ANO1 Steam Generators

NRC Presentation

Current Status of the Arkansas Nuclear One Unit One Steam Generators

Entergy/AREVA NP

December 2009

ANO1 Steam Generators

- Introductions –
  - Entergy
    - Jaime McCoy – EP&C Manager
    - Frank Philpott – EP&C Supervisor
    - Dan Meatheany – SG Program Owner
  - Areva
    - Jeff Brown – EOTSG Component Design Eng.
    - Jim Begley – Technical Consultant
    - Dennis Lang – Product Line Manager

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- AGENDA
  - Opening Remarks – Jaime McCoy
  - Description of EOTSG – Dan Meatheany
  - Outage Results – Dan Meatheany

Proprietary Section

  - Root Cause – Jim Begley

  - Outage Plans for 1R22 – Dan Meatheany
  - Questions
  - Closing Comments – Jaime McCoy

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Opening Comments

Jaime McCoy

Engineering Programs and Components Manager

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- Description of EOTSG – Dan Meatheany
  - Generators Replaced in Fall of 2005 (1R19)
  - First ISI was Spring 2007 (1R20)
  - Second ISI was Fall 2008 (1R21)
  - EOTSG was Manufactured by AREVA NP
  - Design Enhanced from Originals (EOTSG)
  - First of a Kind Design in Several Areas – This was to Address Original OTSG Degradation Issues

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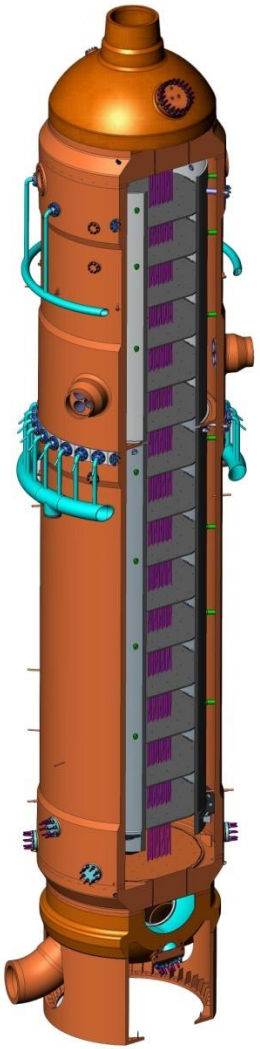

- 15 Tube Support Plates
- External FW and EFW Rings
- Floating TSP/Tie Rod
- TSP are Trefoil Broach SS
- Aspirating Port in 10th Span
- Upper and Lower Shroud
- Orifice Plate in Downcomer
- FW into Downcomer
- EFW Penetrates Shroud
- 52 Tie Rods Concentric Circles

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- Design Changes
  - 690TT Tubing with No Tube Ends
  - No Open Lane
  - Full Depth Hydraulic Expansion in Upper and Lower
  - 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 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

1R20 and 1R21 Outage Results

- Scope
- Bowed Tie Rods
- Wear

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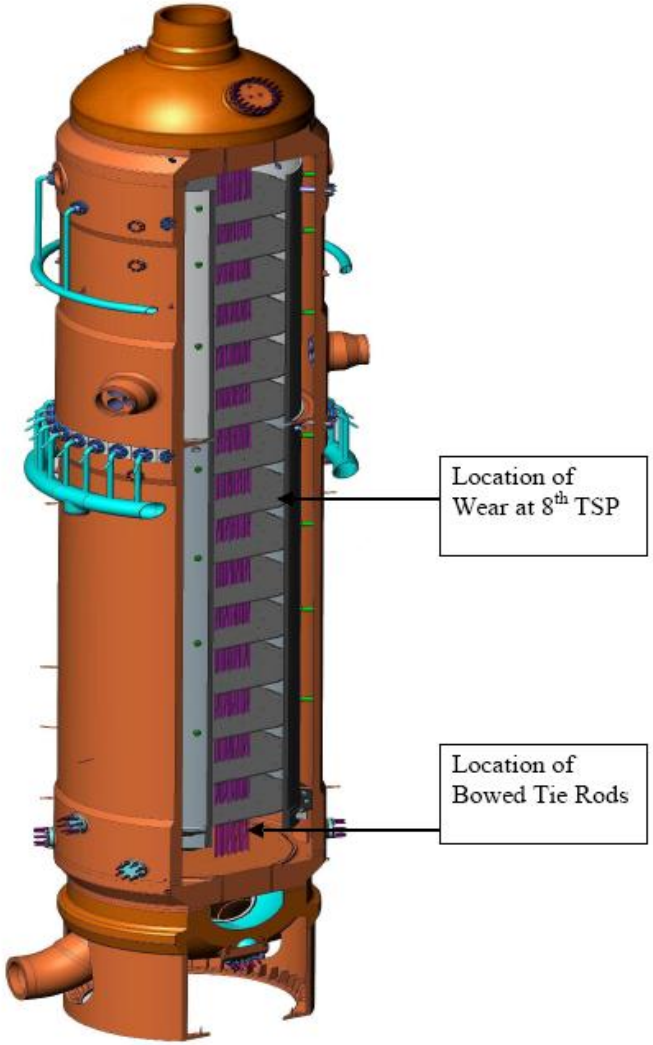

1R21 Scope

- 100% bobbin
- 100% X-probe of all Wear Indications
- Secondary Side Visual
  - Annulus and First Tube Support Plate
  - First Span Inner Bundle of Rods
  - 14th and 15th Tube Support Plate

Bowed Tie Rods

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	1R20	1R21
# of Bowed Tie Rods	9	10
Spans with Contact	1	1
Spans with Bowed Tie Rods	1st, 14th and 15th	1st, 2nd, 13th,14th and 15th
Maximum Extent of Bowing	0.89	1.19
Thermal Cycles	3	1
EFW Actuation	1	0

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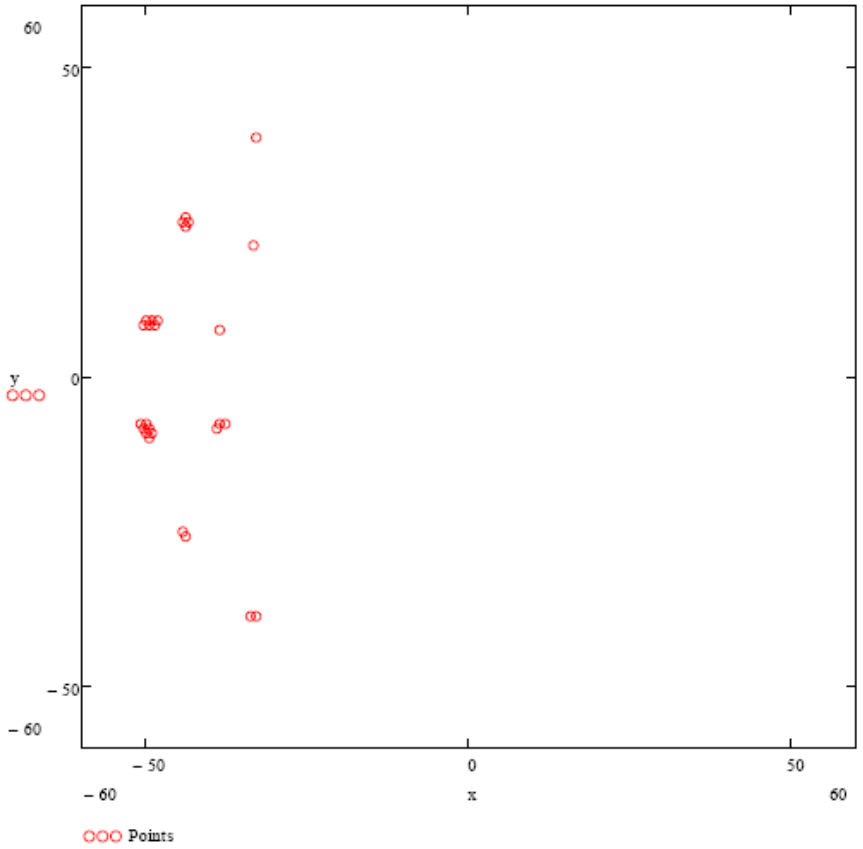

