ANO1 Steam Generators

NRC Presentation
Results of the First ISI

Entergy/AREVA NP
August 2007

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ANO1 Steam Generators

- Introductions – Dale James
  - Cleve Reasoner – Site Eng. Director
  - Bill Greeson – EP&C Supervisor
  - Dan Meatheany – SG Lead
  - Al Buford – SG Design Engineer
  - AREVA NP
    - Jeff Brown
    - Jim Begley
    - Tim Wiger
    - Dennis Lang
    - John Remark
    - Linda McConnell

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ANO1 Steam Generators

- AGENDA
  - Opening Remarks – Cleve Reasoner
  - Description of EOTSG – Dan Meatheany
  - Outage Results – Dan Meatheany

Proprietary Section
- Root Cause – Jim Begley
- Operability – Tim Wiger

  - Outage Plans for 1R21- Bill Greeson
  - Closing Comments – Cleve Reasoner

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ANO1 Steam Generators

Opening Comments

Cleve Reasoner

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ANO1 EOTSG Design

- Description of EOTSG – Dan Meatheany
  - Generators Replaced in Fall of 2005 (1R19)
  - First ISI was Spring 2007 (1R20)
  - EOTSG was Manufactured by AREVA NP
  - Design Enhanced from Originals (EOTSG)
  - First of a Kind Design in Several Areas

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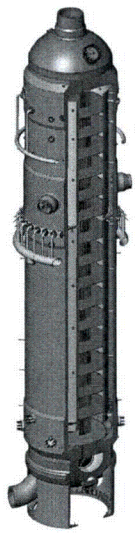
ANO1 EOTSG Design



- 15 Tube Support Plates
- External FW and EFW Rings
- Floating TSP/Tie Rod
- TSP are Trefoil Broach SS
- Aspirating Port in 10th Span
- Upper and Lower Shroud
- FW into Downcomer
- EFW Penetrates Shroud
- 52 Tie Rods in 4 Concentric Circles

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ANO1 EOTSG Design

- Design Changes
  - 690TT Tubing with Flush Tube Ends
  - No Open Lane
  - Full Depth Hydraulic Expansion
  - TSP are Stainless Steel not Carbon Steel
  - Use of a "Filler Plate" on the 1st, 14th and 15th – Original was 1st and 15th Only and was a Wedge Design Attached to TSP
  - Use of Modified TSP Wedges (AREVA NP Design)
  - First Span Tie Rods Reduced in Diameter and Longest Span – 46 inches
  - Tie Rods Are Different in Design/Material
  - Use of a Main Steam Venturi

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1R20 Inspection Results

- Cycle 20 and 1R20 Inspection Findings – Dan Meatheany
  - Cycle 20 had 2 Thermal Cycles and 1EFW Injection
  - Three Significant Inspection Findings:
    - Proximity Indications in the First Span in SGA Indicative of Bowed Tie Rods
    - General TSP Wear Growth Greater than Anticipated
    - Population of Wear at the 8th TSP in SGA was Larger and had a Distinct Pattern

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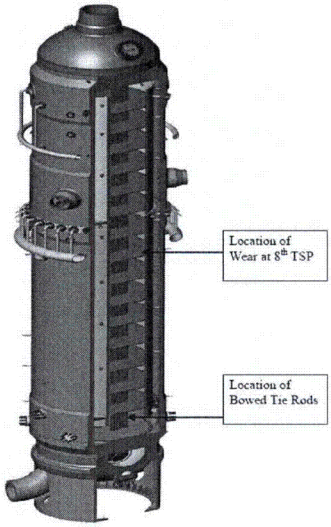
1R20 Inspection Results



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1R20 Inspection Results

Bowed Tie Rods

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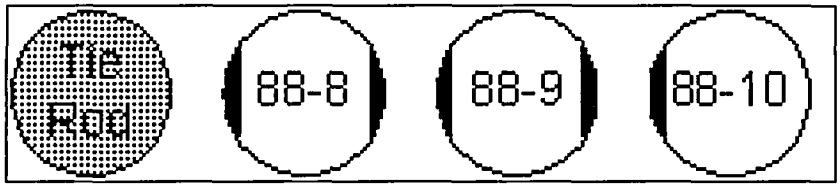
1R20 Inspection Results



