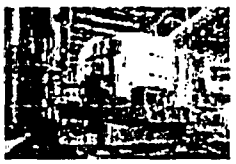
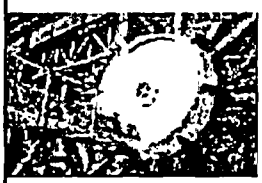
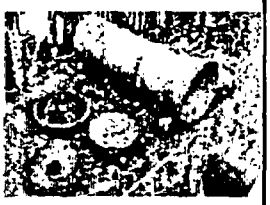
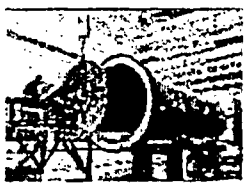
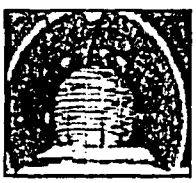



Callaway Steam Generator Replacement Project




Nonproprietary

AGENDA

Introduction

General Description of Replacement Steam Generators (RSG)
- Why Replace/Improvements
- Replacement Steam Generator/Original Steam Generator comparison
- Replacement Steam Generator Features

Westinghouse NSSS RSG Analyses:

RSG Licensing Activities
- T/S Changes
- Methodology Changes

Application of Leak Before Break to the Pressurizer Surgeline
- Plans to address Alloy 600 weld
- Schedule for re-submittal of WCAP-15983

Other Refuel 14 OL Submittals
- MSIV Technical Specifications stroke time increase
- Inclusion of Feedwater Control Valves into Technical Specifications

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General Description of RSGs

Why Replace?

Stress Corrosion Cracking Identified in 1995

- Model F S/G, 80% Mill Annealed I-600 Tubes

- Extensive Maintenance and Repair Required for 40 year life
- S/G Replacement Study Completed in Feb. 2000
- Base Case showed replacement is Cost Justified when considered over life of plant

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Vendor Support and Structure

- March 2001 - SGT Selected for Installation
- December 2001 - Framatome ANP Selected for RSG Fabrication
- December 2001 - Westinghouse Selected for Accident Analysis / Licensing

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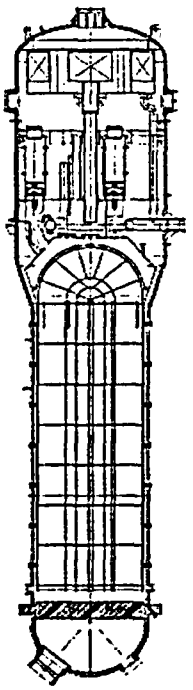

Framatome 73/19T RSG

- Improved Performance
- All Forged Construction
- Integral Steam Nozzle and Flow Restrictor
- High Efficiency Moisture Separators
- Anti-Stratification Feedwater Inlet
- Foreign Object Capture System
- Optimized Level Control Taps
- Improved U-Bend Support System
- Increased Tube Surface Area
- Alloy 690 Thermally Treated Tubing
- Increased Circulation Ratio
- Access Ports at Each Support Plate Elevation
- Elimination of the Tubelane Blowdown Pipe
- Grooved Nozzle Dam Retention Ring
- Electro-Polished Channel Head Bowls
- Self-Draining Channel Heads (No Belly Drain)
- Improved Manufacturing Techniques

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General Description of RSGs

RSG vs. OSG Comparison

	W Model F	Framatome 73/19 T
Tube Material	Alloy 600MA	Alloy 690TT
Tube OD (in.)	11/16	3/4
Tube Wall Thickness (in.)	0.040	0.043
Tube Pitch (in.)	0.98 square	1.031 triangular
Number of Tubes	5626	5872
Tube Surface Area (ft^2)	55,000	78,946
Bundle Height (in.)	348	433.9
Weight, Dry (lbs.)	715,000	743,100
Circulation Ratio	3.64	4.00
Best Est. RCS Flow (gpm)	101,900	104,400
Steam Press (psia) @ T-hot of 614 °F (0% SG tube plugging)	970	1,021
Specified MCO (%)	<0.25	<0.10

