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DATE OF MEETING
02/16/2000

The attached document(s), which was/were handed out in this meeting, is/are to be placed in the public domain as soon as possible. The minutes of the meeting will be issued in the near future. Following are administrative details regarding this meeting:

Docket Number(s)	<u>05000313</u>
Plant/Facility Name	<u>Arkansas Nuclear One, Unit-1</u>
TAC Number(s) (if available)	<u>MA8205</u>
Reference Meeting Notice	<u>02/02/2000</u>
Purpose of Meeting (copy from meeting notice)	<u>Entergy Operations, Inc. requested this meeting to</u> <u>present results from their last steam generator inspection</u> <u>and discuss plans for future repair technologies.</u>

NAME OF PERSON WHO ISSUED MEETING NOTICE	TITLE
M. Christopher Nolan	Project Manager

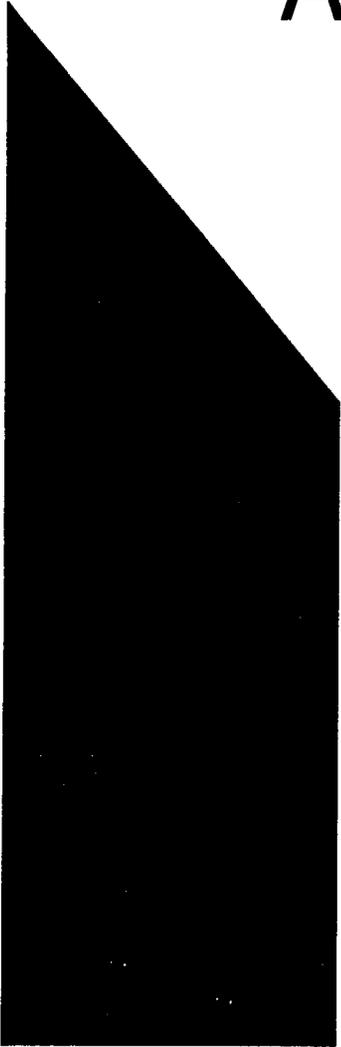
OFFICE  
**Office of Nuclear Reactor Regulation**

DIVISION  
**Division of Licensing Project Management**

BRANCH  
**Project Directorate IV & Decommissioning, Section 1**

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# Arkansas Nuclear One - Unit 1 OTSG Issues

February 16, 2000



# Purpose of Meeting

- Introduction.....Dale James
- Re-roll cracking..... John Hathcote
- Re-roll optimization.....John Hathcote
  - Joint integrity
- Upper tubesheet IGA..... John Hathcote
- Risk-informed approach.....Richard Harris
- Schedule.....Dale James

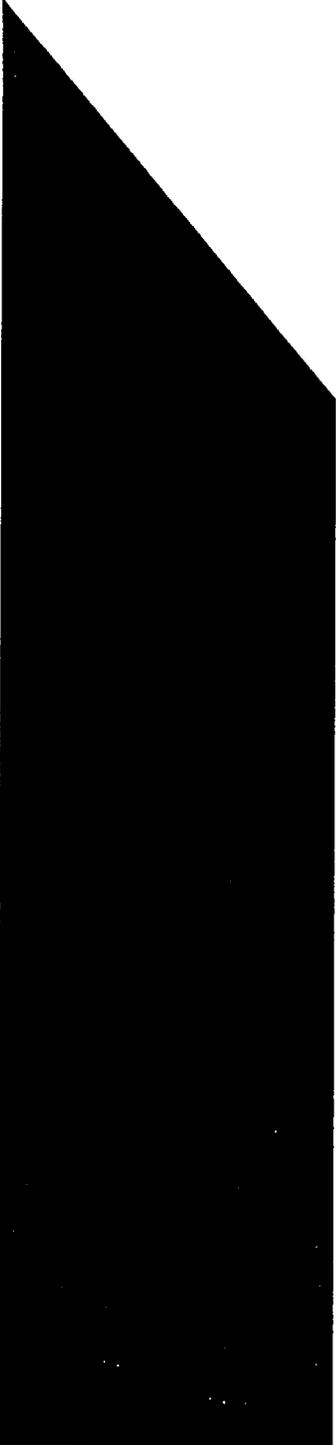


# Re-roll Cracking

- 3,118 re-rolls installed during 1R14 (4/98)
- 100% RPC exam performed in 1R15 (9/99)
  - Required per the qualification report
  - 353 crack-like indications detected in the upper transition
  - Classical PWSCC
  - Some extend into the 1" effective roll
  - None identified in the lower transition
- Potential contributors
  - Roller walk-out
  - Tooling configuration / geometry

