



Tennessee Valley Authority, Post Office Box 2000, Soddy Daisy, Tennessee 37384-2000

December 1, 2014

10 CFR 50.4

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

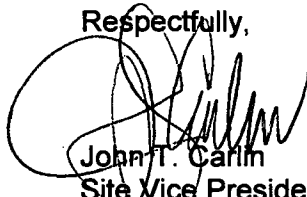
Sequoyah Nuclear Plant, Unit 2
Facility Operating License No. DPR-79
NRC Docket No. 50-328

Subject: Unit 2 Cycle 19 - 180-Day Steam Generator Tube Inspection Report

In accordance with Sequoyah Nuclear Plant (SQN), Unit 2, Technical Specification 6.8.4.k, Steam Generator Program and Technical Specification 6.9.1.16.1, Steam Generator Tube Inspection Report, the Tennessee Valley Authority is submitting the 180-day Steam Generator (SG) Tube Inspection Report that includes the results of inservice inspections performed on Unit 2 SGs during the Unit 2 Cycle 19 refueling outage. SQN Unit 2 Cycle 19 was completed on June 18, 2014, therefore, the due date for this report is December 15, 2014.

There are no new regulatory commitments contained in this letter. If you have any questions concerning this report, please contact Erin Henderson at (423) 843-7170.

Respectfully,



John T. Carlin
Site Vice President
Sequoyah Nuclear Plant

Enclosure:

Unit 2 Cycle 19 - 180-Day Steam Generator Tube Inspection Report

cc: See Page 2

A047
nkr

U.S. Nuclear Regulatory Commission
Page 2
December 1, 2014

Enclosure

cc (Enclosure):

NRC Regional Administrator – Region II

NRC Senior Resident Inspector – Sequoyah Nuclear Plant

U.S. Nuclear Regulatory Commission
Page 3
December 1, 2014

ERH:JWP:SKJ
Enclosure
bcc (Enclosure):

NRC Project Manager – Sequoyah Nuclear Plant

M. A. Balduzzi
T. J. Bradshaw (NSRB Support)
C. R. Church
D. M. Czufin
J. P. Grimes
T. A. Hess
M. R. Henderson
M. W. McBrearty
P. T. Noe
W. J. Pierce
P. P. Pratt
E. D. Schrull
J. W. Shea
S. A. Vance
R. J. Whalen

ENCLOSURE

**TENNESSEE VALLEY AUTHORITY
SEQUOYAH NUCLEAR PLANT**

UNIT 2 CYCLE 19

180-DAY STEAM GENERATOR TUBE INSPECTION REPORT



AREVA Inc.

Engineering Information Record

Document No.: 51 - 9198837 - 001

Sequoyah U2R19 Steam Generator Inspection 180-day Report



Sequoyah U2R19 Steam Generator Inspection 180-day Report

Safety Related? YES NO

Does this document establish design or technical requirements? YES NO

Does this document contain assumptions requiring verification? YES NO

Does this document contain Customer Required Format? YES NO

Signature Block

Name and Title/Discipline	Signature	P/LP, R/LR, A-CRF, A	Date	Pages/Sections Prepared/Reviewed/ Approved or Comments
Victor Newman Principal Engineer		LP	11/20/14	All
Jeff Brown Advisory Engineer		LR	11/20/2014	All
James Campbell Technical Manager, C&SE		A	11/20/14	All
David James TVA		Customer Approval	11/21/14	All
Jeremy Mayo TVA		Customer Approval	11/20/14	All
Tammy Sears TVA		Customer Approval	11/21/14	All

Note: P/LP designates Preparer (P), Lead Preparer (LP)
R/LR designates Reviewer (R), Lead Reviewer (LR)
A-CRF designates Project Manager Approver of Customer Required Format (A-CRF)
A designates Approver/RTM - Verification of Reviewer Independence

Project Manager Approval of Customer References (N/A if not applicable)

Name (printed or typed)	Title (printed or typed)	Signature	Date
Mark Lukowski	Project Manager	N/A	N/A