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General Description of RSGs

RSG vs. OSG Comparison

	W Model F	Framatome 73/19 T
Steam Generator Areas and Volumes		
Primary Side SG Volume, ft^3/SG	962	1,352
Secondary Side SG Water Volume (no load), ft^3/SG	3,560	3,322
Secondary Side SG Steam Volume (100% power), ft^3/SG	3,814	3,491
Main Steam and Feedwater Conditions		
Full Load Main Steam Temperature, °F	538.4	547
Full Load Main Steam Flow (100% power), lb/hr-SG	3.99E+06	4.01E+06
Feedwater Flow (100% power), lb/hr-SG	3.99E+06	4.05E+06
Blowdown Capacity, lb/hr-SG	44,000	120,000

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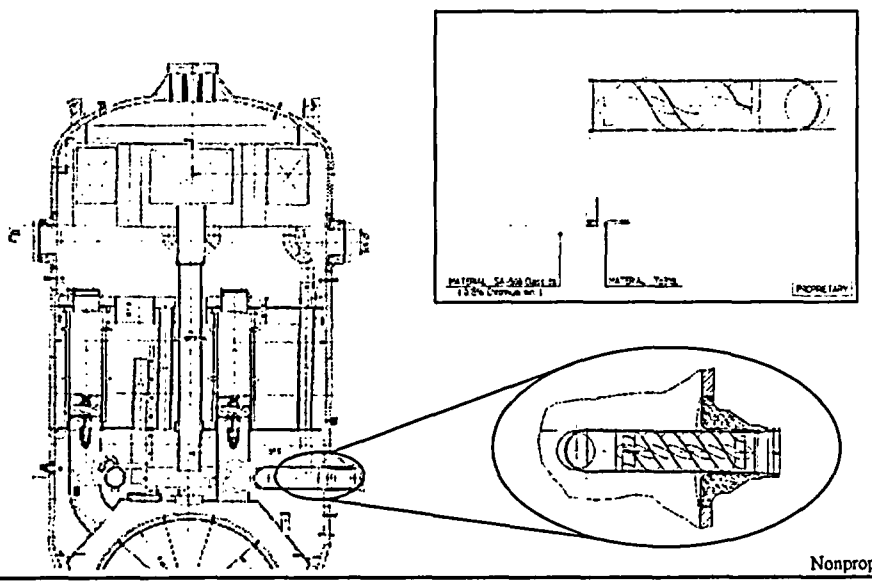
AmerenUE FRAMATOME ANP

Anti-Stratification Device (Helix)



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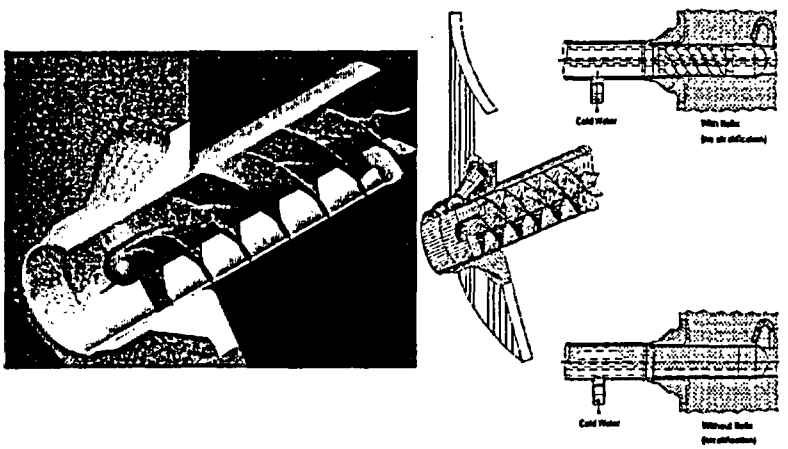
Anti-Stratification Device (Helix)

The Helix is an anti-stratification device which minimizes the effects of thermal stratification, particularly during the injection of cold Auxiliary Feedwater during plant transients. It also acts as a feedwater flow restrictor in the case of a feedwater pipe break.