# Re-roll Cracking Investigation

- Statistical review of installed re-rolls
  - Bobbin profiles, torque and diameter feedback
  - Material properties, geometry parameters
- RSG re-roll history
- Rolled hardware performance (i.e. sleeves)
- Review tooling and installation process
  - Roller geometry, installation technique, torque delivery
- Comparison to other OTSG re-rolls
- Accelerated corrosion testing
- Complete in April



# Re-roll Joint Integrity / Optimization

# Re-roll Joint Integrity

- PSC 2-98
  - Address potential higher axial tube loads (SBLOCA)
  - Complicating factors
    - Thermal hydraulic analysis
    - Calculating axial load and bore dilations
    - Determining joint strength
- Will the rolled joints meet the topical report criteria? - "No slippage"
- Preliminarily concluded some joints may not carry the newly analyzed SBLOCA loads

# Re-roll Joint Integrity

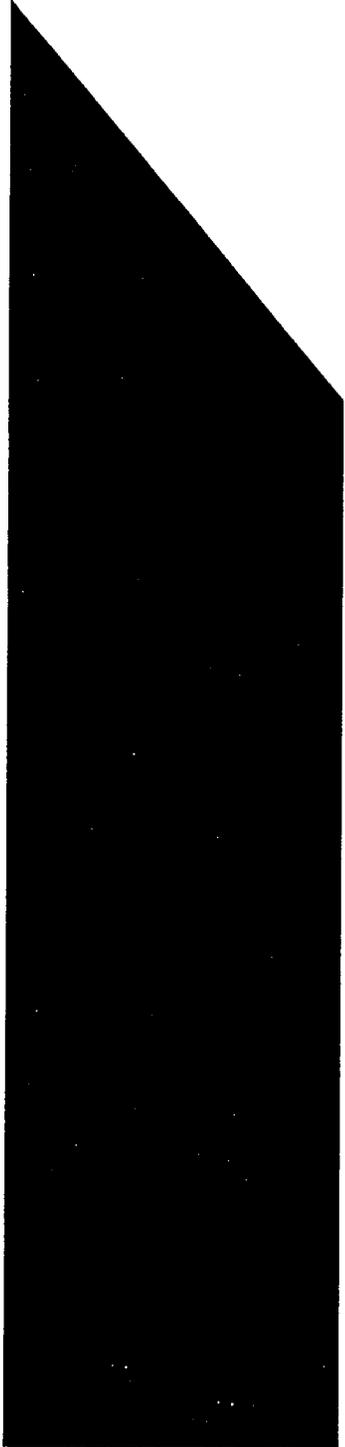
- Initial conclusion based on conservative interpretation of springback an undilated load testing
  - Exclusion zone established where the 1" joint would not carry the load
  - No re-rolling was performed in this area during 1R15
- Developed justification for slippage
  - For SBLOCA no positive pri-to-sec pressure differential
- Recently concluded the 1" joint will not slip
- Re-roll topical revision will include results

# Re-roll Optimization

- BWOG project
- Revision to BWOG generic topical
- Multiple re-rolls in the upper and lower tubesheets
- Additional testing being performed
  - Dilated condition
  - Leakage and pull out load

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# Upper Tubesheet IGA



# IGA Background

- Present since late 70's
- No leakage observed
  - Includes > 450 existing IGA flaws
  - Includes numerous in-situ, lab and pulled tube results
  - Empirical correlation cannot be developed
- No growth observed
  - Several growth rate studies performed
  - No change in the compared parameters
    - Bobbin and plus-point volts
    - Axial and circ extents

# Growth Rate Evaluation

- Currently implement three phases for assessing IGA growth
  - Population comparison
  - Individual flaw comparison
  - Assumption for next cycle growth (leakage)
- 1. Population comparison
  - 0.115" pancake axial and circ extents compared
  - 95% LCL must be below zero
  - Plus-point volts compared
  - The lower 1-sigma must be below zero
  - Not required for other ARCs (e.g. 95-05)

