



UNITED STATES
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D.C. 20555-0001

February 6, 1997

MEMORANDUM TO: David B. Matthews, Chief
Generic Issues and Environmental
Projects Branch
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

FROM: Joseph L. Birmingham, Project Manager
Generic Issues and Environmental
Projects Branch
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

SUBJECT: SUMMARY OF JANUARY 28, 1997, MEETING WITH B&W OWNERS GROUP AND
FRAMATOME TECHNOLOGIES ON PLANS FOR ALTERNATE REPAIR CRITERIA
FOR INTERGRANULAR ATTACK

On January 28, 1997, representatives of the B&W Owners Group (B&WOG) and Framatome Technologies (Framatome) met with U.S. Nuclear Regulatory Commission staff to present information about plans for alternate repair criteria (ARC) for intergranular attack (IGA) in once through steam generators. The Owners Group and Framatome presented an overview describing the need for ARC, the approach to be used, the regulatory framework within which ARC could be used, and a tentative schedule for implementation. The overview was followed by a discussion of the technical basis for the ARC to be used for IGA, supporting programs and projects, results of tube pulls with various defects, and the results to date of a probability of detection study. Additional details are in Attachment 2 which is the slides presented at the meeting.

During the course of the presentations, the industry representatives indicated that the proposed ARC will be based, in part, on the draft steam generator tube integrity rule and regulatory guide. The NRC staff commented that because the draft rule and regulatory guide are not yet finalized, guidance on risk-based aspects of the rule including severe accidents is subject to change until issued. The staff also indicated that, in order to expedite the review process, it would be amenable to reviewing the Owners Group's results as portions became available.

Attachment 1 is a list of the meeting attendees and Attachment 2 is the slides presented by the Owners Group and Framatome.

Attachments: As stated

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X 20-10-6 meeting

B&W Owners Group

Project No. 693

Mr. Robert W. Keaten, Chairman
B&WOG Executive Committee
Vice President & Director of
Technical Functions
GPU Nuclear Corporation
One Upper Pond Road
Parsippany, NJ 07054

Mr. R. B. Borsum, Manager
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Framatome Technologies, Inc.
1700 Rockville Pike, Suite 525
Rockville, MD 20852-1631

Mr. W. W. Foster, Chairman
B&WOG Steering Committee
Director of Safety Assurance
Duke Power Company
Oconee Nuclear Station
PO Box 1439
Seneca, SC 29679

Mr. J. H. Taylor, Manager
Licensing Services
Framatome Technologies, Inc.
P.O. Box 10935
Lynchburg, VA 24506-0935

D. Matthews

Attachment 1 is a list of the meeting attendees and Attachment 2 is the slides presented by the Owners Group and Framatome.

Attachments: As stated

cc w/atts: See next page

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B&W OWNERS GROUP MEETING ATTENDEES
JANUARY 28, 1997

<u>NAME</u>	<u>ORGANIZATION</u>
W MORRIS SAMPLE	DUKE POWER
BLAKE LOWERY	DUKE POWER
W K DAVIS	DUKE POWER
DEWEY ROCHESTER	DUKE POWER
GENE NAVRATIL	GPU NUCLEAR
RICHARD FREEMAN	GPU NUCLEAR
MICHAEL SHEPHERD	TOLEDO EDISON
RICH ACKERMAN	TOLEDO EDISON
PATRICK PETERSON	FLORIDA POWER
JOHN MAKAR	FLORIDA POWER
LARRY SEXTON	FLORIDA POWER
JOHN IFFITH	FRAMATOME
JONATHAN COBURN	FRAMATOME
BRIAN MERDICH	FRAMATOME
JEFF BROWN	FRAMATOME
JOE BIRMINGHAM	NRC\NRR\PGEB
PHIL RUSH	NRC\NRR\EMCB
TED SULLIVAN	NRC\NRR\EMCB
EMMETT MURPHY	NRC\NRR\EMCB
JACK STROSNIDER	NRC\NRR\EMCB
JOHN TSAO	NRC\NRR\EMCB
STEPHANIE COFFIN	NRC\NRR\EMCB

