STEAM GENERATOR TUBE INSPECTION DISCUSSION POINTS

The following discussion points have been prepared to facilitate the conference call arranged with the licensee to discuss the results of the steam generator tube inspections to be conducted during the upcoming spring 2020, Unit 2 refueling outage. This conference call is scheduled to occur towards the end of the planned SG tube inspections, but before the unit completes the inspections and repairs.

The NRC staff plans to document a publicly available summary of the conference call, as well as any material that is provided in support of the call.

1. Discuss any trends in the amount of primary-to-secondary leakage observed during the recently completed cycle.

There was no primary to secondary leakage reported during the last operating cycle (Cycle 21).

2. Discuss whether any secondary side pressure tests were performed during the outage and the associated results.

There were no secondary pressure tests performed during the outage.

3. Discuss any exceptions taken to the industry guidelines.

There are no exceptions taken to the industry guidelines.

4. For each steam generator, provide a description of the inspections performed including the areas examined and the probes used (e.g., dents/dings, sleeves, expansion-transition, U-bends with a rotating probe), the scope of the inspection (e.g., 100% of dents/dings greater than 5 volts and a 20% sample between 2 and 5 volts), and the expansion criteria.

Base Scope Programs:

- 100% full length 0.720 inch bobbin inspection in Rows 5 and higher (non-sleeved tubes)
- 0.720 inch bobbin inspection in Row 5 and higher in all sleeved tubes from TEC to STH
- 100% 0.720 inch bobbin inspection in Rows 1 through 4 HL and CL straight legs (non-sleeved HL tubes)
- 0.630 inch Wide Groove Bobbin in all sleeved tubes in Rows 2 through 4 from STH to 08H
- 100% 0.700 inch bobbin inspection in Row 3 and Row 4 U-bend from 08H to 07C
- 100% hot leg TTS +POINT probe inspection from 6 inches above to 3 inches below TTS in non-sleeved tubes
- 100% +POINT probe inspection of BLG and EXP bobbin reports in hot leg tubesheet below F* distance but above tubesheet neutral axis s
- 100% +POINT probe inspection of cold leg BLG and EXP bobbin reports above the TTS
- 100% 0.610 gimbaled +POINT probe full length from STH +3 to SBH -4 inches in sleeved tubes
- 100% Ghent Version 2 probe of sleeve nickel band region in lower tubesheet sleeve joints
- 100% Row 1 and Row 2 small radius U-bend +POINT probe inspection in each SG using mid-range +POINT coil
- 100% +POINT probe inspection at all dented (hot and cold leg) TSP intersections > 5 volts
- 100% +POINT probe inspection of all TSP DSI/DNI signals >2V

• 100% +POINT probe inspection of all free span dings (all reported voltages)

• 100% +POINT probe inspection of Row 3 through Row 10 U-bends in SG-C (top TSP to top TSP)

• 100% +POINT probe inspection of hot leg dents >2 but < 5V volt at 01H, 02H, 03H, and 04H

• 25% +POINT probe inspection of Row 3 through Row 10 U-bends in SG-A and SG-B (top TSP to top TSP)

• 25% +POINT probe inspection of hot leg dents >2 but < 5V volt at 05H, 06H, 07H, and 08H

• 20% inspection of the SG-A cold leg TTS region from +6 to -3 inches including all SG-A cold leg crevice depths >0.5 inch

• +POINT probe inspection of hot leg and cold leg tubes that contain BRT > 5 inches below the top-of-tubesheet

Special Interest Inspections:

• 100% inspection of bobbin special interest I-codes, such as free span differential signals meeting change criteria

• 100% inspection at TSP DSI signals >1V (not required per GL 95-05)

• 100% inspection of <2V DSI locations previously confirmed by the +POINT probe to contain axial ODSCC

• 100% inspection of all TSP residuals with bobbin phase angle ≤55 degrees and ≥1.25V on the bobbin P1 mix Channel

• 100% of DSI signals regardless of voltage size at TSP 01H/01C and TSP 02C/03C locations.

• High frequency +POINT probe testing of Row 1 U-bends with noise values of 0.65 Vvm and greater

• High frequency +POINT probe confirmatory testing of all U-bend PWSCC indications reported with the mid-range +POINT coil.

• 100% inspection of all dents at AVB sites (+/- 1 inch of AVB)

• 100% inspection of all newly reported signals at AVBs plus any atypical growth (>6%TW growth for Cycle 19) AVB wear indications

• 100% inspection of all free span signals not resolved as MBH/FSH or without historical review

• 100% inspection of newly reported PLP signals (includes 2-tube box) plus locations adjacent to tubes plugged in prior outages for PLP interaction (2 tube box), plus one tube box around SG-A 01C PLP signals from 2R20

• 25% inspection of all bobbin TSP mix residuals >1.5V but <2V plus 100% of >2V mix residuals. TSP mix residuals have bobbin phase angles >55 degrees.