# Growth Rate Evaluation

## 2. Individual flaw comparison

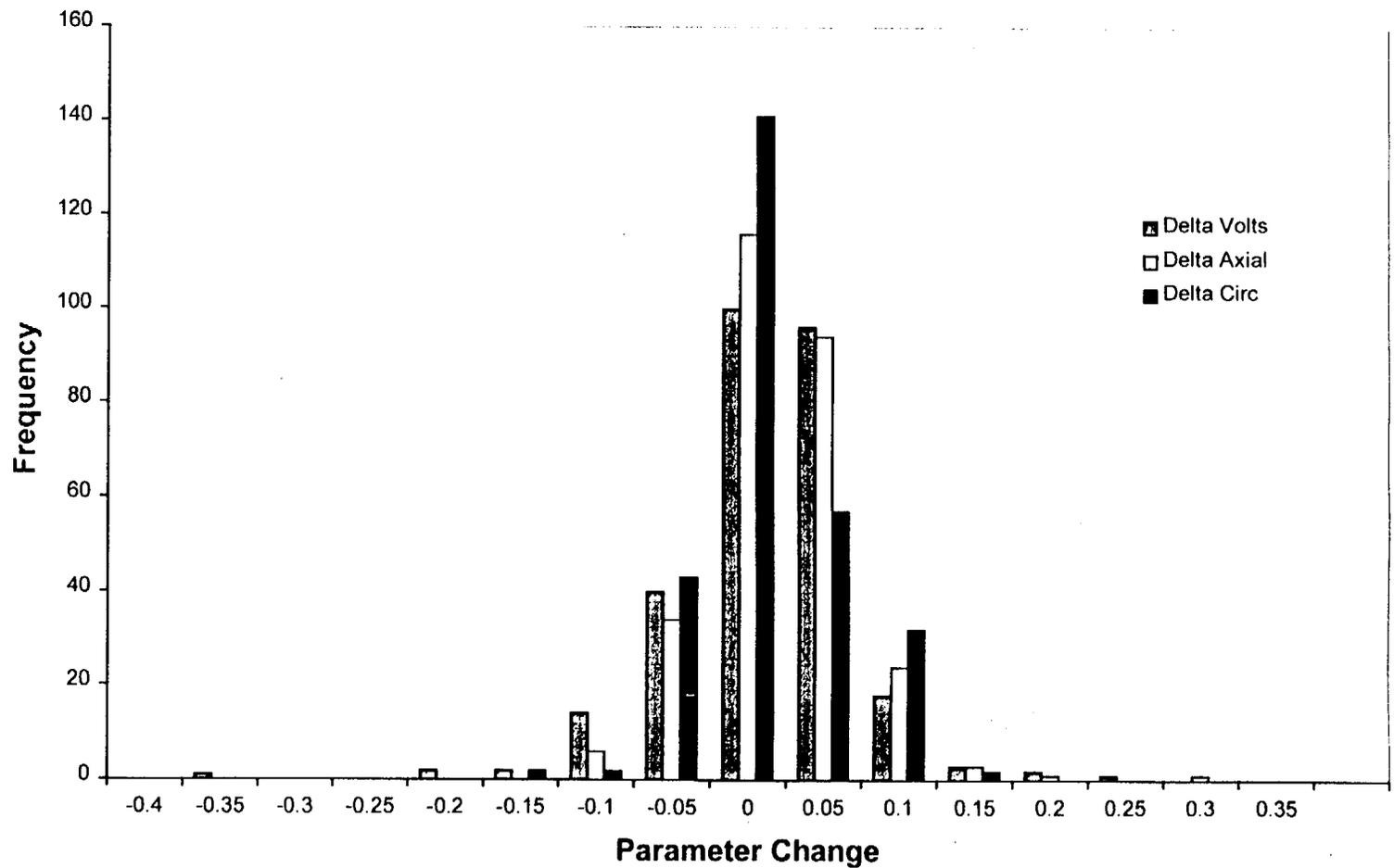
- 95% UCL values (volts, axial and circ extent) from the population comparison are added to the individual values and compared to established repair limits
  - 0.5" for axial and circ extent
  - 1.16 plus-point volts
  - Based on previous testing
- Delta parameter (e.g. 1R14-1R15) is added to the measured value and compared to the repair limits
- The tubes are repaired if any of the six comparisons exceed the repair limit

## 3. Assumption for next cycle growth

- The 95% UCL is added to the axial extents prior to conducting the leakage calculation

# IGA Growth Comparison

"A" OTSG IGA Growth Comparison (1R14 - 1R15)



