

Steam Generator Operating Experience

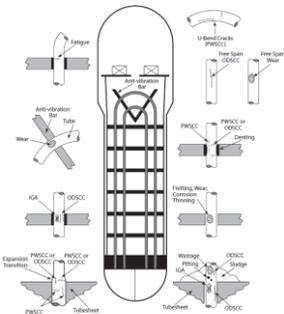
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Steam Generator Designs

- **2 major types of steam generators**
 - **Recirculating: “U-shaped” tubes**
 - **Once-through: Straight tubes**
- **Steam generator tube materials**
 - **Mill Annealed Alloy 600 (600MA)**
 - **Thermally treated Alloy 600 (600TT)**
 - **Thermally treated Alloy 690 (690TT)**

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Types of Tube Degradation



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Industry Program

- **Industry responded to emerging degradation**
- **Industry standardized programs for addressing steam generator issues**
 - **Water Chemistry Guidelines**
 - **Inspection and Integrity Guidelines**
 - **Primary-to-Secondary Leakage Guidelines**

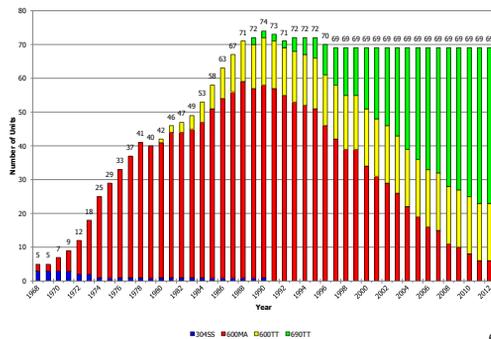
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Steam Generator Replacements

- **57 of 69 units have replaced steam generators**
- **Incorporated design enhancements to address degradation**
 - **Stress relief of U-bend region**
 - **Corrosion resistant materials**

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Units in Operation: 1968-2012



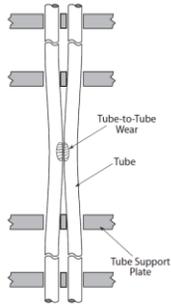
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Operating Experience – Replacement Steam Generators

- Tie rod bowing
- “Large” amounts of wear at tube supports in some replacement steam generators
- Wear due to tube-to-tube contact in once through steam generators
- Wear due to tube-to-tube contact in recirculating steam generators

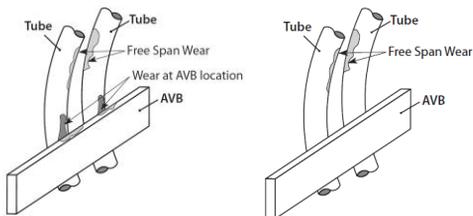
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Tube-to-Tube Wear – Once Through Steam Generators



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Tube-to-Tube Wear – Recirculating Steam Generators



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Regulatory Framework

- **Inspection/Repair of tubes governed by plant technical specifications**
 - risk informed, performance based
- **Multi-Tiered Oversight/Monitoring**
 - Region
 - Headquarters

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Summary

- **Steam generator tubes may degrade**
- **Degradation can be managed**
- **Staff monitors steam generator operating experience**
- **Staff's focus is on tube integrity**

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