INDIANA MICHIGAN POWER
A unit of American Electric Power

Indiana Michigan Power
Cook Nuclear Plant
One Cook Place
Bridgman, MI 49106
IndianaMichiganPower.com

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

Donald C. Cook Nuclear Plant
Unit 2 Updated Steam Generator Tube Inspection Report to Reflect
TSTF-577 Reporting Requirements

In accordance with the requirements of Technical Specification (TS) 5.6.7 of Appendix A to the Donald C. Cook Nuclear Plant (CNP) Unit 2 Operating License, as updated by Amendment 340 (ADAMS Accession Number ML22102A012), Indiana Michigan Power Company (I&M), the licensee for CNP Unit 2, is submitting as an enclosure to this letter the updated Steam Generator (SG) Tube Inspection Report for the inspections completed on Unit 2 during the U2C23 refueling outage.

As documented in I&M's Application to Revise Technical Specifications to Adopt TSTF-577, "Revised Frequencies for Steam Generator Tube Inspections" (ADAMS Accession Number ML21312A518), an updated SG tube inspection report for Unit 2 is required to be submitted within 30 days of implementing CNP Amendment 340. This updated report is required for Unit 2 because CNP is crediting SG inspections completed in 2016 as the start of the TS 5.5.7 inspection period. A similar updated report is not required for CNP Unit 1 because SG tube inspections were completed on Unit 1 during the U1C31 refueling outage in April 2022.

There are no new or revised commitments in this letter. Should you have any questions, please contact me at (269) 466-2649.

Sincerely,

M. K. Scarpello

Michael K. Scarpello
Regulatory Affairs Director

JMT/kmh

Enclosure: Updated Steam Generator Tube Inspection Report for Cook Nuclear Plant U2C23 Refueling Outage

c: R. J. Ancona – MPSC
EGLE – RMD/RPS
J. B. Giessner – NRC Region III
NRC Resident Inspector
R. M. Sistevaris – AEP Ft. Wayne, w/o enclosures
J. E. Walcutt – AEP Ft. Wayne, w/o enclosures
S. P. Wall – NRC Washington, DC
A. J. Williamson – AEP Ft. Wayne, w/o enclosures

