VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

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

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VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNIT 1
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
2021 STEAM GENERATOR INSERVICE INSPECTION REPORT

By letter dated August 27, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21243A313), Virginia Electric and Power Company (Dominion Energy Virginia) submitted information summarizing the results of steam generator (SG) tube inspections performed at Surry Power Station Unit 1 during the spring 2021 refueling outage. On January 11, 2022, the NRC requested additional information related to the SG inspections. The NRC's questions and Dominion Energy Virginia's responses are provided in the attachment to this letter.

If you have any questions or require additional information, please contact Mr. Michael True at (757) 365-2446.

Respectfully,

Fred Mladen
Site Vice President
Surry Power Station

Attachment - Response to NRC Request for Additional Information Regarding Spring 2021 Steam Generator Tube Inspection Report - Surry Power Station Unit 1

Commitments made in this letter: None

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Serial No.: 22-015A
Docket No.: 50-280

ATTACHMENT

Response to NRC Request for Additional Information Regarding Spring 2021 Steam Generator Tube Inspection Report

Surry Power Station Unit 1

Virginia Electric and Power Company
(Dominion Energy Virginia)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING SURRY UNIT 1 SPRING 2021 STEAM GENERATOR TUBE INSPECTIONS

NRC Comment

By letter dated August 27, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21243A313), Virginia Electric and Power Company (the licensee) submitted information summarizing the results of the spring 2021 steam generator (SG) tube inspections performed at Surry Power Station (Surry), Unit 1. These inspections were performed during refueling outage (RFO) 30.

Title 10 of the Code of Federal Regulations Part 50.36 establishes the requirements for pressurized water reactors to have technical specifications (TS) which include a SG program with specific criteria for the structural and leakage integrity, repair, and inspection of SG tubes.

Specifically, Surry's Technical Specification (TS) 6.6.A.3 requires that a report be submitted within 180 days after Tavg exceeds 200°F following completion of an inspection of the SGs performed in accordance with TS 6.4.Q, "Steam Generator (SG) Program." Additionally, these requests for additional information (RAIs) were discussed with your staff and it was determined that a clarification call was not required for these RAIs.

To complete its review of the inspection report, the U.S. Nuclear Regulatory Commission staff requests the following additional information. This request is now released formally with a 30 day calendar response period; thereby, these RAIs are due on February 10, 2022.

1) *Please identify any differences compared to the RFO 29 (Fall 2019) inspections in the sampling strategy for eddy current examination of locations such as tube support plate (TSP) intersections, freespan dings, and bulges. The RFO 29 sampling strategy was described in the request for additional information response dated June 23, 2020 (ADAMS Accession No. ML20181A308). As part of the response, please provide the definitions for dents and dings applied to Surry Unit 1 SG inspections.*

Response

Previous steam generator tube inspections at Surry Power Station employed a sampling approach, whereas 100% of the tubes were inspected in one or two steam generators each outage, alternating the steam generator(s) selected such that each steam generator was inspected every other refuel. During the Spring 2021 refueling outage, 100% of the tubes in all three steam generators were inspected.

Identical to the 1R29 inspection, the in-service tube base scope included a 100% bobbin probe exam, 100% array probe exam of the top-of-tubesheet on both the hot-leg and cold-leg (including all overexpansions within the tubesheet down to the H* distance), 100% full length array probe of all "Tier 1" tubes identified with potentially high residual stress, and a +Point™ exam of all over rolls, bulges, and low row (row 1 and 2) U-bends.

In addition to the base scope, a preplanned special interest scope was developed for both the 1R29 inspection and the 1R30 inspection, which includes a sample of previously identified dents, dings, manufacturing burnish marks, volumetric indications, and wear (excluding AVB wear). The only departure from the 1R29 preplanned special interest strategy and the preplanned 1R30 special interest scope was the sample plan for the inspection of dents/dings.