• +POINT probe inspection of tubes with newly identified foreign objects that have the potential to cause tube wear that are identified from secondary side visual inspections at the applicable elevation (includes 1 tube box).

Expansion criteria:

Since the majority of the inspection programs are at 100%, there is no expansion requirements. If expansion of an inspection program is required, the expansion will follow the direction provided in the 2R21 DA.

Visual Inspections:

• Tube plug video inspection, including PIP repaired plugs and PIP tack welds

• Primary channel head visual inspections per Nuclear Safety Advisory Letter (NSAL) NSAL-12-1, Rev. 1, which includes

- o Divider plate-to-channel head weld
- o Divider plate-to-stub runner weld
- o Tubesheet-to-channel head Z-seam area
- o Entire inside surface of the channel head bowl cladding
- o Targeted visual inspection of the potential cladding anomaly identified in 2R20

• SG secondary side FOSAR of annulus and tube lane with FOSAR of in-bundle possible loose part (PLP) reports from eddy current testing

5. For each area examined (e.g., tube supports, dent/dings, sleeves, etc), provide a summary of the number of indications identified to-date for each degradation mode (e.g., number of circumferential primary water stress corrosion cracking indications at the expansion transition). For the most significant indications in each area, provide an estimate of the severity of the indication (e.g., provide the voltage, depth, and length of the indication). In particular, address whether tube integrity (structural and accident induced leakage integrity) was maintained during the previous operating cycle. In addition, discuss whether any location exhibited a degradation mode that had not previously been observed at this location at this unit (e.g., observed circumferential primary water stress corrosion cracking at the expansion transition for the first time at this unit).

Data as of 11:00 4/21/2020.

	SG A		SG B		SG C		2R21 Total	
Degradation Mech.	**Ind.**	**Tubes**	**Ind.**	**Tubes**	**Ind.**	**Tubes**	**Ind.**	**Tubes**
AVB Wear	52	34	93	47	9	6	154	87
AVB Wear >=40% TW	0	0	0	0	0	0	0	0
FDB Wear	0	0	0	0	1	1	1	1
FS Volumetric at TTS	0	0	3	2	0	0	3	2
FS Volumetric at TSP	1	1	0	0	0	0	1	1
FS Volumetric in FS	0	0	0	0	1	1	1	1
TSP Axial ODSCC (GL95-05)	368	306	463	380	359	298	1190	984
TSP Axial ODSCC at 01H	0	0	1	1	0	0	1	1
TTS Circ ODSCC	47	47	19	19	19	19	85	85
TTS Axial ODSCC	1	1	1	1	0	0	2	2
TTS Mixed Mode ODSCC	0	0	0	0	0	0	0	0
FS Ding Axial ODSCC	0	0	0	0	0	0	0	0
FS Ding Circ ODSCC	0	0	0	0	0	0	0	0
FS Axial ODSCC	0	0	0	0	0	0	0	0

AVB wear:

A total of 154 indications of AVB wear have been reported in 87 tubes in all three SGs, with the majority in SG A and SG B. Only 9 indications in 6 tubes have been reported in SG C.

No indications have exceeded the Tech Spec 40% TW repair limit. The largest indications were measured at 37% TW. All AVB wear indications satisfy the condition monitoring limit of 62% TW.

FDB Wear:

One indication of FDB wear has been reported in SG C. The indication has not yet been depth sized. This is a historical wear indication that measure 21% TW at the prior inspection.

Volumetric Indications:

There are five indications reported to date with volumetric indications in the freespan, near TSPs and at/above the tubesheet. The indications have not been yet been depth sized. Four of the indications are historical in nature and have not shown growth since initial reporting. One indication is newly reported, but historical data reviews have shown to be small and the indication has been present for several cycles with no change in signals character. The largest of these indications was 18% TW during the prior inspection.

Axial ODSCC Indications at TSPs (GL 95-05):

A total of 1190 axial ODSCC indications are reported in all SGs. The NRC GL 95-05 voltage-based repair criteria is applicable to these indications. The maximum bobbin coil voltage measured in each SG is 1.61 volts. The GL 95-05 upper voltage repair limit is 4.60v and any indication that confirms with the +POINT probe that exceeds 2.0v. All indications are below the repair limits. The voltage distributions are bound by previous inspection results.

One axial ODSCC indication was found within a flow distribution baffle location which is not encompassed by the GL95-05 voltage based ARC. The indication had a maximum voltage of 0.18 volts on the 300kHz +POINT probe with a maximum depth of 50% TW using the EPRI Appendix I amplitude based sizing technique. The measured length of the indication was 0.47 inch. The maximum voltage is less than the in situ pressure test screening criteria 0.5v and no portion of the indication exceed the second tier voltage screen of 0.4v over 0.6”.

