Tennessee Valley Authority, Sequoyah Nuclear Plant, P.O. Box 2000, Soddy Daisy, Tennessee 37384

August 19, 2019

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ATTN: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Sequoyah Nuclear Plant, Unit 2
Renewed Facility Operating License No. DPR-79
NRC Docket No. 50-328

Subject: **Response to Request for Information Regarding Unit 2 Cycle 22 - 180-Day Steam Generator Tube Inspection Report**

Reference: TVA letter to NRC, "Unit 2 Cycle 22 - 180-Day Steam Generator Tube Inspection Report," dated April 25, 2019

This letter provides response to an NRC request for information received on June 26, 2019, via email. In the request, NRC noted that two paragraphs of the steam generator report of the Referenced Letter contained typographical errors and desired clarification of this matter.

TVA confirms that the two paragraphs in Section 2.0 g, "The Results of Condition Monitoring, Including the Results of Tube Pulls and In-Situ Testing," did contain typographical errors. This condition was entered into the corrective action program. A revised report is enclosed. The revised report corrects the typographical errors and adds additional specific information regarding observed foreign object wear indications.

There are no new regulatory commitments contained in this letter. If you have any questions concerning this report, please contact Mr. Jonathan Johnson, Site Licensing Manager, at (423) 843-8129.

Respectfully,

Matthew Rasmussen
Site Vice President
Sequoyah Nuclear Plant

Enclosure:
Unit 2 Cycle 22 - 180-Day Steam Generator Tube Inspection Report - Revision 1

cc (Enclosure):
NRC Regional Administrator – Region II
NRC Senior Resident Inspector – Sequoyah Nuclear Plant

ENCLOSURE

TENNESSEE VALLEY AUTHORITY
SEQUOYAH NUCLEAR PLANT

UNIT 2 CYCLE 22

180-DAY STEAM GENERATOR TUBE INSPECTION REPORT

REVISION 1

SG-SGMP-18-22
Revision 1

July 2019

Sequoyah U2R22
180 Day Steam Generator
Tube Inspection Report

SG-SGMP-18-22
Revision 1

Sequoyah U2R22
180 Day Steam Generator
Tube Inspection Report

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Tennessee Valley Authority

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Record of Revisions

Revision	Date	Description
0a	December 2018	Preliminary draft for Tennessee Valley Authority review and comment.
0	January 2019	Final incorporating review comments from the Tennessee Valley Authority.
1	July 2019	Revised to correct two typos in Section g of the report. Also, a list of the foreign object wear indications observed is added to Section d of the report in new Table 2-6. Revisions are shown by a bar in the left-hand margin.

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List of Tables and Figures

1.0 Introduction

This report documents the "Sequoyah U2R22 180-Day Steam Generator Tube Inspection Report" as required by the SQN2 Technical Specifications. Inspections of the replacement steam generators (RSGs) were performed during the Sequoyah Unit 2 (SQN2) fall 2018 refueling outage designated as (U2R22). These inspections included eddy current testing of the SG tubing as well as primary and secondary side cleanings and visual inspections. The original SGs at SQN2 were replaced in 2012 with Westinghouse Model 57AG^{+} SGs which have thermally treated Alloy 690 tubing. The Sequoyah U2R22 outage was conducted after cumulative SG service equivalent to approximately 5.40 effective full power years (EFPY). The service time from the previous SG eddy current inspections during U2R19 was 4.09 EFPY. No tube leakage has been reported during this operating interval. Figure 1-1 below provides the arrangement and location designation of the tube support structures for the SQN2 SGs.

