



South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

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Attention: Document Control Desk
U. S. Nuclear Regulatory Commission
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South Texas Project
Unit 2
Docket No. STN 50-499
2RE19 Inspection Summary Report for Steam Generator Tubing

Enclosed is the summary report describing the results of the South Texas Project Unit 2 steam generator tube inspection performed during refueling outage 2RE19. The summary report satisfies the reporting requirements of ASME Section XI, Article IWA-6230, and Section 6.9.1.7 of the South Texas Project Technical Specifications. This report provides the information required by Technical Specification 6.8.3.o for maintaining steam generator tube integrity.

There are no commitments in this letter.

If there are any questions regarding this report, please contact either Wendy Brost at (361) 972-8516 or me at (361) 972-4414.


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Enclosure: 2RE19 Inspection Summary Report for Steam Generator Tubing (Rev 0) of the South Texas Project Electric Generating Station Unit 2

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Enclosure

2RE19 Inspection Summary Report for Steam Generator Tubing (Rev 0)
of the South Texas Project Electric Generating Station Unit 2



**2RE19 INSPECTION SUMMARY REPORT
FOR STEAM GENERATOR TUBING**

(Rev 0)

of the

SOUTH TEXAS PROJECT

ELECTRIC GENERATING STATION

UNIT 2

P.O. BOX 289

WADSWORTH, TEXAS 77483

Commercial Operation: June 19, 1989

Issue Date: September 19, 2018

**2RE19 INSPECTION SUMMARY REPORT
FOR STEAM GENERATOR TUBING**

(Rev. 0)

of the

SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION

UNIT 2

USNRC DOCKET NO.: 50-499

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SOUTH TEXAS PROJECT UNIT 2

2RE19 INSPECTION SUMMARY REPORT FOR STEAM GENERATOR TUBING

Introduction

This summary report describes the inspection of steam generator tubing at South Texas Project (STP) Unit 2 performed during refueling outage 2RE19 beginning 03/24/2018 and ending with breaker closure on 04/27/2018. Eddy current inspection, sludge lancing, and Foreign Object Search and Retrieval (FOSAR) were conducted in steam generators (SG) 2A, 2B, 2C and 2D.

The eddy current inspection performed during 2RE19 completes the first inspection of the Technical Specification Second Interval for all Unit 2 steam generators. The outage was performed following 147.21 effective full power months cumulative service with the Delta 94 replacement steam generators. This report provides the information required by Technical Specification 6.8.3.o for maintaining steam generator tube integrity and the reporting requirements of Technical Specification 6.9.1.7.

Scope of Examination

The Inspection Plan, "2RE19 Steam Generator In-Service Outage Plan April 2018" identified the steam generator tube areas to be examined by eddy current testing and the related procedures to be used during the inservice inspection. A Degradation Assessment (DA), written prior to the outage established the following scope of primary and secondary side inspections:

Primary Side Inspection Scope

As required by the EPRI Examination Guidelines, the 2RE19 outage inspection program addressed the known degradation mechanism(s) as well as those regarded as potential degradation mechanisms. The following outlines the 2RE19 outage initial inspection plan, as justified in the DA. It is applicable to South Texas Unit 2 Steam Generators 2A, 2B, 2C and 2D:

Bobbin Coil Inspection

- Full length bobbin coil inspection of 100% of the outer (3) peripheral tubes from tube end to tube end, including 10 tubes inwards into the no-tube lane from the periphery.
- 50% Full length bobbin coil inspection of all tubes. Scope shall include all tubes not inspected full length during 2RE16.

Rotating Coil Inspection - Straight Section

- +Point probe inspection of outer three tubes of periphery and divider lane TTS +6 inches/-3 inches, including HL and CL, to aid in foreign objects detection.
- 20% Sample +Point probe inspection of TSH +6 inches/-3 inches.
- 20% Sample +Point probe inspection of TSH +6 inches/-16 inches in tubes with bulges and over-expansions.
- +Point probe inspection of kidney region (hot leg sludge pile area) with 2 tube locations surrounding the sludge pile, +6 inches/-3 inches in all four steam generators.