Figure 3-1: Tubesheet Map of Proximity Signal Locations, 1R20

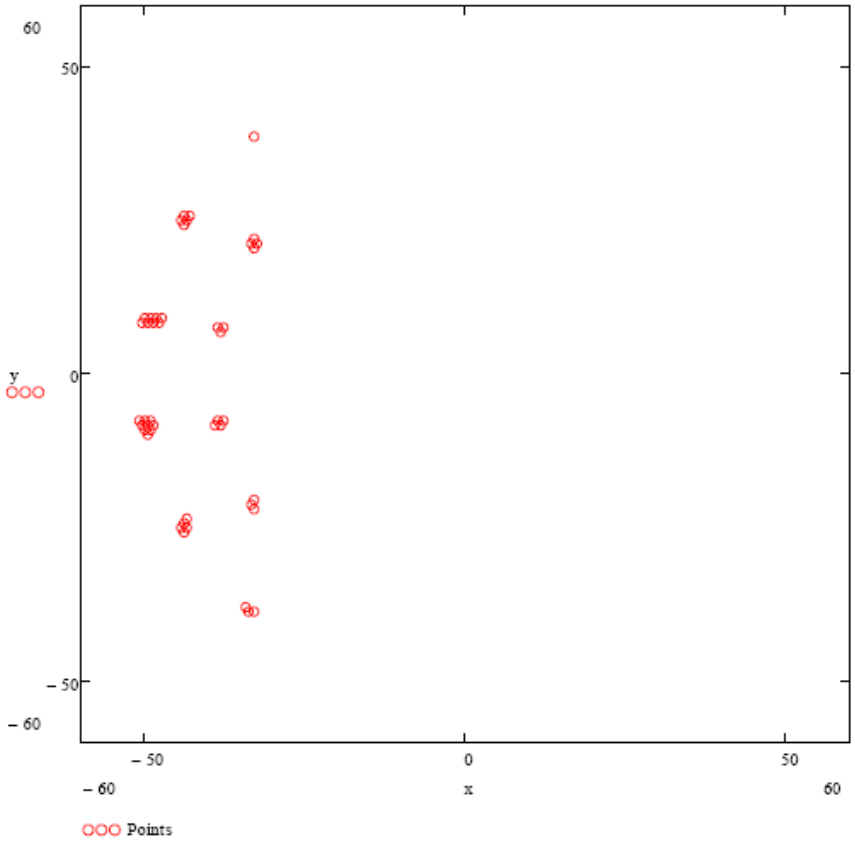

Figure 3-2: Tubesheet Map of Proximity Signal Locations, 1R21

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Table 2-2: Tubes Affected by Proximity Signals in 1R21

Tie Rod (Z-axis)	Bow at R20 (per Root Cause Rpt)	Bow at R21
Outermost Ring		
1st Span Z-Axis		
Row 24		< 0.45
Row 42		< 0.72
Row 64	0.83 < Bow < 0.89	1.17 < Bow < 1.19
Row 88	0.69 < Bow < 0.75	1.12 < Bow < 1.17
Row 110		< 0.84
Row 128		< 0.25
2nd Span Z-Axis		
Row 42	None detected	< 0.14
Row 88		< 0.13
13th Span Z-Axis		
Row 42	None detected	< 0.07
14th Span Z-Axis		
Row 42	None detected	< 0.14
Row 64		< 0.13
Row 88		< 0.13
15th Span Z-Axis		
Row 24	None detected	< 0.05
Row 42		< 0.19
Row 64		< 0.10
Row 88		< 0.15
Row 110	None detected	< 0.15
Row 128	None detected	< 0.13
1st Span Z-Axis		
Row 47	None detected	≤ 0.50
Row 66	0.30 < Bow < 0.37	
Row 86	0.25 < Bow < 0.32	
Row 105		
14th Span Z-Axis		
Row 86	None detected	< 0.09
15th Span Z-Axis		
Row 86	None detected	< 0.05

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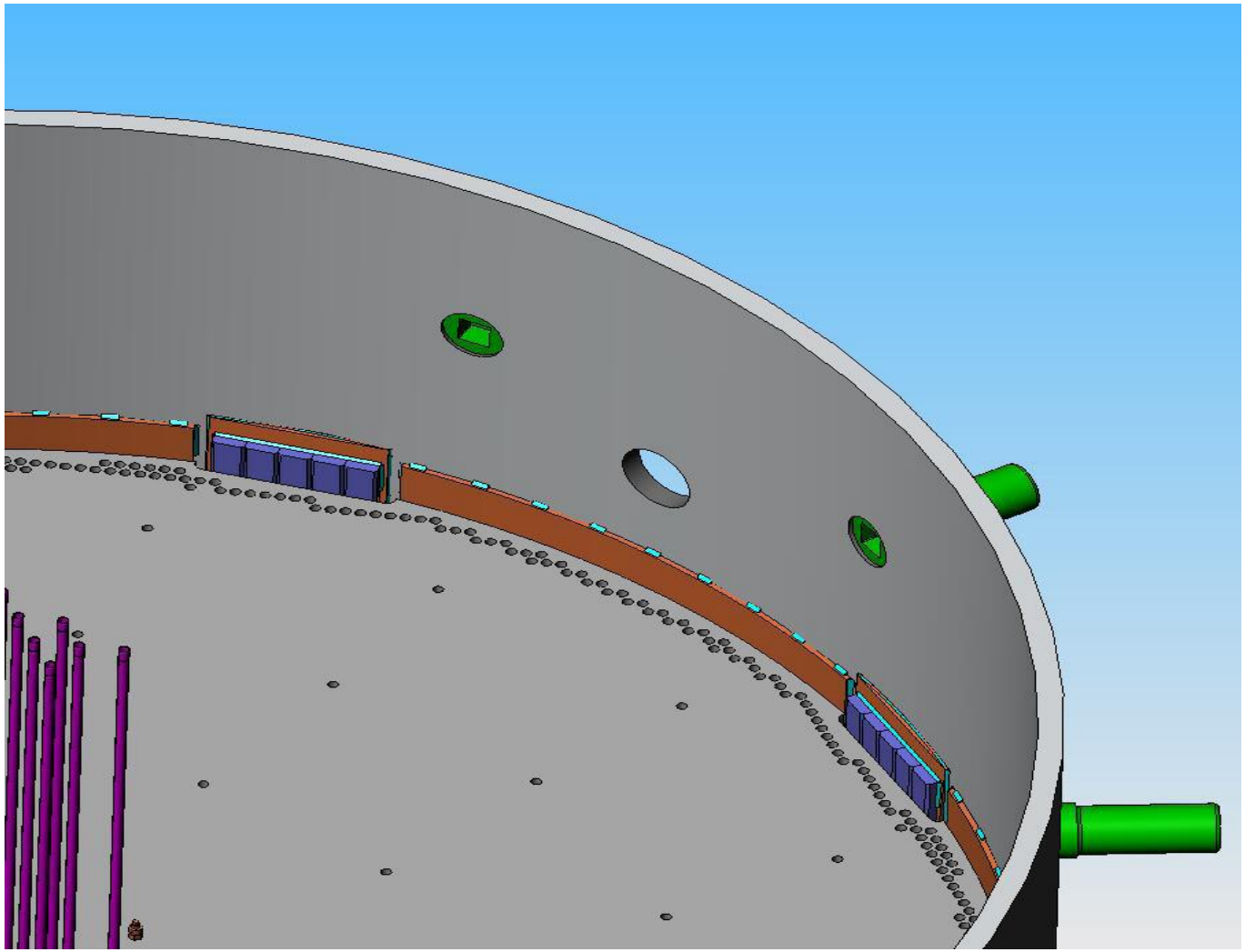