ENCLOSURE TO AEP-NRC-2022-42

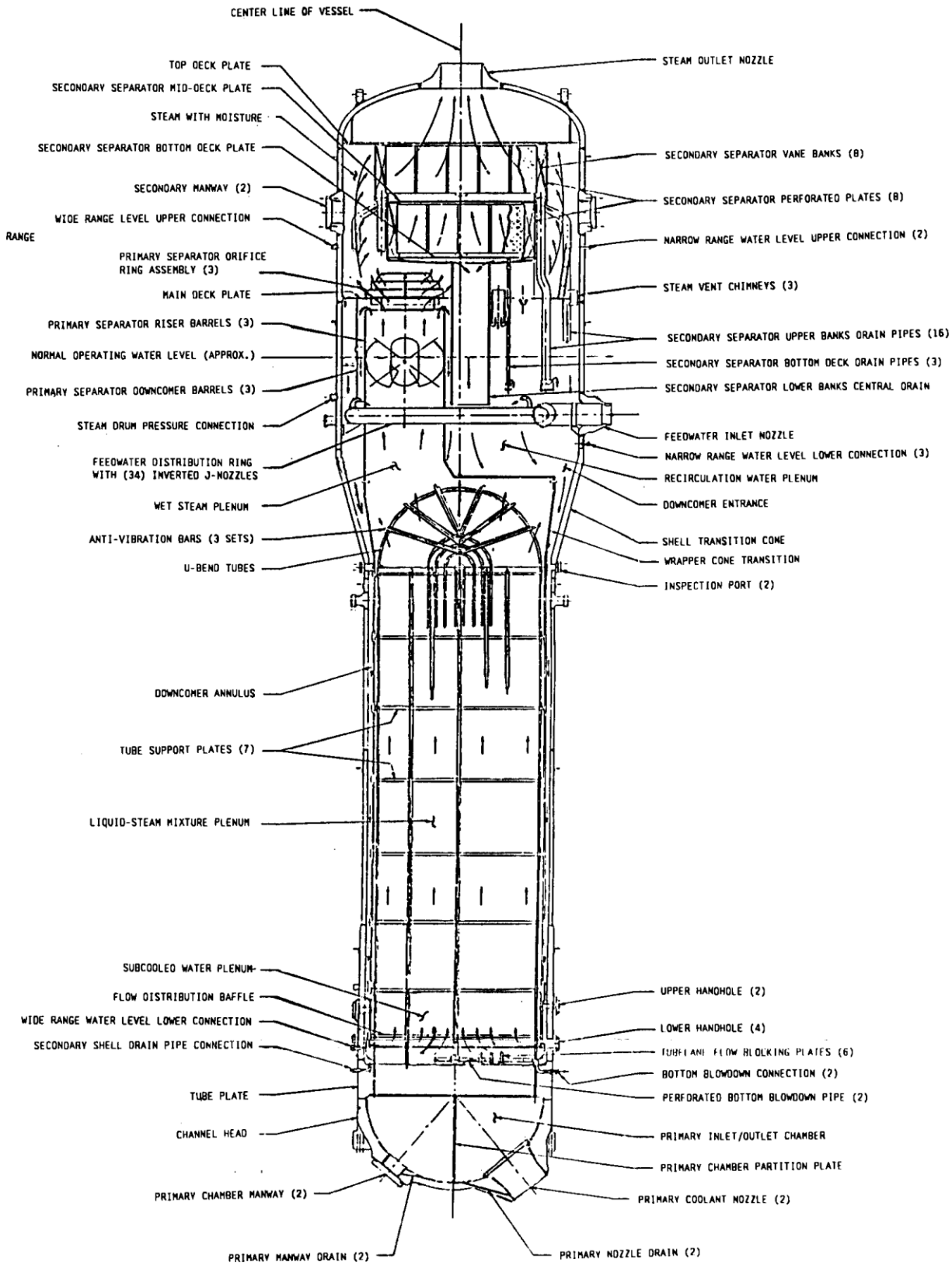
Updated Steam Generator Tube Inspection Report for Cook Nuclear Plant U2C23 Refueling Outage

Updated Steam Generator Tube Inspection Report for Cook Nuclear Plant U2C23 Refueling Outage

1. Design and Operating Parameters

Table 1: Steam Generator (SG) Design and Operating Parameters	
SG Model	Westinghouse Model 51F (also referred to as 54F)
Tube Material	Alloy 690 TT
No. of SGs per Unit	4
Number of Tubes	3592 tubes per SG
Nominal Tube Diameter / Wall Thickness	0.875 inches / 0.050 inches
Support Plates	Broached Quatrefoil ASME SA-240 Type 405 Stainless Steel
Most Recent Inspections	U2C20 (Spring 2012) U2C23 (Fall 2016)
Effective Full Power Months (EFPM) from U2C20 to U2C23	49.5 EFPM
Cumulative EFPM of Steam Generators	243.5 EFPM (at start of U2C23) 299.7 EFPM (on 4/2/2022)
Mode 4 Entry Date	12/21/2016 (following U2C23)
Observed Primary-to-Secondary Leak Rate	On 8/12/2016, a small (0.04-0.08 gallons per day) primary to secondary leak was detected. The leak rate remained stable until the start of U2C23. Following U2C23, there has been no primary to secondary leakage detected.
T_{HOT} During the Prior Inspection Period	606.4 °F (Normal Operating Temperature) 650 °F (Design Temperature)
Loose Parts Strainer	A single basket type strainer is installed in the suction line to each main feed pump
Tube Sub-Populations with Increased Degradation Susceptibility	Tubes near periphery and no-tube lane (increased susceptibility to foreign object wear)
Deviations from Steam Generator Management Program (SGMP) Guidelines Since the Last Inspection	Secondary Water Chemistry Guidelines, Rev. 8: Deviation due to not meeting the 2018 implementation date. Guidelines were fully implemented in 2019.