Sequoyah U2R19 Steam Generator Inspection 180-day Report

Record of Revision

Revision No.	Pages/Sections/ Paragraphs Changed	Brief Description / Change Authorization
000	Initial Release	N/A
001	Cover Page	Proprietary Statement removed at the request of the customer. Changed "Fall" to "Spring" in first sentence of section 1.0



Sequoyah U2R19 Steam Generator Inspection 180-day Report

Table of Contents

	Page
SIGNATURE BLOCK.....	2
RECORD OF REVISION	3
LIST OF TABLES	5
LIST OF FIGURES	6
1.0 INTRODUCTION.....	7
2.0 180-DAY STEAM GENERATOR TUBE INSPECTION REPORT	9
3.0 REFERENCES.....	18



Sequoyah U2R19 Steam Generator Inspection 180-day Report

List of Tables

	Page
TABLE 2-1: EDDY CURRENT INSPECTION SCOPE	10
TABLE 2-2: NUMBER OF INDICATIONS DETECTED FOR EACH DEGRADATION MECHANISM...	14
TABLE 2-3: NDE TECHNIQUES USED FOR EACH DEGRADATION MECHANISM	15
TABLE 2-4: SERVICE-INDUCED INDICATIONS.....	16
TABLE 2-5: NUMBER OF TUBES PLUGGED FOR EACH DEGRADATION MECHANISM	16
TABLE 2-6: TOTAL NUMBER AND PERCENTAGE OF TUBES PLUGGED TO DATE.....	16



Sequoyah U2R19 Steam Generator Inspection 180-day Report

List of Figures

Page

FIGURE 1-1: TUBE SUPPORT ARRANGEMENT FOR SEQUOYAH-2 STEAM GENERATORS..... 8

Sequoyah U2R19 Steam Generator Inspection 180-day Report

1.0 INTRODUCTION

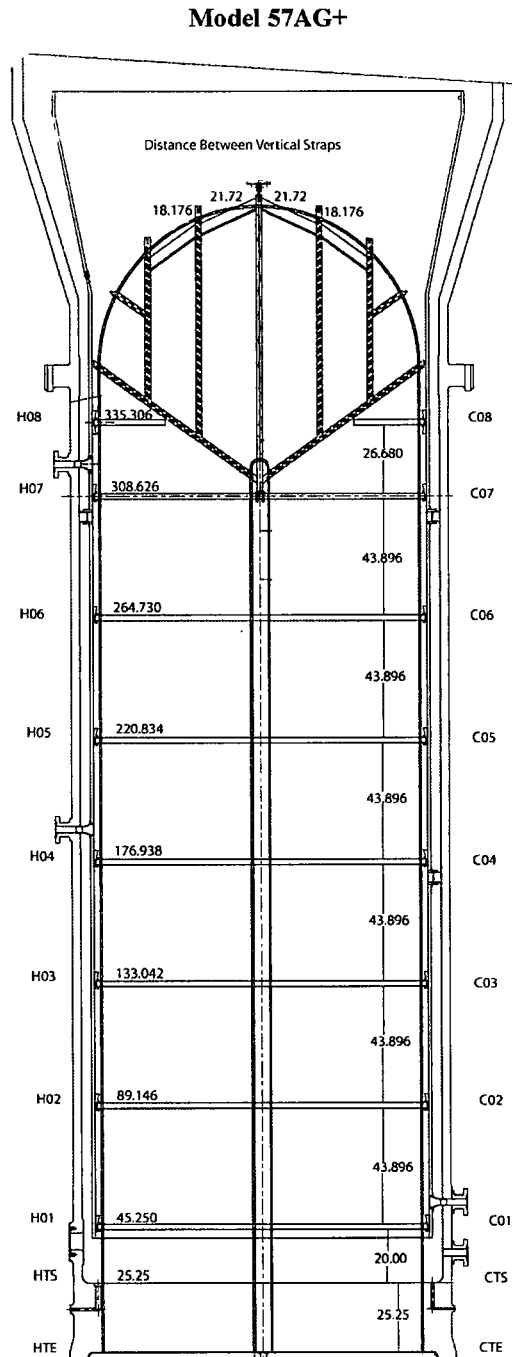
During the Sequoyah Unit 2 (SQN2) Spring 2014 refueling outage (designated as EOC19), inspections of all four SQN2 steam generators (SGs) were performed. These inspections included eddy current inspections of the SG tubing as well as primary and secondary side visual inspections. This report documents the "Sequoyah U2R19 SG Inspection 180-Day Report" as required by the SQN2 Technical Specifications [2].

