UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

April 5, 2022

C. Lee Friant, Chairman
Steam Generator Task Force
1300 West W.T. Harris Boulevard
Charlotte, NC 28262-8550

SUBJECT: NUCLEAR REGULATORY COMMISSION RESPONSE TO INDUSTRY STEAM GENERATOR TASK FORCE REQUEST FOR CLARIFICATION ON TSTF-577 INSPECTION REQUIREMENTS

Dear Dr. Friant:

In a letter dated December 9, 2021,[1] the industry Steam Generator Task Force (SGTF) requested clarification on the inspection requirements in Technical Specifications Task Force (TSTF), TSTF-577, Revision 1,[2] which was approved by the U.S. Nuclear Regulatory Commission (NRC) on April 14, 2021,[3] and incorporated into Revision 5 of NUREG-1430,[4] NUREG-1431,[5] and NUREG-1432[6] (hereafter collectively referred to as the Standard Technical Specifications (STS)). Specifically, the SGTF requested clarification on the scope of the next inspection after crack indications are found in any steam generator (SG) tube and whether inspections of SGs with thermally treated Alloy 600 (Alloy 600TT) tubing on a 72 effective full power month (EFPM) inspection interval can be staggered once the initial 100 percent enhanced probe inspection is performed. The SGTF clarification requests and the NRC staff responses follow.

SGTF Clarification Request #1 – Inspection Scope After Crack Indications Found

> Section 5.5.9.d.3 states, "If crack indications are found in any SG tube [excluding any region that is exempt from inspection by alternate repair criteria], then the next inspection for each affected and potentially affected SG for the degradation mechanism that

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[1] Letter from C. Lee Friant, SGTF Chairman, to Steven Bloom, Branch Chief of the Corrosion and Steam Generator Branch, dated December 9, 2021 (ADAMS Accession No. ML22006A030).
[2] TSTF-577, Revision 1, "Revised Frequencies for Steam Generator Tube Inspections" (ADAMS Accession No. ML21060B434).
[3] TSTF-577, Revision 1, Final Safety Evaluation Package (ADAMS Accession No. ML21099A086).
[4] NUREG-1430, Revision 5, "Standard Technical Specifications –Babcock and Wilcox Plants," dated September 2021 (ML21272A363 (Volume 1) and ML21272A370 (Volume 2)).
[5] NUREG-1431, Revision 5, "Standard Technical Specifications –Westinghouse Plants," dated September 2021 (ML21259A155 (Volume 1) and ML21259A159 (Volume 2)).
[6] NUREG-1432, Revision 5, "Standard Technical Specifications –Combustion Engineering Plants," dated September 2021 (ML21258A421 (Volume 1) and ML21258A424 (Volume 2)).

> caused the crack indication shall be at the next refueling outage." The industry interprets this as a requirement to inspect the tubing in the region of interest where cracking was identified. For example, if cracking is only identified at the hot leg top of tubesheet, and 100% of the hot leg top of tubesheet was inspected with the enhanced probes, at the next outage, the minimum inspection scope required is the hot leg top of tubesheet for the affected and unaffected SGs in accordance with the Technical Specification.

NRC Response to Clarification Request #1

STS Section 5.5.8.d.3 (SGTF letter cited Section 5.5.9.d.3)[7] states, in part, "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 be at the next refueling outage…." Therefore, the inspection at the next refueling outage (RFO) after crack indications are found is for the degradation mechanism that caused the crack indication in the affected and potentially affected SGs. The NRC staff notes that the plant-specific degradation assessment will determine the locations where the tube is to be inspected at the next RFO for the degradation mechanism that caused the crack indication. A degradation assessment identifies degradation mechanisms that the SGs are susceptible to, including tube locations where such degradation may occur, so that inspections capable of detecting those degradation mechanisms are performed. In addition, the staff's expectation is that a licensee's determination of the next RFO inspection scope will have a strong technical basis that considers fleet operating experience.

The SGTF letter included the following example, "…if cracking is only identified at the hot leg top of tubesheet, and 100% of the hot leg top of tubesheet was inspected with the enhanced probes, at the next outage, the minimum inspection scope required is the hot leg top of tubesheet for the affected and unaffected SGs in accordance with the Technical Specification."

For the example provided in the SGTF letter (for a plant with Alloy 600TT tubing), if the plant-specific degradation assessment, which considers fleet operating experience, supports only inspecting at the hot leg top of tubesheet for the degradation mechanism that caused the crack indication, then the NRC staff agrees that the minimum inspection scope required at the next RFO is the hot leg top of tubesheet for the affected and potentially affected SGs.

The NRC staff notes that the example in the SGTF letter assumes the inspection will be at the next RFO and did not state that a 100 percent enhanced probe inspection was performed in all SGs as described in STS Section 5.5.8.d.2. If a 100 percent enhanced probe inspection as described in STS Section 5.5.8.d.2 was performed in all SGs, and assuming the plant-specific operational assessment supports it, then the minimum inspection at the second subsequent RFO would be the hot log top of tubesheet for the affected and potentially affected SGs.