B&V/ OWNERS GROUP

NRC PRESENTATION

**PLANS FOR ALTERNATE REPAIR CRITERIA
FOR INTERGRANULAR ATTACK**

JANUARY 28, 1997



**B&W OWNERS GROUP / NRC MEETING
SUMMARY AND OBJECTIVES**

- SUMMARIZE B&WOG PLANS FOR ALTERNATE REPAIR CRITERIA FOR INTERGRANULAR ATTACK
- SUMMARIZE PROGRESS OF B&WOG PROBABILITY OF DETECTION PROJECT
- OTHER PLANS



ALTERNATE REPAIR CRITERIA FOR IGA

- OBJECTIVE
- PROPOSED WORKSCOPE
- SCHEDULE
- PRESENT STATUS
- DECISION POINTS / RELATED ISSUES



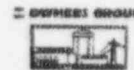
GENERIC ARC FOR IGA

- PURPOSE
 - Develop Technical Basis for Alternate Repair Criteria for Intergranular Attack
- NEED FOR ARC
 - Most Significant Degradation Mechanism Currently Affecting OTSG's
 - Recent Tube Pull Results Confirm IGA
 - Historically Difficult to Depth Size by NDE
 - 40% TW Is Overly Conservative for Some Morphologies (Un-necessary Plugging)



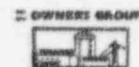
REGULATORY FRAMEWORK FOR PLUGGING CRITERIA

- DRAFT SG INTEGRITY RULE & REG. GUIDE
 - Supplements RG 1.121
 - Provides Guidelines for Development of Tube Repair Criteria and NDE Qualification
- INDUSTRY DOCUMENT (NEI)
 - Intended to Provide for Consistent Industry Application of Rule
- GENERIC LETTER 95-05
 - Guidelines for Implementing ARC for TSP ODSCC
 - General Approach for Probabilistic Criteria



DRAFT SG INTEGRITY RULE

- ALLOWS TWO OPTIONS
 - Deterministic
 - » Specifies Reg. Guide 1.121 Criteria and ASME Code Section III Design Margins
 - Probabilistic
 - » Limits Probability of Tube Rupture and Accident Leakage Exceeding Allowables



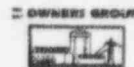
PROPOSED APPROACH FOR IGA

- **PURSUE PROBABILISTIC CRITERIA**
 - Avoid Un-necessary Tube Plugging
 - » Maximize Safe S/G Service Life
 - Significant OTSG IGA Pulled Tube Database Already Exists
 - Initial Data Evaluation Suggests Likely Success



B&WOG OTSG COMMITTEE SUPPORTING PROGRAMS AND PROJECTS

- **TUBE PULL**
 - Cooperative B&WOG Effort
 - Proactive Tube Sample Removal & Analyses for Increased Understanding of OTSG Flaws
 - Funded Into 1998, Expected to Continue
- **TUBE INTEGRITY**
 - NDE, Leak & Burst Testing, Destructive Exam of Laboratory Fiawed Tube Samples
 - Approximately 44 IGA Samples
 - All Testing Completed, Being Documented



B&WOG OTSG COMMITTEE SUPPORTING PROGRAMS AND PROJECTS

- **TUBE PLUGGING CRITERIA**
 - Update Tube Integrity Analyses for Revised Loads and Currently Known Flaw Types
 - To Be Completed 1997
- **OTSG TRENDING REPORT**
 - Yearly Report
 - Compares and Contrasts Experience for All B&WOG Plants
 - Identify Emerging Degradation Trends

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B&WOG OTSG COMMITTEE SUPPORTING PROGRAMS AND PROJECTS

- **CHARACTERIZATION OF IGA**
 - Ongoing Project to Identify Most Appropriate NDE Technique for Detection and Sizing of IGA
- **PROBABILITY OF DETECTION / HUMAN FACTORS**
 - Determine Realistic POD Based on Field Analysis
 - Uses Pulled Tube Database

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SUMMARY OF B&WOG TUBE PULLS SUPPORTING ARC FOR IGA

- TUBE PULLS
 - CR-3 (1992, 94)
 - ANO-1 (1978, 82, 84, 96)
 - TMI-1 (1982, 86)
 - OCONEE-1 (1994)
 - OCONEE-2 (1988, 96)
 - OCONEE-3 (1993)
- EXISTING DATABASE
 - Approximately 118 Samples of Volumetric IGA in 26 Pulled Tubes
 - Lab Exam in Progress for Additional 6 Tubes

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WORKSCOPE

- Characterization of Damage Mechanism
- Correlate Structural and Leakage Performance with NDE Measured Parameter
- Determine NDE Measurement Uncertainty
- Quantify Growth Rate
- Develop Model to Determine Probability of Burst and Leakage
- Topical Report

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SCOPE OF WORK, CONT'D.

