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Loss of Steam Generator Tube Integrity From Wear at Tube Support Plates NRC Staff Perspective

NRC Public Meeting with SGTF
September 5, 2024
Corrosion and Steam Generator Branch, NRR/DNRL

ACRONYMS

- EPRI – Electric Power Research Institute
- SGTF – EPRI Steam Generator Task Force
- TSTF – Technical Specifications Task Force
- RFO – Refueling Outage
- ISPT – In situ Pressure Test
- 3xNOPD – 3 Times Normal Operating Pressure Differential
- CMOA – Condition Monitoring Operational Assessment
- PWR – Primary Water Reactor
- SG – Steam Generator
- MA – Mill Annealed
- TT – Thermally Treated
- EFPM – Effective Full Power Months
- TS – Technical Specifications
- OA – Operational Assessment
- NDE – Nondestructive Examination
- TSP – Tube Support Plates

PWR Fleet SG Technical Specifications History

- Original SG TS until 2005
  - Prescriptive surveillance requirements
- TSTF-449 (2005)
  - Performance based TS framework
- TSTF-510 (2011)
  - Extended inspection periods, deleted mid-points
- TSTF-577 (2021)

Yellow shade = TSTF-577

	Tube Material		
	Alloy 600MA	**Alloy 600TT**	**Alloy 690**
Inspect Interval (maximum)	**Unchanged at 24 EFPM**	**From 48 to 54 (72) EFPM**	**From 72 to 96 EFPM**
Inspect Period	**From 60 to 24 EFPM**	**From 120, 96, 72 to 54 (72) EFPM**	**From 144, 120, 96, 72 to 96 EFPM**

Background - Operating Experience

- Alloy 690 SG tube inspection - Nov. 2023 RFO
- 9 flaws (4 tubes) did not satisfy condition monitoring analytically and required ISPT
- Based on ISPT, 2 tubes failed to meet TS structural integrity performance criterion (3xNOPD)
- Unit had skipped a planned 3rd RFO SG tube inspection after adopting TSTF-577 and revising the OA
- Revised OA was nonconservative:
  - Sub-population of aggressive wear (low rows) not recognized
  - Assumed tapered wear shape in low rows instead of flat wear

NRC Staff Perspective

- This operating experience resulted from an inadequate OA and NDE calibration/sizing error, not from a TSTF-577 issue
- Loss of tube integrity due to wear at support structures should not happen; degradation readily detected and sized with eddy current inspection
- Although tubes failed at or near the 3xNOPD criteria, the revised OA for wear at TSPs also allowed for an additional operating cycle. The inspection interval was limited by tube wear at anti-vibration bars

Discussion Topics

- Are any generic changes needed?
  - EPRI guidelines
  - Tube wear calibration standards and sizing techniques
  - OA techniques
- What is industry's expected level of internal vendor review and licensee review/acceptance of SG CMOA documents?
- For longer inspection intervals or challenging CMOAs, should the OA technique parameters/assumptions that are most sensitive to changing the time between inspections be highlighted within the CMOA?
- When are third party CMOA reviews prudent?
  - Licensee's internal expertise
  - OA results approaching acceptance criteria

References

- Technical Specifications Task Force, TSTF-577, “Revised Frequencies For Steam Generator Tube Inspections,” Final Traveler Safety Evaluation, ADAMS Accession No. ML21098A188

- Licensee Event Report, Event 56834, “Steam Generator Tube Degradation Indicated by Failed In-Situ Pressure Testing,” ADAMS Accession No. ML23364A001

- Notice of Violation, NRC Inspection Report 05000382/2024013, ADAMS Accession No. ML24228A261