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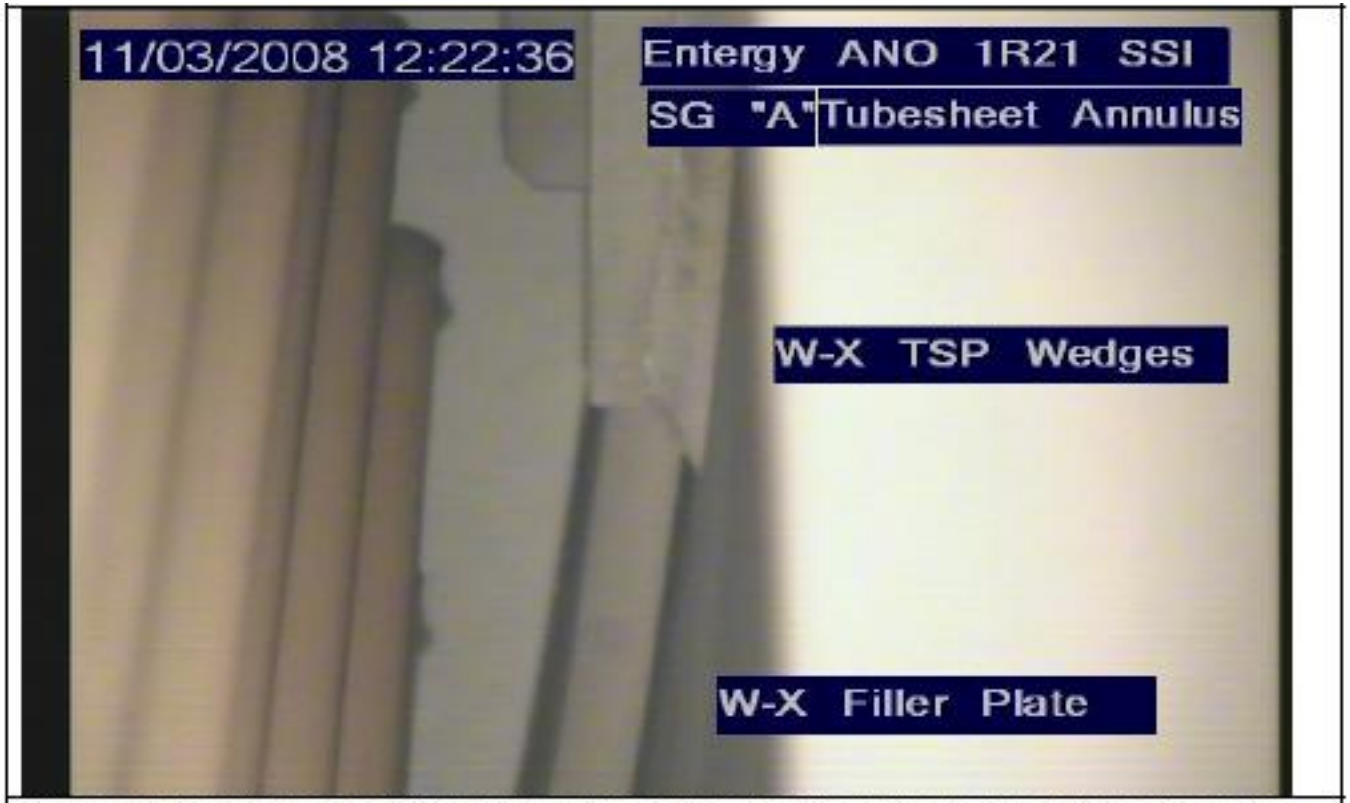

Picture 4 W-X Wedges and Filler Plate. Gap is present on both the wedge and the filler plate. Gap between the TSP and filler plate is larger than between the filler plate and the shroud.

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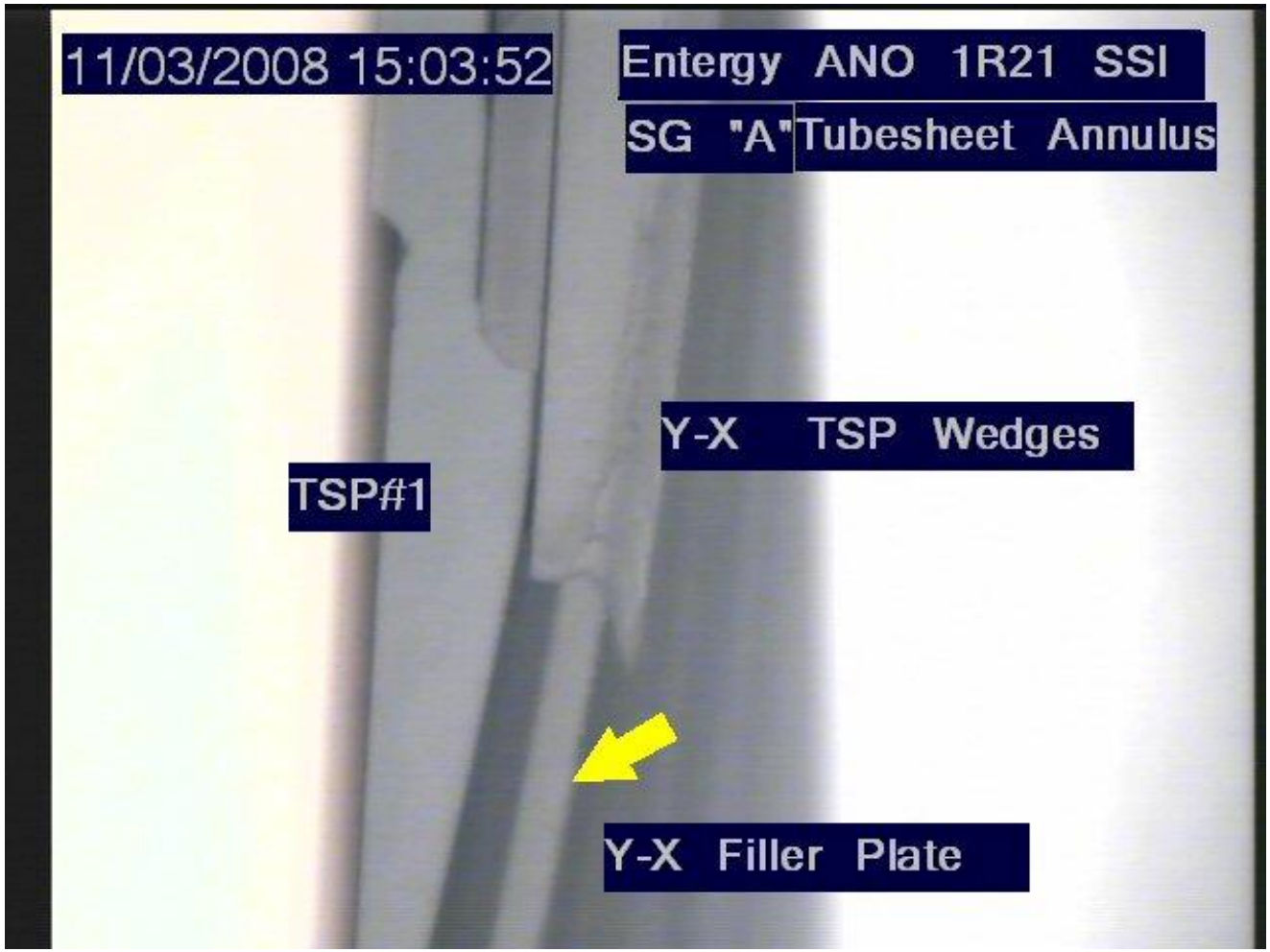

