~~PROPRIETARY INFORMATION – WITHHOLD UNDER 10 CFR 2.390~~
~~This letter is decontrolled when separated from Enclosure 2~~

HOLTEC PALISADES

27780 Blue Star Highway, Covert, MI 49043

PNP 2025-046

10 CFR 50.90

July 30, 2025

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

Palisades Nuclear Plant
NRC Docket No. 50-255
Renewed Facility Operating License No. DPR-20

Subject: Response to Second Request for Additional Information Regarding License Amendment Request to Revise Selected Permanently Defueled Technical Specifications to Support Repairing of Steam Generator Tubes by Sleeving

By letter dated February 11, 2025 (Reference 1), Holtec[1] requested U.S. Nuclear Regulatory Commission (NRC) review and approval of a license amendment request (LAR) to revise the Palisades Nuclear Plant (PNP) Permanently Defueled Technical Specifications (PDTS) to allow use of Framatome Alloy 690 sleeves to repair defective steam generator (SG) tubes as an alternative to removing the tubes from service by plugging.

By electronic mail (email) received on April 14, 2025, the NRC forwarded a draft request for additional information (RAI) regarding the LAR. A clarification call with the NRC reviewers was held on April 29, 2025 to discuss the LAR, and the NRC provided the final RAI in an email dated May 7, 2025 (Reference 3). Holtec provided the responses to the RAI in a letter dated May 29, 2025 (Reference 4).

By email received on June 30, 2025, the NRC provided a second RAI regarding the LAR. Due to the proprietary nature of some of the RAI questions, Proprietary and Non-Proprietary (redacted) versions of the RAI were provided. The Non-Proprietary version of the RAI is in the NRC's Agencywide Documents Access and Management System (ADAMS) as a publicly available document (Reference 5).

Enclosure 1 to this letter provides the Non-Proprietary version of the RAI questions and responses. Enclosure 2 provides the Proprietary version of the RAI questions and responses. Enclosure 3 provides the Framatome Affidavit, Proprietary Information Notice.

The revised TS pages do not alter the no significant hazards consideration contained in the Reference LAR.

[1] Holtec Palisades, LLC ("Holtec Palisades") is the licensed owner of PNP. Pursuant to the license transfer amendment received in connection with the PNP restart (Reference 2), licensed operating authority has transferred from Holtec Decommissioning International, LLC ("HDI") to Palisades Energy, LLC ("Palisades Energy").

In accordance with 10 CFR 50.91(b), *State consultation*, Holtec is notifying the State of Michigan of these RAI responses by transmitting a copy of this letter, with Enclosures, to the designated State of Michigan official.

If you have any questions regarding this submittal, please contact Frank Sienczak, Regulatory Assurance Manager, at (269) 764-2263.

This letter contains no new regulatory commitments and no revisions to existing regulatory commitments.

I declare under penalty of perjury that the foregoing is true and correct. Executed on July 30, 2025.

Respectfully,

Jean A. Fleming

Digitally signed by Jean A. Fleming
DN: cn=Jean A. Fleming, o=Holtec Decommissioning International, LLC, ou=Regulatory and Environmental Affairs, email=J.Fleming@Holtec.com
Date: 2025.07.30 09:03:30 -04'00'

Jean A. Fleming
Vice President, Licensing and Regulatory Assurance
Holtec International

References:

1. Holtec Palisades, LLC (Holtec) letter to U.S. Nuclear Regulatory Commission (NRC), *License Amendment Request to Revise Selected Permanently Defueled Technical Specifications to Support Repairing of Steam Generator Tubes by Sleeving,* dated February 11, 2025 (ADAMS Accession Nos. ML25042A692 and ML25043A348)

2. NRC letter to Holtec, *Palisades Nuclear Plant – Order Approving Direct Transfer of Renewed Facility Operating License and Independent Spent Fuel Storage Installation General License and Issuance of Conforming Amendment No. 275 (EPID L-2023-LLM-0005),* dated July 24, 2025 (ADAMS Accession No. ML25167A243)

3. NRC email to Holtec, *Request for Additional Information RE: Steam Generator Tube Sleeving Amendment (L-2025-LLA-0036),* dated May 7, 2025 (ADAMS Accession No. ML25128A171)

4. Holtec letter to NRC, *Response to Request for Additional Information Regarding License Amendment Request to Revise Selected Permanently Defueled Technical Specifications to Support Repairing of Steam Generator Tubes by Sleeving,* dated May 29, 2025 (ADAMS Accession No. ML25149A013)

5. NRC email to Holtec, *Request for Additional Information RE: Steam Generator Repair by Sleeving Amendment (L-2025-LLA-0036),* dated June 30, 2025 (ADAMS Accession No. ML25182A275)

Enclosure 1: Response to Second Request for Additional Information – License Amendment Request to Revise Selected Permanently Defueled Technical Specifications to Support Repairing of Steam Generator Tubes by Sleeving (Non-Proprietary)

Enclosure 2: Response to Second Request for Additional Information – License Amendment Request to Revise Selected Permanently Defueled Technical Specifications to Support Repairing of Steam Generator Tubes by Sleeving (Proprietary) ***[Withhold Under 10 CFR 2.390(a)(4)]***

Enclosure 2 Attachments ***[Withhold Under 10 CFR 2.390(a)(4)]***

1. Framatome Document 08-9384357-001, Design Specification – "Hydraulically Expanded Sleeves for ¾ Inch Steam Generator Tubes at Palisades Nuclear Power Plant," January 2025.
2. Framatome Document 32-9386352-000, Calculation Summary Sheet, "¾ Mechanical TSP Sleeve Leak Rate Analysis for Palisades," January 2025.
3. Framatome Document 32-9387171-000, "Palisades SG Sleeve Primary Stress and Fatigue Evaluation," January 2025.
4. Framatome Document 43-10202P-00, "Mechanical TSP Sleeve Qualification for ¾ Inch OD Tubes," December 1994.
5. Framatome Document 51-9391941-000, "Palisades Eddy Current Sleeve Site Qualification," May 2025.
6. Framatome Document 51-9321652-000, "Palisades Steam Generator Condition Monitoring for 1R27 and Final Operational Assessment for Cycle 28," January 2021.
7. Framatome Document 51-9385821-001, "Tube Support Plate (TSP) Sleeving Procedure Specification (SPS) for Palisades Steam Generator ¾" Tubes," May 2025.