Steam Generator Schematic:



2. Scope of Inspections

   Inspections performed on all four steam generators during the U2C23 refueling outage included:

   - 100% Eddy Current Testing (ECT) of all in-service tubes
   - Visual inspection of channel head interior surfaces and all installed tube plugs
   - Visual inspection of secondary side top-of-tubesheet region
   - Visual inspection of steam dome internals

   No scope expansions were required.

3. Nondestructive Examination (NDE) Techniques Utilized for Tubes with Increased Degradation Susceptibility

   Tubes near the periphery and no-tube lanes are considered more susceptible to foreign object wear. In all four steam generators, the outer tubes around the periphery and no-tube lanes were visually inspected at the top-of-tubesheet region.

   In SG 21, SG 23, and SG 24, a sample of the top-of-tubesheet region was inspected using a +Point™ probe. The sample included a band around the periphery and no-tube lane (excluding the outermost tubes, which were visually inspected). The extent of examination included top-of-tubesheet ± 3 inches.

   In SG 22, the top-of-tubesheet region was inspected using an array probe. The sample included all in-service tubes (both hot and cold leg sides). The extent of examination included the tube end to the first tube support plate.

4. NDE Techniques Utilized for Degradation Mechanisms Found

   The only degradation mechanisms detected were support wear and volumetric indications. Support wear was found at Anti-Vibration Bars (AVBs) and Tube Support Plates (TSPs). Table 2 lists the NDE technique and corresponding Examination Technique Specification Sheet (ETSS) utilized for each degradation mechanism found.

Table 2: NDE Techniques

Degradation Mechanism	Detection Technique	Sizing Technique
Support Wear - AVB	Bobbin ETSS 96004.1	Bobbin ETSS 96004.1
Support Wear - TSP	Bobbin ETSS 96004.1	Bobbin ETSS 96004.1
Volumetric	Bobbin ETSS 96004.1	+Point™ ETSS 27904.1

5. Degradation Indications

   The total number of support wear indications is shown in Table 3. All support wear indications were less than 20 percent through-wall (% TW). The specific details for each volumetric indication are shown in Table 4.

Table 3: Support Wear Indications			
SG	**Number of TSP Indications**	**Number of AVB Indications**	**Maximum % TW**
21	10	0	13
22	0	2	11
23	59	1	15
24	10	0	10

Table 4: Volumetric Indications				
SG	**Tube (Row-Col)**	**Elevation (TSP ± inches)**	**% TW**	**Bobbin Voltage (V)**
22	46-62	05H+0.85	39	1.20
22	47-57	05H+1.63	38	1.21

6. Condition Monitoring Assessment

   All indications found during the U2C23 inspection satisfied the Condition Monitoring (CM) requirements for structural integrity and accident induced leakage integrity. No in-situ pressure testing was required.

   Condition Monitoring for AVB and TSP Wear

   All AVB and TSP wear indications were characterized as axial partial through-wall degradation less than 135° in circumferential extent. As shown in Figure 1 and Figure 2, all wear indications were below the CM limit for structural integrity. Since wear indications will leak and break at essentially the same differential pressure, leakage integrity was also satisfied.

Figure 1: CM Curve for AVB Wear (ETSS 96004.1)