Commercial operation of the original steam generators began in 1982. Operation of the replacement steam generators (RSG) Westinghouse/Model 57AG SG design began following the Unit 2 EOC18 2012 refueling/steam generator replacement outage. The steam generators operated 1.385 EFPY in their first cycle after replacement. The first ISI was performed during this most recent U2R19 refueling outage. Additional information is available in Reference [1].

Figure 1-1 below provides the arrangement of the tube support structures for the SQN2 SGs.

Sequoyah U2R19 Steam Generator Inspection 180-day Report

Figure 1-1: Tube Support Arrangement for Sequoyah-2 Steam Generators



Sequoyah U2R19 Steam Generator Inspection 180-day Report

2.0 180-DAY STEAM GENERATOR TUBE INSPECTION REPORT

In accordance with SQN2 Technical Specification [2] this report documents the scope and results of the U2R19 SG inspections. There are eight specific reporting requirements (labeled "a" through "h" below). Each reporting requirement is followed with the required information based on the inspections performed during the U2R19 outage.

a. The Scope of the Inspections Performed on Each SG

The U2R19 outage bobbin coil inspection was planned for 100% of the in-service tubes. In addition to the bobbin coil inspections, 4816 array coil inspections were also performed. The array coil exams were aimed at detection of foreign objects and foreign object wear near the top of the tubesheet and support wear up to the C07 cold leg support. 206 additional Special Interest exams were performed with array coil or +Point as required. (see Table 2-1).

Sequoyah U2R19 Steam Generator Inspection 180-day Report

Table 2-1: Eddy Current Inspection Scope

BOBBIN

S/G		Planned Exams	Tests Acquired	Change	Tests Analyzed and Completed	Change	Retests	Change	Percent Complete	Total Remaining to Inspect
2-1	F/L Combo Array/Bobbin	344	344	0	344	0		0	100.00%	0
	Full Length rows 5+	4391	4391	0	4391	0	43	0	100.00%	0
	H/L candycane rows 1-4	248	248	0	248	0		0	100.00%	0
	C/L straight rows 1-4	248	N/A		248	0		0	100.00%	0
2-2	F/L Combo Array/Bobbin	339	339	0	339	0		0	100.00%	0
	Full Length rows 5+	4396	4396	0	4396	0	4	0	100.00%	0
	H/L candycane rows 1-4	248	248	0	248	0	14	0	100.00%	0
	C/L straight rows 1-4	248	N/A		248	0	3	0	100.00%	0
2-3	F/L Combo Array/Bobbin	350	350	0	350	0		0	100.00%	0
	Full Length rows 5+	4385	4385	0	4385	0	85	0	100.00%	0
	H/L candycane rows 1-4	248	248	0	248	0		0	100.00%	0
	C/L straight rows 1-4	248	N/A		248	0		0	100.00%	0
2-4	F/L Combo Array/Bobbin	346	346	0	346	0		0	100.00%	0
	Full Length rows 5+	4389	4389	0	4389	0	11	0	100.00%	0
	H/L candycane rows 1-4	248	248	0	248	0		0	100.00%	0
	C/L straight rows 1-4	248	N/A		248	0		0	100.00%	0
TOTAL		20924	19932	0	20924	0	160	0	100.00%	0

