INDIANA
MICHIGAN
POWER
An AEP Company
BOUNDLESS ENERGY

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

December 14, 2020

AEP-NRC-2020-78
10 CFR 50.90

Docket No.: 50-316

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

Donald C. Cook Nuclear Plant Unit 2
License Amendment Request Regarding a Change to the Steam Generator (SG) Program to Allow for a One-Time Deferral of SG Inspections

Pursuant to 10 CFR 50.90, Indiana Michigan Power Company (I&M), the licensee for Donald C. Cook Nuclear Plant (CNP) Unit 2, is submitting a request for an amendment to the Technical Specifications (TS) for CNP Unit 2. The proposed amendment will revise the requirements of TS 5.5.7 "Steam Generator (SG) Program" by extending, on a one-time basis, the requirement to inspect each Steam Generator (SG) at least every third refueling outage, for another eighteen months to the Fall of 2022, when the Unit 2 Cycle 27 refueling outage is currently scheduled. The one-time license amendment is required due to unforeseen issues as a result of the current COVID-19 pandemic.

On January 31, 2020, the U.S. Department of Health and Human Services declared a public health emergency for the United States to aid the nation's healthcare community in responding to the Novel Coronavirus and its associated disease, COVID-19. On March 10, 2020, Michigan Governor Gretchen Whitmer declared a state of emergency. The COVID-19 outbreak was subsequently characterized as a pandemic by the World Health Organization on March 11, 2020, and on March 13, 2020, President Donald Trump declared the COVID-19 pandemic a national emergency. On October 2, 2020, the U.S. Department of Health and Human Services Secretary Alex Azar announced the renewal of the COVID-19 national public health emergency declaration, effective October 23, 2020.

In response to concerns of a continuation of the COVID-19 public health emergency, in the interest of personnel safety, and to preclude the potential for transmittal and spread of COVID-19, I&M requests the approval of this one time deferral of the CNP Unit 2 SG inspections. This request is part of an overall effort by I&M to reduce the number of outside personnel required on-site, and the overall outage scope, in response to the developing COVID-19 pandemic situation while maintaining the safety and reliability of the plant for the next operating cycle. This effort by I&M assures that the overriding priority of nuclear safety is maintained while providing for plant personnel and public safety and health. Performing the SG inspections would require approximately 95 vendor personnel from across the United States working alongside plant personnel in close proximity for extended periods of time. Including the SG inspections in the spring outage scope would also increase the overall outage duration by approximately one day, increasing the amount of time that supplemental workforce would remain on-site. Additionally, many of the tasks performed by the vendor are specialized and require specific qualifications. Losing a small number of individuals to illness has the potential to halt all work. Current scope reduction efforts have reduced the number of scheduled man-hours from an estimate of 240,000 to approximately 150,000 man-hours, and reduced the number of outside personnel required from an estimate of 1,250 to approximately 850 personnel. This reduction in scope and required outside personnel will allow CNP Unit 2 outage personnel to more effectively follow guidelines for social distancing established by the Centers for Disease Control and Prevention and Michigan Department of Health and Human Services during the spring outage.

Enclosure 1 to this letter provides an affirmation statement. Enclosure 2 is an evaluation of the proposed change to Section 5.5.7 of the Unit 2 TS. Enclosure 3 contains marked up copies of the applicable Unit 2 TS pages. New Unit 2 TS pages, with proposed changes incorporated, will be provided to the Nuclear Regulatory Commission (NRC) Licensing Project Manager when requested. Enclosure 4 provides an Operational Assessment which provides reasonable assurance that the steam generator tubing will meet the technical specification performance criteria until the Unit 2 Cycle 27 refueling outage.

I&M requests review and approval of this application by February 17, 2021, in order to support planning of the CNP Unit 2 Cycle 26 refueling outage. This schedule was discussed with the NRC during a public meeting on August 6, 2020 (ML 20248H475). The license amendment will be implemented within 30 days of U.S. Nuclear Regulatory Commission approval.

In accordance with 10 CFR 50.91, a copy of this application, with enclosures, is being provided to the designated Michigan state officials.

There are no new regulatory commitments made in this letter. Should you have any questions, please contact Mr. Michael K. Scarpello, Regulatory Affairs Director, at (269) 466-2649.

Sincerely,

Quinton S. Lies

Q. Shane Lies
Site Vice President

JMT/mll

Enclosures:

1. Affirmation
2. Evaluation of Proposed Amendment to Revise Unit 2 Steam Generator (SG) Program to allow for a One-Time Deferral of SG Inspections for Donald C. Cook Nuclear Plant Unit 2
3. Donald C. Cook Nuclear Plant Unit 2 Technical Specification Pages Marked To Show Proposed Changes
4. DC Cook Unit 2 SG Operational Assessment to Support Deferral of Planned Inspections at U2C26 (Spring 2021) and U2C27 (Fall 2022)

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

Enclosure 1 to AEP-NRC-2020-78

AFFIRMATION

I, Q. Shane Lies, being duly sworn, state that I am the Site Vice President of Indiana Michigan Power Company (I&M), that I am authorized to sign and file this request with the U. S. Nuclear Regulatory Commission on behalf of I&M, and that the statements made and the matters set forth herein pertaining to I&M are true and correct to the best of my knowledge, information, and belief.

Indiana Michigan Power Company

Quinton S. Lies

Q. Shane Lies
Site Vice President

SWORN TO AND SUBSCRIBED BEFORE ME

THIS 14 DAY OF December, 2020

Micah J. Sawyer

Notary Public

My Commission Expires 02/20/25

Enclosure 2 to AEP-NRC-2020-78

Evaluation of Proposed Amendment to Revise Unit 2 Steam Generator (SG) Program to allow for a One-Time Deferral of SG Inspections for Donald C. Cook Nuclear Plant Unit 2

Table of Contents

1.0 SUMMARY DESCRIPTION

Indiana Michigan Power Company (I&M), licensee for Donald C. Cook Nuclear Plant (CNP) Unit 2, requests an amendment to the CNP Unit 2 Operating License DPR-74 by incorporating the proposed change for the CNP Unit 2 Technical Specifications (TS). The proposed change is a request to revise TS 5.5.7, "Steam Generator (SG) Program" for CNP Unit 2 by deferring, on a one-time basis, the requirement to inspect each Unit 2 Steam Generator at least every third refueling outage, for another eighteen months to the Fall of 2022, when the Unit 2 Cycle 27 refueling outage is currently scheduled. The SG operational assessment and operational experience of the CNP Unit 2 SGs, as described in this enclosure, demonstrate that the proposed change to the SG inspection schedule is appropriate and does not impact the safe operation of the plant. The one-time license amendment is required due to unforeseen issues as a result of the current COVID-19 pandemic.

On January 31, 2020, the U.S. Department of Health and Human Services declared a public health emergency for the United States to aid the nation's healthcare community in responding to the Novel Coronavirus and its associated disease, COVID-19. On March 10, 2020, Michigan Governor Gretchen Whitmer declared a state of emergency. The COVID-19 outbreak was subsequently characterized as a pandemic by the World Health Organization on March 11, 2020, and on March 13, 2020, President Donald Trump declared the COVID-19 pandemic a national emergency. On October 2, 2020, the U.S. Department of Health and Human Services Secretary Alex Azar announced the renewal of the COVID-19 national public health emergency declaration, effective October 23, 2020.

In response to these declarations and in accordance with the Indiana Michigan Power Company (I&M), the licensee for Donald C. Cook Nuclear Plant (CNP) Unit 2 pandemic response plan, I&M is reducing the scope of the Unit 2 refueling outage to minimize the threat of the virus to station personnel and ensure the safe operation of Units 1 and 2 during this pandemic. The one-time extension of the SG inspections will reduce the staffing required to support the outage; therefore, reducing the probability of spread of the coronavirus. This request is consistent with measures taken by NRC as reflected in IMC 2515 Appendix E dated March 27, 2020 (ML20079E700).

This request is part of an overall effort by I&M to reduce the number of outside personnel required on-site, and the overall outage scope, in response to the developing COVID-19 pandemic situation while maintaining the safety and reliability of the plant for the next operating cycle. This effort by I&M assures that the overriding priority of nuclear safety is maintained while providing for plant personnel and public safety and health. Performing the SG inspections would require approximately 95 vendor personnel from across the United States working alongside plant personnel in close proximity for extended periods of time. Including the SG inspections in the spring outage scope would also increase the overall outage duration by approximately one day, increasing the amount of time that supplemental workforce would remain on-site. Additionally, many of the tasks performed by the vendor are specialized and require specific qualifications. Losing a small number of individuals to illness has the potential to halt all work.

Current scope reduction efforts have reduced the number of scheduled man-hours from an estimate of 240,000 to approximately 150,000 man-hours, and reduced the number of outside personnel required from an estimate of 1,250 to approximately 850 personnel. This reduction in scope and required outside personnel will allow CNP Unit 2 outage personnel to more effectively follow guidelines for social distancing established by the Centers for Disease Control and Prevention and Michigan Department of Health and Human Services during the spring outage.

I&M requests review and approval of this application by February 17, 2021, in order to support planning of the CNP Unit 2 Cycle 26 refueling outage. This schedule was discussed with the NRC during a public meeting on August 6, 2020 (ML 20248H475). The license amendment will be implemented within 30 days of the issuance of the license amendment.

2.0 DETAILED DESCRIPTION

2.1 System Design and Operation

The CNP Unit 2 Reactor Coolant System (RCS) consists of four similar heat transfer loops connected in parallel to the reactor vessel. Each loop contains a circulating pump and a steam generator (SG). The system also includes a pressurizer, connecting piping, pressurizer safety and relief valves, and relief tank, necessary for operational control.

During operation, the reactor coolant pumps (RCP) circulate pressurized water through the reactor vessel and the four reactor coolant loops. The RCS provides a boundary for containing the coolant under operating temperature and pressure conditions. During transient operation, the system's heat capacity attenuates thermal transients generated by the core or SGs.
The four replacement Westinghouse SGs were initially placed in service in March of 1989.

Each SG contains 3,592 thermally treated alloy 690 tubes with an outside diameter of 0.875 inches, and a nominal wall thickness of 0.050 inches. The tubes are arranged in a square pitch pattern of 47 rows and 98 columns. All tubes in the eight innermost rows were thermally stress relieved after tube bending to reduce residual stress.

The tube support structure consists of seven 1.12 inch thick support plates with quatrefoil-shaped tube holes, and three sets of anti-vibration bars that are located in the U-bend region of the tubes. There is a flow distribution baffle located between the tubesheet and the first support plate. The flow distribution baffle is 0.75 inches thick with octafoil-shaped tube holes. The support plates, anti-vibration bars, and the flow distribution baffle are made of type 405 stainless steel.

The tubesheet is composed of ASME SA-508 Class 2a low alloy steel forging material and is 21.18 inches thick (without cladding). The surface of the tubesheet in contact with reactor coolant is clad with 0.20 inches of Inconel weld material, making the overall nominal tubesheet thickness with cladding, 21.38 inches. Tubes are hydraulically expanded along the full depth of the tubesheet, with the exception of nine tubes. These tubes lack hydraulic expansion in either the hot leg or cold leg tubesheet due to a manufacturing oversight.

2.2 Current Technical Specifications Requirements

The CNP Unit 2 TS 3.4.13, "RCS Operational LEAKAGE," states that RCS operational LEAKAGE shall be limited to 150 gallons per day primary to secondary LEAKAGE through any one steam generator (SG).

TS Surveillance Requirement (SR) 3.4.13.2 requires verification that primary to secondary LEAKAGE is ≤ 150 gallons per day through any one SG in accordance with the Surveillance Frequency Control Program.

TS 3.4.17, "Steam Generator (SG) Tube Integrity," states that SG tube integrity shall be maintained and that all SG tubes satisfying the tube plugging criteria shall be plugged in accordance with the Steam Generator Program.

TS Surveillance Requirement (SR) 3.4.17.1 requires verification of SG tube integrity in accordance with the Steam Generator Program. TS SR 3.4.17.2 requires verification that each inspected SG tube that satisfies the tube plugging criteria is plugged in accordance with the Steam Generator Program prior to entering MODE 4 following a SG tube inspection.

The SG inspection scope and frequency is governed by TS 5.5.7, "Steam Generator (SG) Program," requirements. Specifically, Item d.2 states:

> *"After the first refueling outage following SG installation, inspect each SG at least every 72 effective full power months or at least every third refueling outage (whichever results in more frequent inspections). In addition, the minimum number of tubes inspected at each scheduled inspection shall be the number of tubes in all SGs divided by the number of SG inspection outages scheduled in each inspection period as defined in a, b, c, and d below."*

TS 5.5.7 Items d.2.a through d state:

a) *After the first refueling outage following SG installation, inspect 100% of the tubes during the next 144 effective full power months. This constitutes the first inspection period*

b) *During the next 120 effective full power months, inspect 100% of the tubes. This constitutes the second inspection period;*

c) *During the next 96 effective full power months, inspect 100% of the tubes. This constitutes the third inspection period; and*

d) *During the remaining life of the SGs, inspect 100% of the tubes every 72 effective full power months. This constitutes the fourth and subsequent inspection periods*

CNP Unit 2 is currently in the 3rd inspection period. The CNP Unit 2 Cycle 27 refueling outage is still part of the CNP Unit 2 3rd inspection period, so the deferral of the U2 SG inspection until that time will not have an impact on meeting the requirements of TS 5.5.7 Items d.2.a through d.

2.3 Reason for the Proposed Change

The proposed change extends on a one-time basis, CNP Unit 2 TS Section 5.5.7.d.2 requirements of inspecting each SG at least every third refueling for Unit 2, until the next refueling outage scheduled for Fall 2022 as indicated below:

The requested deferral of the requirement to inspect each Unit 2 SG at least every third refueling outage, for another eighteen months, will allow the Unit 2 SG inspections to be performed during the Unit 2 Cycle 27 refueling outage currently scheduled for the Fall of 2022. The operational assessment and operational experience of the CNP Unit 2 SGs, as described in this enclosure, demonstrate that the proposed change to the SG inspection schedule is appropriate and does not impact the safe operation of the plant. The one-time license amendment is required due to unforeseen issues as a result of the current COVID-19 pandemic. The requested one-time extension of the Unit 2 SG inspection schedule will not affect the safe operation of the plant and will significantly reduce the number of employees required during the Unit 2 Cycle 26 refueling outage; therefore, reducing the probability of spread of the coronavirus and ensuring the safe operation of CNP Units 1 and 2 during this pandemic.

2.4 Description of the Proposed Change

The proposed change extends on a one-time basis, CNP Unit 2 TS Section 5.5.7.d.2 requirements of inspecting each SG at least every third refueling outage for Unit 2, until the next refueling outage scheduled for Fall 2022 as indicated below:

The CNP Unit 2 TS 5.5.7 "Steam Generator (SG) Program" Item d.2 will be revised as follows:

d. *Provisions for SG tube inspections. Periodic SG tube inspections shall be performed. The number and portions of the tubes inspected and methods of inspection shall be performed with the objective of detecting flaws of any type* *(e.g., volumetric flaws, axial and circumferential cracks) that may be present along the length of the tube, from the tube-to-tubesheet weld at the tube inlet to the tube-to-tubesheet weld at the tube outlet, and that may satisfy the applicable tube plugging criteria. The tube-to-tubesheet weld is not part of the tube. In addition to meeting the requirements of d.1, d.2, and d.3 below, the inspection scope, inspection methods, and inspection intervals shall be such as to ensure that SG tube integrity is maintained until the next SG inspection. A degradation assessment shall be performed to determine the type and location of flaws to which the tubes may be susceptible and, based on this assessment, to determine which inspection methods need to be employed and at what locations.*

1. *Inspect 100% of the tubes in each SG during the first refueling outage following SG installation.*

2. *After the first refueling outage following SG installation, inspect each SG at least every 72 effective full power months or at least every third refueling outage (whichever results in more frequent inspections)* INSERT*.

