1998. After the object was removed, follow-up testing was performed on the above referenced tubes, and on surrounding tubes, with rotating probes to ensure that all existing indications were discovered. This testing confirmed that the only tube damaged by the object was tube SGC R37 C79. The rotating probe result was used to estimate the depth, circumferential, and axial extent of the damage. The most conservative depth estimate (43% TW) exceeded the Technical Specification plugging limit. Therefore, tube SGC R37 C79 was removed from service by plugging.

Other bobbin probe PLP indications at the top-of-tubesheet area were reported but follow-up rotating probe examinations confirmed that no objects were present. Visual inspections confirmed no objects present. Two other objects were identified and removed from the SG by the secondary side inspection team.

2.2 Condition Monitoring Conclusion

Tube R37 C79, which experienced foreign object wear, was evaluated relative to meeting the performance criteria. The degradation was measured to be 43% TW using the most conservative qualified sizing technique available (ETSS 21998). This technique is known to be overly conservative for sizing volumetric flaws with axial dimension greater than 0.25" but was judged to be the most representative of the observed wear indication. The circumferential and axial dimensions of this flaw are estimated to be 0.44" and 0.16", respectively. Since the axial dimension is less than 0.25", it is prudent to conservatively account for potential depth underestimation due to technique and analyst sizing uncertainties. This adjustment is based on parameters provided in the POA and the guidance of EPRI Integrity Assessment Guideline. Specifically, the sizing regression equation used to generate the best estimate flaw depth is,

Best Estimate = (1.02)(M) + 5.81; where
M = field measurement of depth % through wall (% TW).

For the flaw in SGC R37 C79, the total adjustment is performed as follows:

Best Estimate = (1.02)(43% TW) + 5.81
Best Estimate = 49.7% TW

With the combined 90/50 (SQRTSUMSQ) uncertainty value of 12.6% TW the upper bound structural limit (SL) becomes:

Upper Bound @ 90/50 Confidence Level = Best Estimate + 12.6% TW
Upper Bound @ 90/50 Confidence Level = 62.3% TW

This represents a conservative, upper 90/50 estimate of the flaw depth accounting for technique and analyst sizing uncertainty. This value must be compared with the appropriate SL to determine if the structural integrity performance criterion has been met. Since the conservatively calculated 3 ΔP SL is 58.2% TW, the EPRI Flaw Handbook was consulted to provide a more realistic assessment of structural capability to ensure this criterion could be met. The indicated axial length of this flaw was 0.16". Due to coil look-ahead effects, the indicated length of volumetric indications is an overestimate of the actual length. For conservatism, however, it will be assumed that the axial length of this flaw is 0.2". Based upon the Flaw Handbook methodology, a more specific estimate of the SL for volumetric degradation of limited circumferential extent and 0.2" in axial length is 85% TW. Since the upper bound depth estimate of 62.3% TW did not exceed 85% TW, it is concluded that the structural integrity performance criterion was not exceeded during the operating interval preceding this outage. In addition, the absence of other observed degradation provides reasonable assurance that the accident leakage performance criterion would not have been exceeded during a design basis accident.

No primary to secondary SG tube leakage (i.e., <1 GPD) was reported during the previous operating period. Therefore, the operational leakage performance criterion was not exceeded during the operating period preceding this outage.

No inspection findings were indicative that leakage would have occurred in excess of design basis assumptions. Since the findings confirm the identified tube degradation met the structural limit requirements and confirmed the lack of other operative degradation mechanisms, the accident leakage criterion was met during the previous operating cycle.

3.0 Operational Assessment (OA)

It must be demonstrated that the structural integrity performance criterion will not be exceeded prior to the next scheduled examination in any of the three Unit 1 steam generators. This OA addresses degradation observed at this outage; namely foreign object related tube wear. In addition, although no AVB wear has been identified to date in the Unit 1 steam generators, the future growth of hypothetical, undetected AVB wear is also considered.

Going forward the OA considers a three cycle operating interval for SG C based upon the currently planned inspection interval.

3.1 Foreign Object Wear

During this outage three foreign objects were identified in the "C" generator and all three were removed. The as-found conditions were described above. The tube removed from service by plugging will not have any impact on the future integrity of the tube bundle. Pre-plugging stabilization was not considered to be necessary for the following reasons: 1) the offending object was removed and: thus, no further growth of this indication can occur, and 2) the localized nature of the degradation does not present a realistic threat of post-plugging severance.