Proximity Detected with Bobbin

Row 88 Seemed to Be the Bounding Bow

No Wear Associated with Bowed Tie Rods/Tubes

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1R20 Inspection Results

- Initially Detected 7 Tie Rod Locations with Contact in SGA Only – None in SGB
- All in First Span
- Bowing was Toward the Center of the Bundle
- Reviewed all 52 Tie Rod Locations in Both Generators

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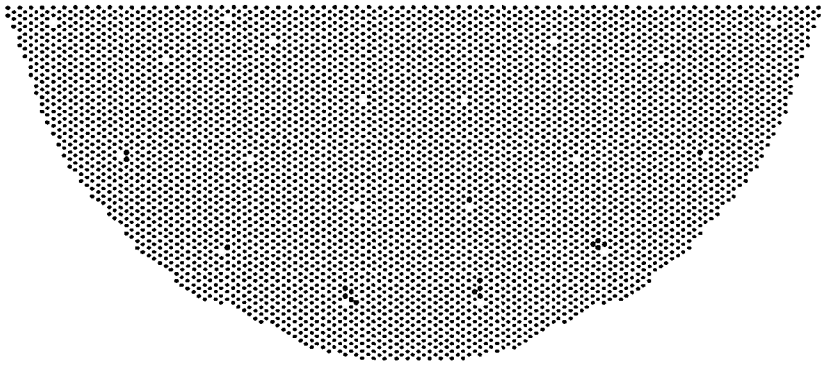
1R20 Inspection Results



Z Axis

First Span

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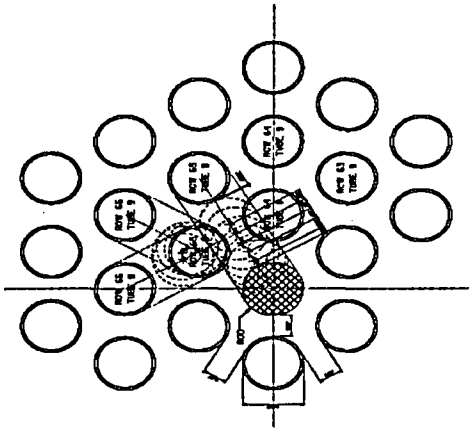
1R20 Inspection Results



Tie Rod Tube Interaction at Location Row 64

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1R20 Inspection Results

TSP Wear Growth Rate

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1R20 Inspection Results

	SGA	SGB
Outage	1R20	1R20
Total Number of Tubes	15595	15597
# of Wear Indications	690	512
# of Tubes with Wear	651	435
% of Tubes with Wear	4.20%	2.80%
Average Depth	7.40%	8.30%
Maximum Depth	23	28
# of Indications ≥ 40% TW	0	0
# of Indications ≥ 20% but ≤ 39%	4	8
# of Indications ≥ 1% but ≤ 19%	686	504
EFPY for Cycle	1.31	1.31
Average Growth	7.40%	8.30%
95/50 Growth	12%	15%
Maximum Growth per EFPY	17.70%	21.50%
# Tubes Plugged in 1R20	0	1
Total Number of Tubes Plugged	2	1

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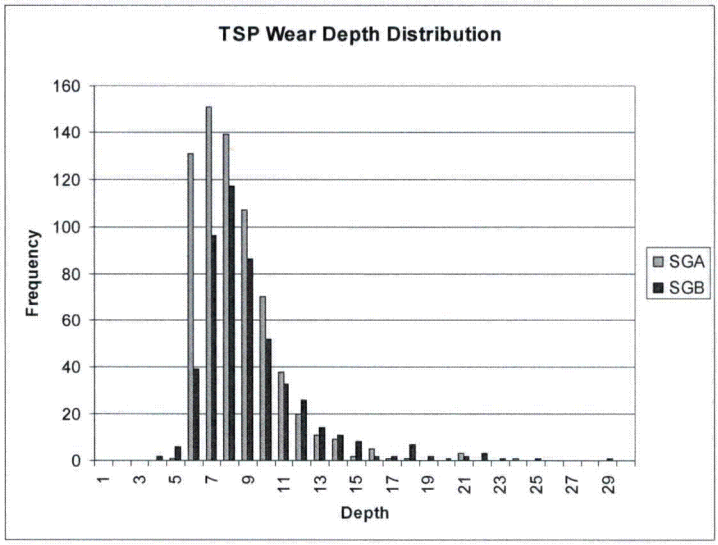
1R20 Inspection Results