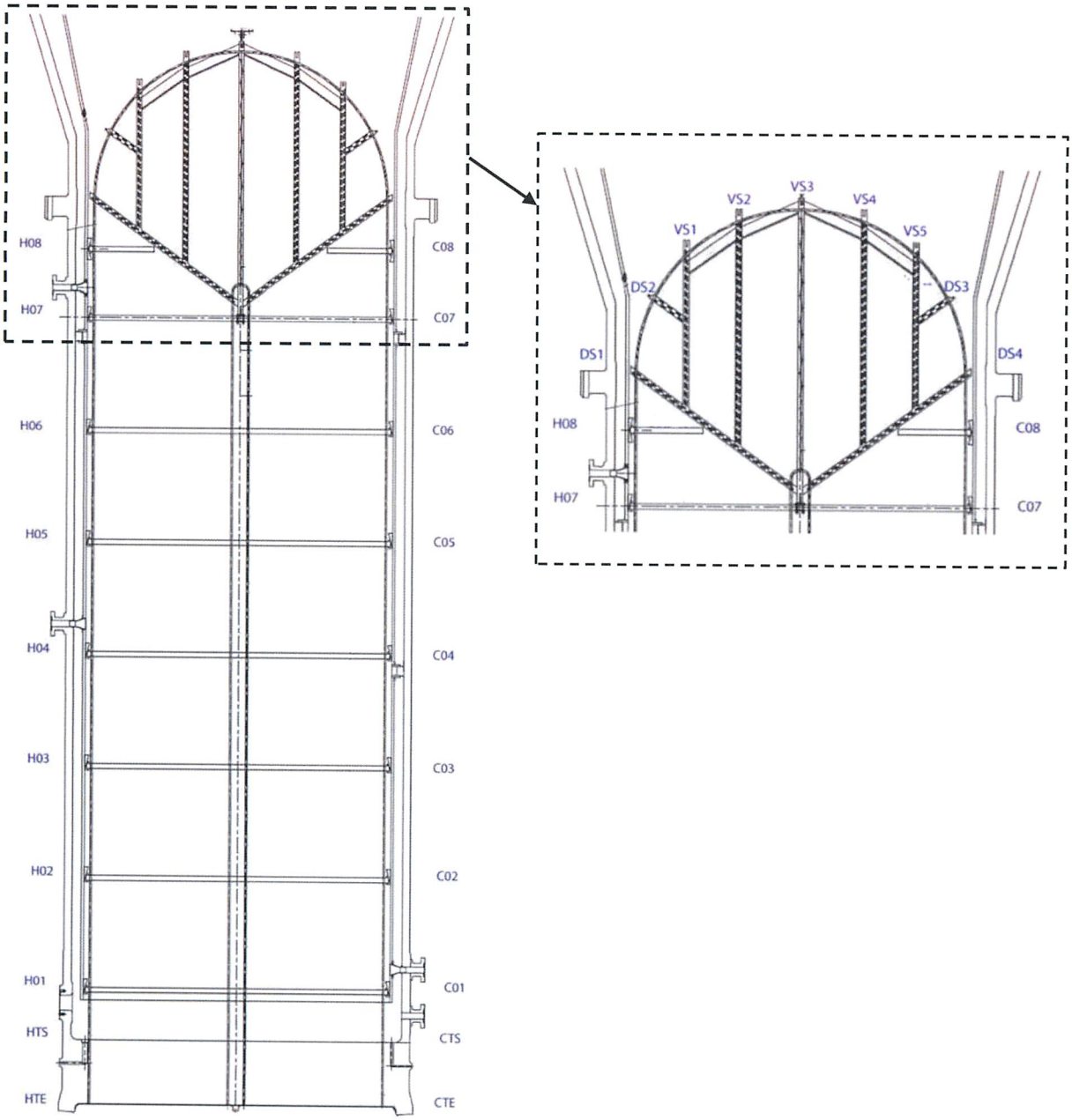

Figure 1-1: Tube Support Arrangement for Sequoyah Unit 2 Model 57AG^{+} Replacement Steam Generators

Notes: VS = Vertical Strap, DS = Diagonal Strap, HTS/CTS = Hot/Cold Tubesheet (designates top of tubesheet), HTE/CTE = Hot/Cold Tube End, Horizontal supports are a lattice grid design

2.0 180 Day Steam Generator Tube Inspection Report

In accordance with SQN2 Technical Specification Section 5.5.7, "Steam Generator Program," and Technical Specification Section 5.6.6, "Steam Generator Tube Inspection Report," this report documents the scope and results of the U2R22 SG inspections. There are eight specific reporting requirements associated with the Technical Specification. Each lettered reporting requirement listed below is followed with the associated information based on the inspections performed during U2R22.