Enclosure 3: Framatome Affidavit, Proprietary Information Notice

cc: NRC Region III Regional Administrator
NRC Senior Resident Inspector – Palisades Nuclear Plant
NRC Project Manager – Palisades Nuclear Plant
Designated Michigan State Official

PNP 2025-046

Enclosure 1

Response to Second Request for Additional Information

License Amendment Request to Revise Selected Permanently Defueled Technical Specifications to Support Repairing of Steam Generator Tubes by Sleeving

(Non-Proprietary)

Response to Second Request for Additional Information

Background

By letter dated February 11, 2025, Holtec Palisades requested U.S. Nuclear Regulatory Commission (NRC) review and approval of a license amendment request (LAR) to revise the Palisades Nuclear Plant (PNP) technical specifications to allow the use of Framatome Alloy 690 sleeves to repair defective steam generator (SG) tubes as an alternative to removing the tubes from service by plugging. The approval of this LAR is contingent upon the prior approval of the LAR, dated December 14, 2023 (ML23348A148), that supports resumption of power operations at PNP (e.g., restores power operation technical specifications) and is currently under NRC review. Accordingly, the technical specification changes contained in both LARs must be approved and implemented to support the resumption of power operations at PNP.

The LAR to permit SG sleeve installation proposed changes to the following PNP technical specifications. Note, these proposed changes modify the PNP power operation technical specifications that are currently under NRC review in a separate LAR.

- Surveillance Requirement (SR) 3.4.1.3, Verify PCS [primary coolant system] total flow rate within the limit specified in the COLR [core operating limits report],
- Technical Specification (TS) 3.4.17, "Steam Generator (SG) Tube Integrity,"
- TS 5.5.8, "Steam Generator (SG) Program," and
- TS 5.6.8, "Steam Generator Tube Inspection Report."

Regulatory Basis

Section 182(a) of the Atomic Energy Act requires nuclear power plant operating licenses to include TS. In 10 CFR 50.36, "Technical specifications," NRC regulatory requirements related to the content of the TS are established. The TS for all current pressurized water reactor (PWR) licenses require that an SG Program be established and implemented to ensure that SG tube integrity is maintained. Programs established by the licensee, including the SG Program, are listed in the administrative controls section of the TS and contain the necessary requirements to operate the facility in a safe manner.

SG tube integrity is maintained by meeting the performance criteria specified in the TS for structural integrity and leakage integrity, consistent with the plant design and licensing basis. The TS require that a condition monitoring assessment be performed during each outage in which the SG tubes are inspected, to confirm that the performance criteria are being met. The TS include provisions regarding the scope, frequency, and methods of SG tube inspections. These provisions require that the inspections be performed with the objective of detecting flaws of any type that may be present along the length of a tube and that may satisfy the applicable tube plugging criteria.

The applicable tube plugging criteria, specified in the TS, are that tubes found during in service inspection to contain flaws with a depth equal to or exceeding 40 percent of the nominal wall thickness shall be plugged, unless the tubes are permitted to remain in service through application of alternate repair criteria provided in the TS. The TS also include a limit on operational primary-to-secondary leakage, beyond which the plant must be promptly shut down. Should an existing flaw that exceeds the tube integrity repair limit not be detected during the periodic tube surveillance required by the plant TS, the operational leakage limit provides

added assurance of timely plant shutdown before tube structural and leakage integrity are impaired, consistent with the design and licensing bases.

The general design criteria (GDC) in Appendix A to Part 50 of Title 10 of the Code of Federal Regulations (10 CFR) provide regulatory requirements that state the reactor coolant pressure boundary (RCPB) shall have "an extremely low probability of abnormal leakage and of gross rupture" (GDC 14), "shall be designed with sufficient margin" (GDCs 15 and 31), shall be of "the highest quality standards practical" (GDC 30), and shall be designed to permit "periodic inspection and testing…to assess …structural and leak tight integrity" (GDC 32). For plants that were issued construction permits before the effective date of 10 CFR Part 50, Appendix A, the plant-specific principal design criteria (PDC) in the plant design basis established similar fundamental regulatory requirements pertaining to the integrity of the steam generator tubing.

Question 1

Enclosure 5 [sic], Figure 3.4-2, provides a longitudinal section of the leak limiting sleeve design. This figure, however, does not provide dimensions on the "Detail of Sealing Ribs." The sealing ribs in this image appear different than the ribs shown in the slides for the closed public meeting in January 2025 (Accession No. ML25006A181). Provide a dimensioned drawing for the sleeve design, length of each hydraulic expansion, distance between adjacent expansions, and include the sealing ribs. Discuss how the sealing ribs interact with the inside diameter of the parent tube into which it is expanded.

Holtec Response to Question 1

For clarification, Figure 3.4-2 is provided in Enclosure 1, not Enclosure 5.

The sealing ribs shown during the closed session of the public meeting were not dimensionally accurate. The rib features were exaggerated to ensure the overall concept was clearly understood.

The Tube Support Plate (TSP) Sleeve details are found on fabrication drawing 02-8155278.

Image 1 (below) shows a portion of the proprietary fabrication drawing to show the relationship between the expander and the sleeve.

Further details of the expanders and installation are referenced in the Tube Support Plate Sleeving Procedure Specification for Palisades SG ¾″ Tubes – Doc ID 51-9385821.

[ ]

Image 1 – [ ]

Rib and Tube Interaction Discussion

Prior to expansion, the ribs have a height range [ ] Refer to Image 1 as well as an actual sample measurement shown on Image 2. During expansion, the sealing ribs permanently deform to [ ] height as shown in the two micrograph images (Images 3 and 4 below). [ ] measurement correlates to the information provided in Framatome Document 08-9384357 titled, "Hydraulically Expanded Sleeves for ¾" Steam Generator Tubes at Palisades Nuclear Power Plant" (Table 9-6: Sleeve Freespan Expansion Dimensions). This interaction creates a restricted leak path between the sealing rib and parent tube wall and improves the leakage performance of the installed sleeve.