Rotating Coil Inspection - Special Interest

- +Point probe inspection of all previously identified dents and dings > 5 volts.
- +Point probe inspection of all prior and 2RE19 "I-code" and/or non-quantifiable indications as determined by bobbin coil inspection or any previously reported signal that has changed.

- +Point probe inspection of PLPs in the eddy current database as identified by previous eddy current inspections.
- +Point probe inspection of a minimum two tube locations surrounding all observed Priority 1 or 2 foreign objects as identified during 2RE16 secondary side video inspections and not removed.
- +Point probe inspection of a minimum two tube locations surrounding any newly identified PLP.
- +Point probe inspection of a minimum two tube locations surrounding newly identified foreign objects that are classified as Priority 1 or Priority 2.
- +Point probe inspection of all tube-to-tube wear indications detected by bobbin coil.
- +Point probe inspection of all bobbin proximity (PRO) signals >1.25 volts.
- +Point probe inspection of all MBM bobbin coil indications that have increased by ≥ 0.5 volt. This includes both new and changed bobbin coil MBM indications.
- +Point probe inspection of prior cycle MBMs that are TTW candidates.
- +Point probe inspection of wear indications left in service.

Other Primary-Side Inspections

- Video Inspection of all installed plugs.
- Video Inspection of all hot and cold leg bowl cladding surfaces.
- Conduct stud hole gauging on SG 2D.

Secondary Side Inspection Scope

- TTS FOSAR in all four steam generators including annulus and no-tube lane.
- TTS In-bundle FOSAR as follows:
 - SG A inspect every fourth column both hot leg and cold leg beginning with Column 3.
 - SG B inspect every fourth column both hot leg and cold leg beginning with Column 3.
 - SG C inspect every fourth column both hot leg and cold leg beginning with Column 4.
 - SG D inspect every 2nd column both hot leg and cold leg beginning with Column 2.
- Sludge lancing on all four steam generators.
- Steam Drum inspections in SG C and SG D.
- Upper Steam Drum inspection in SG C.
- Video probe inspection of 9th support plate on one SG (either SG A or SG C).
- Tube scale profiling and trefoil profiling on SG B and SG C.
- FOSAR of priority 1 and 2 foreign objects left in service after 2RE16 if reachable by tooling.
- FOSAR of all possible loose parts, PLP, identified by eddy current inspection, if reachable by tooling.
- Map the location of hardened deposits on the TTS in each RSG so that the inspection area for the next inspection can be defined.

Inspection Expansion

No inspection expansion was performed due to any type of tube degradation. There were two Priority 2 foreign objects that were subject to a two-tube boxing inspection by a +Point probe.

Primary Side Examination Results

Table 1 presents a summary of the tube NDE indication reported. This summary includes redundant indications that may have been detected by multiple inspection programs.

Table 1: STP Unit 2 2RE19 Eddy Current Inspection – Final Indication Listing

Indication	Condition	Number of Indications				Total
		SG-A	SG-B	SG-C	SG-D	
BLG	Bulge	1	1	0	0	2
DNG	Ding	150	38	86	14	288
DNS	Ding Signal Cleared	37	29	42	23	131
DSS	Distorted Support Signal Cleared	1	1	0	0	2
INF	Indication Not Found	1	1	0	3	5
INR	Indication Not Reportable	56	53	52	19	180
LPR	Loose Part Removed	0	0	4	0	4
MBM	Manufacturing Burnish Mark	56	65	56	80	257
NDF	No Degradation Found	19	15	12	13	59
NQS	Non-Quantifiable Signal	4	13	41	13	71
PCT	Percent	2	0	0	1	3
PLP	Possible Loose Part	0	0	2	0	2
PRO	Tube Proximity	16	4	12	14	46
WAR	Wear	2	0	1	1	4

No crack-like indications were identified during the 2RE19 inspection. No volumetric indications were identified under the hard sludge region of any steam generator. One new occurrence of TSP wear, an existing degradation mechanism that was discussed in the Degradation Assessment, was identified during the 2RE19 inspection. No indications of AVB or foreign object wear were discovered during the 2RE19 inspection. These are described below.