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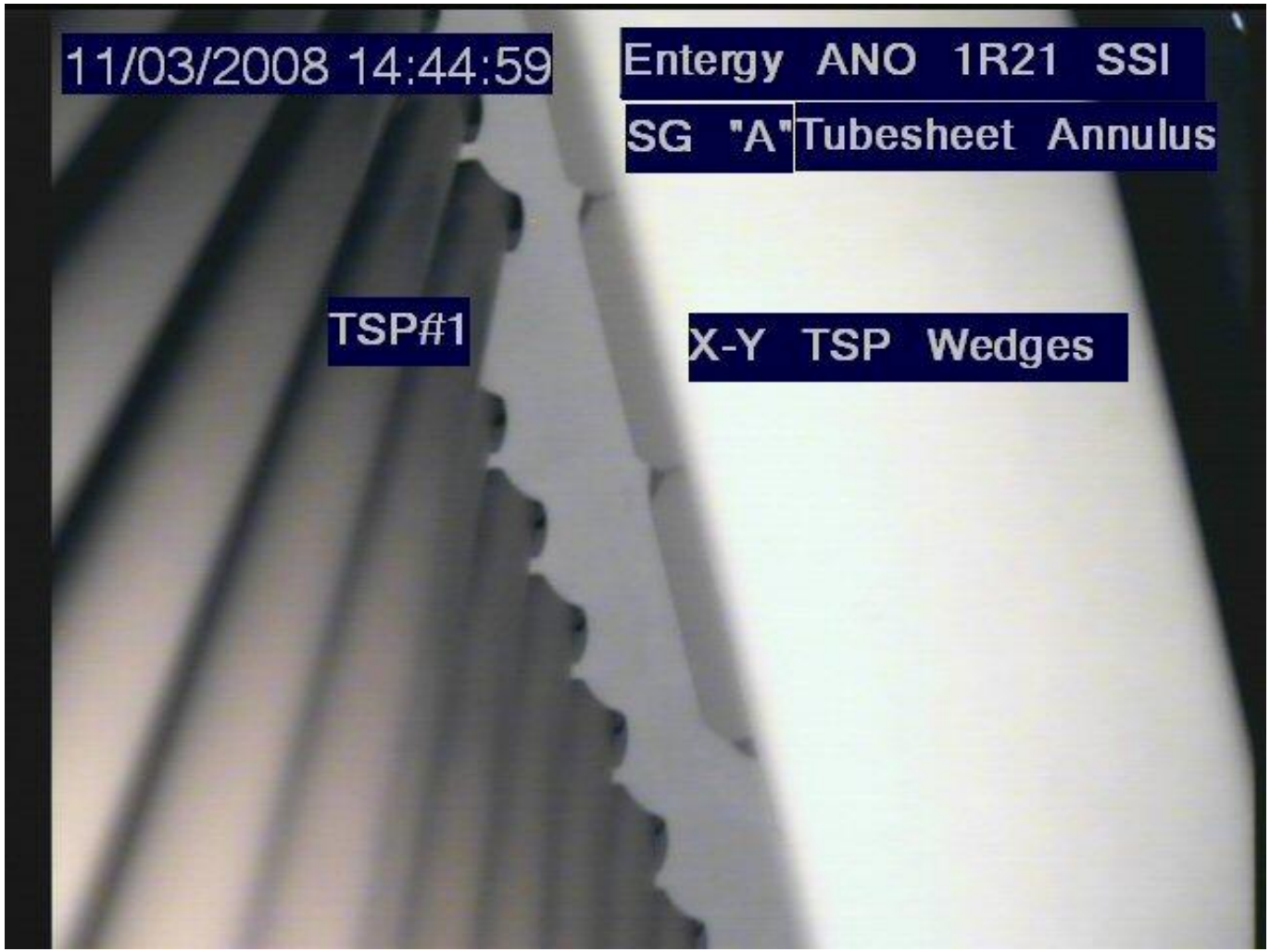

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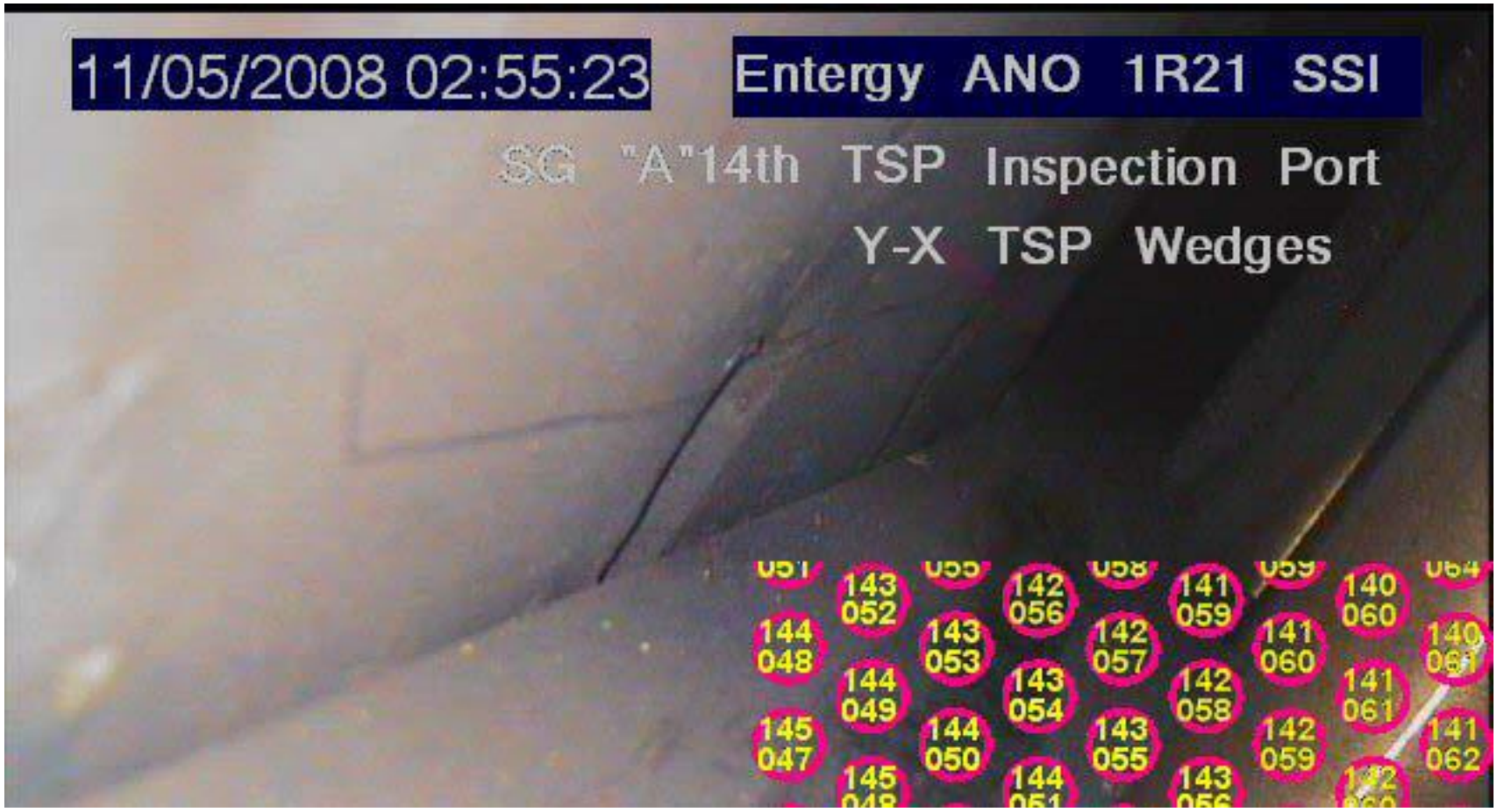