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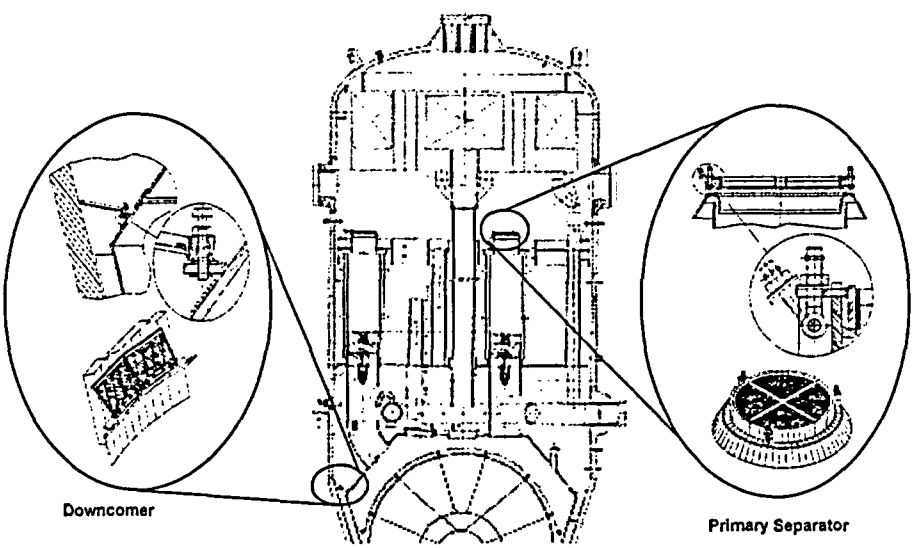
Foreign Object Capture System



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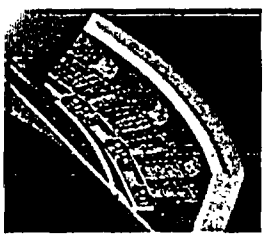
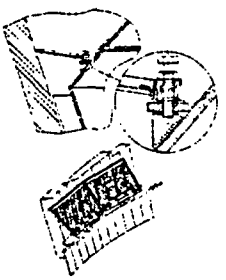
Foreign Object Capture System

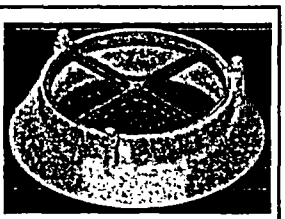


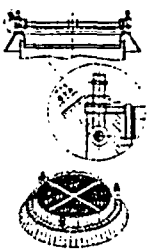


Callaway was the first plant to require a foreign object capture system be included in the RSG design.

The purpose of the system is, of course, to prevent the introduction of foreign objects into the secondary side of the steam generators in order to protect against loose parts damage to the tubes.

Eliminating foreign objects and their associated risk is a key component in the justification of extended operating cycles after the completion of the SGR.





Downcomer

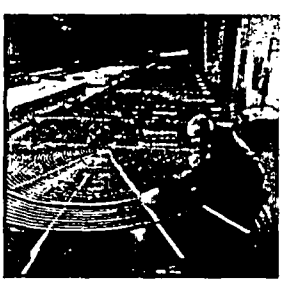
Nonproprietary

Cyclone Separator

SANDVIK Welcome to Sandvik Steel

Tubing

The RSG tubing was manufactured in Sweden by Sandvik Steel. The tubing is the most critical part of the RSG design and fabrication. Alloy 690TT is used as it has been demonstrated to have much higher resistance to corrosion than does Alloy 600. The tubing has a nominal diameter of 0.75" with a nominal wall thickness of 0.043".



Stringent requirements were been placed on the quality of the tubing, including the number and size of imperfections and the minimal signal-to-noise ratio for eddy current examination. The tubing has its own detailed specification for smelting, machining and inspecting. It is included in the Certified Design Specification as Appendix B.