Sequoyah U2R19 Steam Generator Inspection 180-day Report

Table 2-1 continued

Array Top of Tubesheet

S/G		Planned Exams	Tests Acquired	Change	Tests Analyzed and Completed	Change	Retests	Change	Percent Complete	Total Remaining to Inspect
2-1	HL = H01-HTE (from Bobbin/Array Combo Exam)	346	N/A	N/A	346	0	0	N/A	100.00%	0
	HL = H01-HTE	258	258	0	258	0	1	0	100.00%	0
	CL = C01-CTE (from Bobbin/Array Combo Exam)	346	N/A	N/A	346	0	0	N/A	100.00%	0
	CL = C07-CTE	258	258	0	258	0	0	0	100.00%	0
2-2	HL = H01-HTE (from Bobbin/Array Combo Exam)	339	N/A	N/A	339	0	0	N/A	100.00%	0
	HL = H01-HTE	258	258	0	258	0	0	0	100.00%	0
	CL = C01-CTE (from Bobbin/Array Combo Exam)	339	N/A	N/A	339	0	0	N/A	100.00%	0
	CL = C07-CTE	258	258	0	258	0	0	0	100.00%	0
2-3	HL = H01-HTE (from Bobbin/Array Combo Exam)	350	N/A	N/A	350	0	0	N/A	100.00%	0
	HL = H01-HTE	258	258	0	258	6	0	0	100.00%	0
	CL = C01-CTE (from Bobbin/Array Combo Exam)	350	N/A	N/A	350	0	0	N/A	100.00%	0
	CL = C07-CTE	248	248	0	248	0	0	0	100.00%	0
2-4	HL = H01-HTE (from Bobbin/Array Combo Exam)	346	N/A	N/A	346	0	9	N/A	100.00%	0
	HL = H01-HTE	258	258	0	258	0	0	0	100.00%	0
	CL = C01-CTE (from Bobbin/Array Combo Exam)	346	N/A	N/A	346	0		N/A	100.00%	0
	CL = C07-CTE	258	258	0	258	0	0	0	100.00%	0
TOTAL		4816	2054	0	4816	6	10	0	100.00%	0

Sequoyah U2R19 Steam Generator Inspection 180-day Report

Table 2-1 continued

Special Interest Exam

S/G		Locations to Inspect	Tests Acquired	Change	Tests Analyzed and Completed	Change	Retests	Change	Percent Complete	Total Remaining to Inspect
2-1	H/L SI RPC	3	3	0	3	0	0	0	100.00%	
	C/L SI RPC	1	1	0	1	0	0	0	100.00%	
	U-Bend SI RPC	29	29	0	29	0	2	0	100.00%	
	H/L SI Array	30	30	0	30	0	0	0	100.00%	
	C/L SI Array	2	2	0	2	0	0	0	100.00%	
2-2	H/L SI RPC	2	2	0	2	0	0	0	100.00%	
	C/L SI RPC	6	6	0	6	0	0	0	100.00%	
	U-Bend SI RPC	15	15	0	15	0	0	0	100.00%	
	H/L SI Array	23	23	0	23	0	0	0	100.00%	
	C/L SI Array	7	7	0	7	0	0	0	100.00%	
2-3	H/L SI RPC	0	0	0	0	0	0	0		
	C/L SI RPC	0	0	0	0	0	0	0		
	U-Bend SI RPC	3	3	0	3	0	0	0	100.00%	
	H/L SI Array	29	29	0	29	0	0	0	100.00%	
	C/L SI Array	4	4	0	4	0	0	0	100.00%	
2-4	H/L SI RPC	11	11	0	11	0	0	0	100.00%	
	C/L SI RPC	7	7	0	7	0	0	0	100.00%	
	U-Bend SI RPC	8	8	0	8	0	0	0	100.00%	
	H/L SI Array	17	0	0	17	0	0	0	100.00%	
	C/L SI Array	9	9	0	9	0	0	0	100.00%	
TOTAL		206	189	43	206	0	2	0	100.00%	0

Sequoyah U2R19 Steam Generator Inspection 180-day Report

Table 2-1 continued

All Scopes Summary

S/G	Total Exams	Tests Acquired	Change	Tests Analyzed and Completed	Change	Retests	Change	Percent Complete	Total Remaining to Inspect
2-1	6504	5564	0	6504	0	46	0	100.00%	0
2-2	6478	5552	0	6478	0	21	0	100.00%	0
2-3	6473	5525	0	6473	6	85	0	100.00%	0
2-4	6491	5534	0	6491	0	20	0	100.00%	0
TOTAL	25946	22175	0	25946	6	172	0	100.00%	0

Sequoyah U2R19 Steam Generator Inspection 180-day Report

Visual Inspection Results

In addition to the eddy current inspections, visual inspections were also performed on both the primary and secondary sides [1].