[7] The NRC staff response reflects STS numbering based on the recently issued Revision 5 of the STS. Plant-specific technical specifications may use different numbering.

SGTF Clarification Request #2 – Staggered Inspections

> Page 9 of the NRC Regulatory Safety Evaluation Report (Reference 1), Section 3.1 states, “In addition, the NRC staff concludes that there is reasonable assurance that tube integrity is maintained for Alloy 600TT plants up to 72 EFPM between tube inspections, provided that the following two conditions are met: 1. SCC cracking has not been detected during tube inspections (excluding tube end cracking that is already covered by an ARC) AND 2. An enhanced probe inspection method is performed at the 100 percent tube inspection entering each 72 EFPM inspection interval.” Section 5.5.9.d.2 states, “If none of the SG tubes have ever experienced cracking other than in regions that are exempt from inspection by alternate repair criteria and the SG inspection was performed with enhanced probes, the inspection period may be extended to 72 effective full power months.” The industry interprets the Technical Specification to allow a utility to inspect a sample of tubes after the first 100% inspection prior to the next 72 EFPM period. This would permit a utility to stagger the inspections between the SGs or by tube sample populations for outage execution. No tube would operate longer than 72 EFPM between inspections. This was the subject of RAI 1b and 1c from the NRC (Reference 2).

NRC Response to Clarification Request #2

The NRC staff agrees that STS Section 5.5.8 (SGTF letter cited Section 5.5.9.d.2)[8] does not prohibit switching SG tube inspections to a staggered inspection after the initial 100 percent enhanced probe inspection is completed. The NRC staff recognizes that licensees may be interested in implementing staggered inspections for many reasons, including outage planning. There are six units with Alloy 600TT SG tubing that are eligible for 72 EFPM if the enhanced probe inspection method was used, and no cracking was detected. While beyond the SGTF request, the NRC staff is providing the enclosed table with example inspection scenarios as part of its response to Clarification #2 to communicate information in advance of inspections of Alloy 600TT units on a 72 EFPM inspection interval. The inspection scenarios describe the impact crack detection would have on staggered inspections of plants with Alloy 600TT on 18- and 24-month RFO schedules (Inspection Scenarios 1, 1a, and 2a), and the impact crack detection would have on a non-staggered inspection of Alloy 600TT plants on 24-month RFO schedules (Inspection Scenario 2).

Inspection Scenario 1 is a staggered inspection of two SGs after two 18-month operating cycles, followed by inspection of the remaining two SGs after two additional 18-month operating cycles. Inspection Scenario 1a is a staggered inspection of 50 percent of the tubes in each SG after two 18-month operating cycles, followed by inspection of the remaining 50 percent of SG tubes in each SG after two additional 18-month operating cycles. Inspection Scenario 2 is a non-

[8] The NRC staff response reflects STS numbering based on the recently issued Revision 5 of the STS. Plant-specific technical specifications may use different numbering.

staggered 100 percent enhanced probe inspection of all SGs on a 24-month RFO schedule. Inspection Scenario 2a is a staggered inspection of two SGs after two 24-month operating cycles, followed by inspection of the remaining SG after one additional 24-month operating cycle.

It is important to note that for each example inspection scenario once cracking is found in any SG in a unit, the maximum inspection interval for all SGs in that unit is limited to 54 EFPM per STS Section 5.5.8.d.2, and inspections would move to earlier RFOs to meet the maximum inspection interval.

If you have any questions, please contact me at (301) 415-2431 or via e-mail at Steven.Bloom@nrc.gov, or Paul Klein of my staff at (301) 415-4030 or via e-mail at Paul.Klein@nrc.gov.

Sincerely,

Signed by Bloom, Steven
on 04/05/22

Steven D. Bloom, Chief
Corrosion and Steam Generator Branch
Division of New and Renewed Licenses
Office of Nuclear Reactor Regulation

Enclosure:
Table with Example Inspection Scenarios

SUBJECT: NUCLEAR REGULATORY COMMISSION RESPONSE TO INDUSTRY STEAM GENERATOR TASK FORCE REQUEST FOR CLARIFICATION ON TSTF-577 INSPECTION REQUIREMENTS. DATED: APRIL 5, 2022

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ADAMS Accession Nos.:
Package: ML22088A155
NRC Response: ML22088A157
Industry SGTF Request: ML22006A030

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DATE	3/30/2022	4/5/22

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Table. Example Scenarios of How Thermally Treated Alloy 600 (Alloy 600TT) Units On a 72 Effective Full Power Month (EFPM) Inspection Interval Would Be Affected by the Detection of Cracking for the First Time During a Staggered Inspection[1]