As a result of concerns for possible degradation at dent/ding locations, the special interest scope of dents/dings with a +Point™ probe was increased significantly. The specific dent/ding scope performed during the 1R29 inspection included fifty percent of previously identified dents/dings >2 Volts located in hot-leg straight sections (TSH+0.00 to 07H+1.00"), plus any additional indications required to ensure that the five largest voltage dents/dings in hot-leg straight sections are included in the sample. Also, the five largest voltage dents/dings located between the cold-leg tubesheet and the straight section of the hot-leg, (between TSC+0.00 and 07H+1.01") were included in the preplanned scope. The specific dent/ding scope performed during the 1R30 inspection included 100% of all dents/dings ≥ 2 Volts located in the hot leg straight section and 100% of all dents/dings ≥ 5 Volts in the U-bend and cold-leg sections of the tubes.

It should be noted that both terms Dent and Ding refer to a plastic deformation of the tube that results in a reduction in the tube diameter. The two different terms were used to differentiate between the location of the signal. Historically (early generation designs) the term dent referred to local tube diameter reductions due to corrosion products from carbon steel (typically, drilled carbon steel tube support plates). The term ding referred to local tube diameter reductions due to mechanical means (manufacturing, vibration, incidents during maintenance activities, or impact from foreign objects). Since the eddy current signals from both dents and dings are similar, the location of the indication was used to differentiate which term was used (dent for indications at supports and ding for all free span indications).

At Surry Power Station, the referenced dent signals do not represent the same phenomena as classical denting on older generation units caused by drilled carbon steel support plate corrosion damage. Since the Surry units are not similar in design (i.e., quatrefoil stainless steel tube support plate design vs. drilled hole carbon steel tube support plate design) these same "denting" issues do not directly apply to the Surry units. Tube support plate areas are not susceptible to denting caused by corrosion of the tube support plates. However, the historical nomenclature assigned to these signals has existed in the database since the steam generators were installed and has remained unchanged since that time.

In addition to the preplanned scope, if indications are detected during the examination such as deposits, possible loose parts signals, and ambiguous or anomalous indications, which require additional categorization with diagnostic techniques, these indications are examined with a +Point™ probe. The total special interest scope examined with a +Point™ probe in 1R30 was 1,694 locations.

2) *With respect to the stress corrosion crack indication in SG C,*
   a) *Was the indication located in an anomaly, such as an over-expansion?*
   b) *Discuss the relative performance of the array probe and the +Point probe at the crack location, including the results of any lookbacks from previous inspections for the location with the crack indication.*

Response

The indication of circumferential Primary Water Stress Corrosion Cracking (PWSCC) within the Hot-Leg Tubesheet (TSH –0.34 inches) was located adjacent to a historical Single Circumferential Anomaly (SCA). The eddy current signal from the SCA extends upwards from the Top-of-Tubesheet (TTS) and the PWSCC indication is slightly below the TTS. The +Point™ examination on this location of the tube was performed as part of the preplanned special interest scope because of the historical SCA. The PWSCC indication was not detected by the 100% TTS array probe examination which includes both auto-analysis and manual analysis in a dual analysis process.

A reevaluation of previous eddy current data (i.e., historical or look-back evaluation) using the benefit of hindsight was performed. The array probe signal is very small and in the extreme OD plane (172 degrees) beyond the threshold of reportability for either the manual or auto-analysis processes. The depth measurements obtained from the look-back evaluation of the +Point™ data concluded that depth of the indication remained relatively unchanged from the 1R26 (Spring 2015) and 1R28 (Spring 2018) inspections. A diminished discontinuity response can be traced back as far as the 1R23 (Fall 2010) inspection.

3) *With respect to the secondary-side inspections, please clarify for each SG whether foreign objects or loose parts were removed, and the number and type of objects removed. In addition, please describe any foreign objects or loose parts known to remain in the SGs.*

Response

During the 1R29 outage an enhanced tubesheet cleaning process was performed in all three steam generators to remove as much debris and as many legacy foreign objects as possible and to gain an accurate accounting of all un-retrievable foreign objects

remaining. The as-left condition also provided a known baseline to positively identify any new foreign object intrusion during future operational cycles.

The foreign objects identified in Table 1 below include all foreign objects removed during the 1R30 FOSAR and water lancing activities and the foreign objects known to be remaining at the conclusion of 1R30.