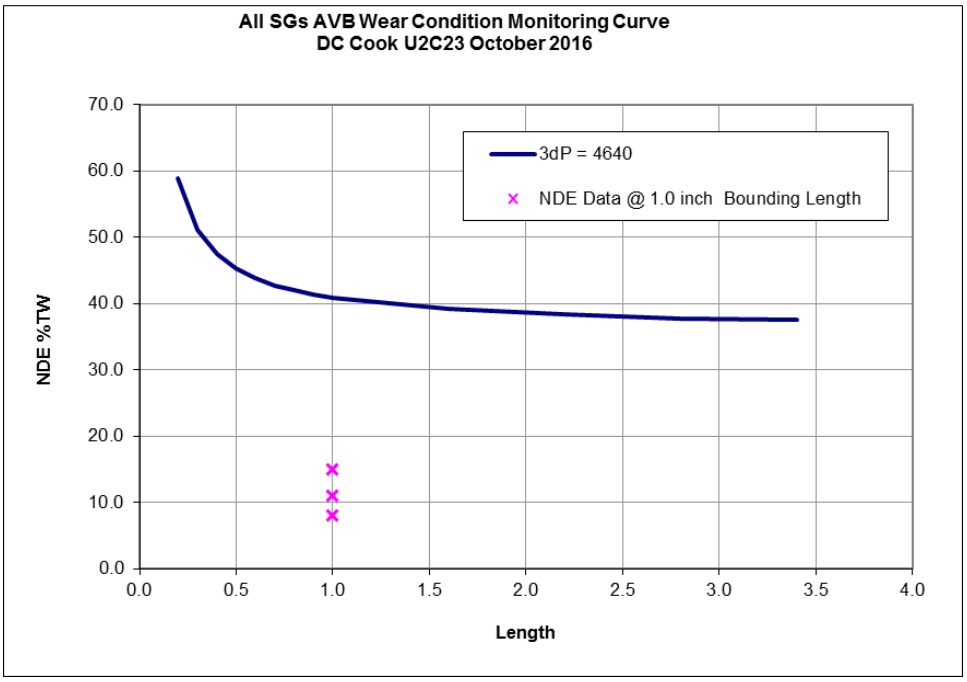
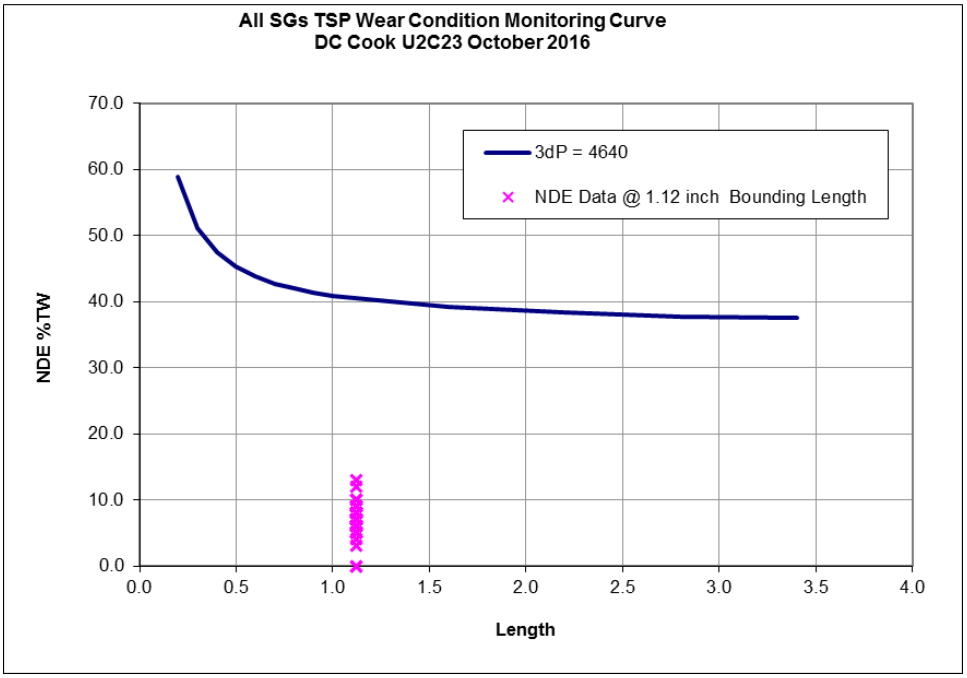