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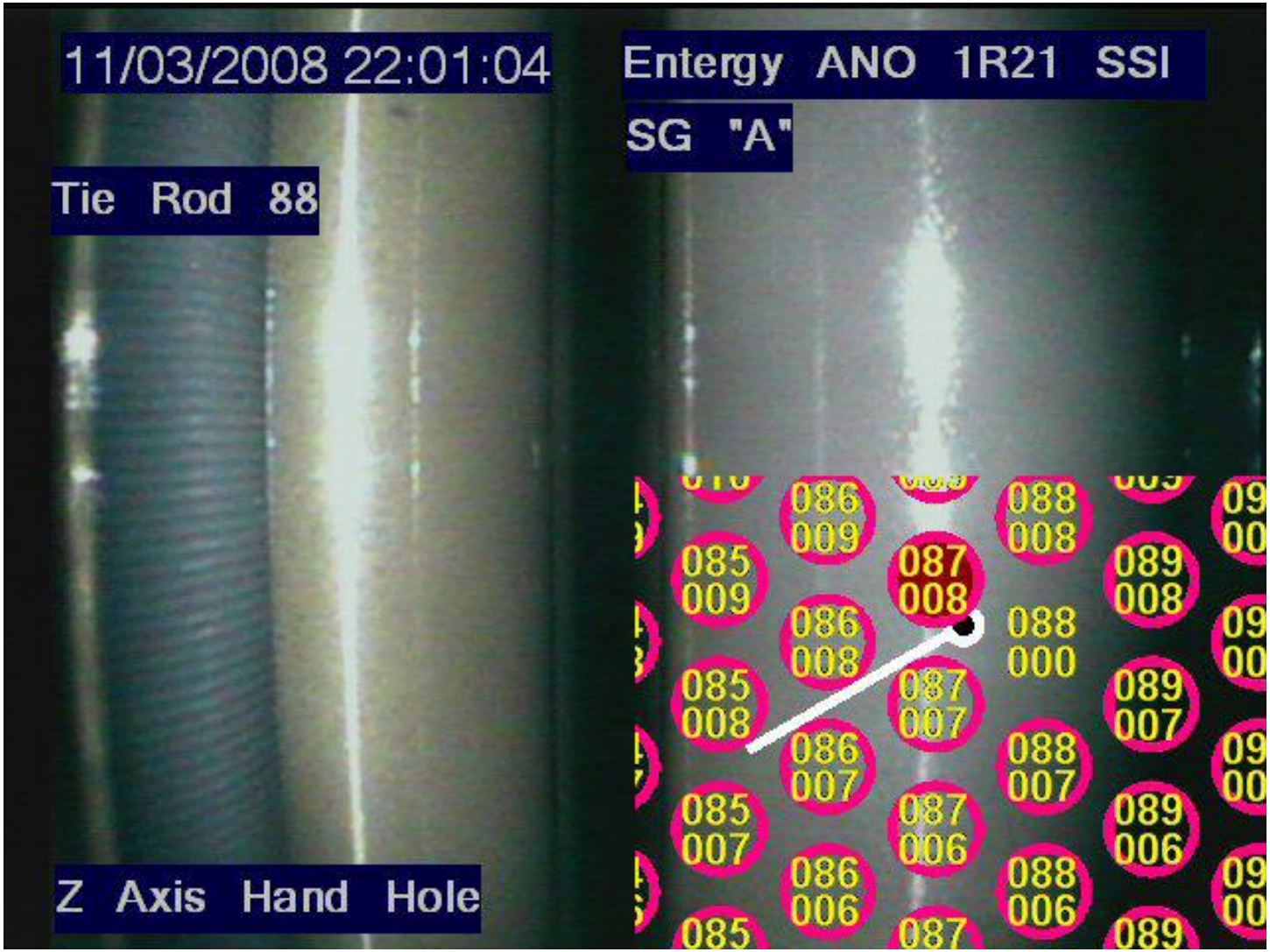

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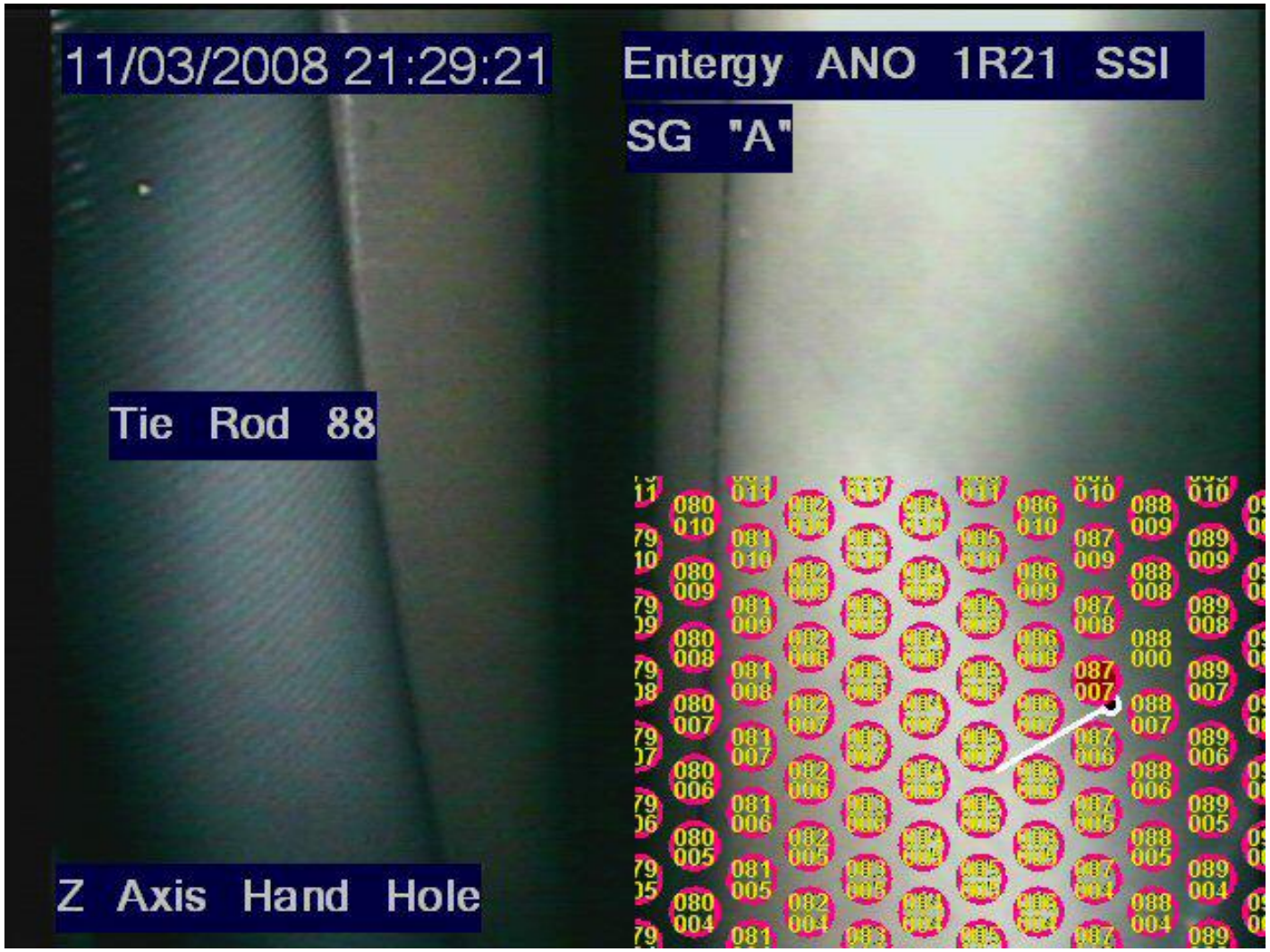