Inspection Scenario	Inspection Description	Initial Crack Detection	Next Inspection and Beyond
1	An initial 100% enhanced probe inspection was performed on all four SGs and no cracking is detected. The SGs enter a 72 EFPM inspection period. Thereafter, staggered inspections by SG **(e.g., SGs 1/3 and SGs 2/4 are offset by two refueling outages (RFOs) on an 18-month fuel cycle).**	After two cycles, a 100% enhanced probe inspection is performed in SGs 1/3. Cracking detected in SG 1. SG 3 had no cracking detected but is potentially affected by the degradation mechanism. SGs 2/4 may or may not have received a partial inspection from initial scope expansion but are potentially affected by the degradation mechanism. All SGs are now limited to a 54 EFPM maximum inspection period.	All SGs are now limited to a 54 EFPM maximum inspection period [basis: STS 5.5.8.d.2].[2] SGs 1/3 – since a 100% enhanced probe inspection was performed and cracking was detected, inspection for the degradation mechanism is required at the second subsequent RFO [basis: STS 5.5.8.d.3]. SGs 2/4 – inspection is required at the next RFO to meet (i) the 54 EFPM maximum inspection period [basis: STS 5.5.8.d.2], and (ii) since the SGs did not receive a 100% enhanced probe inspection after cracking was detected in SG 1 [basis: STS 5.5.8.d.3].
1a	Initial 100% enhanced probe inspection to enter 72 EFPM. Thereafter, staggered inspections by SG subpopulation **(e.g., 50% of each SG per outage offset by two RFOs on an 18-month fuel cycle)**.	After two cycles, enhanced probe inspection is performed on all tubes within the subpopulation in all SGs (e.g., 50% of each SG per inspection). Cracking detected in one SG. All SGs are now limited to a 54 EFPM maximum inspection period.	All SGs are now limited to a 54 EFPM maximum inspection period [basis: STS 5.5.8.d.2]. If less than 100% of tubes were inspected with the enhanced probe in all affected and potentially affected SGs, then inspection for the degradation mechanism is required at the next RFO [basis: STS 5.5.8.d.3]. In addition, any subpopulation of tubes not inspected by an enhanced probe during the RFO when cracking was detected would need to be inspected at the next RFO to satisfy the 54 EFPM inspection period [basis: STS 5.5.8.d.2].

[1] All intervals discussed in this table are maximum values and assume that they are supported by a plant-specific operational assessment. SGs shall not be operated beyond the maximum interval permitted by the plant-specific operational assessment.

[2] The NRC staff response reflects STS numbering based on the recently issued Revision 5 of the STS. Plant-specific technical specifications may use different numbering.

Inspection Scenario	**Inspection Description**	**Initial Crack Detection**	**Next Inspection and Beyond**
			If 100% of all tubes (scope expansion) in all SGs were inspected with the enhanced probe, inspection for the degradation mechanism for affected and potentially affected SGs is required at the second subsequent RFO [basis: STS 5.5.8.d.3]. Those tubes not inspected at the second subsequent RFO would be inspected at the third subsequent RFO to satisfy the 54 EFPM inspection period [basis: STS 5.5.8.d.2].
2	Initial 100% enhanced probe inspection to enter 72 EFPM. **Subsequent 100% enhanced probe inspections every 3rd RFO (24-month fuel cycle)**.	A 100% enhanced probe inspection performed in SGs A, B, and C after 72 EFPM. Cracking detected in SG A. SGs B and C had no cracking detected. All SGs are now limited to a 54 EFPM maximum inspection period.	All SGs are now limited to a 54 EFPM maximum inspection period [basis: STS 5.5.8.d.2]. SGs A, B, and C – since a 100% enhanced probe inspection was performed, inspection for the degradation mechanism is required at the second subsequent RFO (after 48 EFPM) [basis: STS 5.5.8.d.3]. In addition, the second subsequent RFO will likely be used to meet the 54 EFPM maximum inspection period requirement [basis: STS 5.5.8.d.2].
2a	Initial 100% enhanced probe inspection to enter 72 EFPM inspection period. Staggered inspections by SG **(e.g., SGs A/B and SG C are offset starting two RFOs on a 24-month fuel cycle)**.	A 100% enhanced probe inspection performed in SGs A and B after 48 EFPM. Cracking detected in SG A. SG B had no cracking detected. All SGs are now limited to a 54 EFPM maximum inspection period.	All SGs are now limited to a 54 EFPM maximum inspection period [basis: STS 5.5.8.d.2]. Therefore, SG C will likely be inspected at the time cracking was detected in SG A to meet the 54 EFPM maximum inspection period requirement [basis: STS 5.5.8.d.2]. Assuming 100% of all tubes in all SGs receive an enhanced probe inspection, inspection for the degradation mechanism is required at the second subsequent RFO [basis: STS 5.5.8.d.3].

Inspection Scenario	Inspection Description	Initial Crack Detection	Next Inspection and Beyond
			Assuming less than 100% of all tubes in all SGs receive an enhanced probe inspection, inspection for the degradation mechanism is required at the next subsequent RFO [basis: STS 5.5.8.d.3]. In addition, the second subsequent RFO will likely be used to meet the 54 EFPM maximum inspection period requirement [basis: STS 5.5.8.d.2].