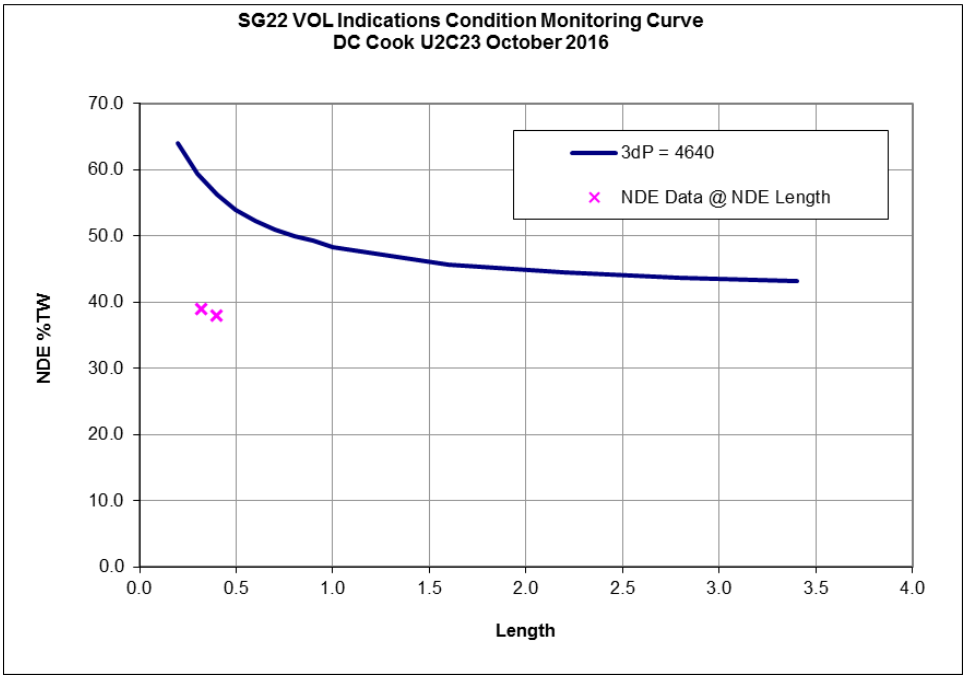
Figure 2: CM Curve for TSP Wear (ETSS 96004.1)



Condition Monitoring for Volumetric (VOL) Indications

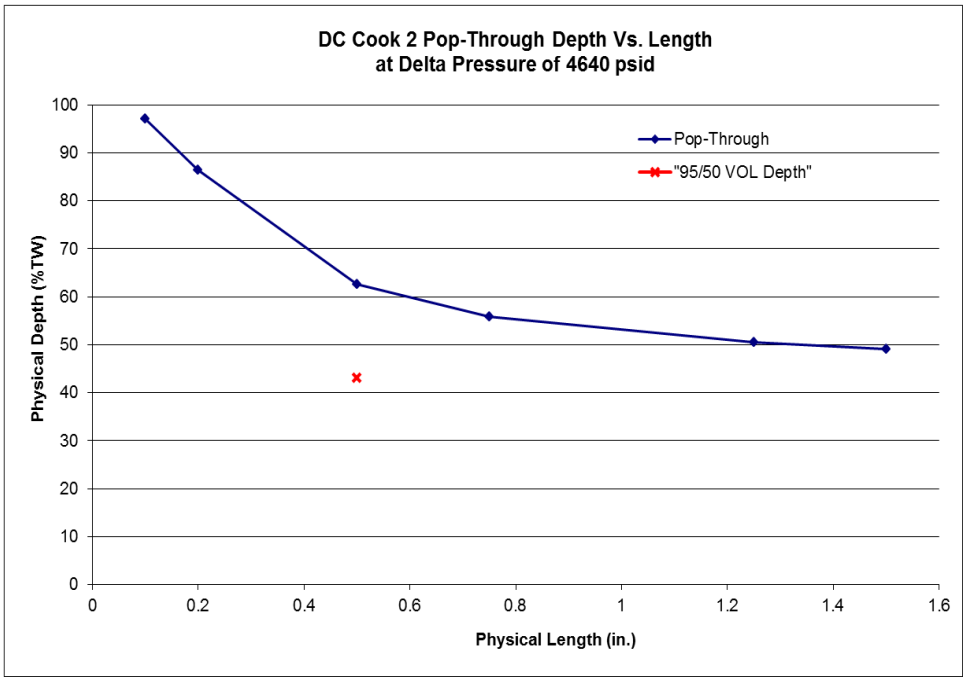
All volumetric indications measured less than 135° in circumferential extent. Therefore, the indications were treated as axial partial through-wall degradation less than 135°. As shown in Figure 3, all volumetric indications were below the CM limit for structural integrity.