*, except for a one-time extension for the Unit 2 Cycle 26 inspection to be deferred to be performed during the Cycle 27 refueling outage in Fall 2022 and will be performed thereafter at the frequency specified above

In addition, the minimum number of tubes inspected at each scheduled inspection shall be the number of tubes in all SGs divided by the number of SG inspection outages scheduled in each inspection period as defined in a, b, c and d below. If a degradation assessment indicates the potential for a type of degradation to occur at a location not previously inspected with a technique capable of detecting this type of degradation at this location and that may satisfy the applicable tube plugging criteria, the minimum number of locations inspected with such a capable inspection technique during the remainder of the inspection period may be prorated. The fraction of locations to be inspected for this potential type of degradation at this location at the end of the inspection period shall be no less than the ratio of the number of times the SG is scheduled to be inspected in the inspection period after the determination that a new form of degradation could potentially be occurring at this location divided by the total number of times the SG is scheduled to be inspected in the inspection period. Each inspection period defined below may be extended up to 3 effective full power months to include a SG inspection outage in an inspection period and the subsequent inspection period begins at the conclusion of the included SG inspection outage.

> *a) After the first refueling outage following SG installation, inspect 100% of the tubes during the next 144 effective full power months. This constitutes the first inspection period;*
>
> *b) During the next 120 effective full power months, inspect 100% of the tubes. This constitutes the second inspection period;*
>
> *c) During the next 96 effective full power months, inspect 100% of the tubes. This constitutes the third inspection period; and*
>
> *d) During the remaining life of the SGs, inspect 100% of the tubes every 72 effective full power months. This constitutes the fourth and subsequent inspection periods.*

Enclosure 3 of this letter contains a mark-up copy of the CNP Unit 2 TS 5.5.7, which reflects the proposed changes. Within the mark-up copy, new text is shown as boxed text.

3.0 TECHNICAL EVALUATION

The proposed license amendment modifies the CNP Unit 2 Technical Specifications (TS) by deferring, on a one-time basis, the performance of the Unit 2 Steam Generator (SG) inspection until the next refueling outage, scheduled for Fall of 2022.

Enclosure 4 to this letter contains Framatone Document No 51-9318053-000 "DC Cook Unit-2 SG Operational Assessment to Support Deferral of Planned Inspections at U2C26 (Spring 2021) and U2C27 (Fall 2022)," Framatone Inc., dated December 1, 2020. This Operational Assessment (OA) was developed to justify deferral of the SG inspections and addresses the limiting degradation mechanisms and all existing degradation mechanisms. This LAR is only requesting a deferral of the U2C26 (Spring 2021) inspection.

3.1 Background

The original Unit 2 Westinghouse model 51 steam generators were replaced with Westinghouse model 54F steam generators in 1989. The replacement was a "two-piece" replacement where new lower assemblies were coupled with a refurbished original steam dome shell and a new moisture separator package. Each of the four replacement steam generators contain 3592 thermally treated (TT) alloy 690 tubes with an outside diameter of 0.875 inches and a nominal wall thickness of 0.050 inches.

The Unit 2 replacement steam generators have undergone a pre-service inspection and nine in-service inspections (ISI). Based on previous inspection results, the steam generators have experienced minor wear from structures (anti-vibration bars, tube support plates) and foreign objects. Additionally, two volumetric indications were detected in one SG during the most recent inspection. Based on the location, shape, and bobbin response, it is believed both indications were caused by a foreign object. To date, a total of 19 tubes have been removed from service in the Unit 2 steam generators.

An updated operational assessment (OA) was performed by Framatome and issued in December 2020. This OA is contained in Enclosure 4 of this letter. The OA evaluated the potential to not perform the upcoming SG inspections planned for the U2C26 refueling outage (Spring 2021) and defer them to the U2C27 refueling outage (Fall 2022). The OA determined that there is reasonable assurance that the Technical Specification performance criteria will remain satisfied until the U2C28 refueling outage, a full operating cycle past U2C27.

3.2 Steam Generator Inspection Schedule

Currently, TS 5.5.7 requires CNP to inspect each steam generator at least every 72 effective full power months or at least every third refueling outage (whichever results in more frequent inspections). Additionally, 100% of the tubes are required to be inspected during each inspection period. In practice, CNP inspects 100% of the steam generator tubes every third refueling outage. As shown in Table 1, CNP Unit 2 is currently in the third inspection period.

TABLE 1: Unit 2 Steam Generator Inspections

Date	Outage	Cumulative SG EFPM	Inspection Period	Insp. Period Cumulative EFPM	Notes
Dec 88-Mar 89	U2C7	0	N/A	N/A	Replacement
June 1990	U2C8	13.36	N/A (1st ISI)	0	Inspection
February 1992	U2C9	26.70	First Inspection Period 144 EFPM	13.34	Inspection
September 1994	U2C10	41.35		28.00	Inspection
March 1996	U2C11	55.37		42.01	Skip
September 1997	U2C12	70.42		57.06	Inspection
January 2002	U2C13	87.26		73.91	Inspection
April 2003	U2C14	99.77		86.41	Skip
October 2004	U2C15	113.95		100.60	Inspection
March 2006	U2C16	129.78		116.42	Skip
September 2007	U2C17	145.96		132.60	Inspection
March 2009	U2C18	162.18	Second Inspection Period 120 EFPM	4.82	Skip
October 2010	U2C19	178.64		21.29	Skip
March 2012	U2C20	194.03		36.67	Inspection
October 2013	U2C21	210.83		53.51	Skip
April 2015	U2C22	226.66		69.30	Skip
October 2016	U2C23	243.48		86.12	Inspection
March 2018	U2C24	257.22		99.86	Skip
October 2019	U2C25	273.59		116.23	Skip
Spring 2021	U2C26	291.59	Third Inspection Period (*estimates*) 96 EFPM	14.23	Potential Deferral
Fall 2022	U2C27	309.59		32.23	Planned Inspection
Spring 2024	U2C28	327.59		50.23	Planned Skip

3.3 Recent Operational Experience

3.3.1 Primary to Secondary Leakage

Since the SGs were replaced in 1989, Cook Unit 2 had operated without any measured primary-to-secondary leakage until August 2016. At that time, a small (0.04-0.08 gallons per day) primary-to-secondary leak was detected prior to the scheduled unit shutdown. The leak was subsequently linked to SG 22. As a result, the eddy current inspection scope for that steam generator was revised to include a 100% array probe inspection from the tube end to the first support in both the hot and cold legs. This was based on the supposition that the leak was most likely foreign object related as this steam generator had no detectable degradation during the previous inspection and alloy 690 tubing has demonstrated resistance to degradation forms other than wear. However, the full length bobbin examination, the array inspection, and the secondary side visual inspections failed to identify the source of the leak. Upon unit restart and replacement of two damaged fuel assemblies, the leak became undetectable. Following this event, no measured primary-to-secondary leakage has been detected to date.

3.3.2 Summary of Most Recent Inspections

The most recent Unit 2 SG inspections were conducted during the U2C23 refueling outage (Fall 2016). In accordance with the reporting requirements of CNP Technical Specification 5.6.7, the results of the inspection were provided to the NRC in Reference 1.

As described in Section 4 of the OA contained in Enclosure 4, the U2C23 work scope included primary side eddy current testing (ECT), primary side visual inspections, water lancing, and secondary side visual inspections in all four SGs. The ECT examinations included 100% full length inspection of all inservice tubes as well as additional targeted inspections with rotating and array probes.

3.3.3 Degradation Detected

Degradation detected during U2C23 is described in Section 4.3 of the OA contained in Enclosure 4. Structural wear was detected at anti-vibration bar (AVB) and tube support plate (TSP) locations. Additionally, two volumetric indications were detected in SG22. In total, 84 indications were identified in 60 tubes.

No abnormalities were identified during secondary side visual inspections.

3.3.4 Tube Plugging

During U2C23, three tubes were plugged and stabilized. Two of the tubes were plugged due to volumetric indications. The third tube had been previously plugged during steam generator manufacture. This tube was unplugged on both ends, tested by bobbin, and re-plugged with mechanical alloy 690 thermally treated plugs during U2C23. The replacement was a proactive measure to remove the old alloy 600 plugs from the steam generator. No tubes were plugged for TSP wear or AVB wear during U2C23.

To date, a total of 19 tubes have been removed from service in the Unit 2 steam generators since they were replaced in 1989. One tube was plugged pre-service. Nine tubes (1994) were plugged due to mechanical damage incurred during pressure pulse cleaning operations. Six tubes (1997 and 2004) were plugged due to foreign object wear. One tube (2012) was plugged due to low row inspection difficulty. Two tubes (2016) were plugged due to volumetric indications resembling foreign object wear.

3.3.5 Relevant OE That Could Impact Tube Integrity

There has been no detectable primary-to-secondary leakage since the last inspection. Additionally, there have been no major chemistry excursions or foreign material events that are suspected of impacting Unit 2 SG tube integrity since the last inspection.

3.3.6 Previous Inspection Condition Monitoring

Condition monitoring from the U2C23 refueling outage is discussed in Section 4.3 of the OA contained in Enclosure 4 as well as in Reference 1. Evaluation of the indications found during the U2C23 inspection indicated that the condition monitoring requirements for structural and leakage integrity were satisfied. Degradation specific condition monitoring limits were applied to the indications for each degradation mode (anti-vibration bar wear, tube support wear, and volumetric). No degradation exceeded the technical specification repair limit of 40% TW or the condition monitoring limits.

The inspection found no indications that met the criteria for in-situ pressure testing and no tubes were required to be pulled.

3.4 Operational Assessment

The OA contained in Enclosure 4 evaluates all existing and potential degradation mechanisms for the Unit 2 steam generators. Existing degradation mechanisms are AVB wear, TSP wear, and two volumetric indications. The potential degradation mechanism is foreign object wear. As the evaluation in Section 5 of the OA illustrates, reasonable assurance is provided that tube integrity will be maintained for all known indications, undetected indications, and new indications for the next 7.5 Effective Full Power Years (EFPY).

3.5 Conclusions

There is reasonable assurance that the structural integrity and leakage integrity performance criteria will remain satisfied until the U2C27 refueling outage. Table 2 summarizes the projected structural and leakage margin at U2C28, a full operating cycle past the U2C27 refueling outage.

Additionally, the absence of secondary side structural degradation in each of the Unit 2 SGs during U2C23 provides a high level of confidence that tube degradation caused by secondary side component deterioration will not occur in any of the SGs prior to U2C27

Table 2: Unit 2 Integrity Margin Summary

Degradation Mechanism	EOC27 (U2C28) Structural		EOC27 (U2C28) Leakage	
	Upper Limit	Projection	Upper Limit	Projection
AVB wear	41.7%TW	≤31 8%TW	0.25 gpm	Zero Leakage
TSP wear	43.2%TW 0.950 POS Lower Limit	≤30.8%TW 0.981 POS	0.25 gpm	Zero Leakage
Foreign object wear / VOLs	43.2%TW	≤43 2%TW	0.25 gpm	Zero Leakage

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

Regulatory Requirements

The proposed changes were developed in accordance with the following NRC regulations and guidance:

- 10 CFR 50.36(c)(2)(i) states that Limiting Conditions for Operation are the lowest functional capability or performance levels of equipment required for safe operation of the facility. When a limiting condition for operation of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met.

- 10 CFR 50, Appendix B, establishes quality assurance requirements for the design, construction, and operation of safety related components. The pertinent requirements of this appendix apply to all activities affecting the safety related functions of these components. These requirements are described in Criteria IX, XI, and XVI of Appendix B and include control of special processes, inspection, testing, and corrective action.

- 10 CFR 100, Reactor Site Criteria, establishes reactor site criteria, with respect to the risk of public exposure to the release of radioactive fission products. Accidents involving leakage or tube burst of SG tubing may comprise a challenge to containment and therefore involve an increased risk of radioactive release.

As described in the CNP Updated Final Safety Analysis Report, Section 1.4, the Plant Specific Design Criteria (PSDC) define the principal criteria and safety objectives for the CNP design. The following PSDC are relevant to the proposed amendment:

PSDC CRITERION 33 Reactor Coolant Pressure Boundary Capability

> *The reactor coolant pressure boundary shall be capable of accommodating without rupture the static and dynamic loads imposed on any boundary component as a result of an inadvertent and sudden release of energy to the coolant. As a design reference, this sudden release shall be taken as that which would result from a sudden reactivity insertion such as rod ejection (unless prevented by positive mechanical means), rod dropout, or cold water addition.*

The proposed changes are consistent with the above regulatory requirements and criteria. Therefore, the proposed changes will assure safe operation by continuing to meet applicable regulations and requirements.

4.2 Precedent

The following are precedents for one-time changes to SG inspection frequencies.

1. Letter from Mahesh L. Chawla, NRC, to Fadi Diya, Senior Vice President and Chief Nuclear Officer (Ameren Missouri), "Callaway Plant, Unit No. 1 - Issuance of Amendment No. 223 Re: One-Time Deferral of the Steam Generator Tube Inspections (EPID L-2020-LLA-0142)," dated October 16, 2020, (ADAMS Accession Number ML20246G570).

2. Letter from Richard V. Guzman, NRC, to Daniel G. Stoddard, Senior Vice President and Chief Nuclear Officer (Dominion Nuclear), "Millstone Power Station, Unit No. 3 - Issuance of Amendment No. 277 to Revise Technical Specification 6.8.4.G to Allow a One-Time Deferral of the Steam Generator Tube Inspections (EPID L-2020-LLA-0178)," dated October 14, 2020, (ADAMS Accession Number ML20275A000).

3. Letter from Eva A. Brown, NRC, to Don Moul, Vice President, Nuclear Division and Chief Nuclear Officer (Florida Power & Light Company), "Turkey Point Nuclear Generating, Unit No. 3 - Issuance of Exigent Amendment No. 291 Concerning the Deferral of Steam Generator Inspections (EPID L-2020-LLA-0067)," dated April 16, 2020, (ADAMS Accession Number ML20104B527).

4.3 No Significant Hazards Consideration

The proposed license amendment modifies the D. C. Cook Nuclear Plant (CNP) Unit 2 Technical Specifications (TS) by deferring, on a one-time basis, the performance of the Unit 2 Steam Generator (SG) inspection until the next refueling outage, scheduled for Fall of 2022.

As required by 10 CFR 50.91(a), Indiana Michigan Power (I&M), the licensee for CNP Unit 2, has evaluated the proposed change using the criteria in 10 CFR 50.92 and has determined that the proposed change does not involve a significant hazards consideration. An analysis of the issue of no significant hazards consideration is presented below:

1. *Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?*

Response: No.