# IGA Growth Summary (1R14 - 1R15)

	OTSG A			OTSG B		
	Change in Voltage	Change in Axial Extent	Change in Circ Extent	Change in Voltage	Change in Axial Extent	Change in Circ Extent
Number of Indications	279	279	279	173	173	173
Average	-0.012	-0.002	-0.008	-0.016	-0.004	-0.015
Standard Error	0.004	0.003	0.003	0.005	0.003	0.003
t	1.97	1.97	1.97	1.97	1.97	1.97
95% UCL	-0.005	0.004	-0.002	-0.007	0.002	-0.009
95% LCL	-0.019	-0.008	-0.013	-0.025	-0.010	-0.022
1 Sigma Upper Limit	-0.008	N/A	N/A	-0.012	N/A	N/A
1 Sigma Lower Limit	-0.015	N/A	N/A	-0.021	N/A	N/A
Maximum Change	0.21	0.26	0.14	0.1	0.1	0.09
Minimum Change	-0.36	-0.13	-0.2	-0.22	-0.13	-0.12
Apparent Growth?	No	No	No	No	No	No

# Proposed Growth Criteria

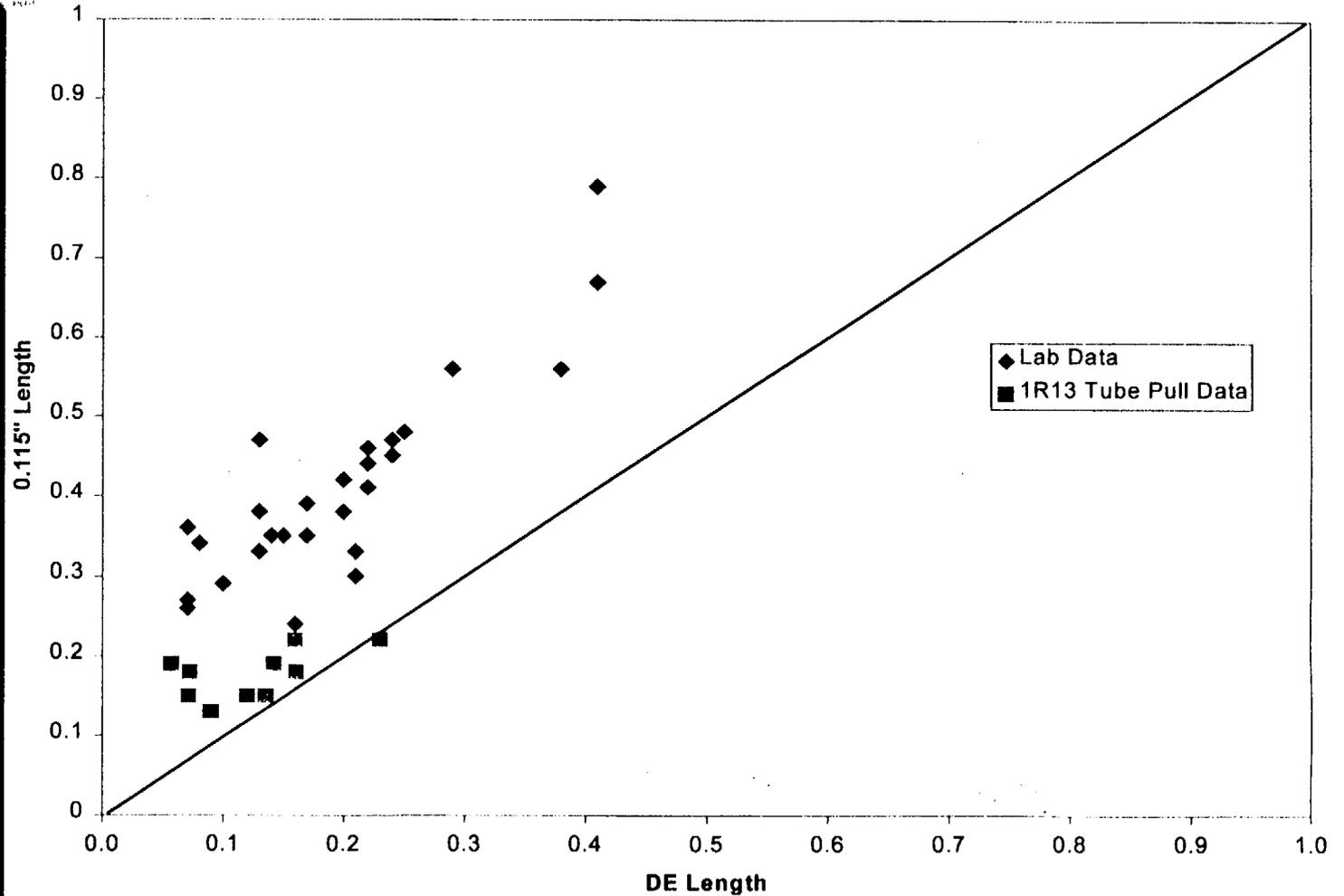
- Focus on individual flaw comparisons
  - Apply the six criteria
  - Compare to the repair limits
- Using baseline data
  - 1R14 or outage detected
- In-situ pressure test a sample of flaws exceeding the repair limit
- Operational assessment for leakage
  - Assess 95% UCL and individual change in axial extent
  - Apply greater of the two
  - Add 10% POD factor to population