[ ]

Image 2 – [ ]

[ ]

Image 3 – [ ]

[ ]

Image 4 – [ ]

Question 2

The final paragraph in the Enclosure 5 Executive Summary states that since most stress corrosion cracking (SCC) indications are on the hot leg, eddy current inspection from the cold leg through the tube U-bend is facilitated. Inspection from the cold leg, particularly for the low row hot leg tubes, may involve using undersized bobbin probes that will have fill factors below those currently being used for inspections. Provide the diameter of eddy current probes to be used for low row tube inspection from the cold leg. If these low row tube inspections require probes with smaller diameter than previously used, provide the fill factor for the undersized probes and discuss if site specific performance demonstration has been performed demonstrating adequate detection of outside diameter stress corrosion cracking (ODSCC). Are there any limitations on sleeving low row tubes due to inspection concerns from the cold leg?

Holtec Response to Question 2

Eddy current inspections for low row tubes, which have sleeves installed, are performed from both the hot and cold leg. Undersized bobbin probes that have fill factors below those currently being used for inspections will not be used to achieve full length tube examinations.

The diameter of the bobbin probe deployed from the cold leg is the same as previous inspections, a 0.610-inch diameter bobbin probe. This probe traverses from the uppermost portion of the highest installed sleeve of the hot leg to the tube end of the cold leg. If the u-bend radius is too tight for the 0.610-inch diameter bobbin probe, a 0.560-inch diameter rotating probe is utilized (extension shafts may be used if necessary).

On the hot leg, the 0.610-inch diameter bobbin probe traverses from the lowermost portion of the lowest installed sleeve to the tube end of the hot leg. The sleeve rotating +Point™ coil is deployed to inspect from the lowermost portion of the lowest elevation of installed sleeve to the uppermost portion of the highest elevation of installed sleeve. This also includes the non-sleeved region of tubing between installed sleeves.

This method ensures an adequate fill factor during the inspections and no limitations on sleeving low row tubes. The specific inspections for all tubing are identified pre-outage in the site-specific inspection plan.

Question 3

The existing SCC in the Palisades steam generator tubes provide an opportunity to gather additional field data on a range of SCC, before and after sleeve installation, using the same eddy current probe design and technique that would be used for inspection of a sleeve/tube assembly. Are there plans to gather additional field data related to detection of SCC with the recently qualified technique that will be used for sleeve assembly inspection? If so, provide a description of the additional inspections, discuss the purpose of any additional planned inspections, and provide any available results.

Holtec Response to Question 3

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Question 4

Enclosure 5, states Section 3.9 States [sic] that, "The sleeve design and sleeving procedure were qualified by testing for leakage in accordance with ASME B&PV Code Section XI, IWA-4725" and "The relevant section in the 2007 Edition with 2008 Addenda of the Code is IWA-4725, *Expansion*." Confirm that the reference to -4725, *Expansion* should be -4720, *Sleeving*.

Holtec Response to Question 4

For clarification, Section 3.9 is provided in Enclosure 1, not Enclosure 5. The wording is also contained in Enclosure 5, Section 3.0.

After review of the relevant sections in the 2007 Edition with 2008 Addenda of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code Section XI, it was concluded that changes to Enclosures 1 and 5a of the LAR are required to properly respond to this question.

Please replace the second paragraph in Section 3.9, *ASME Code Reconciliation,* of Enclosure 1 with the following clarified and revised paragraph:

> The sleeves are designed and constructed in accordance with ASME B&PV Code Section III, Subsection NB. The sleeve design and sleeving procedure were qualified by testing for leakage in accordance with ASME B&PV Code Section XI, IWA-4720, *Sleeving,* IWA-4721, *General Requirements,* and IWA-4725, *Expansion*.

Please replace the third paragraph in Section 3.9 of Enclosure 1 with the following clarified and revised paragraph:

> The repair activities are completed in accordance with the NRC approved version of ASME Section XI, 2007 Edition with Addenda through 2008, which is the PNP approved Code of record. The sleeves were originally qualified to the NRC approved version of ASME Section XI, 1989 Edition with no Addenda and supplemented with ASME Section XI, 2007 Edition with Addenda through 2008. The relevant paragraph in Section XI, 1989 Edition used to qualify the sleeve was IWB-4300, *Heat Exchanger Tube Sleeving*. The relevant Sections in the 2007 Edition with 2008 Addenda of the Code are IWA-4720, *Sleeving,* IWA-4721, *General Requirements,* and IWA-4725, *Expansion*. A comparison of the Code Editions concluded that there are no changes to technical requirements. Therefore, the technical requirements of the ASME B&PV Code, Section XI, 2007 Edition with Addenda through 2008 are met.

Please replace the second paragraph in Section 3.0 of Enclosure 5a, *ASME CODE DISCUSSION,* with the following clarified and revised paragraph:

> The sleeves are designed and constructed in accordance with ASME B&PV Code Section III, Subsection NB [2]. The sleeve design and procedure were qualified by testing for leakage in accordance with ASME B&PV Code Section XI, IWA-4720, *Sleeving,* IWA 4721, *General Requirements,* and IWA-4725, *Expansion* [2].

Please replace the fourth paragraph in Section 3.0 of Enclosure 5a with the following clarified and revised paragraph:

The repair activities are completed in accordance with the NRC approved version of the ASME B&PV Code, Section XI, 2007 Edition with Addenda through 2008, which is the Palisades approved code of record. The sleeves supplied by Framatome were originally qualified to NRC approved version of ASME Section XI, 1989 Edition with no Addenda and supplemented with ASME Section XI, 2007 Edition with Addenda through 2008 [2]. The relevant Paragraph in Section XI, 1989 Edition with no Addenda used to qualify the sleeve was IWB-4300, *Heat Exchanger Tube Sleeving*. The relevant Sections in the 2007 Edition with 2008 Addenda of the Code are IWA-4720, *Sleeving,* IWA-4721, *General Requirements,* and IWA-4725, *Expansion*. A comparison between the Code Editions was completed and it is concluded that, while there are administrative changes that do not require reconciliation between the various Editions of the Code, there are no changes to technical requirements between the Code Editions. Therefore, the technical requirements of the ASME B&PV Code, Section XI, 2007 Edition with Addenda through 2008 are met.