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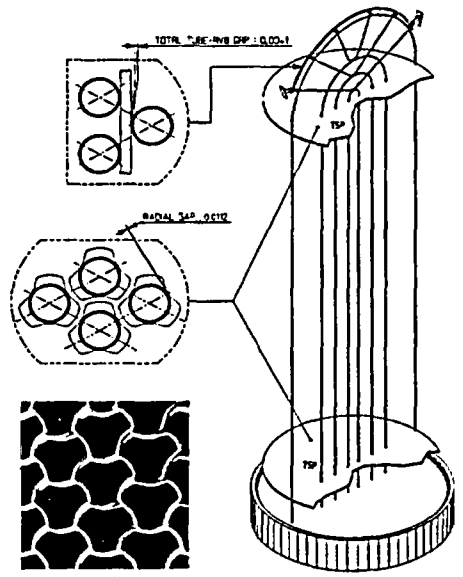
Tube Bundle



Broached plate

The bundle consists of 5872 Alloy 690TT tubes, each having a nominal OD of 3/4" and a nominal wall thickness of 0.043". A total heat transfer area of 78,946 ft² provides the required steam exit pressure (1010 psia) at a reduced T_{hot} of 614°F.

The tube bundle is of the "incremented type", which uses increased straight length of tubes as their bending radii increase.

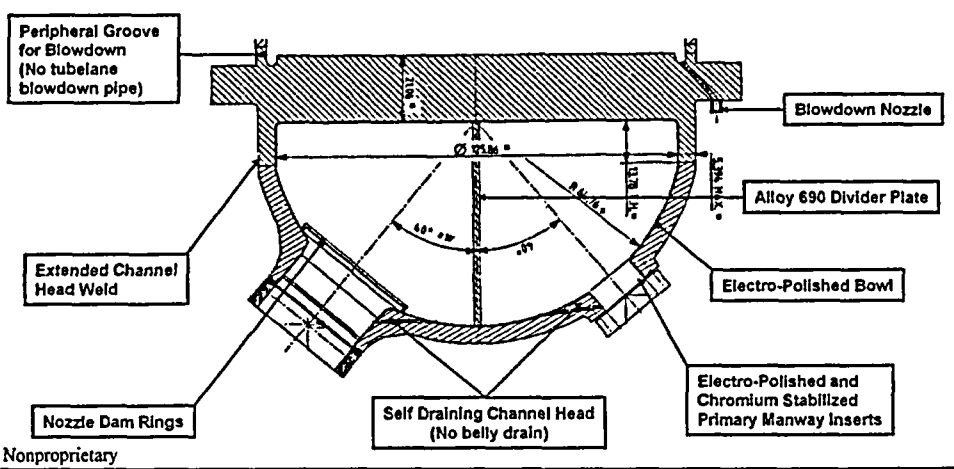
Eight 410SS Tube Support Plates (TSPs) are utilized to avoid vibration. The TSPs have broached holes, with three flat lands per broached opening, for tube support. TSPs are laser aligned prior to tube installation.

The top portion of the tube bundle is supported by three sets of 405SS Anti-Vibration Bars (AVBs). All U-bends, including Row 1, are supported. A very small tube / AVB gap of 4.1 mils is used to prevent fretting and wear of the tube.

Nonproprietary

Primary Channel Head

The primary channel head is a low allow steel forging with two (each) integral nozzles and manways. After cladding, the channel head will be mechanically finished to 40 Ra, followed by electro-polishing. The channel heads are self-draining, allowing the elimination of the belly drains. The tubesheet forging is extended several inches to allow the primary circumferential weld (and PWHT) to be performed at a distance from the expanded tubes.