The noted single tube damage was sized at 43% TW using the most conservative sizing technique. This indicated depth corresponds with a best estimate depth of 49.7% TW after accounting for ETSS 21998 sizing regression (see Section 2.0). The 1998 inspection data indicated the possible presence of the foreign object but no tube damage was confirmed. Therefore, it can be estimated that the flaw grew approximately 50% TW in four operating cycles.

The object that caused the tube damage is presumed to be an original fabrication or construction installation remnant. If any other similar objects were left in the other generators, it is likely that evidence of the object(s) would have been revealed during inspections performed since that time. There have been several opportunities for detection since then. All three generators have undergone secondary side visual examinations during outages since the replacement outage. These inspections included the 7^{th} tube support plate, as well as, steam drum and top-of-tubesheet locations. In addition, the tubes have been eddy current tested at least once since steam generator replacement. Therefore, there is reasonable assurance that similar objects in the other generators, if they existed, would have been detected during previous eddy current and secondary side visual examinations.

Should similar objects exist undetected in the other steam generators, it is reasonable to expect that they would behave similarly to those detected during this outage. It has been demonstrated in the above condition monitoring section that even after four cycles of growth, substantial margin existed between the upper bound depth estimate (62.3% TW) and the applicable structural limit (85% TW). There is reasonable assurance that similar foreign objects will not cause the structural integrity performance criterion to be exceeded prior to the next tube examination and; therefore, the operational leakage and accident leakage performance criteria would also be met.

3.2 Anti-Vibration Bar (AVB) Induced Wear

Even though no AVB wear indications have been identified in any North Anna steam generator to date, it could reasonably be expected to develop at some point in unit life. AVB wear, detected and sized with the bobbin probe, typically begins to be reported at a depth of 10% TW. Industry experience to date on similar design steam generators has reported minimal AVB wear. The following evaluation was performed to evaluate a potential undetected existing 10% TW AVB wear conditions relative to tube integrity requirements at the end of the next planned operating interval of 3 cycles for SG C.

Using a conservative 95/50 AVB growth rate of 7.23% TW per operating cycle from a similar unit (i.e. Surry), the time is projected as follows:

Best Estimate % TW:	y = 0.97x + 3.49
(Based on ETSS 96004.1 Eq,)	y = 0.97 (10% TW) + 3.49
	y = 13.2% TWD
Total Random Uncertainty @ 90/50:	10.7% TW
Bounding Structural Limit Based on Uniform Thinning:	58.2% TW

Time Interval to Reach Structural Limit (SL) in cycles:

SL = 13.2 % TW + 10.7 % TW + [(7.23 % TW/cycle) x (Interval)] = 58.2% TW

Interval = 4.74 cycles

This projected time interval required for hypothetical AVB wear indication to grow to a depth equaling the most conservative structural limit (uniform thinning), far exceeds the typical 3 cycle operating interval for any of the Unit 1 steam generators. Therefore, AVB wear does not represent a realistic concern from the perspective of tube structural integrity. As such, no accident leakage or operational leakage concerns exist relative to AVB wear for any steam generator.

3.3 Secondary Side Internals Degradation

No degradation of secondary internals, which could impact tube integrity prior to the next examination, was identified during this outage. Feed ring and J-tube examinations confirmed that the advancement of flow assisted corrosion (FAC) is minimal and will not impact tube integrity in the foreseeable future.

4.0 Conclusion

The North Anna Unit 1 steam generators, as indicated by the results of the current condition monitoring evaluation of steam generator "C" and past assessments pertaining to the other steam generators, continue to satisfy the safety margin requirements with respect to structural and leakage integrity.

The only defective tube identified during this outage met the structural integrity performance criterion by a large margin providing a high degree of confidence that the accident leakage performance criterion was also met. No tube leakage was reported during the previous operating cycle; therefore, the operational leakage performance criterion was met.

The evaluation herein has demonstrated that there is reasonable assurance that

operation of steam generator "C" throughout the next operating interval and the remaining intervals on the uninspected generators will not cause the tube integrity performance criteria to be exceeded.

Corrective Actions Planned

None

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

Not Applicable