Question 5

The NRC staff notes that IWA-4721 contains multiple sub-sections that are applicable to the hydraulic sleeves addressed by this LAR. Confirm that all applicable sub-sections of IWA-4720 have been included in your qualification process.

Holtec Response to Question 5

Yes. All applicable sub-sections of IWA-4720, *Sleeving,* related to hydraulic sleeves have been included in the qualification process. Sleeve qualification and testing comply with the in-service Inspection and Repair requirements of ASME Code Section XI, IWA-4721, *General Requirements*, and more specifically Subsection IWA-4725, *Expansion,* pertaining to the process for expanded sleeves, 2007 Edition with Addenda through 2008.

Question 6

Figure 5-1 of Enclosure 5 illustrates locations that cannot be sleeved due to interference with a bend in the tube or due to the diagonal support. Clarify whether this diagram indicates just three locations that cannot be sleeved, or whether it illustrates that all tubes with specific characteristics, such as an upper sleeve expansion near a bend interference or adjacent to a diagonal support cannot be sleeved. How many total hot leg support plate locations would not be candidates for sleeving based on these restrictions?

Holtec Response to Question 6

For clarification, Figure 5-1 is redacted from Enclosure 5, but is contained in Enclosure 5a.

The figure illustrates those tubes with specific characteristics, such as an upper sleeve near a bend interference or adjacent to a diagonal support, that cannot be sleeved.

Tubes in Rows [ ] cannot be sleeved for interferences at [ ] This represents [ ] total hot leg support plate locations in each steam generator that cannot be sleeved due to these interferences at [ ] Of the [ ] hot leg locations, only about [ ] of these would require plugging during the current outage.

[

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Question 7

Enclosure 5, Section 6.5.2 describes Framatome Testing and Analysis. Section 6.5.2.1 discusses the Stress Indexing Test. Respond to the following questions:

a) PROPRIETARY SHOWN IN BRACKETS [[ ]]?

b) Was the sleeve installed using the same installation process and parameters as proposed for Palisades?

c) [[ ]].

d) [[ ]]. However, the location of the cracking on the OD of the tube is different than the expected ID location, based on the industry investigations cited in Section 6.5.1 and [[ ]]. Please discuss why this result may have been obtained. In addition, if cracking of the parent tube were to occur, [[ ]].

Holtec Response to Question 7

For clarification, Section 6.5.2.1 is redacted from Enclosure 5, but is contained in Enclosure 5a.

a) and b) For the Stress Indexing Test, an Alloy 690 sleeve was installed in a single 316L stainless steel tube using the same installation process and parameters as sleeves for Palisades.

c) Prior to the Stress Index Testing, [

]

[redacted]

d) The Stress Indexing Test results reported in Section 6.5.2.1 have a typographical error. A review of the Stress Indexing Test results has now revealed the cracks were mainly circumferential and on the ID of the tube, which is consistent with the industry investigations, the finite element analysis, and the X-ray diffraction measurements. If cracking of the parent tube were to occur, it would be expected to have a circumferential orientation and be located on the ID of the parent tube.

Please replace the Stress Indexing Test results reported in Section 6.5.2.1 of Enclosure 5a with the following:

> A sleeve was installed into 316L stainless steel tubing and subjected to a boiling magnesium chloride solution. The sleeve had holes pre-drilled into the sample so the corrosion environment could attack each expansion transition. The following results were obtained:

- SCC cracks were found at each expansion transition in the parent tube.
- Based on the test time, the residual stresses were greater than 17 ksi.
- The cracks were mainly circumferential and on the ID of the tube. Thus, the direction of maximum tensile residual stress is axial.
- The sealing "ribs" on the sleeve did not cause SCC to initiate in the parent tube.

Question 8

Enclosure 5, Section 6.5.2.2, discusses the measurement of residual stresses from sleeve installation using an X-Ray diffraction technique that measures strain of the parent tube's crystal lattice. The second paragraph states that the PROPRIETARY SHOWN IN BRACKETS **[[**

]]. Please clarify whether this is in both directions from the apex and whether each of the eight hydraulic expansions would be expected to have similar peak stresses at the expansion transition.

Holtec Response to Question 8

For clarification, the second paragraph of Section 6.5.2.2 is redacted from Enclosure 5, but is contained in Enclosure 5a.

[

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Question 9

Section 6.5.2.4 of Enclosure 5 states that Framatome's investigation into residual stress from hydraulic expansion agrees well with industry evaluation of hydraulic and explosive tubesheet expansions. The statement is made that expansion diameter has little effect on the residual stresses induced by hydraulic expansions. Please clarify if the expansion diameter means the diameter of the tubing being expanded (e.g., ¾ inch as compared to ⅝ inch tubing) or the expansion amount (e.g., labeled expansion size in Table 6-2). Please provide a technical basis for this statement that expansion diameter has little effect on the residual stresses induced by hydraulic expansions.

Holtec Response to Question 9

For clarification, portions of Section 6.5.2.4 are redacted from Enclosure 5, but are contained in Enclosure 5a.

Section 6.5.2.4 of Enclosure 5 refers to the "expansion diameter," which is the largest tube OD in the tube expansion region.

The conclusion that hydraulic expansion size has little effect on residual stresses was reached in Reference 11 of Enclosures 5 and 5a, W.B. Middlebrooks, D.L. Harrod, and R.E. Gold,

"Residual Stresses Associated with Hydraulic Expansion of Steam Generator Tubing into Tubesheets," Nuclear Engineering and Design 143, 1993.