The proposed TS change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

The proposed license amendment modifies the CNP Unit 2 TS by deferring, on a one-time basis, the Unit 2 Steam Generator inspection by one cycle until the Unit 2 refueling outage scheduled for Fall of 2022. The SG tubes continue to meet the SG Program performance criteria and remain bounded by the plant's accident analyses. The operational assessment reanalysis demonstrates that the SG tubes meet the SG Program performance criteria throughout the 18-month one-time extension of the SG inspection.

Therefore, it is concluded that the proposed amendment does not involve a significant increase in the probability or the consequences of an accident previously evaluated.

2. *Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?*

Response: No.

The proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated

The proposed license amendment modifies the CNP Unit 2 TS by deferring, on a one-time basis, the Unit 2 Steam Generator inspection by one cycle until the Unit 2 refueling outage scheduled for Fall of 2022. The proposed change does not alter the design function or operation of the SGs or the ability of an SG to perform its design function. The SG tubes continue to meet the SG Program performance criteria. The proposed change does not create the possibility of a new or different kind of accident due to credible new failure mechanisms, malfunctions, or accident initiators that are not considered in the design and licensing bases.

Therefore, the proposed change does not create the possibility of a new or different kind of accident, from any accident previously evaluated.

3. *Does the proposed amendment involve a significant reduction in a margin of safety?*

Response: No.

The proposed amendment does not involve a significant reduction in a margin of safety

The proposed TS changes do not involve a significant reduction in the margin of safety. The proposed license amendment modifies the CNP Unit 2 TS by deferring, on a one-time basis, the Unit 2 Steam Generator inspection by one cycle until the Unit 2 refueling outage scheduled for Fall of 2022. Deferring the inspection schedule does not involve changes to any limit on accident consequences specified in the CNP Unit 2 licensing bases or applicable regulations, does not modify how accidents are mitigated and does not involve a change in a methodology.

Therefore, the proposed amendment does not involve a significant reduction in margin of safety.

Based upon the above analysis, I&M concludes that the proposed license amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92, "Issuance of Amendment," and accordingly, a finding of "no significant hazards consideration" is justified.

4.4 Conclusions

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5.0 ENVIRONMENTAL CONSIDERATION

I&M has evaluated the proposed amendments for environmental considerations. The review has resulted in the determination that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 REFERENCES

1. Letter from Q. S. Lies, Indiana Michigan Power Company (I&M), to U. S. Nuclear Regulatory Commission (NRC), "Donald C. Cook Nuclear Plant, Unit 2, 2016 Steam Generator Tube Inspection Report," dated May 24, 2017, Agencywide Documents Access and Management System Accession (ADAMS) No. ML17150A304.

Enclosure 3 to AEP-NRC-2020-78

Donald C. Cook Nuclear Plant Unit 2 Technical Specification Pages
Marked To Show Proposed Changes

5.5-5
5.5-6
5.5-7

5.5 Programs and Manuals

5.5.7 Steam Generator (SG) Program

A Steam Generator Program shall be established and implemented to ensure that SG tube integrity is maintained. In addition, the Steam Generator Program shall include the following:

a. Provisions for condition monitoring assessments. Condition monitoring assessment means an evaluation of the "as found" condition of the tubing with respect to the performance criteria for structural integrity and accident induced leakage. The "as found" condition refers to the condition of the tubing during an SG inspection outage, as determined from the inservice inspection results or by other means, prior to the plugging of tubes. Condition monitoring assessments shall be conducted during each outage during which the SG tubes are inspected or plugged to confirm that the performance criteria are being met.

b. Performance criteria for SG tube integrity. SG tube integrity shall be maintained by meeting the performance criteria for tube structural integrity, accident induced leakage, and operational LEAKAGE.

   1. Structural integrity performance criterion: All in-service steam generator tubes shall retain structural integrity over the full range of normal operating conditions (including startup, operation in the power range, hot standby, and cool down), all anticipated transients included in the design specification, and design basis accidents. This includes retaining a safety factor of 3.0 against burst under normal steady state full power operation primary-to-secondary pressure differential and a safety factor of 1.4 against burst applied to the design basis accident primary-to-secondary pressure differentials. Apart from the above requirements, additional loading conditions associated with the design basis accidents, or combination of accidents in accordance with the design and licensing basis, shall also be evaluated to determine if the associated loads contribute significantly to burst or collapse. In the assessment of tube integrity, those loads that do significantly affect burst or collapse shall be determined and assessed in combination with the loads due to pressure with a safety factor of 1.2 on the combined primary loads and 1.0 on axial secondary loads.

   2. Accident induced leakage performance criterion: The primary to secondary accident induced leakage rate for any design basis accident, other than a SG tube rupture, shall not exceed the leakage rate assumed in the accident analysis in terms of total leakage rate for all SGs and leakage rate for an individual SG. Leakage is not to exceed 0.25 gpm in an individual SG, for a total leakage rate of 1 gpm for all SGs.

5.5 Programs and Manuals

5.5.7 Steam Generator (SG) Program (continued)

3. The operational LEAKAGE performance criterion is specified in LCO 3.4.13, "RCS Operational LEAKAGE."

c. Provisions for SG tube plugging criteria. Tubes found by inservice inspection to contain flaws with a depth equal to or exceeding 40% of the nominal tube wall thickness shall be plugged.

d. Provisions for SG tube inspections. Periodic SG tube inspections shall be performed. The number and portions of the tubes inspected and methods of inspection shall be performed with the objective of detecting flaws of any type (e.g., volumetric flaws, axial and circumferential cracks) that may be present along the length of the tube, from the tube-to-tubesheet weld at the tube inlet to the tube-to-tubesheet weld at the tube outlet, and that may satisfy the applicable tube plugging criteria. The tube-to-tubesheet weld is not part of the tube. In addition to meeting the requirements of d.1, d.2, and d.3 below, the inspection scope, inspection methods, and inspection intervals shall be such as to ensure that SG tube integrity is maintained until the next SG inspection. A degradation assessment shall be performed to determine the type and location of flaws to which the tubes may be susceptible and, based on this assessment, to determine which inspection methods need to be employed and at what locations.

1. Inspect 100% of the tubes in each SG during the first refueling outage following SG installation.

2. After the first refueling outage following SG installation, inspect each SG at least every 72 effective full power months or at least every third refueling outage (whichever results in more frequent inspections), *except for a one-time extension for the Unit 2 Cycle 26 inspection to be deferred to be performed during the Cycle 27 refueling outage in Fall 2022 and will be performed thereafter at the frequency specified above*. In addition, the minimum number of tubes inspected at each scheduled inspection shall be the number of tubes in all SGs divided by the number of SG inspection outages scheduled in each inspection period as defined in a, b, c and d below. If a degradation assessment indicates the potential for a type of degradation to occur at a location not previously inspected with a technique capable of detecting this type of degradation at this location and that may satisfy the applicable tube plugging criteria, the minimum number of locations inspected with such a capable inspection technique during the remainder of the inspection period may be prorated. The fraction of locations to be inspected for this potential type of degradation at this location at the end of the inspection period shall be no less than the ratio of the number of times the SG is scheduled to be inspected in the inspection period after the determination that a new form of degradation could potentially be occurring at this location divided by the total number of times the SG is

scheduled to be inspected in the inspection period. Each inspection period defined below may be extended up to 3 effective full power months to include a SG inspection outage in an inspection period and

5.5.7 Steam Generator (SG) Program (continued)

the subsequent inspection period begins at the conclusion of the included SG inspection outage.

a) After the first refueling outage following SG installation, inspect 100% of the tubes during the next 144 effective full power months. This constitutes the first inspection period;

b) During the next 120 effective full power months, inspect 100% of the tubes. This constitutes the second inspection period;

c) During the next 96 effective full power months, inspect 100% of the tubes. This constitutes the third inspection period; and

d) During the remaining life of the SGs, inspect 100% of the tubes every 72 effective full power months. This constitutes the fourth and subsequent inspection periods.

3. If crack indications are found in any SG tube, then the next inspection for each affected and potentially affected SG for the degradation mechanism that caused the crack indication shall not exceed 24 effective full power months or one refueling outage (whichever results in more frequent inspections). If definitive information, such as from examination of a pulled tube, diagnostic non-destructive testing, or engineering evaluation indicates that a crack-like indication is not associated with a crack(s), then the indication need not be treated as a crack.

e. Provisions for monitoring operational primary to secondary LEAKAGE.

Enclosure 4 to AEP-NRC-2020-78

DC Cook Unit-2 SG Operational Assessment to Support Deferral of Planned Inspections at U2C26 (Spring 2021) and U2C27 (Fall 2022) framatome

20004-026 (08/12/2020)

Framatome Inc.

Engineering Information Record

Document No.: 51 - 9318053 - 000

DC Cook Unit-2 SG Operational Assessment to Support Deferral of Planned Inspections at U2C26 (Spring 2021) and U2C27 (Fall 2022)

framatome

20004-026 (08/12/2020)
Document No : 51-9318053-000

DC Cook Unit-2 SG Operational Assessment to Support Deferral of Planned Inspections at U2C26 (Spring 2021) and U2C27 (Fall 2022)

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, M, A-CRF, A	Date	Pages/Sections Prepared/Reviewed/ Approved or Comments
Chuck Martin Advisory Engineer	*CE MARTIN 11/30/2020*	LP		All
Kent Colgan Advisory Engineer	*KA COLGAN 11/30/2020*	LR		All
Wayne Belden Technical Manager	*WD BELDEN 11/30/2020*	A		All

Note: P/LP designates Preparer (P), Lead Preparer (LP)
M designates Mentor (M)
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
Jeff Ross	Project Manager	*JL ROSS 12/1/2020*	

Record of Revision

Revision No.	Pages/Sections/ Paragraphs Changed	Brief Description / Change Authorization
000	All	Original Issue

Table of Contents

Table of Contents
(continued)

Page

List of Tables

List of Figures

1.0 INTRODUCTION

1.1 Purpose

This report provides an operational assessment (OA) of the DC Cook Unit-2 Steam Generators (SGs). The purpose is to demonstrate that, due to COVID-19 concerns, the primary and secondary side examinations planned for the U2C26 (EOC25) refueling outage (spring 2021) may be safely deferred by one additional operating cycle to the U2C27 (EOC26) refueling outage (fall 2022). Additionally, this OA also evaluates the potential to skip the SG primary and secondary side inspections at the U2C27 refueling outage (until the next refueling outage at U2C28 (EOC27)) in the event that DC Cook Unit-2 is approved for the Tech Spec extension per proposed TSTF-577.

1.2 Scope

The OA is prepared in accordance with the requirements of NEI 97-06 [1] and the EPRI Steam Generator Integrity Assessment Guidelines [2.a]. The OA is a "forward-looking" assessment using eddy current and visual examination results together with in-outage repairs (e.g., tube plugging) to provide reasonable assurance that the steam generator tubing will meet the technical specification performance criteria until the next scheduled SG inspection.

1.3 Methodology

The methodology used in this document is consistent with the OA performed at the last SG inspection during U2C23 [4.b]. This OA also incorporates the following technical information (from Reference [3] documents) as requested by the NRC specifically for SG inspection deferral requests regarding COVID-19 concerns:

1. Recent operational experience including (Section [4.0])
    a. Primary-to-secondary leakage
    b. Summary of primary and secondary inspections
    c. Summary of degradation detected and inspection findings
    d. Summary of tube plugging
    e. Relevant operating experience that could impact tube integrity
2. Previous inspection condition monitoring (Section [4.3])
    a. Most limiting as-found condition compared to tube performance criteria
3. Operational assessment for additional operating cycle (Section [5.0])
    a. Degradation mechanisms considered
    b. Inspection strategy for each mechanism at prior inspection
    c. Predicted margin to tube integrity performance criteria

2.0 ASSUMPTIONS

There are no assumptions requiring verification used in this document. All other assumptions used for determining appropriate structural limits or as inputs into the OA evaluations are discussed and justified in the applicable sections.

3.0 BACKGROUND

3.1 SG Design [4.a]

The original DC Cook Unit-2, Westinghouse model 51 steam generators, manufactured using Alloy 600 mill-annealed tubing, were replaced with Westinghouse model 54F steam generators in 1989 due to accelerated tube degradation. The replacement was a "two-piece" replacement where new lower assemblies were coupled with a refurbished original steam dome shell and a new moisture separator package. Each of the four replacement steam generators contain 3592 thermally treated (TT) Alloy 690 tubes with an outside diameter of 0.875 inches and a nominal wall thickness of 0.050 inches. The tubes were manufactured by Sandvik of Sweden and arranged in a square pitch design (1.225 inch pitch) consisting of 47 rows and 98 columns. All tubes in the eight innermost rows were thermally stress relieved after bending. In addition, the bundle U-bend area has an increased tube bend radius i.e., row 1 bend radius is equal to 3.14" vs. 2.19" radius in the original steam generators, which further reduces the residual stress in the U-bend. The U-bend radius for the outermost tube row (row 47) is 59.491 inches.

The vertical part of the tube bundle is supported by seven 1.12 inch thick support plates (TSPs) manufactured with quatrefoil holes. The U-bend region is supported by three sets of anti-vibration bars (AVBs) measuring 0.69 by 0.345 inches. The lower (AV1 and AV6), middle (AV2 and AV5) and upper (AV3 and AV4) set of AVBs are inserted down to, and including, tube rows 8, 14 and 25 respectively. A flow distribution baffle (FDB) (containing a center cutout) is located approximately midway between the top of tubesheet and the first TSP. The FDB is 0.75 inches thick and manufactured with octafoil holes. All of the support plates, anti-vibration bars, and the flow distribution baffle are made of 405-stainless steel.

All internal surfaces of the channel head bowl are clad with austenitic stainless steel, except across the junction of the channel head to tube plate girth weld which is clad with Inconel. The replacement SG tube sheet is a nominal 21 inches thick plate made of ASME SA-508 Class 2a low alloy steel forging material with Inconel cladding on the primary side. With the exception of nine tubes that were not fully expanded due to manufacturing oversight, all the remaining tubes are hydraulically expanded into the tube sheet holes.

Due to the favorable inspection results, minimal plugging has been performed to date. No other repair techniques (sleeving) or alternate repair criteria have been necessary to manage degradation on the Cook Unit 2 steam generators.

The lower (replacement) bundle was constructed to ASME III Class A – 1983 Edition through Summer 1984 Addenda, while the refurbished original steam dome was constructed to ASME III Class A – 1968 Edition through 1968 Winter Addenda, Code Cases 1401 and 1498.

The DC Cook Unit 2 SG design parameters are summarized in Table 3-1. The tubing material properties are based on the ASME Code minimum tube properties at 650 °F and summarized in Table 3-2. Since the material properties are ASME Code minimum properties, there is no associated standard deviation.