Table 1: 1R30 Foreign Objects

SG-Item#	Description	Location	Configuration	ECT Results	Estimated Size	Fixity	2021 Disposition
A-1	Historical (1R20) Metal disk	R6-C69 R7-C68 R7-C69 TSC +0.24" to +1.24"	Legacy metal disk lodged between tubes R6-C69 and R7-C69. The disk is sitting on its edge and is fused to the top of the C/L tubesheet.	NDD	1.1" diameter 0.2" thick	Fixed	Initially identified 1R20. Evaluated in 2009 (1R22) with Framatome CR 2009-2529. Object has remained fixed since that time. Position and fixity again confirmed during 1R30. Object has not caused tube degradation. Leave as is and monitor during future visual and eddy current inspections.
A-2	Historical (1R21) mass of fine wire and sludge at TSH	R30-C47 R30-C48	Legacy mass of fine wire and sludge located at TSH located behind the center stay rod	NDD	Not Determined	Fixed	During 1R29, a small pile of legacy fine wires embedded in fixed sludge was aggressively raked and water lanced. During 1R30, configuration confirmed by SSI. Wires pose no threat to tube integrity (since 2007). Leave as is and monitor by ECT and SSI at next ISI.
A-3	(1R29) Irregular object at TSH	R36-C73 R37-C73	Irregular shaped object discovered at TSH during 1R29 post lance SSI	NDD	~0.4" diameter	Fixed	Irregular object identified during 1R29 Post Lance. Object is tightly lodged in place between two tubes. ECT history shows object present back to 2006. 1R30 ECT was NDD. Leave as is and continue to monitor by ECT and SSI at next ISI.
A-4	(1R30) Disk shaped object discovered and removed	R25-C82 R24-C82	Disked shaped object discovered at TSH during 1R30 post lance SSI	NDD	0.35" Diameter	Retrieved during 1R30	During 1R30, a disk-shaped object was discovered and subsequently removed. ECT PLPs changed to LPR after performing post removal ECT. Item is considered closed out and no future actions required.
A-5	(1R30) Flat shaped object discovered and removed	R44-C44 R44-C45	Flat shaped object discovered at TSH during 1R30 post lance SSI	NDD	0.30" x 0.30" x 0.10"	Retrieved during R30	During 1R30, the flat-shaped object was discovered and subsequently removed. ECT was NDD. Item is considered closed out and no future actions required.
A-6	(1R30) Lancing strainer parts	TTS	Parts captured in the lancing strainers during 1R30 TTS lancing	N/A	Various parts ranging from ~1/8" to ~1/2"	Retrieved during 1R30	During 1R30, many objects were captured in the SG-A lancing strainers. Most are sludge related. There were also fragments of small diameter wire, flex gasket material, and other metallic objects.

SG-Item#	Description	Location	Configuration	ECT Results	Estimated Size	Fixity	2021 Disposition
B-1	Historical (1R23) Foreign object wear at 02H that resulted in two tubes being plugged at 1R23.	Plugged tubes: R37-C22 R38-C21	During 1R30, No signs of wear or PLPs on bounding tubes at 02H	NDD	Inaccessible to SSI	Unknown	Two tubes were plugged and stabilized at EOC23 for PLP and WAR indications. During subsequent outages and at 1R30 bounding tubes showed no signs of PLPs or wear. Continue to monitor with ECT.
B-2	(1R29) Lodged round object at TSH. Likely hard sludge.	R40-C39 R40-C40	1R29 Foreign object lodged between two tubes at TSH	NDD	0.4" diameter	Fixed	Review of 1R23, R25, and R27 ECT data confirmed object present. No wear identified. Object is tightly lodged. During 1R30 ECT was PLP with no wear. Continue to monitor with ECT and SSI.
B-3	(1R30) Metallic Object	R45-C47 R44-C47	Object appears to be part of a hex nut. Discovered 1R30 post lance inspection and removed	NDD	1.25" x 0.6" x 0.5"	Retrieved during 1R30	During 1R30, item identified during post lance ISI and removed. ECT results NDD. Item closed out at 1R30. Going forward no further actions required.
B-4	(1R30) Lancing strainer parts	TTS	Parts captured in the lancing strainers during 1R30 TTS lancing	N/A	Various parts ranging from ~1/8" to ~1/2"	Retrieved during 1R30	During 1R30, many objects were captured in the SG-B lancing strainers. Most are sludge related. There were also fragments of small diameter wire and flex gasket material.
C-1	(1R20) Historic FO wear at 02H	R29-C77 @ 02H	1R26 Legacy FO wear at 02H. Tube plugged.	NDD	Inaccessible to SSI	Unknown	During 1R30, bounding tubes inspected by ECT. All tubes NDD. Going forward continue to monitor with ECT.
C-2	(1R20) Historic FO wear at 03H	R15-C62 @ 03H	1R20 Legacy FO wear at 03H. Tube plugged.	NDD	Inaccessible to SSI	Unknown	During 1R30, bounding tubes inspected by ECT. All tubes NDD. Going forward continue to monitor with ECT.
C-3	(1R20) Historic FO wear at 01H	R38-C62 @ 01H	1R20 Legacy FO wear at 01H. Tube plugged.	NDD	Inaccessible to SSI	Unknown	During 1R30, bounding tubes inspected by ECT. All tubes NDD. Going forward continue to monitor with ECT.
C-4	(1R30) Lancing strainer parts	TTS	Parts captured in the lancing strainers during 1R30 TTS lancing	N/A	Various parts ranging from ~1/8" to ~1/2"	Retrieved during 1R30	During 1R30, many objects were captured in the SG-C lancing strainers. Most are sludge related. There were also fragments of small flex gasket material.