The same conclusion was reached by the caustic corrosion test summarized in Table 6-2 of Framatome Document 51-9385467 (table shown below). [

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The "Caustic Corrosion Test Results" along with the quoted reference above support the statement that hydraulic expansion diameter has little effect on residual stress.

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Question 10

Results from caustic corrosion testing are presented in Enclosure 5, Section 6.5.2.5. Table 6-2 provides results from caustic corrosion tests. Are these Alloy 690 sleeves installed in Alloy 600 tubing using the same installation process and parameters as proposed for Palisades?

Holtec Response to Question 10

For clarification, Table 6-2 is redacted from Enclosure 5, but is contained in Enclosure 5a.

Yes. For the caustic corrosion tests, Alloy 690 sleeves were installed in Alloy 600 tubing using the same installation process and parameters as the sleeves for Palisades.

Question 11

The Caustic Corrosion Testing section states that PROPRIETARY SHOWN IN BRACKETS [[

]]. This appears to be a valid conclusion to draw from the laboratory test results. The applicability to the Palisades SGs is uncertain. If available, provide any primary side water chemistry measurements that would be representative of steam generator tubing primary side conditions between permanent shutdown and when the primary side chemistry was restored to within Electric Power Research Institute (EPRI) primary water chemistry guidelines. Has an assessment been made of how the primary water chemistry (prior to restoring the reactor coolant system to EPRI water chemistry guidelines) could potentially affect PWSCC in Palisades SG tubes?

Holtec Response to Question 11

The primary side chemistry of the SG tubes during the two-year shutdown from May 2022 to May 2024 is not well known. No sleeves were installed and exposed to that uncertain primary chemistry environment. Primary chemistry control was re-established in May 2024. Following plant restart, primary chemistry is planned to be controlled by industry guidelines.

Based on the August 2024 inspection, the detected primary water stress corrosion cracking (PWSCC) in the Palisades SGs continues to be confined to the hot leg tubesheet region within the tubesheet expanded region, the top-of-tubesheet expansion transition region, and the occasional dented tube location consistent with the historical locations of PWSCC in these SGs. Therefore, the primary side chemistry during the shutdown period has not adversely affected PWSCC in the remainder of the tubing away from the hot leg tubesheet region, including the areas where TSP sleeves are to be installed to repair ODSCC.

Question 12

The service life of Framatome's Hydraulic Sleeve is discussed in Enclosure 5, Section 6.5.3. The final sentence in this section states that the operating history of Palisades provides confidence that the hydraulicly [sic] expanded sleeves will last for the expected remaining life of the SGs. This statement is based on PROPRIETARY SHOWN IN BRACKETS [[

]]. An alternate way of interpreting the Table 6-2 data is that some small percentage of the parent tubes with sleeves may experience relatively short times to crack initiation. Therefore, demonstrating detection of parent tube SCC in the sleeve-to-parent tube pressure boundary is a necessary part of the proposed eddy current qualification. Discuss how the eddy current qualification data demonstrates that parent tube SCC in the sleeve-to-tube assembly joints can be reliably detected before challenging tube integrity.

Holtec Response to Question 12

For clarification, portions of Section 6.5.3 are redacted from Enclosure 5, but are contained in Enclosure 5a.

From a tube integrity management perspective, the parent tube SCC in the sleeve-to-tube assembly joints is expected to be like the tubesheet expansion transition SCC regarding

probability of detection (POD), growth rates, and structural/leakage performance limits. The +Point™ probe has historically been used at Palisades to detect SCC at the tubesheet expansion transitions. The following EPRI Examination Technique Specification Sheets (ETSS) have been used to detect axial and circumferential OD and ID SCC at the tubesheet expansion transitions at Palisades:

I28424 Rev 4	Axial ODSCC +Point™ TSP and sludge pile 80% POD at 47% through wall (TW)
I11524 Rev 0	Circ PWSCC +Point™ for expansion transitions 80% POD at 40%TW
21409.1 Rev 7	Axial ODSCC +Point™ for sludge pile and tubesheet crevice
20511.1 Rev 8	Axial PWSCC +Point™ for expansion transitions
21410.1 Rev 6	Circ ODSCC +Point™ for expansion transitions
20510.1 Rev 7	Circ PWSCC +Point™ for expansion transitions

From the sleeve +Point™ qualification, the following estimates of POD were made from a log-logistic fit of the hit or miss qualification data:

[ ]

The detection performance of the sleeve +Point™ probe is comparable to the detection performance of the +Point™ probe techniques already being used to manage SCC at the tubesheet expansion transitions. Furthermore, the location and orientation of parent tube cracking at the sleeve joint assembly expansion transitions is expected to be PWSCC on the parent tube inner diameter in the circumferential direction based on the stress indexing testing, industry investigations, finite element analysis, and X-ray diffraction measurements. The detection performance of the sleeve +Point™ probe was best when detecting parent tube inner diameter PWSCC flaws in both axial and circumferential orientations.

Based on the detection performance cited above, SCC in the sleeve-to-tube assembly joints can be reliably detected before challenging tube integrity.

Question 13

Leakage is discussed in Enclosure 5, Section 8.2.5. Only the non-severed test specimens are discussed in this section, since this is the condition expected in the Palisades steam generator. For the main steam line break (MSLB) leakage calculations, each installed sleeve is assumed to be leaking at the sleeve MSLB leakage rate. It is possible that over time a parent tube could experience circumferential cracking at the outermost expansion that is not detected until propagating to a larger crack size. What was the range and maximum leakage obtained from the samples PROPRIETARY SHOWN IN BRACKETS **[[**

]].

Holtec Response to Question 13

For clarification, portions of Section 8.2.5 are redacted from Enclosure 5, but are contained in Enclosure 5a.