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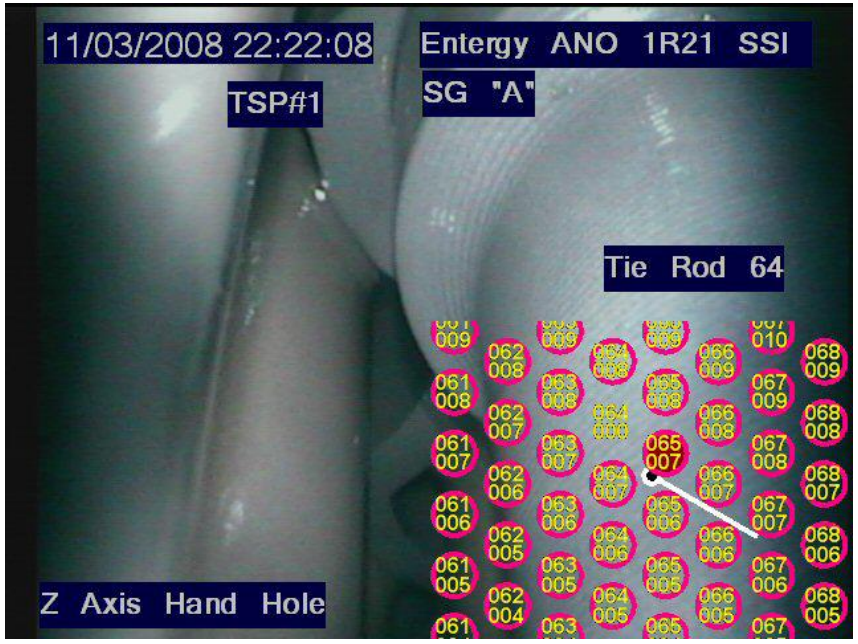

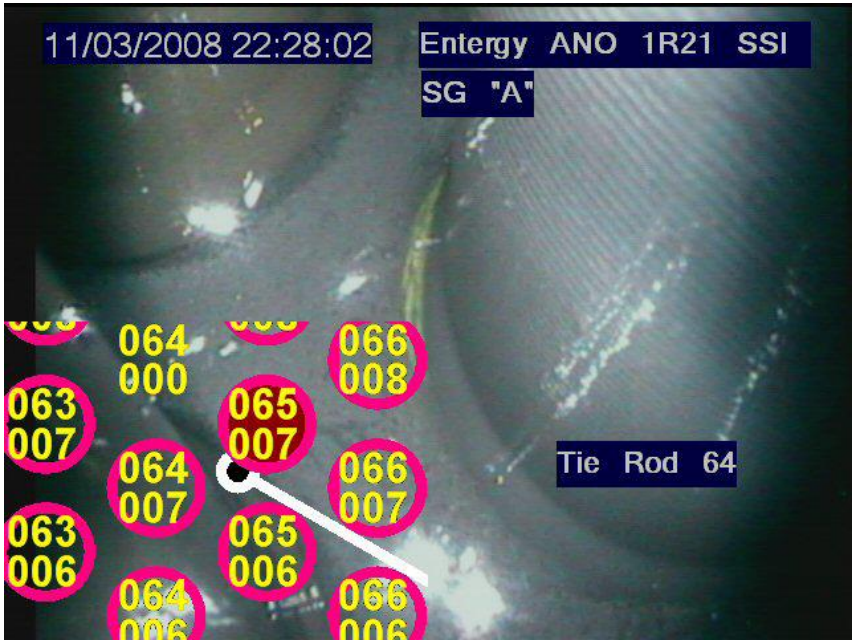

TSP Wear

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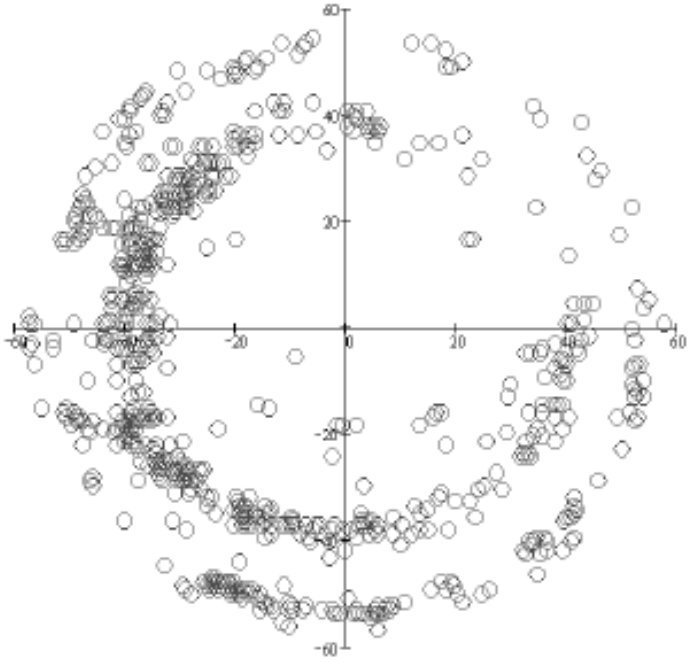
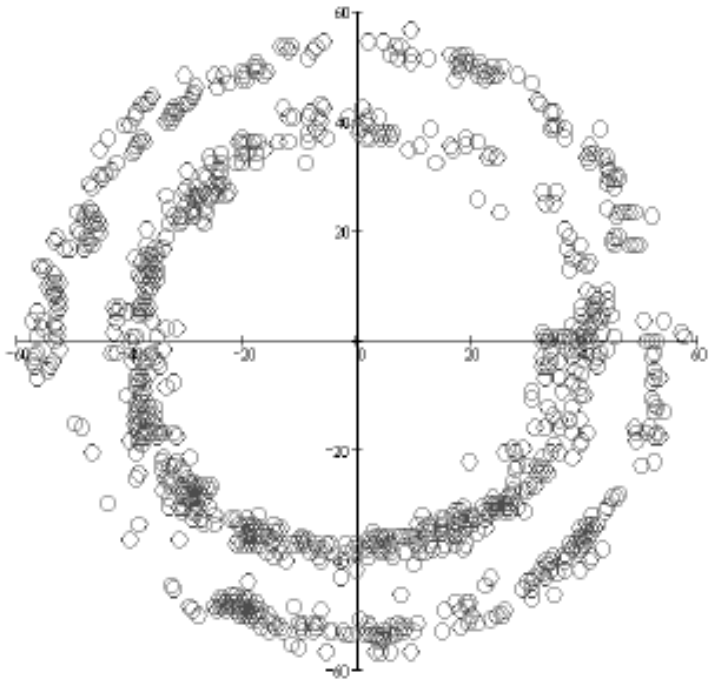