Inspection Results - Volumetric Indication Under Hard Sludge Deposits

A sludge pile volumetric indication similar to that found during the Unit 1 1RE19 was not identified during the 2RE19 inspection of the Unit 2 steam generators.

Inspection Results - TSP Wear

The Degradation Assessment categorized tube support plate (TSP) wear as an existing degradation mechanism. During the STP Unit 2 steam generator inspections conducted during 2RE19, four locations were found to have TSP wear. These locations and their wear depths, as determined by ETSS 96004.1, are summarized in Table 2. C-R3C115-06C is a new indication, first reported in 2RE19. A review of past inspection data ascertained a depth of 6 percent through-wall (%TW) at 2RE16, showing no growth in this indication. As Table 2 shows, the three existing TSP wear indications did not grow either.

Table 2: TSP Wear Depth Summary for Unit 2

Unit	Location	2RE19	2RE16	2RE13	2RE10		# TSP Lands	Wear Type
2	A-R7C57-08C	7	8	4	3		Single	Pin point
2	A-R8C154-06C	9	9	5	NDD		Single	Pin point
2	C-R3C115-06C	6	6	4	NDD		Single	Pin point
2	D-R23C153-09C	5	5	3	NDD		Single	Pin point

Note: TSP wear depths are reported as %TW. Shaded areas were obtained from a data review in a previous outage; the shaded areas were not reportable indications during the applicable outage.

Potential Degradation Mechanisms

The Degradation Assessment categorized AVB wear, tube-to-tube wear, and foreign object wear as potential degradation mechanisms. The results are as follows:

- Mechanical Wear Indications at Anti-Vibration Bars

There were no tubes in the South Texas Unit 2 steam generators with indications of wear at the anti-vibration bars.

- Mechanical Wear Indications due to Tube-to-Tube Contact

There were no tubes in the South Texas Unit 2 steam generators with indications of wear due to tube-to-tube contact. A review of MBM and PRO indications did not indicate the presence of wear.

- Mechanical Wear Indications due to Foreign Objects

There were no tubes in the STP Unit 2 steam generators with indications of foreign object wear.

- Wear (WAR) Indications

In 2RE19, mechanical wear indications were to be segregated into VOL (volumetric) and WAR (wear) indications. WAR indications are associated with support structure wear (TSP and AVB). VOL indications are associated with all other mechanical wear (foreign object wear). There were no occurrences of VOL indications. All four WAR indications listed in Table 2 are associated with wear at TSPs. There were no occurrences of wear at AVB locations.

- Non-Relevant Degradation Mechanisms

Indications first reported with potential flaw-like characteristics in the South Texas Unit 2 SGs may include indications initially reported as distortions or preexisting signals such as manufacturing burnish marks or dents and dings (MBI, MBM, DNI, and DNS), benign indications (DFI, DFS, DSI, DSS), anomalous signals at the tubesheet or elsewhere (DTI, DTS), nonquantifiable signals in the sludge pile region (NQI, NQS) and permeability indications (PVN).

The character of I-code signals, when observed, is determined by history review, Lead Analyst Review, or by +Point probe examination. The four support plate indications noted in were initially reported as DSI indications, and were finally characterized as WAR indications of support structure wear. All other I-code indications were dispositioned as non-flaw conditions. There were no unresolved I-codes at 2RE19.

PVNs are technically not I-code signals but rather interferences that can compromise detection of flaw signals. There were no flaws associated with PVN indications.

Ding (DNG) is a baseline indication where the tubing inside diameter is less than normal. The Degradation Assessment specified that all dings greater than 5 volts that were reported in the baseline examination would be inspected with a +Point probe coil. There were 8 dings in the South Texas Unit 2 SGs greater than 5 volts; these were inspected with a +Point probe. No degradation was found.

The use of the Dent (DNT) indication code was discontinued. Prior cycle DNT indications are now associated with the DNG three-letter code.

Bulge (BLG) is a condition where the tubing outside diameter is greater than normal. An overexpansion (OXF) is a similar condition associated with anomalies in the tubesheet. There were no new BLG/OXP locations identified in 2RE19. Existing BLG/OXP locations were inspected with a +Point probe. The results of the tests were that no defects were found (NDF).