The range and maximum leakage obtained from the fully severed samples between the outermost and second tube expansion samples are as follows. The Main Steam Line Break (MSLB) leak test results ranged from **[**

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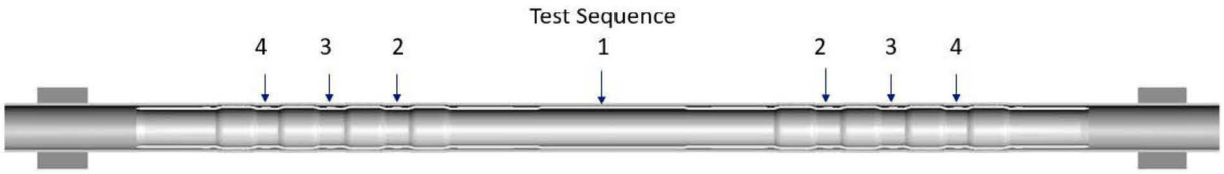
In addition to the leak test above, non-severed samples were leak tested after cyclic testing by drilling holes between the expansions (as shown in the figure below) to see what effect a through-wall defect between expansions would have on the primary-to-secondary leak rate. This test is more representative of the installed sleeve configuration because the samples included mid expansion loading on the sealing ribs.



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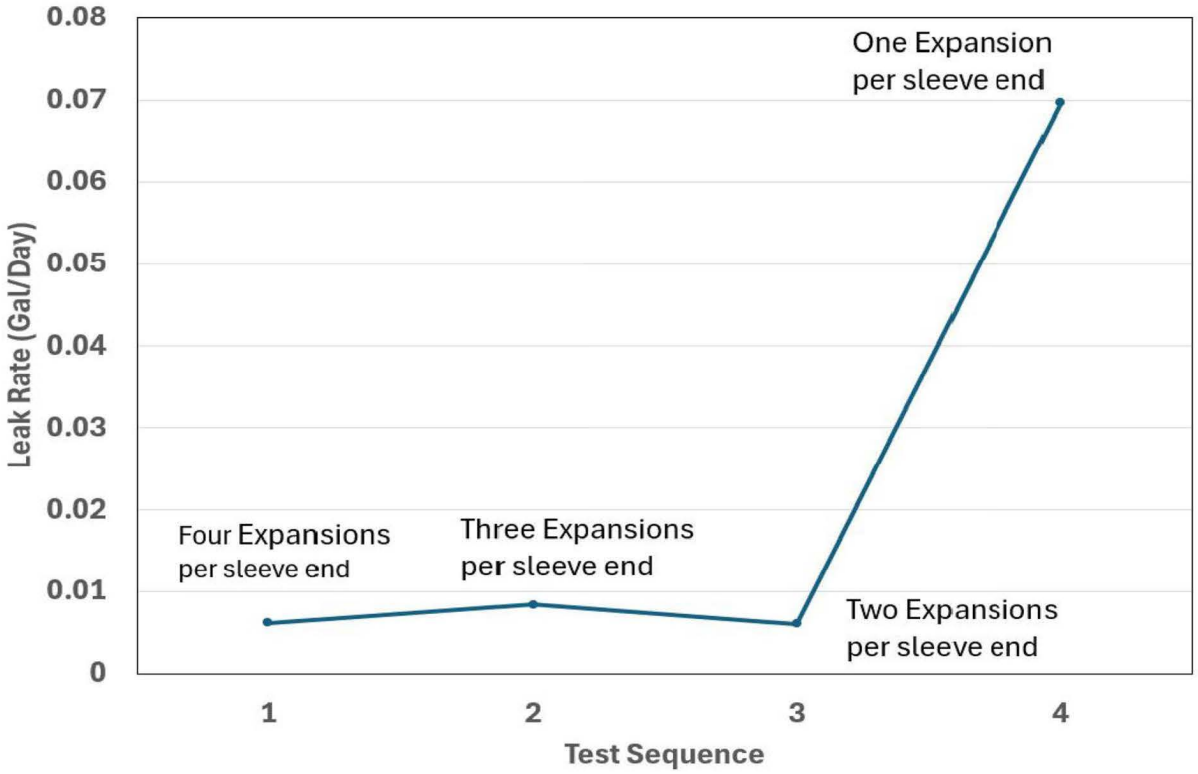

[

] For a double ended sever with no sleeve present, the maximum steam generator tube rupture leak rate is approximately 537 GPM, based on an assumed 54 lbm/sec maximum flow rate from Figure 14.15-5 of the Palisades FSAR (Reference 7 of LAR Enclosure 1) Steam Generator Tube Rupture analysis. The double ended sever (tube rupture) is an analyzed plant condition. The plant will begin the shutdown process once leakage greater than administrative limits is detected.

Question 14

Section 9 of Enclosure 5 discusses sleeve installation. Figure 9-3 provides the typical installation process expansion curve. Discuss the actions taken if there is a deviation from the typical curve during sleeve installation. In addition, describe what steps would be taken if a system leak is detected during installation of a sleeve to ensure the sleeve is properly installed and that the most recent sleeve installations before the leak was detected were properly installed.

Holtec Response to Question 14

For clarification, Figure 9-3 is redacted from Enclosure 5, but is contained in Enclosure 5a.

For a typical installation, the process expansion curve is shown in the graph labelled “Typical Sleeve Process Curve” below. The graph labelled [ ] represents the system response when a deviation occurs. The following steps are taken if [ ]

[
]

Question 15

Eddy current inspection following the installation of a tube sleeve is described in Enclosure 5, Section 9.3. Provide a detailed discussion of the information obtained in the baseline eddy current examination performed after sleeve installation, including whether bobbin coil profiling is used to verify that the sleeve expansion was in the expected range.

Holtec Response to Question 15

The sleeves are inspected with the sleeve bobbin coil and the sleeve +Point™ coil. The bobbin coil data is used to validate the sleeve position relative to the tube support plate as required by ASME Boiler and Pressure Vessel Code Section XI IWA-4725. The +Point™ coil data is collected to provide a pre-service baseline for the post installation of sleeves to use as a comparison, as needed, for future In-service Inspections.

[

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Question 16

Enclosure 5, Section 10.1 – Eddy Current Requirements for Tubing with Sleeves, states that in tubing with multiple hot leg sleeves, the parent tubing between the sleeves is inspected full length with the +Point™ probe. Please confirm that the +Point will be used for the entire parent tube inspection even when sleeve elevations are far apart (e.g., Tube Support Plate (TSP)-1 and TSP-5). In addition, if the highest sleeve elevation in a given tube is at TSP-4, discuss which inspection technique will be used from the TSP-4 sleeve elevation to the TSP-5 elevation.