a. The Scope of the Inspections Performed on Each SG

The U2R22 outage included a 100% bobbin inspection of the full length of all in-service tubes. The combination bobbin and array probe was used to inspect the top of tubesheet intersections of tubes along the tube bundle periphery and center tubelane a minimum of three tubes deep on both the hot leg (HL) and cold leg (CL) side. As a result, the inspection included all tubes with prior indications of degradation and all tubes not inspected during the previous SG in-service inspection. Array and rotating pancake coil (RPC) probes were used for special interest testing and resolution of bobbin indications when necessary. Table 2-1 below summarizes the number and type of eddy current examinations performed during U2R22.

Table 2-1: Sequoyah U2R22 Steam Generator Eddy Current Inspection Scope

Scope #	Eddy Current Exam Type	SG 1	SG 2	SG 3	SG 4	Total
1	0.610 Full Length Bobbin[1]	2,380	4,247	3,685	3,495	13,807
2	0.610 HL Bobbin VS3-HTE[1]	2,115	248	810	1,000	4,173
3	0.610 CL Bobbin VS3-CTE[1]	2,115	248	810	1,000	4,173
4	0.610 HL Array Rows 1-9 H01-HTE	787	787	787	756[2]	3,117
5	0.610 CL Array Rows 1-9 C01-CTE	787	787	787	787	3,148
6	0.610 Array HL&CL Special Interest	18	16	13	93	140
7	0.610 HL RPC Special Interest	0	0	0	9	9

Note 1: Either the full length was inspected in one complete test or each half of the tube was tested in two separate tests. Also, combination bobbin and array probe tests used to capture the tube bundle periphery inspection scope are counted under these programs.

Note 2: The remaining array probe tests were captured in scopes one through three where combination bobbin and array probes were used.

In addition to the eddy current inspections, visual inspections were also performed on both the primary and secondary sides. Primary side visual inspections included the channel head bowl cladding and the divider plate. There were no previously installed tube plugs to inspect from the primary side. Secondary side visual inspections were performed at the top of the tubesheet for the detection of foreign objects, assessment of hard deposit buildup in the tube bundle interior 'kidney region' and for determining the effectiveness of the tubesheet cleaning performed in all four SGs.

b. Active Degradation Mechanisms Found

Volumetric wear was the only degradation mechanism detected during the U2R22 inspection. The support structure wear indications detected were located at the U-bend or horizontal tube supports. There were also foreign object wear indications located near the first support on the hot leg side (H01) in SG 4. Table 2-2 below shows the number of indications reported during the U2R22 inspection.

Table 2-2: Number of Indications Detected for Each Degradation Mechanism

Degradation Mechanism	SG 1	SG 2	SG 3	SG 4	Total
U-Bend Support Structure Wear	3	5	1	1	10
Horizontal Tube Support Grid Wear	5	1	3	6	15
Foreign Object Wear	0	0	0	4	4

c. Nondestructive Examination Techniques Utilized for Each Degradation Mechanism

Table 2-3 below provides the nondestructive examination (NDE) techniques that were used for the detection of each degradation mechanism that was considered as existing or potential for the U2R22 inspection.

Table 2-3: NDE Techniques for Each Existing or Potential Degradation Mechanism

Degradation Mechanism	Eddy Current Probe Type	EPRI ETSS Detection Technique
U-Bend Support Structure Wear	Bobbin Array Array	96004.1, Revision 13 11956.1, Revision 3 11956.2, Revision 2
Horizontal Tube Support Grid Wear	Bobbin Array Array	96004.1, Revision 13 11956.1, Revision 3 11956.2, Revision 2
Foreign Object Wear	Bobbin Array Array RPC	27091.2, Revision 2 1790X.1, Revision 0[1] 1790X.3, Revision 0[1] 2790X.1[1]
Tube-to-Tube Contact Wear	Bobbin Array RPC	13091.1, Revision 0 13902.1, Revision 0 13901.1, Revision 1