Other Primary Side Inspection Results

Tube Plug Visual Inspections

A 100% visual inspection of all tube plugs in all four SGs was performed from the primary side during South Texas Unit 2 2RE19. There were no anomalous conditions, such as a degraded tube plug or excessive surrounding boron deposits reported during performance of the visual inspections.

NSAL-12-1 SG Channel Head Primary Side Bowl Inspection

A visual inspection of the bottom of the SG channel head bowl was performed in both legs of all SGs during South Texas Unit 2 2RE19, necessitated by the industry operating experience discussed in the DA. Visual inspections were performed on the entire inside surface of the SG channel head bowl. Key areas of inspection include the channel head cladding, the divider plate-to-channel head weld and the channel head-to-tubesheet weld. Inspections were performed in accordance with guidance provided by Westinghouse Nuclear Safety Advisory Letter (NSAL) NSAL-12-1 recommendations using the SG manway channel head bowl cameras.

Two brown spots were observed in the hot leg of SG-D, located in the bowl cladding, several inches below the nozzle. Upon closer inspection it was shown that one of the brown spots had been smeared by one of the hoses in the bowl. The other spot was not located along a transition between two strips of cladding or two different cladding processes as is the operating experience for cladding flaws. These were therefore determined to be surface deposits and not any kind of cladding anomaly. Satisfactory inspection results were observed in all SGs.

Stud Hole Gauging

All stud holes of the SG-D hot and cold leg primary manways were inspected with go/no-go gauges and confirmed that these stud holes were in good condition and without any visible damage.

Tube Repair Summary

No crack-like indications were reported and no tubes were repaired as a result of the 2RE19 steam generator eddy current inspection.

Summary of Secondary Side Inspection and Maintenance Plan

- TTS FOSAR in all four steam generators including annulus and no-tube lane.
- TTS In-bundle FOSAR as follows:
 - SG-A inspect every fourth column both hot leg and cold leg beginning with Column 3.
 - SG-B inspect every fourth column both hot leg and cold leg beginning with Column 3.
 - SG-C inspect every fourth column both hot leg and cold leg beginning with Column 4.
 - SG-D inspect every 2nd column both hot leg and cold leg beginning with Column 2.
- Ultra sludge lancing on all four steam generators.
- Sludge collector inspection and cleaning on SG-C (this was tentatively planned, but was not performed in 2RE19).
- Steam Drum inspections in SG-C and SG-D.
- Upper Steam Drum inspection in SG-C.
- Video probe inspection of 9th support plate on SG-A.
- Tube scale profiling and trefoil profiling on SG-B and SG-C.
- FOSAR of foreign objects left in service during 2RE16, if reachable by tooling.
- FOSAR of all PLPs identified by eddy current inspection, if reachable by tooling.

Secondary Side Inspection and Maintenance Results

Sludge Lancing

The post-lance inspection revealed that generally the top of tubesheet of all four SGs were clean with essentially all sludge removed. No anomalies were noted on any tubesheet location. The kidney region, encompassing the tubes within approximately Rows 19-35 from Columns 72-84, has hardened collars at the TTS.

Steam Drums

Visual observations were made of the steam drums of SG-C and SG-D to assess the condition of the steam drum in each SG and to ensure reliable operations until the next inspection period. The steam drums were inspected for erosion, mechanical damage, cracked welds, corrosion, foreign material and any unusual conditions.

The inspection revealed no abnormal conditions. All components were in good condition with no cracking, erosion, or deformation. The inspection of the steam drums showed that all surfaces were gray in color, similar to last inspection during 2RE16.

In-Bundle Inspection of the Ninth Tube Support Plate

The inspection showed a thin layer of magnetite covering the TSP top surface, along with some loose deposits that were present in somewhat greater quantity than in 2RE16, but still not to any significant extent. No deposit bridging across the trefoil to tube outside diameter (OD) surface was observed. No departures from the expected appearance of the TSP ligaments were observed. No negative impact on steam generator operation is expected.