Holtec Response to Question 16

As an initial clarification, the term "H" designates "hot leg" and "C" designates "cold leg."

For clarification, the protocol for sleeve installation is to install "corrective" sleeves at locations where ODSCC has been detected and to install "preventive" sleeves in locations where ODSCC has not yet been detected, up to the fifth hot leg tube support (TSP-5 or 05H) elevation. Therefore, sleeve elevations will not be far apart (e.g., first hot leg tube support (TSP-1 or 01H) and fifth hot leg tube support (TSP-5 or 05H)) because preventive sleeves would be installed at the second (TSP-2 or 02H), third (TSP-3 or 03H), and fourth (TSP-4 or 04H) hot leg tube support in this example case. The parent tubing between the sleeves is inspected full length with the sleeve +Point™ probe.

If the highest sleeve elevation in a tube is at 04H [

] the straight section of the tube is inspected with bobbin probes from the cold leg tube end through the U-bend to the top of the sleeve at 04H. For Rows 1-3, the U bend region will utilize the 0.560-inch diameter +Point™ coil from 04H to the fifth cold leg support (05C). For Rows 1-3, only the straight section of the tube is examined with a 0.610-inch diameter bobbin probe from the cold leg tube end through 05C. For Rows 4 and above, the 0.610-inch diameter bobbin probe is used from the cold leg tube end through the U-bend to the upper-most installed sleeve on the hot leg. The specific inspections for all tubing are identified pre-outage in the site-specific inspection plan.

Question 17

From the drawings included in LAR Enclosure 5, Figure 5-4, there appears to be an OD taper at both ends of each sleeve, which creates a small air gap between the sleeve and parent tube. Please discuss how this air gap affects eddy current inspection capability in this region and how the transition from the end of a sleeve to the parent tube affects eddy current data, including noise.

Holtec Response to Question 17

For clarification, Figure 5-4 is redacted from Enclosure 5, but is contained in Enclosure 5a.

[ ]

[

]

Question 18

Enclosure 5, Section 10.3.4 Eddy Current Sleeve Experience Conclusion Section, states that OE in the industry also demonstrated the successful detection of axial ODSCC (groove intergranular attack (IGA)) below the sleeve in the parent tubing with the +Point™ probe at a Once-Through Steam Generator (OTSG) plant. Please discuss these inspection results in more detail, such as the groove IGA location relative to the sleeve, and the depth and length of groove IGA that was detected, if available.

Holtec Response to Question 18

Numerous Operating Experiences (OE) in OTSG plants had ODSCC (groove IGA) in tubing based on B&W Owners Group (BWOG) proprietary reports. Specifically, for tubes that contain sleeves, there is OE where a sleeved tube had an axial orientated eddy current indication on the ID of the parent tubing in the region of the sleeve upper roll region (approximately 0.42″ below the upper sleeve end). [

]

Question 19

Confirm that all in-service tube/sleeve assemblies will be inspected each outage that SG tube inspections are performed.

Holtec Response to Question 19

Holtec cannot confirm this statement with the stipulated conditions because it deviates from the provisions of TS 5.5.8.d as previously provided in Enclosures 2 and 3 of the LAR. This position and basis are further discussed below.

During installation, all tube/sleeve assemblies are examined. A sampling program consistent with inspection requirements is used for subsequent examinations to inspect some, but not all, in-service tube/sleeve assemblies during each outage that SG tube inspections are performed. Future inspections of the in-service tube/sleeve assembly are controlled by TS 5.5.8.d. The specific wording under TS 5.5.8.d.2 allows for a sampling inspection to assure that 100% of the tubes are inspected within a 60 effective full power month period and that no SG shall operate for more than 24 effective full power months or one refueling outage (whichever is less) without being inspected. If defects are found in the tube/sleeve assemblies during the sample inspection, the sample inspection is expanded to include additional tube/sleeve assemblies per industry guidelines.

Question 20

Reference 3 to Enclosure 5 of the LAR is Framatome Document 08-9384357-001, "Hydraulically Expanded Sleeves for ¾ Inch Steam Generator Tubes at Palisades Nuclear Power Plant," January 2025. Table 9-6 in this document provides "Sleeve Freespan Expansion Dimensions." Define what portion of the sleeve is considered the sleeve Freespan. There is a typographical error for the maximum Tube OD dimension. Also, clarify if the listed values for maximum and minimum tube wall, sleeve ID, and sleeve OD that don't seem consistent with the column headings of maximum and minimum are correct.

Holtec Response to Question 20

For clarification, Reference 3 is redacted from Enclosure 5, but is contained in Enclosure 5a.

"Freespan" refers to the portion of the tubing in which the outer expansions are made, not the sleeve. The freespan expansion is made in the freespan portion of the tubing above and below the TSP and away from the tubesheet.

Framatome agrees the "Tube OD" in the "Maximum (in)" column has a typographical error; i.e., 0.0750 should be 0.750.

The purpose of Table 9-6 is to calculate the Expanded Sleeve Inner Diameter, the Expanded Tube Outer Diameter, and the Expanded Tube Inner Diameter values as shown on the last three rows of Table 9-6. The listed input values in each column are correct in that they combine to generate the maximum and minimum values found in the last three rows.

To ensure clarity the table below reflects the above stated information.

Table 9-6: [ ]

Question 21

Provide a sample of eddy current test results (e.g., range of flaw amplitudes and flaw lengths) that compare Palisades stress corrosion cracking signals before and after sleeving that demonstrate the ability to detect cracking in the parent tube behind the sleeve with eddy current testing.

Holtec Response to Question 21

The response to Question 3 provides the information requested in Question 21.