Table 3-1: Summary of Cook-2 SG Design Parameters

SG Feature	Dimension
Tube Material	690-TT
# Tubes	3592
Tube OD (in)	0 875
Tube Wall (in)	0 050
# Rows	47
# Columns	98
Tube Pitch (in)	1 225
Min U-bend radius (in)	3.14
Max U-bend radius (in)	59.491
AVB Material	405-SS
Sets of AVBs	3
AVB (L x W) (in)	0.69 x 0 345
TSP Material	405-SS
# TSPs	7
TSP Thickness (in)	1.12
Pitch	Square
TSP hole design	Quatrefoil
Tubesheet Material	SA-508
Tubesheet Thickness (in)	21
Tube expansion method	Full Hydraulic

Table 3-2: Cook-2 SG Tubing Material Properties (ASME Code Minimum)

Material Property	Value at 650 °F
Yield strength, (σ_y), psi	31,500
Ultimate strength, (σ_u), psi	80,000
Yield + ultimate, ($\sigma_y + \sigma_u$), psi	111,500

3.2 Performance Criteria

NEI 97-06 [1] and Cook Unit 2 Technical Specification TS 5.5.7 [6.a] establish these steam generator performance criteria:

- Structural Integrity Performance Criteria (SIPC) – Margin of 3.0 against burst under normal steady state power operation and a margin of 1.4 against burst under the most limiting design basis accident. Additional requirements are specified for non-pressure accident loads.

- Operational Leakage – RCS operational primary-to-secondary leakage through one steam generator shall not exceed 150 gallons per day (gpd).
- Accident Induced Leakage Performance Criteria (AILPC) – Leakage shall not exceed 0.25 gallons per minute (gpm) in an individual SG, for a total leakage rate of 1.0 gpm for all SGs.

3.3 Technical Specification Trending

DC Cook Unit-2 has adopted TSTF-510 for governance of SG inspection frequencies and tube sample selection. TSTF-510 requires that 100% of the tubing be inspected during the first in-service inspection (ISI) and that 100% be examined during the first 144 EFPM following the first in-service inspection. Subsequent inspections are 100% at the end of the next 120 EFPM, 96 EFPM, and 72 EFPM thereafter. No SG shall go longer than 72 EFPM or three refueling outages (whichever is less) without inspection.

The Cook Unit 2 SGs completed the last full cycle of operation (in the 2nd inspection interval of 120 EFPM) at the U2C25 outage. The SGs will be entering the third inspection interval consisting of 96 EFPM. The cycle lengths presented in Table 3-3 for EOC25 and onward (of 1.5 EFPY) represent conservative bounding cycle lengths [6.b].

Table 3-3: Cook-2 Tech Spec Trending Since SG Replacement

Date	EOC/ Outage	SG EFPY	Cumulative SG EFPY	Cumulative SG EFPM[1]	Inspection Interval	Insp. Interval Cumulative EFPM[1]	Notes
Dec 88-Mar 89	6/U2C7	0	0	0	N/A	N/A	Replacement
June 1990	7/U2C8	1.113	1.113	13.36	N/A (1st ISI)	0	Inspection
February 1992	8/U2C9	1.112	2.225	26.70	First Inspection Interval (after 1st ISI) of 144 EFPM duration	13.34	Inspection
September 1994	9/U2C10	1.221	3.446	41.35		28.00	Inspection
March 1996	10/U2C11	1.168	4.614	55.37		42.01	Skip
September 1997	11/U2C12	1.254	5.868	70.42		57.06	Inspection
January 2002	12/U2C13	1.404	7.272	87.26		73.91	Inspection
April 2003	13/U2C14	1.042	8.314	99.77		86.41	Skip
October 2004	14/U2C15	1.182	9.496	113.95		100.60	Inspection
March 2006	15/U2C16	1.319	10.815	129.78		116.42	Skip
September 2007	16/U2C17	1.348	12.163	145.96		132.60	Inspection
March 2009	17/U2C18	1.352	13.515	162.18	Second Inspection Interval of 120 EFPM	4.82[2]	Skip
October 2010	18/U2C19	1.372	14.887	178.64		21.29	Skip
March 2012	19/U2C20	1.282	16.169	194.03		36.67	Inspection
October 2013	20/U2C21	1.403	17.572	210.83		53.51	Skip
April 2015	21/U2C22	1.316	18.888	226.66		69.30	Skip
October 2016	22/U2C23	1.402	20.290	243.48		86.12	Inspection
March 2018	23/U2C24	1.145	21.435	257.22		99.86	Skip
October 2019	24/U2C25	1.364	22.799	273.59		116.23	Skip
Spring 2021[3]	25/U2C26	1.5	24.299	291.59	Third Inspection Interval of 96 EFPM	14.23[4]	Potential Deferral
Fall 2022[3]	26/U2C27	1.5	25.799	309.59		32.23	Potential Skip
Spring 2024[3]	27/U2C28	1.5	27.299	327.59		50.23	Inspection

Note 1: The first inspection interval, which is the initial Technical Specification inspection interval, begins after the 1st ISI. The total cumulative EFPM is the total EFPM since steam generator replacement.

Note 2: 11.4 EFPM (144 – 132.60) remains within the 1st interval leaving 4.82 EFPM (162.18 – 145.96 – 11.4 = 4.82) for carryover to the 2nd interval.

Note 3: Used bounding 1.5 EFPY for EOC25, EOC26, and EOC27.

Note 4: 3.77 EFPM (120 – 116.23) remains within the 2nd interval leaving 14.23 EFPM (291.59 – 273.59 – 3.77 = 14.23) for carryover to the 3rd interval.

3.4 SG Performance

A review of the steam generator secondary side pressure trending was performed on plant data to determine the appropriate normal operating pressure differential (NOPD) to be used when performing this operational assessment. Figure 3-1 shows the secondary side pressure trending over cycles 23, 24, and partial cycle 25 (until August 12, 2020) and provides the basis for concluding that the NOPD value used in this analysis (1600 psi) will remain conservative throughout proposed deferral period.

3.5 Structural Integrity Limits

Per the EPRI Integrity Assessment Guidelines (IAG) [2.a], the limiting structural integrity performance criterion (SIPC) is the greater of: "3ΔP" defined as 3 times the normal-operating-primary-to-secondary pressure differential (NOPD), or "1.4*LAPD" defined as 1.4 times the limiting accident primary-to-secondary differential pressure differential, or "1.2*Combined Loads" defined as 1.2 times the combined LAPD plus the effects of non-pressure loads (external loads).

When considering a primary side pressure of 2235 psig and the minimum secondary side pressure of 792 psig (Figure 3-1, SG22 on 7/29/2019) over the operating period since the last ISI at 2016 results in a maximum 3ΔP of 4329.

The maximum primary-to-secondary differential pressure during faulted conditions (i.e., MSLB) is 2560 psig based on the lift tolerance of the primary safety valves. Use of the 1.4 factor of safety leads a 1.4*LADP of 3584 psid.

When considering both pressure and non-pressure loading, per Section 3.7.2 of the EPRI SG Integrity Assessment Guidelines, axial degradation located anywhere in the SG tube bundle is not affected by non-pressure loads. Circumferentially orientated degradation (circumferential cracks or volumetric degradation that has a circumferential component (e.g., wear scars)) must however consider the impact of non-pressure loads (external loads). The screening criteria provided in Section 3.7.2 shows that degradation with a circumferential component that meets any of the following three criteria will NOT be affected by non-pressure loads:

1. Located in straight sections below the top TSP and < 270° in circumferential extent, or
2. Located at the flanks of the U-bends (includes flat bar wear), or
3. Has a Percent Degraded Area (PDA) of less than 25%

In the event of degradation not satisfying these criteria, an evaluation of external loads (in addition to pressure loading) is required. The limiting structural integrity parameter for the DC Cook Unit-2 steam generators is defined in Framatome document "DC Cook Units 1 and 2 Limiting Structural Integrity Performance Criteria" [5.a]. This document identifies that the DC Cook Unit-2 SGs have a bounding value for the outer fiber bending stress of 32400 psi. This stress level equates to a burst pressure reduction of 1232 psi in the most limiting u-bend location. Similarly, the bounding axial primary membrane stress associated with seismic loading is 300 psi and equates to a burst pressure reduction of 72.7 psi. Per the EPRI Flaw Handbook [2.d], the limiting accident pressure load/non-pressure load combination can be expressed in terms of a single differential pressure consisting of the worst case accident pressure differential of 2560 psi (SLB), a maximum bending stress burst pressure reduction of 1232 psi, and a maximum seismic axial stress burst pressure reduction of 72.7 psi. Applying the required safety factor of 1.2 leads to a degraded tube burst pressure of 4638 psi, 1.2*(2560 + 1232 + 72.7) = 4638 psi.

In summary, the Cook Unit 2 loadings for tube integrity evaluations can be categorized as follows:

- NOPD Loading:
    - NOPD = 1443 psid (Bounding of Cook 2 SGs per Section 3.4)
    - 3ΔP: 3×1443 = 4329 psid
- Faulted Condition Loading:
    - 1.4×2560 = 3584 psid
- Combined LADP plus non-pressure loads
    - 1.2*(2560 + 1232 + 72.7) = 4638 psid

For operational assessment tube integrity evaluations, Cook Unit-2 has elected to use the design NOPD of 1600 psi leading to 3ΔP value of 4800 psid. Use of the 4800 psid bounds each of the above loadings and is therefore considered the Cook Unit-2 limiting SIPC.

The high probability (Framatome term) structural limits used in this document consider material and relational uncertainties (i.e. no technique sizing uncertainty) and have been determined using the Framatome Mathcad Implementation of Flaw Handbook Equations Calculator [5.d]. The Cook Unit-2 degradation (AVB wear, TSP wear, volumetric indications) have been conservatively modeled as having a finite length over the full 360° tube circumference at a uniform depth. This model is commonly referred to as the finite length uniform thinning model from Section 5.3.2 of the EPRI Flaw Handbook [2.d]. Note that the combined use of the 4800 3ΔP and the uniform thinning model provides significant conservatism in evaluation of the Cook-2 degradation mechanisms.

- Use of the 3ΔP pressure differential (4800 psid) together with the Table 3-2 tube material properties yield the high probability structural limits summarized in Table 3-4.

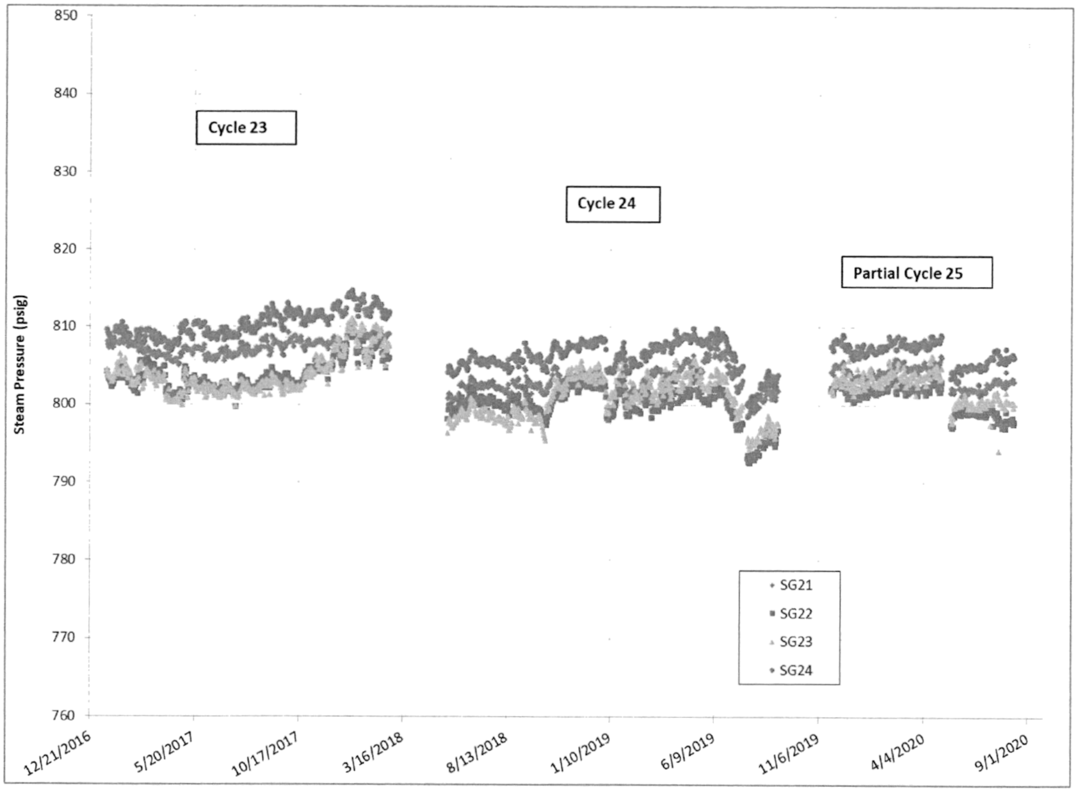
Table 3-4: Cook-2 High Probability Structural Limits

Degradation	Length (In)	Depth (%TW)
AVB Wear	1.6[1]	41 7
TSP / Foreign Object Wear / VOL Indications	1.2[2]	43.2

Notes:

1. This length bounds the limiting AVB to tube geometries.
2 The 1.2 inch length bounds the axial length of TSP supports (1.125 inches), the two VOLs in SG22, and assumed bounding for axial length of potential foreign object wear.

Figure 3-1: Cook-2 SG Steam Pressures Since BOC23



3.6 Degradation Mechanisms

The degradation mechanisms targeted by the most recent inspections at U2C23 (October 2016) are governed by the following general classifications of tube degradation and are summarized in Table 3-5 which identifies the inspection method and scope used for detection.

- **Existing** – Degradation which has been previously observed in the Cook Unit-2 SGs
- **Potential** – Degradation which has not been observed in the Cook Unit-2 SGs but is determined to have reasonable potential to occur in the near term based on engineering evaluations, predictive studies, or operating experience of similar steam generators in the industry population.

Note that per IAG [2.a] an OA is only required to evaluate existing degradation mechanisms, with other degradation mechanisms addressed per the degradation assessment (DA); however, the OA in this document will evaluate all existing and potential degradation mechanisms.

Table 3-5: Cook-2 Degradation Mechanisms

Type	Mechanism	Detection Strategy (Note 1)
Existing	AVB Wear	• 100% F/L Bobbin probe examinations
	TSP Wear	• 100% F/L Bobbin probe examinations
	VOLS	• 100% F/L Bobbin probe examinations
Potential	Foreign Object Wear (Note 2)	• 100% F/L Bobbin probe examinations • SG21, 22, and 23: +Point™ TTS examination of two-tube band of periphery/no-tube lane tubes (H/L and C/L) inboard of outer most tube • SG22: 100% (H/L and C/L) Array probe (from 1st TSP to Tube-end)

Note 1: 100% bobbin was performed on all tubes except the U-bends in rows 1 and 2 which were examined using +Point™

Note 2: The first row of the no-tube lane (NTL) and the outermost tubes in each column were excluded from the +Point™ examination except for tubes affected by a foreign object found during SSI or tubes with possible loose part (PLP) indications SSI served as the primary examination for foreign objects on the outer periphery tubes. Additionally, even though foreign object wear has been detected in the Cook Unit-2 SGs, it is classified as potential as the foreign object causing the wear typically is either removed from the SG or the tube(s) exhibiting wear is plugged.