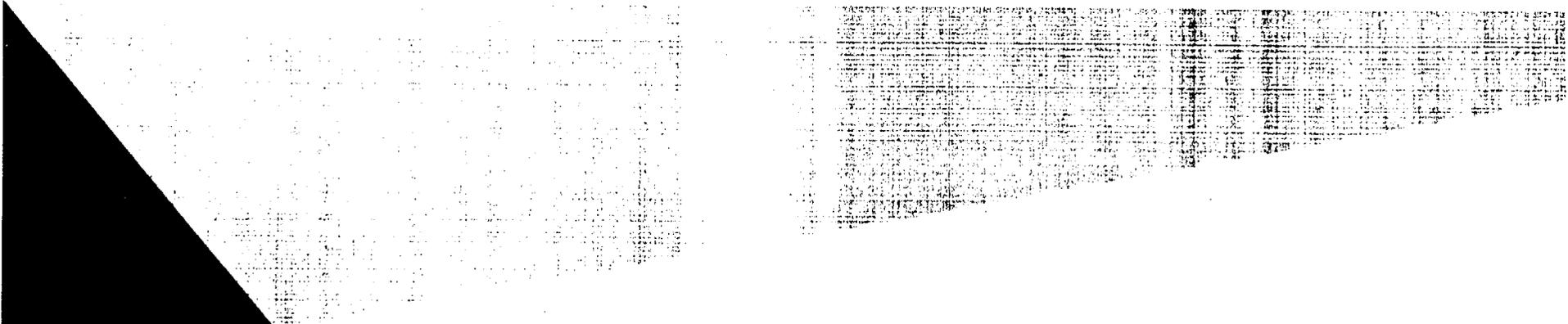
# Leakage Assessment

- Leakage evaluation
  - Assumption is made that some number of flaws will leak
    - High probability that none will leak (based on past experience)
  - Extents used to calculate leakage are based on ECT
    - Pulled tube and lab data demonstrates that the 0.115" pancake oversizes extent measurements (look ahead and fall behind)
  - The patches are chosen assuming each one has an equal chance of leaking
    - In reality the "small" patches have a negligible probability of leaking

# Extent Sizing Comparison

Fractography vs 0.115" Pancake for Axial Extent





# Risk Informed Approach

# Risk Informed Analysis

- Tube rupture risk contributors
  - Spontaneous SGTR occurring during normal ops
  - Pressure transient induced SGTR
  - Core damage induced SGTR
- Burst cannot occur
- No increase in frequency to any of the SGTR scenarios

# Risk Informed Analysis

- Five principals established in RG 1.174
  1. Meets current regulations
    - ASME code, GDC-19 and 10CFR100
  2. Consistent with defense-in-depth philosophy
  3. Maintains sufficient safety margins
    - Burst is precluded
    - Leakage is assessed programmatically (<1 gpm)

# Risk Informed Analysis

## 4. Increase in risk is small

- No expected increase in risk
- Upper bound sensitivity analysis performed
  - Tube Rupture frequency not increased
  - No increase in CDF due to leakage < makeup flow (70 gpm)
  - Sequences considered:
    - ATWS
    - MSSVs fail open
    - Turbine fails to Trip
    - MSLB
    - Excessive MFW
    - TBVs fail open
  - Assume early sequences are Large to obtain increase in LERF
- Very small change in LERF (<1E-7) and CDF (<1E-6)
- Conclusion: **Not risk significant**

# Risk Informed Analysis

- 5. Monitored using performance measurement strategies
  - Evaluate IGA as part of the SG integrity program
    - 100% bobbin and RPC examinations each outage
    - Repair if linear characteristics are developed
    - Perform operational assessments (evaluate leakage)
  - Developing approach for licensing amendment
  - Considering methodology for other damage mechanisms contained by the UTS

# Schedule

- Re-roll cracking CAR complete - April
- Re-roll optimization submittal - July
- Upper tubesheet IGA
  - Deterministic management program submittal - April
  - Risk-informed TS change - April