Nonproprietary

RSG Safety Analysis Scope

Westinghouse NSSS analysis and licensing efforts to support the RSG which included:

- Analyses and evaluations to support RSG
- Analysis of LBLOCA and SBLOCA events using updated Westinghouse Appendix K Methodology
- Re-analysis of most Non-LOCA events using the RETRAN-02 computer code
- Analyses to support a 15-second MSIV stroke time for a future plant modification and T/S change

Nonproprietary

RSG Safety Analysis Scope

Westinghouse NSSS analysis and licensing efforts to support the RSG which included (continued):

- Calculation of T/S instrumentation uncertainties and protection system setpoints
- Updating the Containment P/T and Steam Tunnel Subcompartment Analysis using the GOTHIC computer code
- Removal of the SG Trip Time Delays from the Callaway design and from the T/S

Nonproprietary

Licensing Activities

The proposed amendment would revise the following Technical Specifications (TS) :

- TS 2.1.1, "Reactor Core Safety Limits"
- TS 3.3.1, "RTS Instrumentation"
- TS 3.3.2, "ESFAS Instrumentation"
- TS 3.4.1, "RCS Pressure, Temperature and Flow DNB Limits"
- TS 3.4.5, "RCS Loops – MODE 3"
- TS 3.4.6, "RCS Loops – MODE 4"

Nonproprietary

Licensing Activities

The proposed amendment would revise the following Technical Specifications (continued) :

- TS 3.4.7, "RCS Loops- MODE 5, Loops Filled"
- TS 3.4.13, "RCS Operational Leakage"
- TS 3.7.1, "Main Steam Safety Valves"
- TS 5.5.9, "Steam Generator Tube Surveillance Program"
- TS 5.5.16, "Containment Leakage Rate Testing Program"
- TS 5.6.10, "Steam Generator Tube Inspection Report"

Nonproprietary

Licensing Activities

The proposed amendment would also add new TS 3.4.17, "Steam Generator Tube Integrity", pursuant to Technical Specifications Task Force (TSTF) Improved Standard Technical Specifications Change Traveler TSTF-449, Revision 2.

Nonproprietary

Licensing Activities

The following analyses for the Callaway RSG Project use first-time methodology applications:

- Excessive Increase in Secondary Steam Flow Event
  This analysis was performed using a simplified statepoint hand calculation analysis instead of an explicit analysis via the RETRAN code. Results show that the acceptance criteria are met.
- Loss of Normal Feedwater Event
  Previously, an overly-conservative single analysis was performed to bound the FSAR Chapter 15 analysis and the AFW System Reliability analyses. For the RSG, a dual-analyses approach that separately addresses both scenarios was implemented. Results show that all acceptance criteria are met.

Nonproprietary

Licensing Activities

The following analyses for the Callaway RSG Project use first-time methodology applications (continued):

- Although these two methodologies are being employed at Callaway for the first time, they have been used in numerous submittals for other plants to the NRC in the recent past.

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Other Refuel 14 OL Submittals

- A revision to TS 3.7.3 that will add the main feedwater control valves and bypass valves to LCO 3.7.3. These valves are backup and diverse equipment in the RSG MFLB analysis, being added to LCO 3.7.3 as Criterion 4 equipment credited in the event of an MFIV failing open. Submittal was signed 27 Oct 2004.
- A revision to TS 3.7.2 that will increase the allowed MSIV closure to 15 seconds in support of plans to install new MSIV actuators during Refuel 14. This additional time delay has been accounted for in the RSG analyses. Submittal is scheduled for 15 Dec 04.

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LBB for the Pressurizer Surge Line

Mitigation measures to be applied at the Alloy 82/182 pressurizer nozzle safe end weld are being evaluated:

- Weld overlay
- Replace Alloy 600 Weld with a Stainless Steel Weld

Nonproprietary

LBB for the Pressurizer Surge Line

Proposed schedule for implementation mitigation measures and approval of WCAP-15983:

- Evaluation of the effects of this mitigation measure on the surge line LBB analysis and an update to the WCAP if necessary – January to Mid February
- NRC approval of WCAP-15983 and any relief requests if required – prior to outage start
- Implementation of mitigation measure – Callaway Refueling Outage 14 scheduled for Fall 05

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