4.0 RECENT OPERATIONAL EXPERIENCE

4.1 Primary-to-Secondary Leakage

Since the SGs were replaced in 1989, Cook Unit-2 had operated without any measured primary-to-secondary leakage up until August 12, 2016 at which time elevated activity was detected by a steam jet air ejector monitor. The leakage ranged from 0.04 to 0.08 gallons-per-day (gpd) and was determined, by site chemistry, to originate from SG22 [4.a: Section 5.3.5]. The leakage was substantially below the 5 gpd amount defined in Section 9.3 of the EPRI IAG [2.a] that drives the inspection activities to be undertaken at the next scheduled inspection outage (in this case U2C23 (fall 2016)). Notwithstanding the fact that the leakage was far below the 5 gpd threshold, the plant proactively performed ECT examinations to include 100% bobbin coil examinations and 100% top of tubesheet (TTS) array examinations on both the H/L and C/L of SG22. TTS secondary side visual inspections (SSI) were also performed. Since the ECT and SSI inspections did not reveal the source of the leakage, the plant (after start-up) continued to monitor the primary to secondary leakage in accordance with their technical specifications. Upon unit restart and replacement of two damaged fuel assemblies, the leak became undetectable. Following this event, no measured primary-to-secondary leakage has been detected to date.

4.2 U2C23 SG Workscope

The U2C23 (fall 2016) work scope included primary side ECT inspections, primary side visual inspections, TTS water lancing, and secondary side visual inspections (TTS, underside of FDB, and steam drum) in all four SGs [4.a: Sections 9.1, 8.8, 8.7.2, 9.2].

4.2.1 Primary Side ECT Inspections (All four SGs)

In all four SGs, primary side ECT examinations included 100% full length bobbin probe examinations on all in-service tubes with exception of the row 1 and row 2 U-bends which were completed using the rotating +Point™ probe.

In SG21, SG23, and SG24, the H/L and C/L TTS periphery was examined (using +Point™) for detection of foreign objects/ foreign object wear. Additionally, a sample of the H/L sludge pile region was proactively examined, in these three steam generators, for detection of corrosion related degradation.

In SG22, 100% TTS (both H/L and C/L) array probe examinations were performed to locate a potential leak in that steam generator. The array probe examinations also targeted detection of foreign objects / foreign object wear and corrosion related degradation.

4.2.2 Primary Side Visual Inspections (All four SGs)

- As-found and as-left visual examinations of primary channel heads (both H/L and C/L)
- Nuclear Safety Advisory Letter (NSAL) 12-1 inspections (both H/L and C/L)
- Visual inspections of all plugs

4.2.3 Secondary Side Workscope (All four SGs)

- TTS Water lancing followed by post lance TTS inspections
- Foreign Object Search and Retrieval (FOSAR)
- Visual inspections of steam drums

4.3 U2C23 Degradation Detected and Inspection Results

Per the Cook-2 U2C23 CMOA [4.b: Section 5.0 and Tables 5-4, 5-5, 5-6, 5-7, 5-8, 6-2, 6-3], structural wear was detected at AVB and TSP locations. Additionally, two volumetric indications were detected in SG22. Table 4-1 summarizes the number of tubes/indications for each mechanism. The maximum ECT depth and associated upper 95/50 depth is listed in Table 4-2. Both AVB wear and TSP wear were sized using bobbin ETSS 96004.1 Rev 13. The two VOL indications located in SG22 were sized using +Point™ ETSS 27904.1. The ETSS sizing uncertainty parameters are shown in Table 4-3.

Table 4-1: Cook-2 Summary of Degradation Detected at U2C23

Location	SG21		SG22		SG23		SG24		Total	
	Tubes	Inds.	Tubes	Inds.	Tubes	Inds.	Tubes	Inds.	Tubes	Inds.
AVB	0	0	2	2	1	1	0	0	3	3
TSP	7	10	0	0	41	59	7	10	55	79
VOL	0	0	2	2	0	0	0	0	2	2
Total	7	10	4	4	42	60	7	10	60	84

Table 4-2: Cook-2 Maximum ECT Wear Depths Detected at U2C23

SG	AVB Wear Depth (%TW)		TSP Wear Depth (%TW)		VOL Depth (%TW)	
	Max ECT	Upper 95/50 Estimate[1]	Max ECT	Upper 95/50 Estimate[1]	Max ECT	Upper 95/50 Estimate[1]
21	N/A	N/A	13	23	N/A	N/A
22	11	21	N/A	N/A	39	43
23	15	25	10	20	N/A	N/A
24	N/A	N/A	10	20	N/A	N/A
Note 1: Upper 95/50 ECT depth adjusted using ETSS sizing uncertainty listed in Table 4-3.						

Table 4-3: Cook-2 ECT Sizing Parameters at U2C23

ETSS	Sizing Regression (Actual vs. NDE Depth)	Uncertainty (%TW)
96004.1 Rev13	Depth = 0.98×NDE + 2.89	4.19
27904.1 Rev 2	Depth =0.99×NDE + 1.28	1.61

4.3.1 AVB Wear

During U2C23 AVB wear was detected and sized using bobbin probe ETSS 96004.1, R13. Three AVB wear indications were detected; two in SG22 and one in SG23. The two AVB wear indications located in SG22 were both new at the U2C23 outage. The single AVB wear indication located in SG23 was a repeat indication (originally detected U2C20) and grew from 11%TW to 15%TW, equating to growth rate of 0.97 %TW/EFPY. All of the AVB wear indications were ≤ 20%TW and all were returned to service. All AVB wear met condition monitoring requirements at U2C23 [4.b: Table 5-7 and Figure 6-1].

4.3.2 TSP Wear

During U2C23, TSP wear was detected and sized using bobbin probe ETSS 96004.1, R13. A total of 79 TSP wear indications were detected between SG21, SG23 and SG24. No TSP wear was detected in SG22. Of the 79 indications, 40 were repeat indications and 39 were new indications. All of the TSP wear indications were ≤ 20%TW and all were returned to service. All TSP wear met condition monitoring requirements at U2C23 [4.b: Table 5-6 and Figure 6-2].

4.3.3 VOL Indications

During U2C23 two volumetric indications were detected by the bobbin probe in SG22 in periphery tubes R46-C62 and R47-C57. Both indications were further characterized using the +Point™ and Array probes. Neither of the two VOL locations exceeded the tech spec plugging limit of 40%TW or the condition monitoring limit. The VOL indications did not meet any criteria that would require plugging; nevertheless, both VOL indications were conservatively plugged and stabilized during U2C23 [4.b: Section 5.1.1.8].

4.3.4 Secondary Side

4.3.4.1 TTS

During the DC Cook U2C23 outage, a combined campaign of TTS water lancing, SSI, FOSAR, and ECT was employed to detect and remove foreign objects from the Unit-2 steam generators.

Going into the U2C23 outage, numerous legacy foreign objects and/or PLPs required investigation by ECT and/or SSI. In addition to the legacy items, three new foreign objects (all in SG24) were detected by SSI and subsequently removed by FOSAR during U2C23. All tubes that could be affected by foreign objects and/or PLP locations were examined using the +Point™ probe. All eddy current PLP locations were bounded by additional examinations. Any confirmed PLP location was subsequently investigated by FOSAR, if accessible [4.b: Section 5.1.1.9].

No foreign object wear (near the TTS) was detected in any of the Cook Unit-2 SGs. Two volumetric indications (discussed previously) located just above the 5th TSP in SG22 are believed to have resulted from foreign objects but this could not be conclusively substantiated due to inaccessibility to this location by SSI and the lack of foreign object signals by ECT [4.b: Section 5.1.1.9].

4.3.4.2 Steam Drum

During the DC Cook U2C23 outage, visual inspections were performed in the steam drums of all four SGs. These inspections identified no degradation that would pose a threat to tube integrity [4.b: Table 5-10].

4.4 Tube Plugging

During U2C23 (2016), three tubes were plugged and stabilized, all in SG22. Tubes R46-C62 and R47-C57 were plugged/stabilized due to the two volumetric indications. Tube R8-C3 was originally plugged pre-service while in the shop, using I-600 welded taper plugs. During the U2C23 outage, the two welded taper plugs were removed from the tube ends, and re-plugged/stabilized using AREVA I-690 long rolled plugs. No tubes were plugged for TSP wear or AVB wear at U2C23. To date, as illustrated in Table 4-4, a total of 19 tubes have been removed from service from all SGs since replacement [4.b: Section 5.1.5]. Nine tubes (1994) were plugged due to mechanical damage incurred during pressure pulse cleaning operations. Six tubes (1997 and 2004) were plugged due to foreign object wear. One tube (2012) was plugged due to low row inspection difficulty resulting in an incomplete examination of the tube [4.c: Sections 3.0 and 6.7].

Table 4-4: Cook-2 Repairable Tube Summary at U2C23 (2016)

Outage	SG 21	SG 22	SG 23	SG 24	Total
Pre Service	0	1	0	0	1
1990	0	0	0	0	0
1992	0	0	0	0	0
1994	0	3	6	0	9
1997	1	0	0	4	5
2002	0	0	0	0	0
2004	0	1	0	0	1
2012	0	1	0	0	1
2016	0	2	0	0	2
Total Tubes Plugged	1	8	6	4	19
Total Percentage	0 03%	0 22%	0 17%	0 11%	0.13%

4.5 Industry Operating Experience

This section reviews industry operating experience (OE) since the U2C23 outage that may be relevant to Cook Unit-2 regarding tube integrity.

4.5.1 Foreign Objects Resulting in Tube Wear

In 2017 Salem-1 identified a primary-to-secondary steam generator tube leak in SG13 that stabilized at approximately 7 gpd and decreased to non-detectable levels after approximately 12 days. The low level of leakage allowed the plant to continue operation until the scheduled fall refueling outage. The cause of the leakage was determined to be a volumetric wear indication located below the 3rd TSP on the C/L side. The wear indication was assumed to be caused by a foreign object; however, neither ECT nor SSI visuals were able to identify any PLPs in the area of interest.

In 2020 Salem-1 identified a primary-to-secondary steam generator tube leak in SG14. The plant was safely shut down to perform a full ECT inspection. The source of the leaking tube was identified to be a volumetric wear indication at the H/L flow baffle plate caused by a foreign object that was subsequently removed from the SG.

In both situations all affected tubes were in-situ pressure tested and the tests demonstrated that the performance criteria for structural integrity and accident leakage were not exceeded (i.e., the tube did not burst or leak beyond allowable levels).

Like Salem-1, Cook-2 also has a history of foreign objects entering the SGs. During TTS lancing at U2C23, flexitallic gasket, small wires, potential pieces of weld slag, and other metallic pieces were retrieved from the lancing strainers. Yet in spite of an operating history with loose parts present in the SGs, no loose part wear (LPW) was identified by ECT at U2C23. In fact, the only time LPW (at the TTS) was detected in the Cook-2 SGs was during U2C12 (1997) and U2C15 (2004). Therefore, Cook-2 operated for 12 years without the occurrence of LPW even though PLPs were detected (and metallic loose parts removed from the SGs) during the U2C17, U2C20, and U2C23 outages {[4.d: Section 4.3.3], [4.c: Section 8.2], [4.b: Section 5.1.1.9]}. This indicates that the types of objects historically transported to the tube bundle in combination with the flow characteristics at the TTS have posed no threat to tube integrity.

4.5.2 Upper Steam Drum Degradation

Sizewell B Swirl Vane Separator Barrel

During the 2016 (RFO14) SG inspection, Sizewell B identified a through-wall defect on a swirl vane separator barrel in SGA. The condition was a result of impingement from the J-nozzle feedwater flow onto an auxiliary feedwater pipe support bracket. Sizewell was able to start back up and operate another cycle before repairing the defect in the following outage RFO15 [5.c].

Gravelines 2 Swirl Vane

Inspections performed in the Gravelines 2 SGs (Framatome Model 51M) during their 2019 outage identified erosion on cyclone separators between the propellers and the barrel inner diameter. Gravelines 2 was able to start back up with plans to repair the cyclones in 2021.

Cook Unit-2 has inspected the steam drums in each of the four SGs (most recently during U2C23, fall 2016) and has identified no indications of degradation on any components.

4.5.3 Top-of-Tubesheet Denting

In SG inspections at Ginna (OE33123), Spanish plants Asco 1 and 2 and Almaraz 1 and 2, Slovenian plant Krsko, and German plant Neckarwestheim 2; denting was identified at the TTS in the hard sludge pile region. In the case of Almaraz 1 and 2, Asco 1, and Neckarwestheim 2 which have tubes made of Incoloy 800 modified material, circumferential ODSCC was subsequently identified in a population of dented tubes. The denting is thought to have been caused by tubesheet steel corrosion and expansion of the resulting corrosion products.

For Cook-2, only minor denting (dent/ding) at the TTS has been detected. In those SGs with denting near the TTS, the dents are located near the periphery away from the typical kidney region associated with sludge build-up. Additionally, Cook-2 typically performs TTS lancing to potentially mitigate any aggressive buildup of sludge deposits. Cook-2 also has Alloy 690 tube material which has demonstrated no susceptibility to SCC in the field.

4.5.4 Tie Rod Bowing in Once-Through SGs (SGMP-20-04)

During the David Besse SG inspections in their spring 2020 outage long absolute drift indications were identified by bobbin coil probe and were confirmed by array probe to be indications of tube-to-tube and tube-to-tie rod proximity. No tube wear was associated with these proximity indications, and all tube-to-tube proximity is confirmed to have been a result of tie rods bowing. Similar indications had been identified in the Arkansas Nuclear One Unit-1 (ANO-1) SGs. Both Davis Besse and ANO-1 have once-through steam generator (OTSG) designs, the only SG design in which tie rod bowing has been identified.

To date, no known proximity signals (due to tie rod bowing) have been detected in any recirculating SG (RSG) design. Since Cook-2 is of the RSG design it is not anticipated that tie rod bowing will be an issue going forward.

5.0 OPERATIONAL ASSESSMENT

The following sections summarize the operational assessment (OA) performed in support of the effort to defer the U2C26 (spring 2021) SG examinations to U2C27 (fall 2022) due to COVID-19 concerns. Additionally, this OA also evaluates the potential to skip the SG primary and secondary side inspections at the U2C27 refueling outage (until the next refueling outage at U2C28, spring 2024) in the event that DC Cook Unit-2 is approved for the technical specification extension per proposed TSTF-577.

Per the IAG guidelines [2.a] the OA is only required to evaluate existing degradation mechanisms, while potential degradation mechanisms are addressed within the degradation assessment (DA). However, the OA in this document evaluates all existing and potential degradation mechanisms identified in Table 3-5.

The existing degradation mechanisms are AVB wear, TSP wear, and two volumetric indications (resembling foreign object wear). This OA will use existing degradation growth rates to project forward the EOC depths at U2C27 and again at U2C28 for comparison to the EOC high probability structural depth. Growth rate is typically evaluated by comparison of previous depth measurements to current depth measurements for the same indications. Total growth is determined by using a bounding 1.5 EFPY cycle length over four cycles until U2C27 and again over five cycles until U2C28. During the most recent Cook-2 examination at U2C23 there were 40 indications of repeat TSP wear and 39 indications of new TSP wear. There was also one indication of repeat AVB wear and two indications of new AVB wear. In SG22, two volumetric indications (VOLs) were also detected resembling foreign object wear [4.b: Section 5.0].