1R20 - SGA



1R21 - SGA

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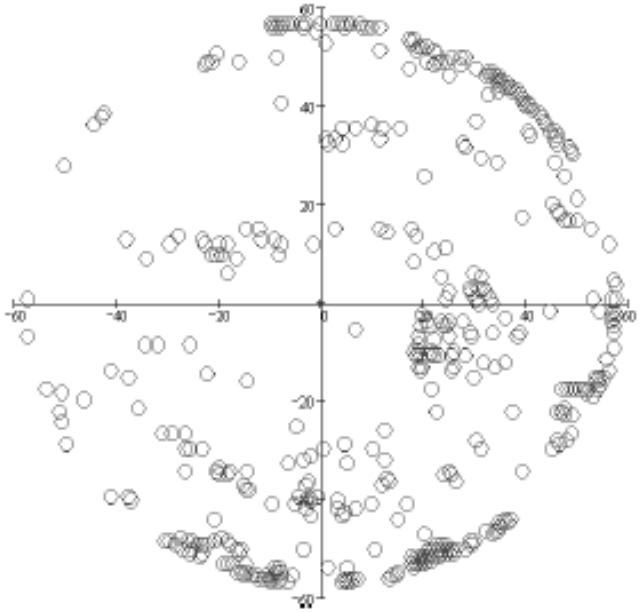
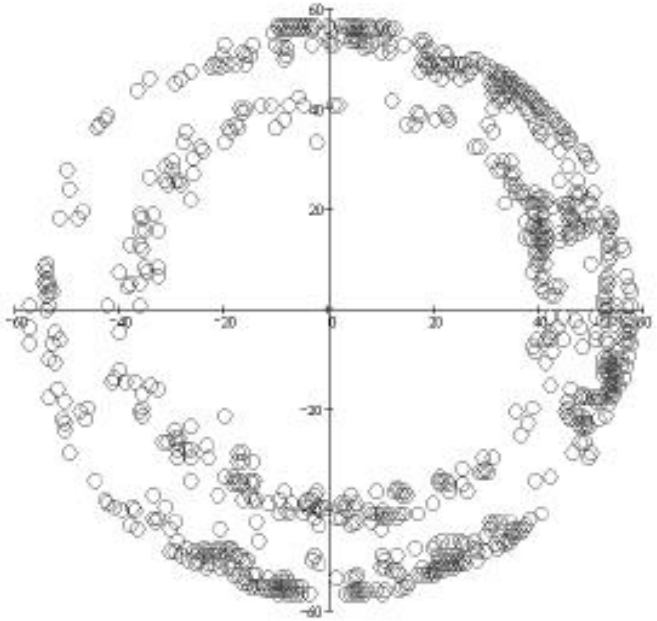


1R20 - SGB



1R21 - SGB

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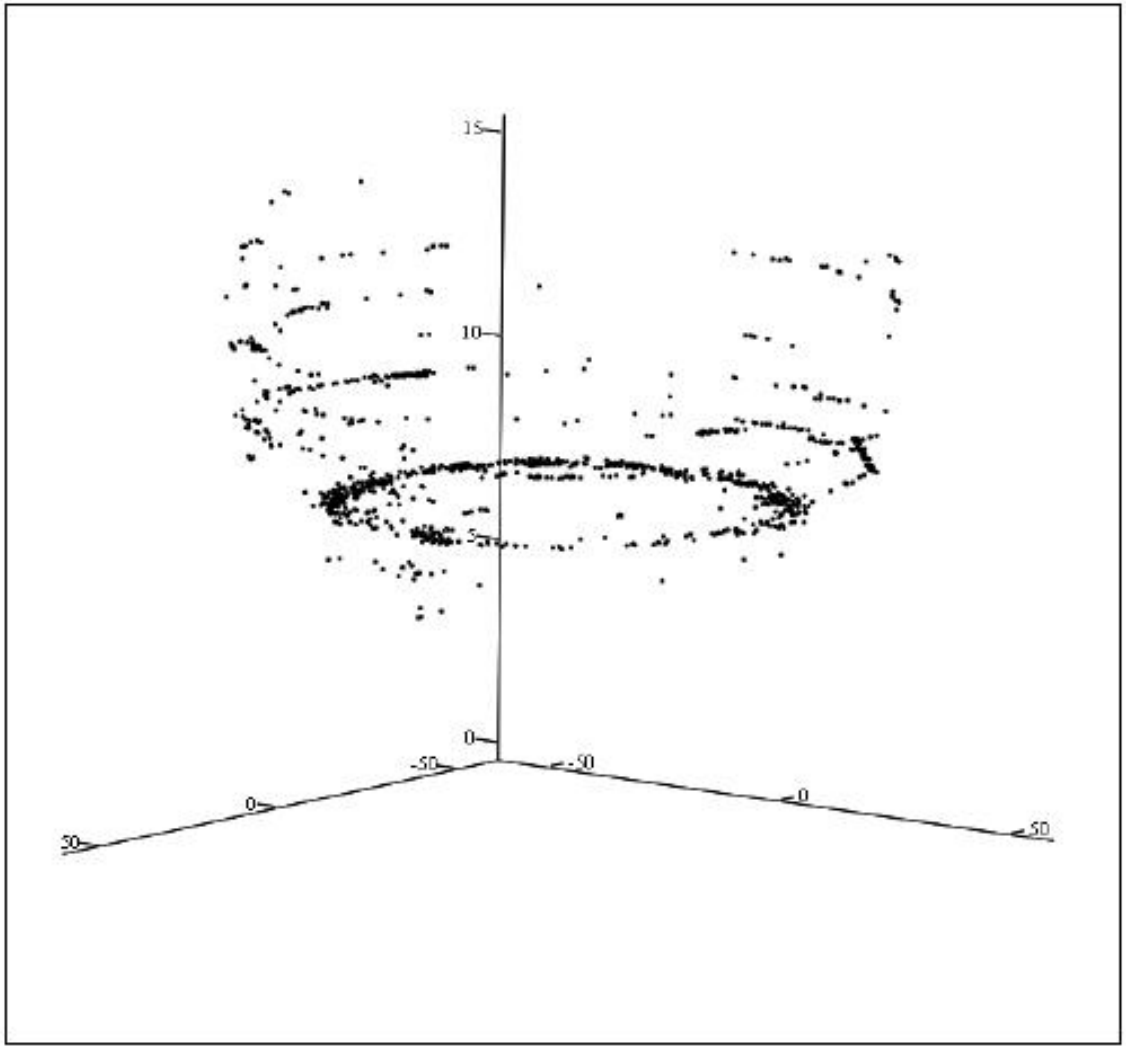