Note 1: The applicable ETSSs are numbered 2790X.1 where X is variable between 1 and 7. For ETSS 1790X.1 and 1790X.3 techniques X is variable between 1 and 6 and all are Revision 0. Techniques and corresponding uncertainty used for sizing of foreign object wear is dependent on foreign object wear indication geometry.

d. Location, Orientation (if Linear), and Measured Sizes (if Available) of Service Induced Indications

Table 2-4, Table 2-5 and Table 2-6 below provide a listing of all service-induced indications reported during the U2R22 inspection including the estimated percent through-wall (%TW) depths from the qualified eddy current sizing technique.

Table 2-4: Sequoyah U2R22 U-bend Support Structure Wear Indications

SG	Row	Col	Locn	Inch	Ind	%TW	Characterization
1	69	95	DS4	0.93	PCT	18	U-bend Support Wear
1	92	62	VS3	0.79	PCT	18	U-bend Support Wear
1	97	61	VS2	0.89	PCT	19	U-bend Support Wear
2	89	59	VS2	-0.96	PCT	15	U-bend Support Wear
2	93	59	VS2	-1.07	PCT	23	U-bend Support Wear
2	93	59	VS3	0.73	PCT	13	U-bend Support Wear
2	95	63	VS3	0.35	PCT	17	U-bend Support Wear
2	98	64	DS3	-0.77	PCT	16	U-bend Support Wear
3	82	78	VS2	-0.57	PCT	24	U-bend Support Wear
4	67	67	DS4	-0.7	PCT	15	U-bend Support Wear

Table 2-5: Sequoyah U2R22 Horizontal Tube Support Grid Wear Indications

SG	Row	Col	Locn	Inch	Ind	%TW	Characterization
1	3	1	C04	-1	PCT	20	Horizontal Tube Support Grid Wear
1	3	1	C05	-0.98	PCT	17	Horizontal Tube Support Grid Wear
1	3	91	C04	-0.92	PCT	17	Horizontal Tube Support Grid Wear
1	3	91	C05	0.66	PCT	22	Horizontal Tube Support Grid Wear
1	6	60	H03	0.05	PCT	16	Horizontal Tube Support Grid Wear
2	3	85	C05	0.64	PCT	21	Horizontal Tube Support Grid Wear
3	14	122	C05	-0.99	PCT	17	Horizontal Tube Support Grid Wear
3	22	54	H04	-1.11	PCT	22	Horizontal Tube Support Grid Wear
3	43	119	C05	-1.04	PCT	21	Horizontal Tube Support Grid Wear
4	1	93	C06	-0.95	PCT	18	Horizontal Tube Support Grid Wear
4	3	39	C04	-0.94	PCT	15	Horizontal Tube Support Grid Wear
4	3	93	C06	-0.97	PCT	15	Horizontal Tube Support Grid Wear
4	4	102	C05	0.73	PCT	16	Horizontal Tube Support Grid Wear
4	5	33	C06	0.71	PCT	15	Horizontal Tube Support Grid Wear
4	5	33	C07	-0.99	PCT	17	Horizontal Tube Support Grid Wear

Table 2-6: Sequoyah U2R22 Foreign Object Wear Indications

SG	Row	Col	Locn	Inch	Ind	%TW	Characterization
4	98	76	H01	-1.08	VOL	21	Foreign Object Wear
4	99	75	H01	-1.15	VOL	8	Foreign Object Wear
4	97	75	H01	-1.15	VOL	23	Foreign Object Wear
4	96	74	H01	-1.32	VOL	9	Foreign Object Wear

e. Number of Tubes Plugged During the Inspection Outage for Each Active Degradation Mechanism

Table 2-7 below provides the numbers of tubes plugged for each degradation mechanism detected. As shown in the table, there were no tubes plugged prior to U2R22 and there were no tubes plugged during U2R22. Therefore, there are currently no tubes plugged in any SG at Sequoyah Unit 2.