5.1 AVB Wear

5.1.1 Existing AVB Wear

Due to the very small population of AVB wear in the Cook-2 SGs (Table 5-1) the arithmetic OA approach, described in the IAG [2.a], is used for evaluation of AVB wear. This approach involves adjusting the deepest return to service (RTS) indication to account for ECT uncertainties, applies a 95th percentile growth rate, and compares the EOC flaw depth to the EOC high probability structural depth. The parameters used in this OA approach are shown in Table 5-2. For the OA projection, a growth rate of 0.97%/EFPY (maximum AVB wear growth rate at U2C23) was used since an insufficient population of AVB wear indications exist in the Cook-2 SGs to render a statistical upper 95th value. As the evaluation in Table 5-2 illustrates, reasonable assurance is provided that tube integrity will be maintained for existing AVB wear in the Cook-2 SGs over the bounding 7.5 EFPY operating period (BOC23 (fall 2016) to EOC27 (spring 2024)). These projections are conservative since the deepest wear indication is projected to continue wearing at the same %TW rate until reaching its EOC depth when in fact, a vast body of industry experience demonstrates that repeat wear growth rates decrease with time. One reason for this is that when conservatively assuming a constant work rate and metal volume loss over time, the resulting %TW penetration rate decreases with time (i.e., a given change in metal volume results in a smaller change in %TW depth penetration as the flaw becomes deeper).

Table 5-1: Cook-2 AVB Wear Indications at U2C23, [4.b: Table 5-7]

SG	Tube Row-Col	Elevation TSP+/- inch	C20 %TW BOB	C23 %TW BOB	Growth %TW / EFPY	Status
SG22	45-49	AV4+0.32	NDD	8	New at U2C23	Returned to Service
SG22	46-46	AV4+0 27	NDD	11	New at U2C23	Returned to Service
SG23	47-50	AV3-0 32	11	15	0.97	Returned to Service

Table 5-2: Arithmetic OA Calculation for AVB Wear

Parameter	Calculation	Value
Determine max return to service NDE depth	Obtained from ECT data	15 %TW
Adjust NDE depth for ECT regression (96004.1 Rev 13)	0.98 * 15%TW + 2.89%TW	17.6 %TW
Calculate NDE upper 95th sizing uncertainty	1.645 * 4.19 %TW	6.9 %TW
Add the upper 95th sizing uncertainty to the adjusted NDE depth	17.6 %TW + 6.9 %TW	24.5 %TW
Determine upper bound growth rate. (Actually max growth rate)	(15 %TW – 11 %TW) / 4.121 EFPY	0.97 %TW/EFPY
Calculate projected EOC max depth at U2C27	24.5 %TW + 6.0 EFPY * 0.97 %TW/EFPY	30.3 %TW
Compare EOC max depth at U2C27 to EOC high probability limit (Table 3-5)	30.3 %TW < 41.7 %TW	Acceptable
Calculate projected EOC max depth at U2C28	24.5 %TW + 7.5 EFPY * 0.97 %TW/EFPY	31.8 %TW
Compare EOC max depth at U2C28 to EOC high probability limit (Table 3-5)	31.8 %TW < 41.7 %TW	Acceptable

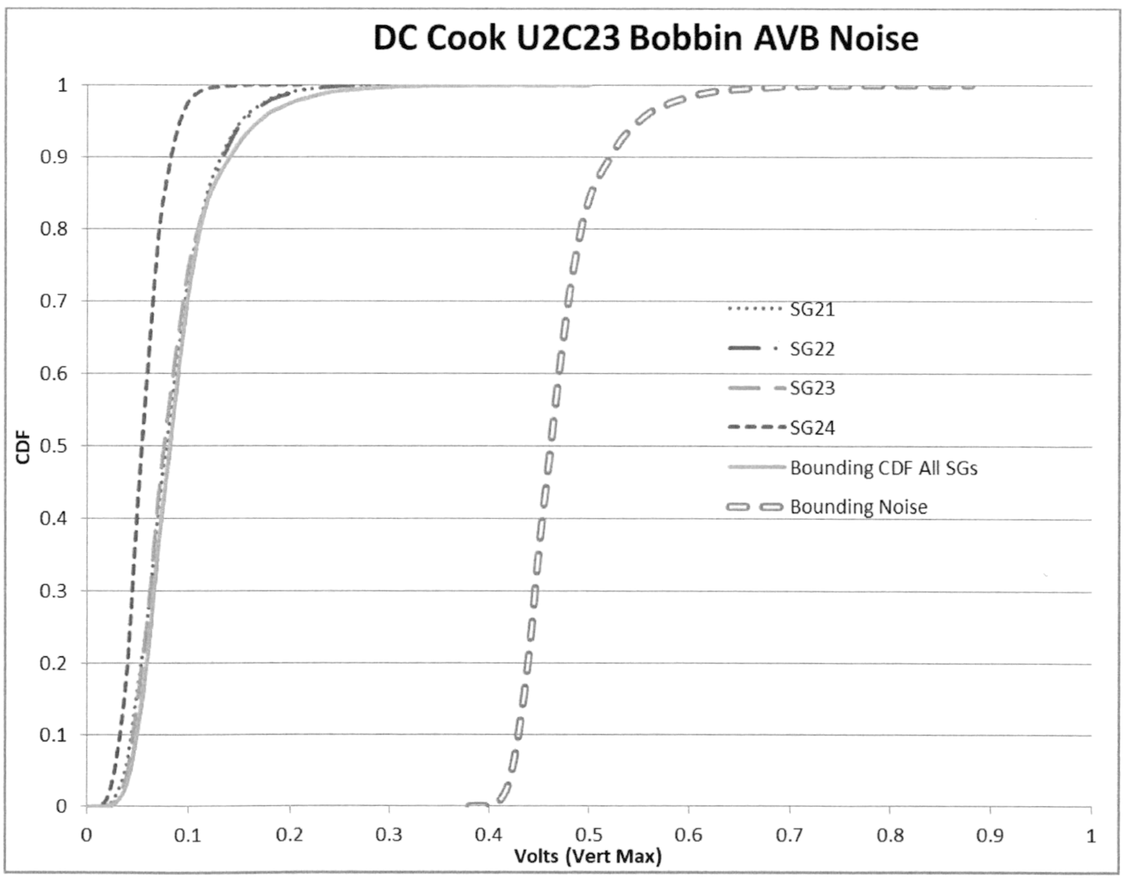
5.1.2 Undetected AVB Wear

The possibility of undetected AVB wear flaws must also be considered. A review of ETSS 96004.1 (from EPRIQ.com) reveals that during the technique qualification, all wear flaws in the qualification data set, with depths ranging from 4 to 90% TW, were detected. Based on this data, it is unlikely that flaws sized greater than those detected during U2C23 (i.e., 15 %TW for AVB wear) remain undetected in the SG due to technique POD.

No tubes were plugged due to AVB wear during U2C23. The largest detected AVB wear flaw (15%) was therefore analyzed in the assessment above and justified to remain in service. If the largest undetected flaw is the same size as the largest detected flaw, the same assessment is valid. During U2C23, 100% of the in-service tubes in contact with AVBs were examined full length with the bobbin coil. Therefore, it is unlikely that any meaningful AVB wear remains undetected in any of the DC Cook Unit-2 tubes. On this basis, the assessment of detected AVB wear is considered to be bounding for any undetected AVB wear.

To quantify the probability of detection (POD) for AVB wear, SG noise cumulative distribution functions (CDFs) were developed using the U2C23 bobbin data. Use of these CDFs also allowed the bounding CDF for all SGs to be determined. These distributions are illustrated on the left-hand side of Figure 5-1. The bounding noise distribution that coincides with a 95% POD for a 35%TW "must detect" depth was determined using the EPRI MAPOD (model assisted probability of detection) software [2.f]. The must detect depth of 35%TW was determined by subtracting the projected AVB wear growth (0.97 %TW/EFPY *7.5 EFPY) from the EOC high probability limit (41.7 %TW). This bounding noise distribution is illustrated in Figure 5-1. As the figure illustrates, ample margin exists between the bounding CDF for all SGs and the bounding noise distribution, thus providing reasonable assurance that growth of potentially undetected AVB wear over the 7.5 EFPY operating period will not lead to a compromise in steam generator tube integrity.

Figure 5-1: Comparison of AVB Noise to its Bounding Noise Distribution



5.1.3 New AVB Wear Indications

As shown in Table 5-1, only three AVB wear indications have been detected in the Cook Unit-2 replacement SGs. The first detection was during the U2C20 (2012) outage where AVB wear was detected in a single tube located in SG23 with a depth of 11%TW [4.a: Section 6.11.1]. The next detection of AVB wear was during the U2C23 (2016) outage where two new AVB wear indications were detected, both in SG22.

It is reasonable to expect new AVB wear indications to continue to occur in the Cook-2 SGs. Based on the history of the Cook-2 AVB wear indications it is expected that the behavior of any new AVB wear will be bounded by the behavior of the existing wear flaws. The depth of any new wear is not expected to exceed the depth of existing flaws; thus, the evaluation of existing wear above is bounding. There is reasonable assurance that the SIPC will remain satisfied throughout the 7.5 EFPY operating period.

5.2 TSP Wear

5.2.1 Existing TSP Wear

DC Cook-2 TSP wear is characterized by a moderate number of wear indications exhibiting low growth rates. TSP wear was first detected in the Cook-2 steam generators during U2C12 (1997) with the deepest indication being 11%TW [4.c: Section 9.2.2]. During U2C13 (2002) and U2C15 (2004) the deepest TSP indications measured 9%TW and 13%TW respectively [4.d: Table 4-1]. During U2C17 (2007), the deepest TSP wear indication measured 12%TW [4.e: Table 9-1]. During U2C20 (2012), the deepest TSP wear indication measured 14%TW [4.c: Table 9-2]. The depth of the deepest return to service TSP wear indication at the most recent inspection (U2C23) was 13%TW [4.b: Table 7-1]. During U2C23 no tubes were plugged because of TSP wear [4.b: Section 5.1.5]. The maximum growth rate (repeat indications) observed over the past three inspections has been 1.11 %TW/EFPY at U2C17 [4.e: Table 9-1], 0.5 %TW/EFPY at U2C20 [4.c: Section 9.2.1], and 0.73 %TW/EFPY at U2C23 [4.b: Section 7.1.1]. For the TSP wear OA projection that follows, the maximum TSP wear growth rate (over the past three inspections) of 1.11 %TW/EFPY will be used.

TSP wear when evaluated using the arithmetic OA approach described in the IAG [2.a] involves adjusting the deepest return to service (RTS) flaw to account for the eddy current uncertainties, applies a 95th percentile growth rate (max growth rate actually applied), and compares the EOC depth to the EOC high probability limit. This OA approach is presented in Table 5-3.

As the evaluation in Table 5-3 illustrates, reasonable assurance is provided that tube integrity will be maintained for existing TSP wear indications in the Cook-2 SGs over the bounding 7.5 EFPY operating period. These projections are conservative since the deepest wear indication is projected to continue advancing at the same %TW rate until reaching its EOC depth. As discussed earlier, broad industry experience demonstrates that wear rates decrease with time.

Table 5-3: Arithmetic OA Calculation for TSP Wear

Parameter	Calculation	Value
Determine max return to service NDE depth	Obtained from ECT data	13 %TW
Adjust NDE depth for ECT regression (96004.1 Rev 13)	0.98 * 13%TW + 2.89%TW	15.6 %TW
Calculate NDE upper 95th sizing uncertainty	1.645 * 4.19 %TW	6.9 %TW
Add the upper 95th sizing uncertainty to the adjusted NDE depth	15.6 %TW + 6.9 %TW	22.5 %TW
Determine upper 95th growth rate	3 %TW / 2.7 EFPY (U2C17 Growth Rate)	1.11 %TW/EFPY
Calculate projected EOC max depth at U2C27	22.5 %TW + 6.0 EFPY * 1.11 %TW/EFPY	29.2 %TW
Compare EOC max depth at U2C27 to EOC high probability limit (Table 3-5)	29.2 %TW < 43.2 %TW	Acceptable
Calculate projected EOC max depth at U2C28	22.5 %TW + 7.5 EFPY * 1.11 %TW/EFPY	30.8 %TW
Compare EOC max depth at U2C28 to EOC high probability limit (Table 3-5)	30.8 %TW < 43.2 %TW	Acceptable

5.2.2 Undetected TSP Wear

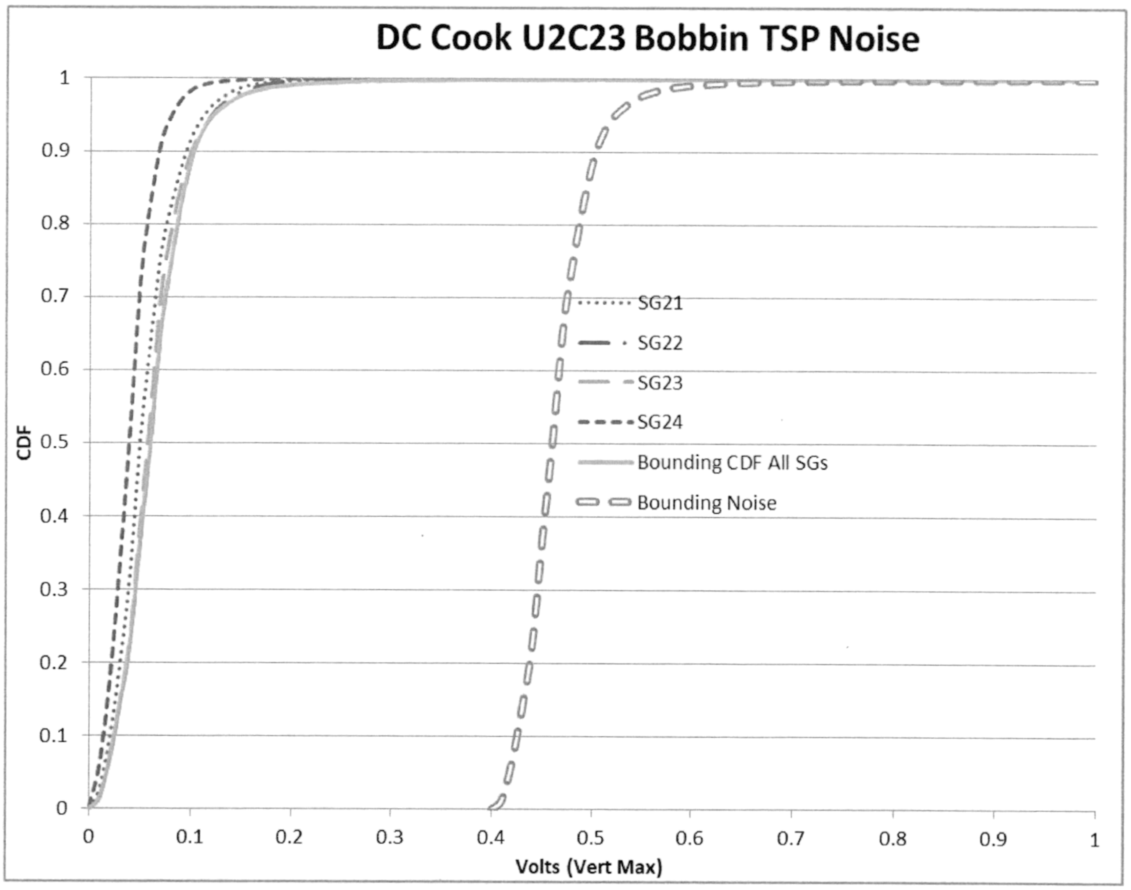
The possibility of undetected TSP wear flaws must also be considered. A review of ETSS 96004.1 (from EPRIQ.com) reveals that during the technique qualification, all wear flaws in the qualification data set, with depths ranging from 4 to 90%TW, were detected. Based on this data, it is unlikely that flaws greater than those detected during U2C23 (i.e., 13%TW for TSP wear) remain undetected in the SG due to technique POD.