Foreign Object Mapping and Retrieval

Foreign object search and retrieval (FOSAR) was performed at the top of the tubesheet, the tube bundle-shell annulus, and the tube lane in all four SGs. Six (6) foreign objects were identified during the top of tubesheet video probe inspections in SG-A after the first sludge lance; no foreign objects were identified during the top of tubesheet video probe inspections after the second sludge lance, these were all presumably removed by the second sludge lance. Seven (7) foreign objects were identified during the top of tubesheet video probe inspections in SG-D. No foreign objects were identified by video probe inspection in SG-B or SG-C.

Based on existing wear analyses and top of the tubesheet velocity maps, prioritization criteria were developed and used to assign priorities to each of the identified foreign objects. Based on existing wear analyses and top of the tubesheet velocity maps, prioritization criteria were developed and used to assign priorities to each of the identified foreign objects.

Table 2-4: Unretrieved 2RE19 TTS Foreign Objects

SG	ID	Priority	Description	Col	Row	Leg	Length	Width	Height	Metallic	Legacy	Comments
D	2D001	3	BRISTLE	77	75	CL	0.1	0.03	0.03	yes	no	FOUND DURING CLEANLINESS, C77-78
D	2D002	3	BRISTLE	77	81	CL	0.15	0.01	0.01	yes	no	FOUND DURING CLEANLINESS, OBJECT NOT FIXED
D	2D004	3	GRAPHITE	60	68	HL	0.125	0.125	0.125	no	no	FOUND IN 60-61
D	2D005	3	GRAPHITE	61	37	HL	0.02	0.02	0.02	no	no	FOUND IN 60-61, DISAPPEARED WHILE RETRIEVING
D	2D006	2	WIRE	77	33	HL	0.5	0.063	0.063	yes	no	FOUND IN 76-77, ONE END OF OBJECT FIXED IN PLACE
D	2D008	2	WIRE	82	24	HL	0.5	0.063	0.063	yes	no	FOUND IN COL 82-83 IN A PILE OF SLUDGE, OBJECT FIXED IN PLACE

There were six objects that could not be removed from the steam generators (Table 2-4). This includes four Priority 3 objects, two Priority 2 objects and no Priority 1 objects. Each identified foreign object, not retrieved from the respective steam generator, was subjected to a foreign object wear analysis to support the planned operating period through Cycle 22.

Dropped Object Steam Generator 2C

During 2RE19, while performing Steam Generator 2C steam drum inspections, the latch of an inspection camera opened and released the lithium battery. The battery fell from the steam drum through a primary separator can, coming to rest on the top of the tube bundle. Retrieval efforts were unsuccessful and the battery was dispositioned based upon a Chemistry and Loose Parts analysis.

Extensive evaluation by STP and Westinghouse reveals that the camera battery will not negatively impact the steam generator operation thru cycles 20, 21, and 22. Chemistry impacts are expected to be minimal, and a loose part wear analysis conducted by Westinghouse reveals that, under worst case scenario assumptions, no tube will be worn beyond structural integrity limits over the next three cycles.

During startup operations from 2RE19, significant dissolution of the lithium-ion battery components appears to have occurred following heat-up to 567°F. The observation of lithium, fluoride and aluminum in the bulk water confirmed that good communication between the battery and the bulk water existed.

All impurities identified during heat-up following 2RE19 have been cleaned up to levels well below respective control, action level or Chemistry Effectiveness Indicator (CEI) thresholds. Impurity return was observed at normal operating pressure and temperature and impurity cleanup was complete prior to exceeding 20% power.

Condition Monitoring Conclusions and Operational Assessment

Based on the final South Texas Unit 2 2RE19 inspection data, no tubes exhibited degradation that required in situ pressure testing to demonstrate structural and leakage integrity. There was no reported primary-to-secondary leakage prior to the end of the SG inspection interval. The Condition Monitoring limits provided in the DA, and correspondingly, the performance criteria of NEI 97-06 for operating leakage and structural integrity, were satisfied for the prior South Texas Unit 2 SG operating interval.

A final Operational Assessment was performed and determined that NEI 97-06 performance criteria will be satisfied for three full cycles of operation through at least the end of Cycle 22.

The next Unit 2 steam generator inspection is scheduled for refueling outage 2RE22.