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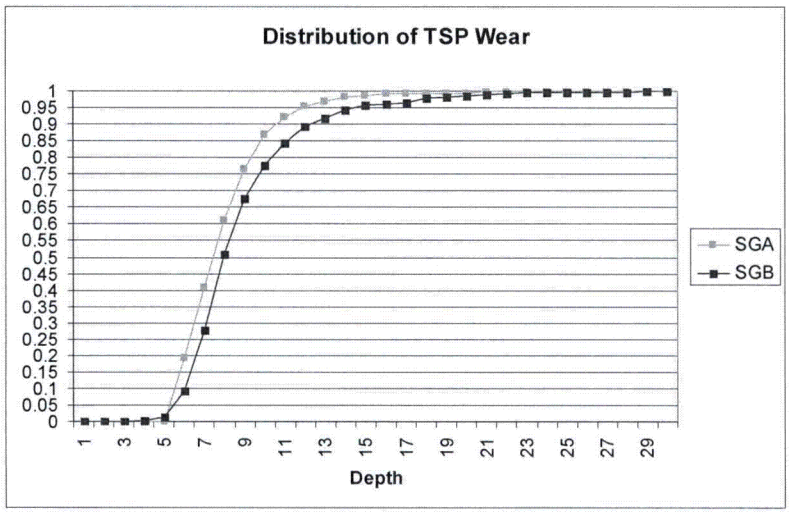
1R20 Inspection Results



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1R20 Inspection Results

8th TSP Wear in SGA

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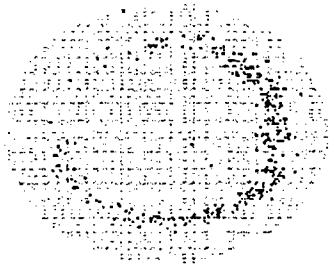
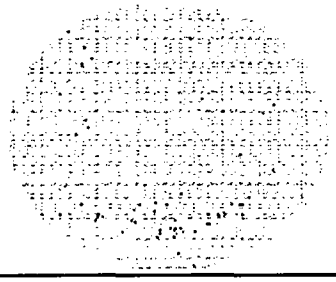
1R20 Inspection Results



Z Axis on SGA

8th TSP Indications in SGA and SGB – Note crescent shape in SGA



Z Axis on SGB

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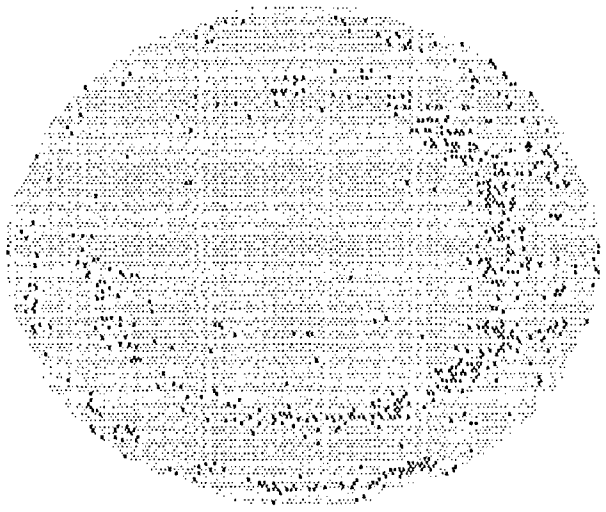
1R20 Inspection Results



Z Axis on SGA

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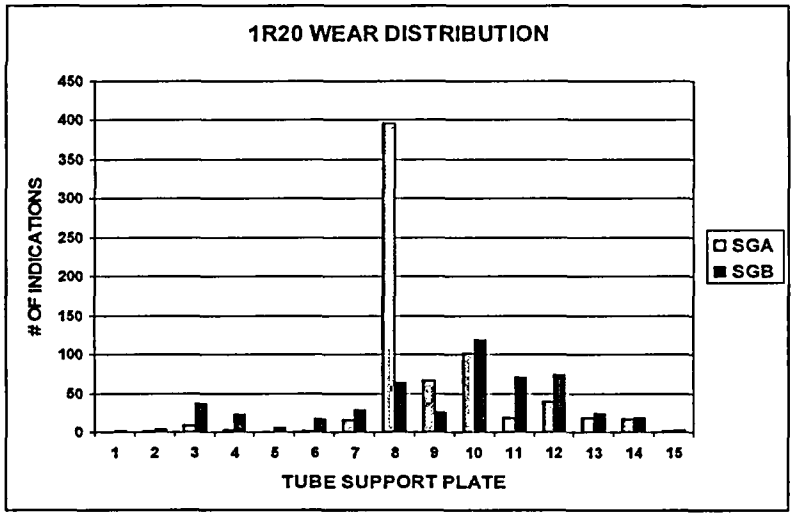
1R20 Inspection Results