SGA – 1R21

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	SGA	SGB
Total Number of Tubes examined	15595	15596
# of Wear Indications	990	1029
# of Tubes with Wear	913	823
% of Tubes with Wear	5.85%	5.28%
# New Wear Indications	524	685
# Repeat Wear Indications	466	344
New Average Depth	7.6%TW	8.2%TW
New + Repeat Average Depth	7.7%TW	9.1%TW
Maximum Depth	32%TW	32%TW
# of Indications > 40% TW	0	0
# of Indications $\geq$ 20% but $\leq$ 39%	13	30
# of Indications > 1% but $\leq$ 19%	977	999
New+Repeat Average Growth	2.84 %TW/EFPY	4.34 %TW/EFPY
95/50 Growth (New Indications)	8.56 %TW/EFPY	9.99 %TW/EFPY
95/50 Growth (Repeat Indications)	3.57 %TW/EFPY	5.71 %TW/EFPY
Max Growth (New Indications)	22.11 %TW/EFPY	19.97 %TW/EFPY
Max Growth (Repeat Indications)	15.69 %TW/EFPY	14.27 %TW/EFPY
# Tubes Plugged	8	5

TSP Wear Growth Rate

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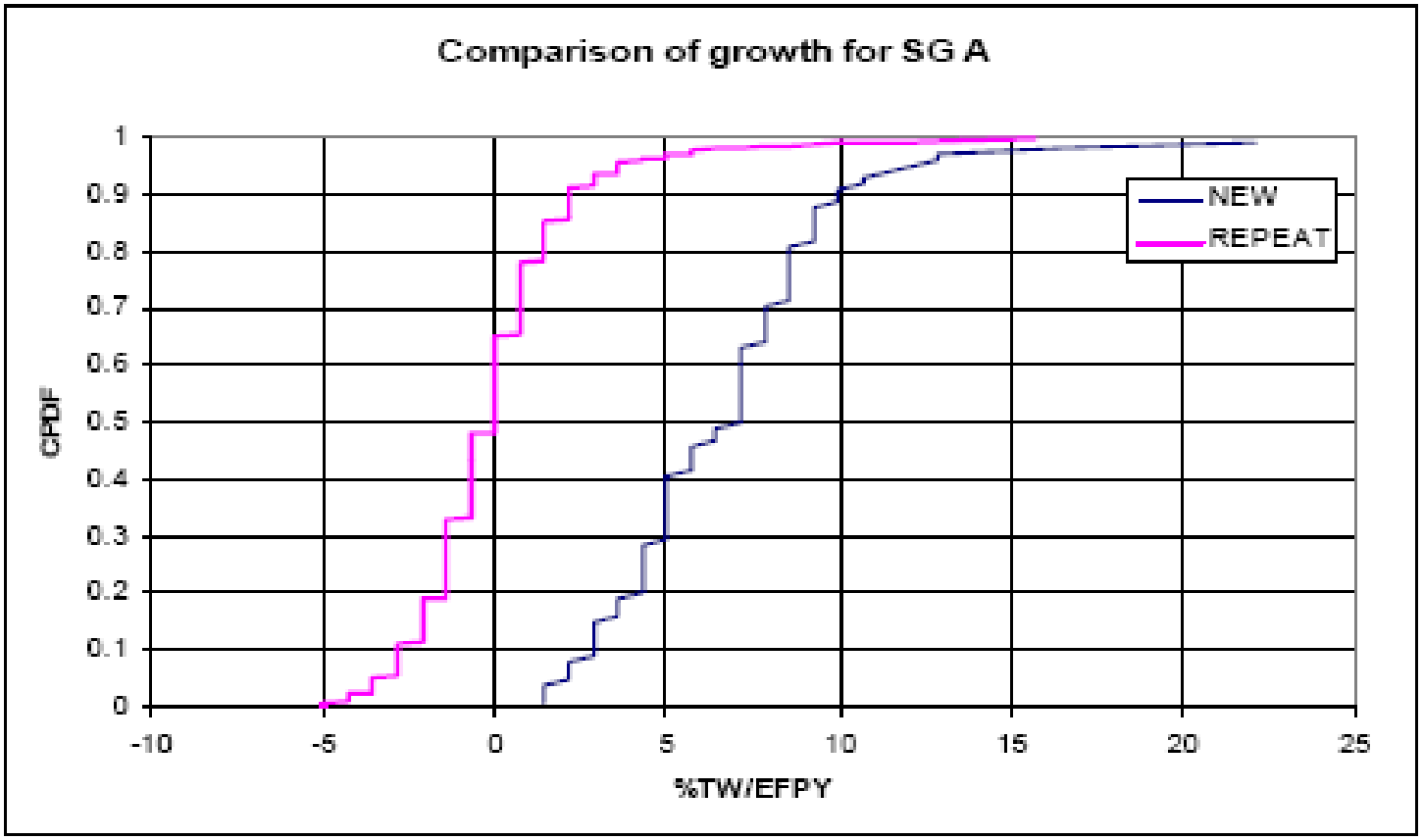

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Growth Rate Data from 1R21

	SGA	SGB
New+Repeat Average Growth	2.84 %TW/EFPY	4.34 %TW/EFPY
95/50 Growth (New Indications)	8.56 %TW/EFPY	9.99 %TW/EFPY
95/50 Growth (Repeat Indications)	3.57 %TW/EFPY	5.71 %TW/EFPY
Max Growth (New Indications)	22.11 %TW/EFPY	19.97 %TW/EFPY
Max Growth (Repeat Indications)	15.69 %TW/EFPY	14.27 %TW/EFPY

Proprietary Section

ANO Unit 1 Tie Rod Bowing Review

Jim Begley

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ANO Unit 1 1R22
Inspection Plan

Dan Meatheany

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- 1R22 Inspection Plans
  - Purpose of Inspections
  - Scope of Inspection
  - Contingency Inspection/Repair Plans
  - Acceptance Criteria
  - Definition of Success

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- Purpose of Inspections
  - Confirm Apparent 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

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- Current Scope of 1R22 Inspection Plans

  Bobbin Test of Surrounding Tubes for All 52 Tie Rods in Both Steam Generators

Acceptance Criteria for Tie Rod Lateral Bowing

Category	1R21 Inspection Value	Acceptance Criteria	Potential Additional Analysis, Repairs or Inspections
Maximum Lateral Extent of Tie Rod Bowing in **First Span, Outermost Ring**	1.19 inch	≤1.5 inch	> 2.0 inch
Maximum Lateral Extent of Tie Rod Bowing in **First Span, Second Outermost Ring**	0.47 inch	≤ 0.63 inch	>0.78 inch
Maximum Lateral Extent of Tie Rod Bowing in **14th and 15th Spans, Outermost Ring**	0.19 inch	≤ 0.25 inch	>0.32 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	>2

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

Category	1R21 Inspection Value	Acceptance Criteria	Potential Additional Analysis, Repairs or Inspections
Wear on Tube from Tie Rod	0	0	≥ 5% TW
Tube to Tube 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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- Definition of Success (1R22)
  - Tie rod bowing magnitude is as predicted
  - No free-span wear found in tubes around tie rods
  - No denting found in tubes adjacent to tie rods
  - Results of inspection will be used to confirm the applicability of the ASME code qualified stress calculation for “A” steam generator
- Future Plans (1R23)
  - Based on Wear will perform 100% Bobbin
  - Re-evaluate Extent of Bowing
  - Plan to Skip 1R24 and Possibly 1R25

Questions ?

Closing Comments – Jaime McCoy