Figure 3: CM Curve for VOL Indications (ETSS 27904.1)



If the volumetric indications are treated as a form of wear-like indication, leak and break will essentially occur at the same differential pressure, thus demonstrating leakage integrity. Since the volumetric indications resemble an elliptical patch of degradation, leakage due to pop-through was also considered. When considering the worst-case accident pressure differential, the largest volumetric indication (after being recast into its 95/50 depth of 43% TW) continues to remain bounded by the pop-through curve as illustrated in Figure 4. Therefore, leakage integrity was satisfied for both volumetric indications.

Figure 4: Pop-Through Curve with Largest VOL Indication



The U2C23 ECT results were bounded by the behavior projected in the previous operational assessment as demonstrated by satisfying condition monitoring limits for all degradation mechanisms. The previous operational assessment projected growth rates of 5% TW/EFPY (Effective Full Power Year) for AVB wear and 3% TW/EFPY for TSP wear. The maximum growth rates measured during U2C23 were 0.97% TW/EFPY for AVB wear and 0.73% TW/EFPY for TSP wear.

7. Number of Tubes Plugged During the Inspection Outage

   As shown in Table 5, two tubes were removed from service during U2C23.

Table 5: Tubes Removed from Service during U2C23

SG	Tube (Row-Col)	Reason for Tube Plugging
22	46-62	Volumetric Indication at 05H+0.85
22	47-57	Volumetric Indication at 05H+1.63

In addition to the two tubes listed in Table 5, one out-of-service tube in SG 22 (Row 8/Column 3) was unplugged on both ends and re-plugged with alloy 690 tube plugs. The original welded plugs were made of alloy 600 material and installed pre-service. Plug replacement was a proactive measure to remove the alloy 600 plug material from the steam generator.

8. Repair Methods Utilized

   No tube repairs were completed during U2C23.

9. Operational Assessment

In 2020, an updated Operational Assessment (OA) was completed to evaluate continued operation through the end of operating cycle 27 (EOC 27), which coincides with the start of the U2C28 refueling outage. The OA evaluated all existing and potential degradation mechanisms using a bounding operating period of 7.5 EFPY (90 EFPM). The OA illustrates reasonable assurance that tube integrity will be maintained for all known indications, undetected indications, and new indications until the U2C28 refueling outage. Table 6 summarizes the OA projections.

For evaluation of AVB wear, the arithmetic OA approach was used. This approach involves adjusting the deepest return-to-service indication to account for ECT uncertainties, applies a 95th percentile growth rate, and compares the EOC flaw depth to the EOC high probability structural limit. For AVB wear, a conservative growth rate of 0.97% TW/EFPY (maximum AVB wear growth rate at U2C23) was used.

For evaluation of TSP wear, the arithmetic OA approach was used. The maximum growth rate observed over the past three inspections (1.11% TW/EFPY at U2C17) was conservatively applied. A probabilistic, full bundle approach was also used to evaluate TSP wear. The U2C23 growth rates from all SGs combined were modeled with a Kunin fit. The quantity of new wear scars was projected using a Weibull fit of historical wear initiations. The depth value assigned to each new wear scar within the full bundle model was determined using a Monte Carlo simulation that sampled from a bounding Kunin fit to the collective U2C23 distribution of new wear scar depths. Each TSP wear scar (repeat and new) was assigned a fixed structural length of 1.2 inches (bounding for the TSP thickness) and a fixed structural depth to max depth ratio of 1.0. This ratio represents the most bounding profile (flat wear). The Probability of Survival (POS) estimate determined by the full bundle analysis is shown in Table 6.