No tubes were plugged due to TSP wear during U2C23. The largest detected TSP wear flaw (13%TW) was therefore analyzed in the assessment above and justified to remain in service. If the largest undetected flaw is the same size as the largest detected flaw, the same assessment is valid. During

U2C23, 100% of the TSP intersections were examined with the bobbin coil. Therefore, it is unlikely that any meaningful TSP wear remains undetected in any of the DC Cook Unit-2 tubes. On this basis, the assessment of detected TSP wear is considered to be bounding for any undetected TSP wear.

Quantifying the probability of detection for TSP wear follows the same logic used above for AVB wear. Here, a 35%TW must detect depth was determined by subtracting the projected TSP wear growth (1.11 %TW/EFPY * 7.5 EFPY) from the EOC high probability limit (43.2 %TW). The resulting CDFs are illustrated in Figure 5-2. Again, ample margin exists between the bounding CDF for all SGs and the bounding noise distribution, thus providing reasonable assurance that growth of potentially undetected TSP wear over the 7.5 EFPY operating period will not lead to a compromise in steam generator tube integrity.

Figure 5-2: Comparison of TSP Noise to its Bounding Noise Distribution



5.2.3 New TSP Wear Indications

TSP wear was first detected in the Cook-2 steam generators during U2C12 after 5.868 EFPY of accumulated operation. The first indications were reported in SG21 of 4%TW, 6%TW, 7%TW, and 11%TW [4.b: Section 7.1.2]. During the U2C17 examination after 12.163 EFPY of operation three new indications were detected with the largest indication being 11%TW [4.e: Table 9-1]. During U2C20, 33 new indications were detected with the largest new indication being 9%TW [4.c: Sections 3.0 and 9.2.2].

During U2C23 after 20.29 EFPY, 39 new indications were detected with the largest new indication being 10 %TW [4.b: Tables 5-5 and 5-6]. This history of new TSP wear indications in the Cook-2 SGs demonstrates that while the number of new TSP wear indications has increased over time, there is no trend toward increasing size of newly-detected TSP wear indications. The Cook-2 new TSP wear indication history is summarized in Table 5-4.

Table 5-4: Cook-2 New TSP Wear History

Outage / Year	SG EFPY	Number New	Largest New
U2C12 / 1997	5.868	4	11 %TW
U2C13 / 2002	7.272	0	N/A
U2C15 / 2004	9.496	0	N/A
U2C17 / 2007	12.163	3	11 %TW
U2C20 / 2012	16.169	33	9 %TW
U2C23 / 2016	20.290	39	10 %TW

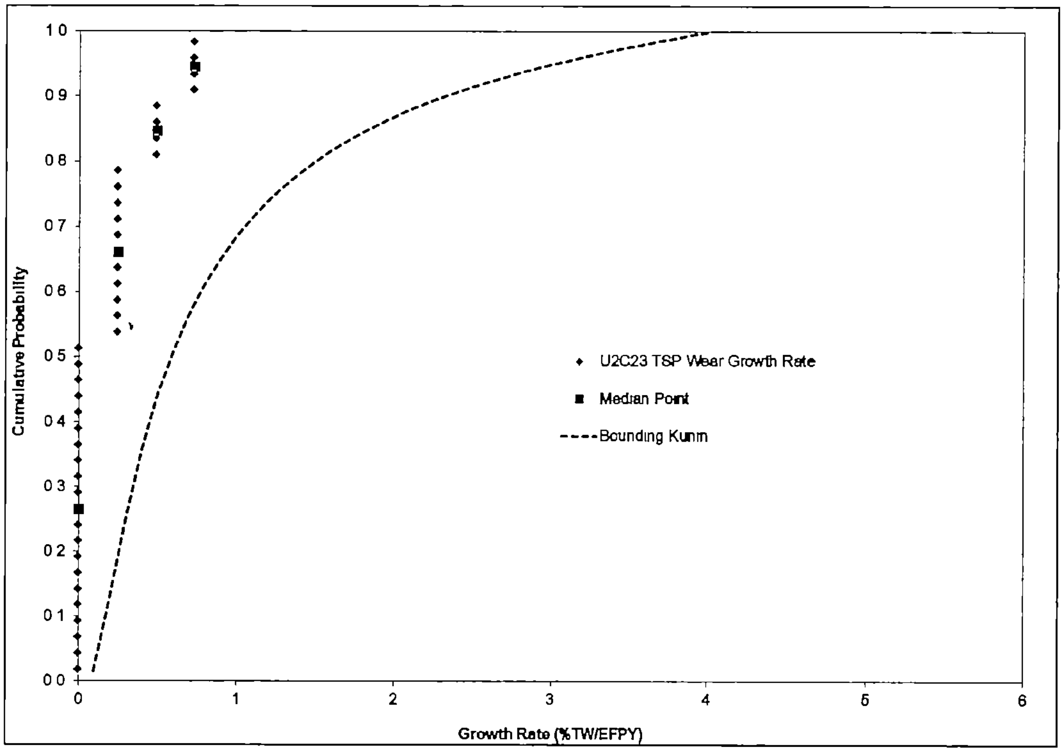
It is reasonable to expect new TSP wear indications to continue to occur; however based on the history of Cook-2 TSP wear, it is expected that new TSP wear indications will continue to grow at the milder growth rates previously demonstrated (bounded by 1.11 %TW/EFPY) and that the depth of new TSP wear indications will be similar to or bounding of the new wear depths over the past 19 years.

5.2.4 Full Bundle Evaluation of TSP Wear

In addition to the deterministic approach for TSP wear, the OA methodology also included a probabilistic, full bundle approach. This approach was implemented using the Framatome Mathcad SG Full Bundle, Fully Probabilistic model [5.b]. The simplified single flaw deterministic approach applied earlier typically produces amply conservative results for small flaw populations (as the case for the Cook-2 SGs). The probabilistic approach is more responsive to extreme value growth rates because it explicitly captures the fact that if more deep flaws are returned to service, there is an increasing probability that large growth rates will be matched with large BOC depths, making deep EOC flaws more likely.

The probabilistic OA methodology uses a 3ΔP burst pressure of 4800 psi over two consecutive operating periods totaling 7.5 EFPY (4.5 EFPY + 3.0 EFPY). A Kunin fit was used to model the U2C23 TSP wear growth rates from all SGs combined. This fit is illustrated in Figure 5-3 and conservatively excludes negative growth rates while also providing growth rate margin by shifting the fit curve (Bounding Kunin) to the right of the U2C23 data. This fit curve also bounds, by a large margin, the maximum growth rate of 1.11 %TW/EFPY experienced in all SGs over the past three inspections (discussed in Section [5.2.1]).

Figure 5-3: Cook U2C23 Repeat TSP Wear Growth Rate Distribution



As part of the OA full bundle analysis, all pertinent uncertainties were considered including uncertainties associated with material properties, NDE detection, and burst equation relationship. The EOC probability of meeting the structural integrity requirement of a minimum burst pressure of 3ΔP (4800 psi) was calculated for each TSP wear scar returned to service, together with the appearance of 123 new wear scars at EOC25 (4.5 EFPY following U2C23) and 99 new wear scars at EOC27 (7.5 EFPY following U2C3). The quantity of new wear scars at EOC25 and EOC27 was projected using a Weibull fit of the Cook-2 historical wear initiations (see Figure 5-4). The depth value assigned to each new wear scar within the full bundle model was determined using a Monte Carlo simulation that samples from a bounding Kunin fit to the collective (all SGs) U2C23 distribution of new wear scar depths. This Kunin fit is illustrated in Figure 5-5 and has purposely been shifted to the right of the data to bound the depth (with large margin) of the largest new wear scar ever detected (11%TW) in the Cook-2 replacement SGs.

Each TSP wear scar (repeat and new) was assigned a fixed structural length of 1.2 inches (bounding for the 1.12 inch TSP thickness) and a fixed structural depth to max depth ratio of 1.0 (one). This ratio represents the most bounding profile (flat wear).

Table 5-5 summarizes the TSP wear inputs used within the full bundle model.

Figure 5-4: Cook-2 New TSP Wear and Weibull Projection

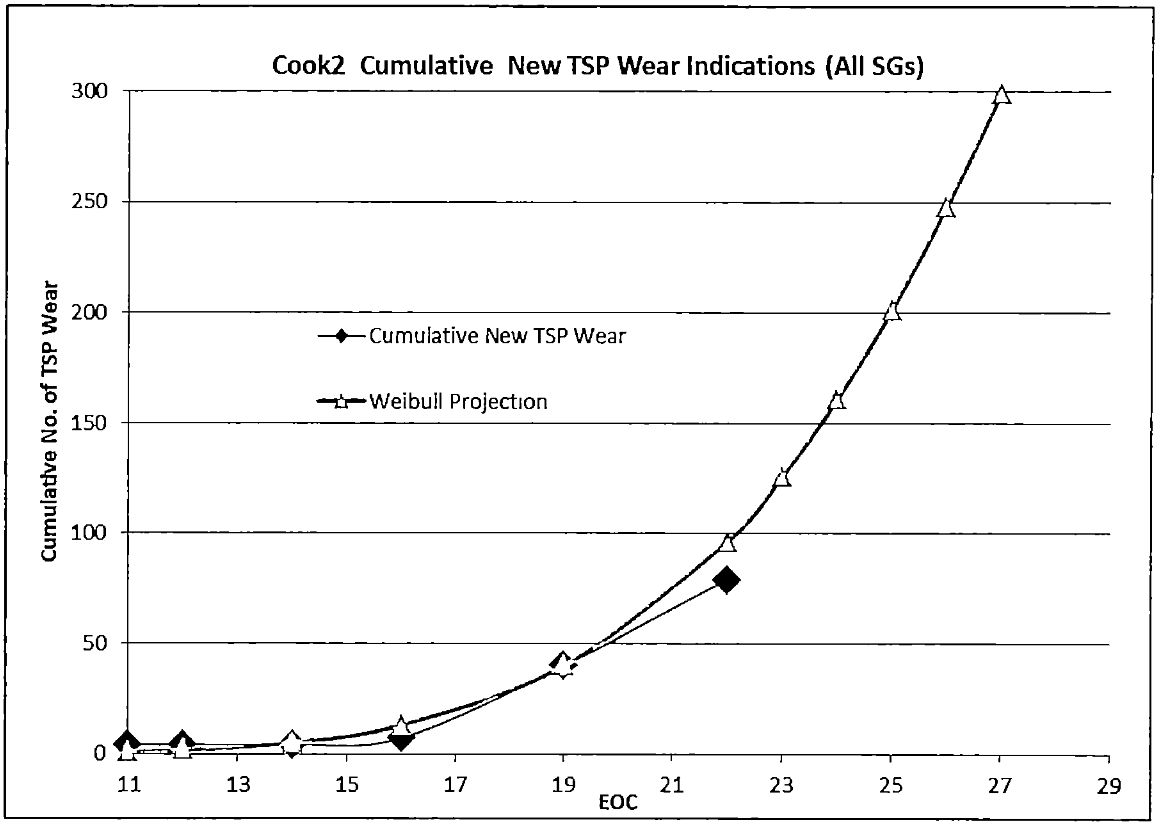


Figure 5-5: Cook U2C23 New TSP Wear Depth Distribution

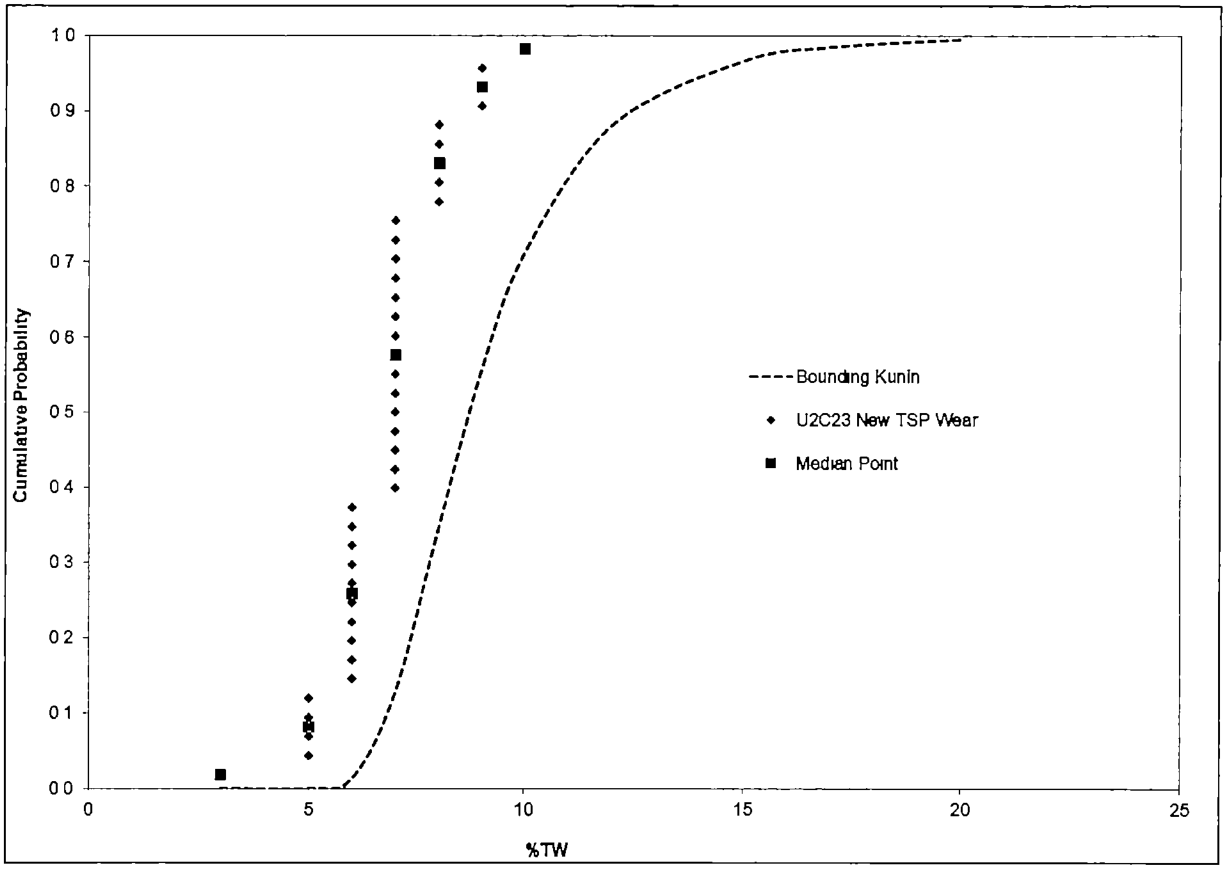


Table 5-5: Cook-2 TSP Wear Full Bundle Model Inputs

Parameter	Value
Mean of (Sy + Su) at temperature	111,500 psi
Standard Deviation of (Sy + Su)	Zero since using ASME Code (Sy + Su)
3ΔP	4800 psi
Tubing wall thickness / outer diameter	0 050 inch / 0.875 inch
Structural Length	Fixed at 1 2 inch
Structural Depth to Maximum Depth Ratio	Fixed at 1 0
ETSS Technique	96004.1 Rev 13 Y = 0.98*NDE + 2.89%TW, Sy,x = 4 19 %TW
Growth rates (new and repeat indications)	See Figure 5-3
New indication projections and depths	See Figure 5-4 and Figure 5-5, respectively
Number of New TSP Wear Indications	EOC25 = 123, EOC27 = 99
Duration of Operation	7.5 EFPY (4.5 + 3.0)

Due to the relatively small population of existing TSP wear indications in each of the Cook-2 SGs at U2C23 (SG21 = 10, SG22 = 0, SG23 = 59, SG24 = 10), the TSP wear indications from all SGs were combined to form a single population of 79 TSP wear indications for input into the full bundle model. This conservatively bounds the TSP wear indication population and TSP wear indication depths associated with each SG individually.