Table 2-7: Number of Tubes Plugged for Each Degradation Mechanism

	SG 1	SG 2	SG 3	SG 4	Total
Plugged Tubes Prior to U2R22	0	0	0	0	0
Tubes Plugged During U2R22	0	0	0	0	0
Total Plugged to Date	0	0	0	0	0
Percentage Plugged to Date	0.00%	0.00%	0.00%	0.00%	0.00%

f. Total Number and Percentage of Tubes Plugged to Date

Table 2-7 in the previous section provides the number and percentage of tubes plugged to date.

g. The Results of Condition Monitoring, Including the Results of Tube Pulls and In-Situ Testing

Tube Integrity

A condition monitoring (CM) assessment was performed as required by the SQN2 steam generator program. The tube degradation detected during the U2R22 inspection included wear at the U-bend and horizontal grid tube support structures and wear due to foreign objects. The CM results for each of these mechanisms are as follows:

- The deepest U-bend tube support structure wear indication had a measured depth of 24%TW from the bobbin coil exam and was located at a vertical strap. Conservatively assuming an enveloping flaw length greater than the width of the support (2.5 inches), the CM limit for U-bend support structure wear is 45%TW.

- The deepest horizontal grid support tube wear indication had a measured depth of 22%TW from the bobbin coil exam. Conservatively assuming an enveloping flaw length equal to the full width of the support (2.0 inches), the CM limit for horizontal grid support structure wear is 46%TW.

- The deepest foreign object wear indication had a measured depth of 23%TW from the array coil exam and was located just below the bottom edge of Tube Support H01 near the tube bundle periphery. The array coil ETSS technique 17905.1 corresponding to flat volumetric wear was applied to size the foreign object wear indications. Conservatively assuming an enveloping flaw length of 1.5 inches, the CM limit for foreign object wear is 47%TW.

These CM limits include uncertainties for material properties, NDE depth sizing, and the burst pressure relationship. Since the deepest flaw has an estimated depth less than the corresponding CM limit, the structural integrity performance criterion was met for the operating interval prior to U2R22. Since volumetric wear indications will leak and burst at essentially the same pressure, accident-induced leakage integrity at a much lower accident pressure differential is also satisfied. Operational leakage integrity was demonstrated by the absence of any detectable primary-to-secondary leakage during the inspection interval from U2R19 to U2R22. Since tube integrity was demonstrated analytically, in-situ pressure testing was not required nor performed during the U2R22 outage. No tube pulls were planned or performed during U2R22.

Visual Inspection Results

Visual inspections were also performed on both the primary and secondary sides during U2R22. Primary side inspections included visual inspections of the channel head bowl cladding and the divider plate. Satisfactory inspection results were observed in all SGs with no indications of cladding surface degradation or observable change in the known existing bowl clad surface discolorations.

Prior to the secondary side foreign object search and retrieval (FOSAR) inspections, sludge, scale, foreign objects, and other deposit accumulations at the top of the tubesheet were removed as part of the top of tubesheet water lancing process. The secondary side FOSAR inspections performed in all four SGs included visual examination of tube bundle periphery tubes from the hot leg and cold leg annulus and center tubelane. A total of 24 foreign objects were identified during FOSAR inspections, 18 of which were removed from the top of the tubesheet region while 6 objects remain on the secondary side among the four SGs. The foreign objects remaining are three small bristles, a small piece of wire mesh and two sludge rocks. Any foreign objects not able to be retrieved were characterized and an analysis performed to demonstrate acceptability of continued operation without exceeding the performance criteria. A limited top of tubesheet

in-bundle visual inspection was also performed in each SG for the purpose of assessing and trending the level of hardened deposit buildup in the kidney region. Finally, a special interest secondary side visual inspection was performed in SG 4 viewing upwards from the tubesheet at the tube intersections with Tube Support H01 to view the tube locations with new foreign object wear detected by eddy current. This inspection verified that no foreign object was still present at the H01 elevation for the tubes affected by foreign object wear.

h. The Effective Plugging Percentage for All Plugging in Each SG

There are no sleeves installed in the SQN2 replacement SGs. Therefore, the effective plugging percentage is the same as the plugging percentage shown in Table 2-7.