Foreign object wear and volumetric indications were also evaluated in the OA. No top-of-tubesheet foreign object wear has been reported since 2004. During U2C23, two volumetric indications were detected in SG 22 above the 5th support plate. Both exhibited degradation indicative of loose part wear. Examination of bounding tubes revealed no evidence of a loose part. Based on Cook Nuclear Plant Unit 2 operating experience, it is unlikely that new foreign object wear would exceed the high probability structural limit of 43% TW (using a conservative differential pressure of 4800 psi and structural length of 1.2 inches).

Table 6: OA Projections

Degradation Mechanism	EOC27 Structural		EOC27 Leakage	
	Limit	Projection	Limit	Projection
AVB wear	41.7% TW	≤31.8% TW	0.25 gpm	Zero Leakage
TSP wear	43.2% TW 0.950 POS	≤30.8% TW 0.981 POS	0.25 gpm	Zero Leakage
Foreign object wear / volumetric	43.2% TW	≤43.2% TW	0.25 gpm	Zero Leakage

10. Total Number of Tubes Plugged

Table 7 shows the current number of tubes plugged in the Unit 2 steam generators.

Table 7: Total Tubes Plugged			
SG	**Number of Tubes**	**Number of Tubes Plugged**	**Plugging Percentage**
21	3,592	1	0.03%
22	3,592	8	0.22%
23	3,592	6	0.17%
24	3,592	4	0.11%
Total	14,368	19	0.13%

11. Secondary Side Inspections

Secondary side visual inspections were performed in all four steam domes. The scope included the primary separators, secondary separators, feedwater ring (except SG 22), and U-bend region. No adverse conditions were identified by these inspections.

After water lancing, the top-of-tubesheet region was visually inspected in each SG. The scope included the annulus region, no-tube lane, and multiple in-bundle passes in the hot leg and cold leg of each SG. Possible Loose Part (PLP) signals from eddy current were visually investigated where accessible. Hard sludge accumulation was identified in areas of the hot leg side of each SG. This is not considered a new or abnormal condition.

Table 8 provides the list of known foreign objects left in the steam generators following the U2C23 refueling outage. Sludge piles and sludge rocks are not included.

Table 8: Foreign Objects Remaining in Steam Generators			
SG	**Description**	**Location**	**Disposition**
22	Wire Length ≈ 4” Diameter ≈ 1/8”	Cold Leg Tubesheet Rows ≈ 3-4 Cols ≈ 55-56	The object was discovered in 2004 and has remained constrained in the same location. ECT during U2C23 confirmed the object has not caused any degradation to surrounding tubes.
24	Wire Length ≈ 1” Diameter ≈ 0.13”	Hot Leg Tubesheet Rows ≈ 8 Cols ≈ 42-43	The object was discovered in 2007 and has remained constrained in the same location. ECT during U2C23 confirmed the object has not caused any degradation to surrounding tubes.

12. Secondary Side Cleaning

Water lancing was performed in each SG. In total, approximately 87 pounds of material was removed.

13. Primary Side Visual Inspections

    Each of the steam generator channel heads (hot leg and cold leg sides) were visually inspected. The scope included low-lying areas, channel head cladding, tubesheet cladding, divider plate, divider plate welds, and nozzle dam rings. The inspections looked for evidence of gross defects such as degraded welds, unusual discoloration, dings, or gouges. No discrepancies or anomalous conditions were identified.

    A visual inspection was performed on all previously installed tube plugs as well as tube plugs installed during U2C23. No degraded tube plugs were identified.

    In conjunction with the lnservice Inspection (ISI) Program, visual inspections were performed on the inner radius nozzles (inlet and outlet) on each steam generator. The results of these inspections were all acceptable.

14. Plant-Specific Reporting Requirements

    Cook Nuclear Plant has no plant-specific reporting requirements.