Primary Side:

- SG Channel Head interior as-found and cladding inspection.
- Since there were no plugs installed in the SGs, plug inspection was not applicable
- During the initial channel head visual as-found and cladding inspection, discolored areas were noted, particularly in SG 22 cold leg. The discoloration was evaluated by the SG OEM and deemed not to affect SG function or integrity. The discoloration will be monitored in future inspections. Causal reasons for the discoloration are indeterminate. Possible explanations range from residue left during the electropolishing of the primary channel head bowls to refraction effects of the LED lights utilized during the examination of the primary channel head inspection which identified the discoloration [1].

Secondary Side:

- Foreign Object Search and Retrieval (FOSAR) in all SGs as follows:
 - As required based on ECT (none required in the absence of any applicable ECT indications)
 - Removal of foreign objects detected visually
 - TTS annulus area in all four SGs (following lancing)
 - No-tube lane in all four SGs (following lancing)
 - In the area of foreign objects removed, to inspect for visual evidence of damage (no damage found)

b. Active Degradation Mechanisms Found

Volumetric wear was the only degradation mechanism detected during the U2R19 inspection. All of the wear indications detected were located at U-bend support structures in SG22. None of the indications were plugged. No wear indications attributable to foreign objects were reported. Table 2-2 below shows the number of indications reported during the U2R19 inspection

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

	Location	SG21		SG22		SG23		SG24		Total	
		Tubes	Indications	Tubes	Indications	Tubes	Indications	Tubes	Indications	Tubes	Indications
Detected	U-bend support	0	0	2	3	0	0	0	0	2	3
Plugged	U-bend support	0	0	0	0	0	0	0	0	0	0
Returned to Service	U-bend support	0	0	2	3	0	0	0	0	2	3

Sequoyah U2R19 Steam Generator Inspection 180-day Report

c. Nondestructive Examination (NDE) Techniques Used for Each Degradation Mechanism

Table 2-3 below provides the NDE techniques that were qualified for the detection of each degradation mechanism that was considered as existing or potential for the U2R19 inspection [3]. Not all techniques were used as some mechanisms (e.g. loose parts wear, pitting, and tube-to-tube wear) were not detected.

Table 2-3: NDE Techniques Used for Each Degradation Mechanism

Degradation Mechanism	Location	Inspection Technique	EPRI ETSS
Tube Wear	Straps/Grids	Bobbin / Differential / Detection & Sizing Bobbin / Absolute / Detection & Sizing +Point / Straps and Supports / Detect and Size	96004.1 Rev 13 96004.3 Rev 13 96910.1 Rev. 10 10908.4 Rev 1
Tube Wear	Tube-to-tube	Bobbin / Absolute / Detection +Point / Sizing X-Probe™ / Detection / Sizing (Axial) X-Probe™ / Detection / Sizing (Circ)	13091.1 Rev. 0 13901.1 Rev. 1 13902.1 Rev. 0 13902.2 Rev. 0
Tube Wear	Loose Parts	Bobbin / Differential / Detection Bobbin / Absolute / Detection +Point / Sizing X-Probe™ / TSP Wear (Axial sensitive coil set) / Detection X-Probe™ / TSP Wear (Circumferential sensitive coil set) / Detection	27091.2 Rev 1 27091.3 Rev 1 21998.1 Rev 4 27901.1 Rev 1 27902.1 Rev 1 27903.1 Rev 1 27904.1 Rev 1 27905.1 Rev 1 27906.1 Rev 1 27907.1 Rev 1 11956.3 Rev 2 11956.4 Rev 2
Pitting	Freespan	Bobbin / Differential / Detection X-Probe™ / Detection	96005.1 Rev 9 24998.1 Rev 1
MBM	Freespan	Bobbin / Absolute / Detection	96010.1 Rev 7

In addition to the detection techniques shown in the above table, +Point™ probes were also used for confirmation, characterization, and length sizing of wear indications at the U-bend supports.