Question 22

Please provide the following reference documents on the docket:

- Framatome Document 08-9384357-001, Design Specification – "Hydraulically Expanded Sleeves for ¾ Inch Steam Generator Tubes at Palisades Nuclear Power Plant," January 2025.
- Framatome Document 32-9386352 Calculation Summary Sheet, "¾ Mechanical TSP Sleeve Leak Rate Analysis for Palisades," January 2025.
- Framatome Document 32-9387171-000, "Palisades SG Sleeve Primary Stress and Fatigue Evaluation," January 2025.
- Framatome Document 43-10202-P-00, "Mechanical TSP Sleeve Qualification for ¾" OD Tubes," December 1994.

- Framatome Document 51-9391941, "Palisades Eddy Current Sleeve Site Qualification," May 2025.
- Framatome Document 51-9321652-000, "Palisades Steam Generator Condition Monitoring for 1R27."
- Framatome Condition Monitoring and Operational Assessment (CMOA) for Restart Inspection 1D28.
- Framatome Document 51-9385821, "Tube Support Plate (TSP) Sleeving Procedure Specification (SPS) for Palisades Steam Generator ¾" Tubes," May 2025.

Holtec Response to Question 22

The Framatome Condition Monitoring and Operational Assessment (CMOA) for Restart Inspection 1D28 document is still in progress and will be available for NRC review on or before September 23, 2025, following completion of all steam generator inspection and repair activities. Accordingly, Framatome will provide the CMOA to the NRC on the docket.

The remaining seven documents are being provided without a redacted non-proprietary version since as per LIC-204, Revision 4, "Handling Requests to Withhold Proprietary Information from Public Disclosure," (ML20049A139), these documents contain extensive proprietary information to an extent that a redacted version would be of no value to the public.

PNP 2025-046

Enclosure 3

Framatome Affidavit, Proprietary Information Notice

(4 pages follow)

A F F I D A V I T

1. My name is Philip A. Opsal. I am Manager, Product Licensing for Framatome Inc. (formally known as AREVA Inc.), and as such I am authorized to execute this Affidavit.

2. I am familiar with the criteria applied by Framatome to determine whether certain Framatome information is proprietary. I am familiar with the policies established by Framatome to ensure the proper application of these criteria.

3. I am familiar with the Framatome information contained in the following documents referred to herein collectively as "these Documents."

- Holtec Palisades letter PNP 2025-046 dated July 30, "Response to Second Request for Additional Information – License Amendment Request to Revise Selected Permanently Defueled Technical Specifications to Support Repairing of Steam Generator Tubes by Sleeving, Enclosure 2

Enclosure 2 Attachments:

- Attachment 1, Framatome Document 08-9384357-001, Design Specification – "Hydraulically Expanded Sleeves for ¾" Steam Generator Tubes at Palisades Nuclear Power Plant," January 2025

- Attachment 2, Framatome Document 32-9386352-000 Calculation Summary Sheet, "¾ Mechanical TSP Sleeve Leak Rate Analysis for Palisades," January 2025

- Attachment 3, Framatome Document 32-9387171-000, "Palisades SG Sleeve Primary Stress and Fatigue Evaluation," January 2025

- Attachment 4, Framatome Document 43-10202P-00, "Mechanical TSP Sleeve Qualification for ¾ Inch OD Tubes," December 1994.

- Attachment 5, Framatome Document 51-9391941-000, "Palisades Eddy Current Sleeve Site Qualification," May 2025.

- Attachment 6, Framatome Document 51-9321652-000, "Palisades Steam Generator Condition Monitoring for 1R27 and Final Operational Assessment for Cycle 28," January 2021

- Attachment 7, Framatome Document 51-9385821-001, "Tube Support Plate (TSP) Sleeving Procedure Specification (SPS) for Palisades Steam Generator ¾" Tubes," May 2025.

Information contained in these Documents has been classified by Framatome as proprietary in accordance with the policies established by Framatome for the control and protection of proprietary and confidential information.

4. These Documents contain information of a proprietary and confidential nature and is of the type customarily held in confidence by Framatome and not made available to the public. Based on my experience, I am aware that other companies regard information of the kind contained in these Documents as proprietary and confidential.

5. These Documents have been made available to the U.S. Nuclear Regulatory Commission in confidence with the request that the information contained in these Documents be withheld from public disclosure. The request for withholding of proprietary information is

made in accordance with 10 CFR 2.390. The information for which withholding from disclosure is requested qualifies under 10 CFR 2.390(a)(4) "Trade secrets and commercial or financial information."

6. The following criteria are customarily applied by Framatome to determine whether information should be classified as proprietary:

(a) The information reveals details of Framatome's research and development plans and programs or their results.

(b) Use of the information by a competitor would permit the competitor to significantly reduce its expenditures, in time or resources, to design, produce, or market a similar product or service.

(c) The information includes test data or analytical techniques concerning a process, methodology, or component, the application of which results in a competitive advantage for Framatome.

(d) The information reveals certain distinguishing aspects of a process, methodology, or component, the exclusive use of which provides a competitive advantage for Framatome in product optimization or marketability.

(e) The information is vital to a competitive advantage held by Framatome, would be helpful to competitors to Framatome, and would likely cause substantial harm to the competitive position of Framatome.

The information in these Documents is considered proprietary for the reasons set forth in paragraphs 6(a), 6(b), 6(c), 6(d) and 6(e) above.

7. Public disclosure of the Enclosure 2 documents would reveal Framatome's research and development programs and results, analytical techniques and methods and associated specifications for the design and qualification of Framatome's proprietary tube sleeving process and for the operational assessment for steam generator structural and leakage integrity performance. Due to the extent of Framatome proprietary information in Enclosure 2

documents, a non-proprietary version of these seven documents would be of no value to the public. Therefore, a non-proprietary version is not being submitted to the NRC.

8. In accordance with Framatome's policies governing the protection and control of information, proprietary information contained in these Documents has been made available, on a limited basis, to others outside Framatome only as required and under suitable agreement providing for nondisclosure and limited use of the information.

9. Framatome policy requires that proprietary information be kept in a secured file or area and distributed on a need-to-know basis.

10. The foregoing statements are true and correct to the best of my knowledge, information, and belief.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on July 30, 2025.

Philip A. Opsal

Philip A. Opsal