Axial and Circumferential ODSCC at Expansion Transitions:

A total of 85 circumferential ODSCC indications have been reported at the hot leg expansion transition region; 47 in SG A, 19 in SG B, and 19 in SG C. The +POINT probe 300 kHz voltages range from 0.05 volts to 0.52 volts. All, but one are below the in situ pressure test initial voltage screening criteria of 0.5v. The flaw with the 0.52 volt indication was depth profiled and resulted in a PDA of 34.5 which is below the Condition Monitoring Limit and in situ criteria of 47 PDA. No other indications met the initial voltage screening criteria for proof and leakage in situ testing.

The largest PDA from depth profiling of the 16 largest indications was 64.6 PDA which exceeds the Condition Monitoring limit of 47% PDA. The voltage of this flaw was 0.27 volts which does not meet the initial in situ screening criteria, however, this tube will be in situ pressure tested as a conservative measure.

The range of maximum depth measurements by phase analysis are 0% TW to 99% TW, it should be noted that phase-based depth assessment of small voltage signals can be inaccurate due to the expansion transition geometry and deposit influence. The Indicated circumferential crack arc lengths range from 31 degrees to 309 degrees.

A total of 2 axial ODSCC indications have been reported at the hot leg expansion transition region. The +POINT probe 300 kHz voltage was 0.13 volt and 0.28 volt. The in situ pressure test voltage screening criteria is 0.5v. The measured axial crack lengths range from 0.13 inch and 0.16 inch. The critical crack length for structural integrity is 0.4 inch for a 100% TW flaw over the entire length.

One indication of circumferential ODSCC at a freespan ding (21 volt ding) has been detected by the +POINT probe during the 100% ding inspection program. Sizing and disposition of the indication is still in progress.

To date, there have been no indications of PWSCC of any type or axial ODSCC within the freespan and dings, which have been reported in prior outages.

6. Describe repair/plugging plans.

As of 0700 hrs, 04/22/2020

SG	ACQUIRED	COMPLETE	POTENTIAL REPAIRS
A	93.77%	92.98%	49
B	99.98%	99.46%	21
C	93.88%	93.41%	21
TOTAL	95.72%	95.11%	91

7. Describe in-situ pressure test and tube pull plans and results (as applicable and if available).

One tube in SG A (R10 C26) will be in-situ pressure tested. Several other tubes are being screened as possible candidates.

8. Discuss the following regarding loose parts:

   - what inspections are performed to detect loose parts

Primary side eddy current; secondary side visual inspections

   - a description of any loose parts detected and their location within the SG (including the source or nature of the loose part, if known)

Three objects were observed in SG A secondary side tube bundle (top of tubesheet)

No objects were observed in SG B secondary side tube bundle (top-of-tubesheet)

Two objects were observed in SG C secondary side tube bundle (top-of-tubesheet)

- if the loose parts were removed from the SG

In SG A secondary side, 2 of the 3 pieces of foreign material observed were removed. One piece was a small wire bristle & the other item was a piece of scale. The item that was not removed was a small wire bristle embedded in the hard sludge pile. Attempts to retrieve the wire bristle were unsuccessful. The wire bristle is fixed in place. No tube wall wear was associated with this part. The wire bristle will remain in the SG and monitored in future outages.

No foreign material observed in SG B secondary side

In SG C secondary side, 1 of the 3 pieces of foreign material observed were removed. The removed piece was a sludge rock. Two pieces of hard scale were also observed in SG C. Attempts to retrieve the hard scale were unsuccessful. The two pieces are fixed in place. No tube wall wear was associated with either part. The hard scale will remain in the SG and monitored in future outages.

- indications of tube damage associated with the loose parts

No indications of tube damage have been associated with the loose parts that have been detected/observed in the secondary side of the SGs.

9. Discuss the scope and results of any secondary side inspection and maintenance activities (e.g., in-bundle visual inspections, feedring inspections, sludge lancing, assessing deposit loading, etc).

No secondary side feedring inspections were scheduled during the 2R21 outage.

Secondary side visual inspections included the annulus, blown down lane & selected in-bundle tube locations (selected by eddy current results. Generators look relatively clean. In-bundle inspections are described above.

SG A - ~30 lbs w/o filter weight

SG B - ~30 lbs w/o filter weight

SG C - ~ 31.5 lbs w/o filter weight

10. Discuss any unexpected or unusual results.

None experienced to date

11. Provide the schedule for steam generator-related activities during the remainder of the current outage.

Close out inspection programs, in-situ pressure test in SG A, remediate tubes as required (plug or sleeve), install manway covers