4) The spring 2021 inspection revealed perforations of moisture separator riser barrels in SG C attributed to erosion. Please provide the following additional information:

a) Considering no such degradation was described in the previous inspection reports for SG B (fall 2019, fall 2016), SG C (spring 2018), or SG A (spring 2015), is this considered a new form of degradation or change in trend for previously detected degradation?

b) How is the potential for loose parts from this degradation being managed?

c) Please describe plans for future inspection of the moisture separators and other steam drum components and structures.

Response

The localized erosion of some primary moisture separator riser barrels was detected and repaired during the mid 1990's at both Surry units. Repairs were also performed on the riser barrels of Unit 2 in the Spring of 2011. The erosion appears to be due to impingement of feedwater discharge through an adjacent J-nozzle, which would not have generated foreign objects. Riser barrel erosion is on the outer surface of the barrel, i.e., the internal diameter of the barrel is essentially the same as originally designed.

The riser barrel repair consists of installing impingement plates over the degraded areas on the riser barrels. The impingement plates were approximately 16x16 inches and rolled such that the plate inside diameter (ID) surface matched the outer diameter (OD) surface of the riser barrels and provide protection for all degraded areas. Based on the site ultrasonic thickness measurements of the degraded regions, the installed impingement plates extend well beyond the scouring pattern and onto undamaged base material.

Although the riser barrels are not pressure boundary components, the addition of the impingement plates represents a change to the original design of the moisture separator riser barrels. Structural analyses have been performed to demonstrate the adequacy of the attachment welds. The welds attaching the impingement plates are structurally adequate such that the presence of the impingement plates will not increase the potential for operation with a loose part/foreign object in the steam generator. Moisture separator and impingement plate weld integrity following replacement will be maintained during all plant conditions.

Since the degraded areas have been repaired, future inspections are described and performed in accordance with the Surry Steam Generator program.

Acronyms

BPC	Baffle Plate Cold
BPH	Baffle Plate Hot
C/L	Cold Leg
ECT	Eddy Current Testing
EFPM	Effective Full Power Month
EOC	End of Cycle
ETSS	Examination Technique Specification Sheet
FO	Foreign Object
GPD	Gallons Per Day
H/L	Hot Leg
ID	Inside Diameter
ISI	In-Service Inspection
LPR	Loose Part Removed
MRPC	Motorized Rotating Pancake Coil
NDD	No Degradation Detected
NSAL	Nuclear Safety Advisory Letter
NTE	No tube Expansion
OD	Outer Diameter
ODSCC	Outside Diameter Stress Corrosion Cracking
OVR	Over Roll
OXP	Over Expansion
PARC	Permanent alternate repair criteria
PLP	Possible Loose Part
PWSCC	Primary Water Stress Corrosion Cracking
SSI	Secondary Side Inspection
TEC	Tube End Cold-leg
TEH	Tube End Hot-leg
TSC	Top of Tube Sheet Cold-leg
TSH	Top of Tube Sheet Hot-leg
TSP	Tube Support Plate
TTS	Top of Tubesheet
TW	Through Wall
WAR	Wear