Sequoyah U2R19 Steam Generator Inspection 180-day Report

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

Table 2-4 below provides a listing of all service-induced indications reported during the U2R19 inspection including the estimated depths from the bobbin coil. If length sizing was available, this information is also provided as reported from the +Point™ inspections.

Table 2-4: Service-Induced Indications

SG	Row	Col	Location	Depth (%TWD) (bobbin)	Length (in.) (+Point)
22	89	59	VS2 -0.83	7	0.35
22	93	59	VS3 +0.81	6	0.37
22	93	59	VS2 -1.14	12	0.58

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

Table 2-5 below provides the number of tubes plugged for each degradation mechanism detected.

Table 2-5: Number of Tubes Plugged for Each Degradation Mechanism

Inspection	SG21	SG22	SG23	SG24	Total
Prior to service	0	0	0	0	0
2R19 2014	0	0	0	0	0
Total	0	0	0	0	0

f. Total Number and Percentage of Tubes Plugged to Date

Table 2-6: Total Number and Percentage of Tubes Plugged to Date

Inspection	SG21	SG22	SG23	SG24	Total
Prior to service	0 tubes 0%	0 tubes 0%	0 tubes 0%	0 tubes 0%	0 tubes 0%
2R19 2014	0 tubes 0%	0 tubes 0%	0 tubes 0%	0 tubes 0%	0 tubes 0%
Total	0 tubes 0%	0 tubes 0%	0 tubes 0%	0 tubes 0%	0 tubes 0%

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

As required by the SQN2 Steam Generator Program, a condition monitoring (CM) assessment was performed [1]. The only tube degradation detected during the U2R19 inspection was wear at U-bend support structures. The deepest indication had an estimated depth of 12%TW from the bobbin coil exam. The maximum NDE length of any wear flaw was 0.58". The CM limit for a flaw of this length is approximately 48% TWD. This CM limit includes uncertainties for material properties, NDE depth sizing, and the burst pressure relationship. Since the deepest flaw has an NDE depth less than the CM limit, the structural integrity performance criterion was met for the operating period prior to U2R19.

Sequoyah U2R19 Steam Generator Inspection 180-day Report

Since wear indications will leak and burst at essentially the same pressure, accident-induced leakage integrity at a much lower accident pressure differential is also demonstrated. Operational leakage integrity was demonstrated by the absence of any detectable primary-to-secondary leakage during the operating period prior to U2R19.

Since tube integrity was demonstrated analytically, in-situ pressure testing was not required nor performed during the U2R19 outage. Likewise, no tube pulls were planned nor performed during U2R19.

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

There are no sleeves installed in the SQN2 SGs. Therefore, the effective plugging percentage is the same as the plugging percentage shown in Table 2-6. No tubes are plugged, so the effective plugging percentage is 0%.

Sequoyah U2R19 Steam Generator Inspection 180-day Report

3.0 REFERENCES

References identified with an (*) are maintained within the TVA Records System and are not retrievable from AREVA Records Management. These are acceptable references per AREVA Administrative Procedure 0402-01, Attachment 8. See the signature page for Project Manager Approval of customer references.

1. AREVA Document 51-9196412-000 "Sequoyah Unit 2 Condition Monitoring for U2R19 and Final Operational Assessment for Cycles 12, 13, and 14"
2. * Sequoyah Unit 2 Technical Specifications (Administrative Controls), 6.9.1.16.1 "Steam Generator (SG) Tube Inspection Report", September 26, 2012, Amendment No. 305, 323, 324
3. AREVA Document 51-9198829-000 "Sequoyah U2R19 Steam Generator Degradation Assessment"