The probability that the tube bundle will meet a minimum burst pressure of 3ΔP is the product of all the probabilities of each wear scar (the returned to service population and the projected new wear scar population) within the tube bundle meeting 3ΔP and is termed the Probability of Survival (POS). The POS result (Table 5-6) exceeds the required 0.95 probability, as directed by the EPRI IAG [2.a], demonstrating with reasonable assurance that the structural performance criteria will be satisfied over the 7.5 EFPY operating period. Note that the probability of burst (POB) is one minus the probability of survival, (POB = 0.019).

In summary, the use of a bounding 7.5 EFPY operating period, the use of a conservative growth rate distribution (new and repeat indications), the use of a conservative new indications depth distribution, the use of a conservative population of both new and repeat indications, the use of a conservative 3ΔP value, all combine to make the probability of survival estimate conservative for TSP wear.

Table 5-6: Cook-2 TSP Wear Full Bundle Model Results

SG	Probability of Survival (POS)	Required POS
All	0.981	0.95

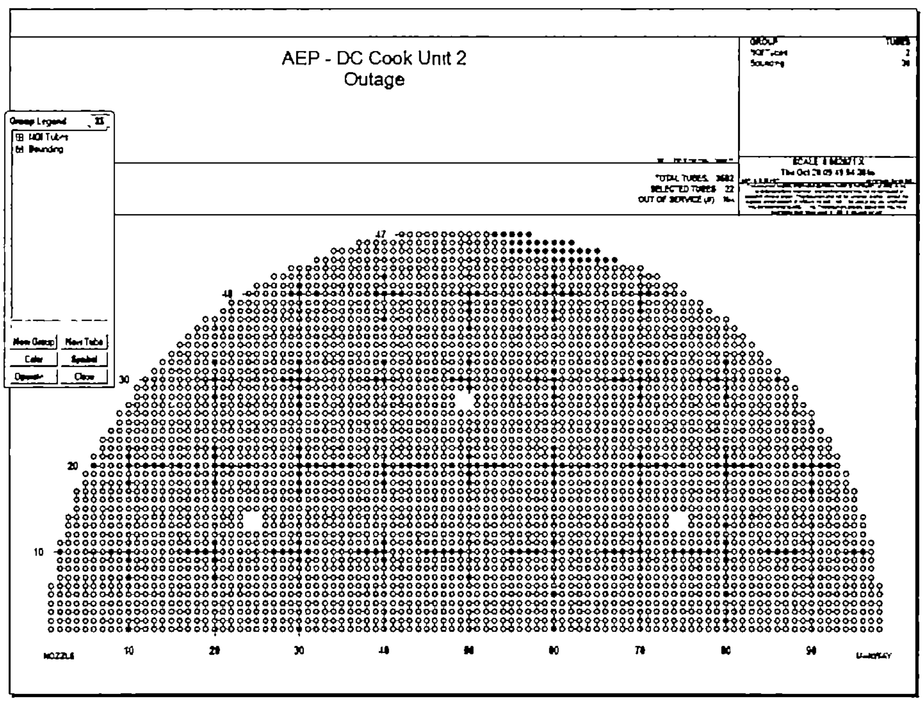
5.3 Foreign Object Wear and VOL Indications

As discussed previously, sludge lancing and extensive ECT and visual examinations were performed during U2C23. The combination of NDE techniques and visual inspections provide a high level of confidence in detecting the presence of foreign objects or foreign object wear and in minimizing the risk of future foreign object wear.

The potential development of new foreign object wear during the operating period through EOC27 must be considered. It is difficult to predict if and when foreign object wear will occur, but based on the previous history of the Cook-2 SGs, no TTS foreign object wear has been reported since 2004 {[4.d: Section 4.3.3], [4.c: Section 8.2], [4.b: Section 5.1.1.9]}. During U2C23 two VOL indications were detected in SG22 during the bobbin probe inspection and thought to be related to foreign object wear. Although both indications are traceable back to the 1997 data, they were flagged during U2C23 due to a change in the bobbin probe signal response.

Each of these indications was subsequently characterized using both the +Point™ and Array probes. The Array probe showed that both indications exhibited degradation indicative of loose part wear. Both VOLs were determined to be located just above the 5th TSP on the H/L side in periphery tubes (R46-C62 and R47-C57) with each indication located on the wrapper side of the tube. Since this area was not accessible by SSI, conclusive visual determination if a loose part was present could not be confirmed. To provide reasonable assurance that no loose part was present, an additional population of 30 bounding tubes was examined. The results showed no evidence of any other degradation or presence of a loose part. The 30 bounding tubes plus the two bobbin tubes (32 tubes total) were also examined using the +Point™ probe. Based on these results, the two bobbin indications were dispositioned as VOLs and the 30 bounding tubes were reported as NDD (no degradation detected) with no associated loose part(s) presence. Both VOL indications were sized using +Point™ ETSS 27904.1. The largest VOL indication was sized by bobbin at 12%TW and at 39%TW using +Point™. The corresponding resulting upper 95/50 depth was calculated to be 43%TW as illustrated in Table 4-2. The VOL indications and bounding tubes are illustrated in Figure 5-6.

Figure 5-6: Cook-2 SG22 VOL Indications and 30 Bounding Tubes



Based on the Cook-2 operating experience, it is unlikely that new foreign material introduced into the SGs since U2C23 would cause tube degradation. Recall that Cook-2 has proactively performed TTS lancing in parallel with ECT examinations. Since the lancing effort (performed at the end of every 3rd cycle) could have dislodged foreign objects in contact with SG tubes and prevented the occurrence of foreign object wear, it is recommended that Cook-2 consider performing TTS lancing in each SG prior to the U2C28 outage.

Assuming that tube degradation was to occur from a foreign object, it is not expected to exceed the high probability structural limit of 43%TW (using a conservative 3ΔP of 4800 psi and structural length of 1.2 inches). In the unlikely event of such an occurrence, primary to secondary leakage monitoring procedures in place at Cook-2 provide a high degree of confidence of safe unit shut-down without challenging the SIPC or AILPC.

5.4 Leakage Integrity

Since support wear flaws will leak and burst at essentially the same pressure, and since the evaluations above conclude that structural integrity will be maintained throughout the period from BOC23 to

EOC27, leakage integrity at the much lower faulted pressure differential of 2560 psig is also demonstrated for the degradation evaluated in this OA. Although there are no known conditions of concern, sensitivity to primary-to-secondary leakage events will continue under the DC Cook-2 conservative monitoring procedures.

5.5 Secondary Side Internals

The absence of secondary side structural degradation in each of the Cook-2 SGs during U2C23 [4.b] provides a high level of confidence that tube degradation caused by secondary side component deterioration will not occur in any of the SGs prior to EOC27.

6.0 CONCLUSIONS

There is reasonable assurance that the structural integrity and leakage integrity performance criteria will remain satisfied throughout the operating period from BOC23 to EOC27. Table 6-1 summarizes the projected structural and leakage margin at EOC27 for each evaluated mechanism. It is recommended that consideration be given to performing TTS sludge lancing in each SG prior to EOC27.

Table 6-1: Cook-2 Integrity Margin Summary

Degradation Mechanism	EOC27 Structural		EOC27 Leakage	
	Upper Limit	Projection	Upper Limit	Projection
AVB wear	41 7%TW	≤31 8%TW	0 25 gpm	Zero Leakage
TSP wear	43 2%TW 0 950 POS Lower Limit	≤30 8%TW 0 981 POS	0 25 gpm	Zero Leakage
Foreign object wear / VOLs	43 2%TW	≤43 2%TW	0 25 gpm	Zero Leakage

7.0 COMPUTER FILES

This section summarizes the computer files used to perform the operational assessment in this document.

All files were transferred to the following Framatome ColdStor directory:\cold\General-Access\51\51-9318053-000\official

Table 7-1: Computer Files

Filename	File Type	Description	Modified Date	Modified Time (hrs.)
01Probability Burst Kunin and Piecewise-003 xmcd	Mathcad	Mathcad Full Bundle Model for performing probabilistic evaluations of TSP wear	8/29/2020	1440
02Dual Benard and Data-003_Bug Fix xlsx	MS Excel	Input file for Mathcad Full Bundle of TSP wear	8/29/2020	1442
03Kunin Maker xlsm	MS Excel	Excel file used to construct Kunin fits for TSP wear (new indications) and (growth rates)	11/19/2020	1528
04Cook2 New TSP Wear Weibull xlsx	MS Excel	Excel file used to construct Weibull fit for TSP wear, new indications	8/29/2020	1439
05Cook2 New TSP Wear Weibull xmcd	Mathcad	Mathcad file used to construct Weibull fit for TSP wear, new indications	8/29/2020	1443
06Cook2 VOL_360_R0_96004 1 xmcd	Mathcad	Mathcad file used to calculate HP EOC limits	8/29/2020	1516
07Cook2 SG Pressures BOC23 to Aug2020 xlsx	MS Excel	Excel file showing Cook2 SG pressures	9/7/2020	1855
08Cook2 EFPY Table xlsx	MS Excel	Excel file for calculation of EFPY Table	9/7/2020	1914
09Cook2 2016 Bobbin AVB Noise xlsx	MS Excel	Excel file for calculation of AVB noise values	9/7/2020	2010
10Cook2 2016 Bobbin TSP Noise xlsx	MS Excel	Excel file for calculation of TSP noise values	9/7/2020	2043
11Cook2 AVB Bobbin Noise csv	MS Excel	Excel csv file containing AVB noise values	8/15/2020	1336
12Cook2 TSP Bobbin Noise csv	MS Excel	Excel csv file containing TSP noise values	8/16/2020	1130
13AVB Noise +0 38 Volt Conservative Ahat png	PNG	MAPOD printout of AVB bounding noise	9/5/2020	2340
14TSP Noise +0 40 Volt Conservative Ahat png	PNG	MAPOD printout of TSP bounding noise	9/6/2020	0010
15Ahat_96004_1 Conservative csv	MS Excel	Excel csv file containing most appropriate ETSS 96004 1 Ahat data [5 e]	4/25/2019	1110
16ROI_Cook2 ref	Ref	File containing Cook2 Regions of Interest (ROI)	8/7/2020	0815

8.0 REFERENCES

References identified with an (*) are maintained within DC Cook Records System and are not retrievable from Framatome Records Management. These are acceptable references per Framatome Administrative Procedure 0402-01, Attachment 7. See page [2] for Project Manager Approval of customer references.

1. NEI 97-06, "Steam Generator Program Guidelines," Rev. 3, March 2011
2. EPRI Documents
    a. EPRI Report 3002007571, "Steam Generator Management Program: Steam Generator Integrity Assessment Guidelines Revision 4, June 2016
    b. EPRI Report 3002007572, "Steam Generator Management Program: Pressurized Water Reactor Steam Generator Examination Guidelines: Revision 8", June 2016 (Includes Interim Guidance SGMP-19-01 incorporated April 2019)
    c. EPRI Report 3002007856, "Steam Generator Management Program: In-situ Pressure Test Guidelines, Revision 5", November 2016
    d. EPRI Report 1019037, "Steam Generator Management Program: Steam Generator Degradation Specific Management Flaw Handbook, Revision 2," October 2015
    e. EPRI Report 3002003048, "Steam Generator Management Program: Flaw Handbook Calculator (SGFHC) for Excel 2010 v1.0," June 2014
    f. EPRI Report 3002010334, "Model Assisted Probability of Detection Using R (MAPOD-R), Version 2.1," September 2017
    g. EPRI SG Degradation Database (SGDD). On EPRI Website http://sgdd.epri.com/
    h. EPRI Appendix H Performance Based Database and Appendix I Database. On EPRI Website http://sgmp.epriq.com
3. NRC Documents
    a. ADAMS Accession number ML20097J188, "Braidwood Station, Unit 2,Emergency License Amendment Request for a One-Time Extension of the Steam Generator Tube Inspections", Dated April 6, 2020
    b. ADAMS Accession number ML20098F341, "Turkey Point Nuclear Plant, Unit 3 – Exigent License Amendment Request 272, One-Time Extension of TS 6.8.4 Steam Generator Inspection Program – Response to Request for Additional Information", Dated April 7, 2020
    c. ADAMS Accession number ML20101M879, "Comanche Peak, Exigent License Amendment Request (LAR) 20-003 Revision to Technical Specification (TS) 5.5.9, 'Unit 1 Model D76 and Unit 2 Model D5 Steam Generator Program'", Dated 4/10/2020
    d. ADAMS Accession number ML20105A223, "Surry, Units 1 and 2, Proposed License Amendment Request: One-Time Deferral of Surry Unit 2 Steam Generator "B" Inspection", Dated April 14, 2020

e. NRC Information Notice 2013-20, "Steam Generator Channel Head and Tubesheet Degradation," October 3, 2013

4. DC Cook-2 Prior Inspection Documents
   a. Framatome Document 51-9198861-001, "DC Cook Unit 2 Steam Generator Degradation Assessment U2C23"
   b. Framatome Document 51-9263363-000, "DC Cook U2C23 Steam Generator Condition Monitoring and Operational Assessment"
   c. Framatome Document 51-9181068-000, "DC Cook Unit 2 SG Condition Monitoring and Operational Assessment for U2C20"
   d. Framatome Document 51-9056553-000, "Steam Generator Degradation Assessment – DC Cook Unit 2 Cycle 17"
   e. Framatome Document 51-9063150-002, "DC Cook Unit 2 Steam Generator Condition Monitoring and Operational Assessment Evaluation for U2C17"
5. Framatome Documents
   a. Framatome Document 51-9031678-001, "DC Cook Units 1 and 2 Limiting Structural Integrity Performance Criteria"
   b. Framatome Document 32-9104082-003. "Mathcad Implementation of SG Fully Probabilistic Operational Assessment"
   c. Framatome Document 51-9299884-000, "Sizewell B Steam Generator Outage Report RFO 16 (Spring 2019)"
   d. Framatome Document 32-5033045-002, "Mathcad Implementation of SG Flaw Handbook Equations for Integrity Assessment"
   e. Framatome Document 51-9282129-001, "SG ECT Noise Monitoring Guidance – Tube Integrity Engineering"
6. * Cook-2 Documents
   a. Cook Unit-2 Tech Spec 5.5.7 "Steam Generator (SG) Program"
   b. AEP Design Information Transmittal, "DIT-S-00705-25, October 3, 2019"