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Entergy

ANO1 Steam Generators

AREVA

ANO Unit 1 1R21
Inspection Plan

Bill Greeson

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Entergy Current 1R21 Inspection Plans

AREVA

- Purpose of Inspections
- Scope of Inspection
- Acceptance Criteria
- Definition of Success

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Entergy Purpose of 1R21 Inspections

AREVA

- Confirm Apparent Root Cause and Analysis Inputs
  - Determine magnitude of tie rod bow
  - Determine if free-span wear exists on tubes around tie rods
  - Determine if denting exists on tubes around tie rods
- Evaluate general wear for comparison to predictions
- Evaluate wear on 8th TSP
- Identify anything unexpected

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Current 1R21 Inspection Scope

- Primary – Both Generators
  - 100% Bobbin Both Generators
  - Array Probe/ RPC of all Wear for Orientation
  - Emphasis on Tubes Around Tie Rods

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Acceptance Criteria for Tie Rod Lateral Bowing

Category	1R20 Inspection Value	Acceptance Criteria	Potential Additional Analysis, Repairs or Inspections
Maximum Lateral Extent of Tie Rod Bowing in First Span, Outermost Ring	0.89 inch	≤1.1 inch	> 1.1 inch
Maximum Lateral Extent of Tie Rod Bowing in First Span, Second Outermost Ring	0.38 inch	≤ 0.48 inch	>0.48 inch
Maximum Lateral Extent of Tie Rod Bowing in 14th and 15th Spans, Outermost Ring	0.11 inch	≤ 0.17 inch	>0.17 inch
Maximum Lateral Extent of Tie Rod Bowing in 14th and 15th Spans, Second Outermost Ring	No bowing detected	≤ 0.06 inch	> 0.06 inch
Bowed Rods in Contact with Tubes outside of First Span	0	0	≥1

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Acceptance Criteria for Wear/Dents caused by Tie Rod Lateral Bowing

Category	1R20 Inspection Value	Acceptance Criteria	Potential Additional Analysis, Repairs or Inspections
Freespan Wear on Tube from Tie Rod	0	0	≥ 5% TW
Tube to Tube Freespan Wear as a Results of Tie Rod Bowing	0	0	≥ 5% TW
Dents in Tubes Around Bowed Tie Rods ≥ 1 volt	0	0	≥ 1

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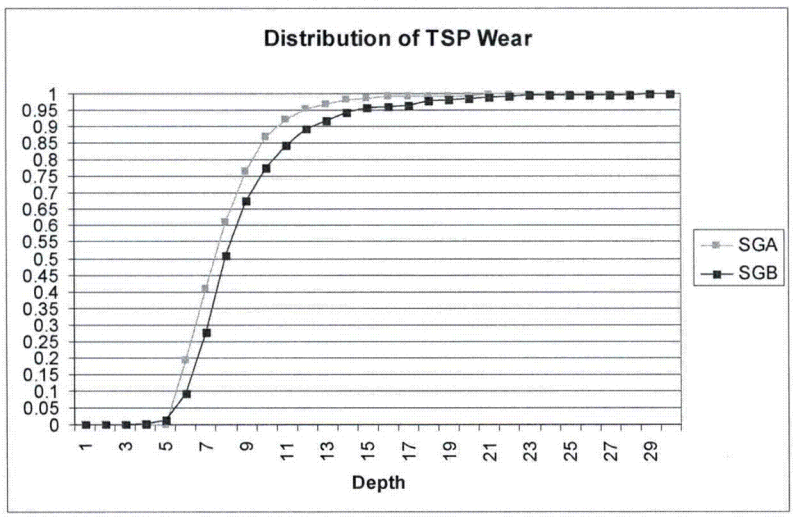
Acceptance Criteria for General Wear



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Definition of Success (1R21)

- Tie rod bowing magnitude is as predicted
- No freespan wear found in tubes around tie rods
- No denting found in tubes adjacent to tie rods
- General wear rates (including 8th TSP) $\leq$ 1st refuel cycle
- Max new wear depth is $\leq$ 28%
- Results of inspection will input into ASME code qualified stress calculation for "A" steam generator

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ANO1 Steam Generators

Closing Comments

Cleve Reasoner

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