- CHARACTERIZE DAMAGE MECHANISM
 - Determine Range of Flaw Sizes to be Addressed
 - Determine Location in OTSG
 - Supported by Existing B&WOG Programs
 - » Tube Pull
 - » Tube Pull NDE
 - » Plant to Plant Trending



SCOPE OF WORK, CONT'D.

- TUBE INTEGRITY ASSESSMENT
 - Establish Burst Characteristics
 - Establish Leak Characteristics
 - Assess Integrity for Remaining Operational Loads (i.e., axial, bending)
 - Supporting Programs
 - » Tube Pull
 - » Tube Integrity
 - » Tube Plugging Criteria



SCOPE OF WORK, CONT'D.

- **ADDITIONAL WORK FOR TUBE INTEGRITY**

- Structural Integrity for Non-Burst Conditions
 - » To Be Addressed Analytically
- Leakage Integrity
 - » Additional Data to Assess Leak Rate & Probability of Leak
 - » Sample Fabrication (Laboratory)
 - » Hot Leak Testing



SCOPE OF WORK, CONT'D.

- **NDE EVALUATION**

- Determine Best NDE Technique / Parameter
- Probability of Detection
- NDE Uncertainty / Human Factors
- Supporting Programs
 - » Tube Pull
 - » Tube Integrity
 - » Characterization of IGA
 - » POD / Human Factors
 - » Probe Wear
- Additional Work Required
 - » Combine and Correlate Data to Structural and Leakage Integrity



SCOPE OF WORK, CONT'D.

- **GROWTH RATE**

- Based on ECT Data Re-Analysis
 - » Based on ECT Database on in-Service Tubes
 - » Normalize Calibrations
 - » Based on Chosen NDE Parameter
- Evaluate Over At Least Three Cycles
- Incorporate Data From All Plants as Available
- Verify Consistent Plant-to-Plant Behavior



SCOPE OF WORK, CONT'D.

- **BURST AND LEAK PROBABILITY MODEL**

- Statistical Approach Consistent with Prior ARC Submittals
- Compute Probability of Burst and Leakage for a Given Distribution of Flaws
- Includes Allowances for NDE Uncertainties
- Used for Past Cycle Evaluation and EOC Prediction

- **TOPICAL REPORT**

- Summarizes Criteria
- Documents Basis (All Previous Tasks)



PRESENT STATUS

- **CHARACTERIZATION OF DAMAGE MECHANISM**
 - Completed, Documented
- **TUBE INTEGRITY - STRUCTURAL**
 - Analysis in Progress
- **TUBE INTEGRITY - LEAK INTEGRITY**
 - Specification for Lab Samples in Progress
- **PROBABILISTIC MODEL DEVELOPMENT**
 - In Progress
- **POD**
 - In Progress

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INDUSTRY / NRC INTERFACE

- **INVOLVEMENT OF EPRI / INDUSTRY ARC COMMITTEE**
 - Maintain Consistency with Other Industry Submittals
 - Plan to Present Technical Basis to EPRI ARC Committee for Independent Review Prior to Submittal to NRC
- **NRC INTERFACE**
 - Periodic Meetings / Reviews Desired

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SCHEDULE

- TOPICAL REPORT PREPARED FOR UTILITY REVIEW
BY LATE 1997
- TOPICAL REPORT SUBMITTED TO NRC BY END OF
1997
- FIRST POSSIBLE USE SPRING 1998



NRC MEETING ON ARC

- BWOOG POD Project Plan Presented to NRC in August 1996
- Eddy Current Analysis Performed in September 1996
- Progress of POD Project to Date



PURPOSE OF PROJECT

- POD Can Be Used for Many Purposes
 - Alternate Repair Criteria
 - Operating Cycle Duration
 - Examination Scope Requirements
 - Damage Specific Management
 - Draft NRC Rulemaking
- Determine Appropriate POD Numbers
 - Voltage Relation
 - Depth Relation
 - Damage Mechanism Relation



TEST STRUCTURE

- **Analysis Structure**
 - Typical Primary / Secondary / Resolution Analysis
 - Ten OTSG Production Analysts and 5 Resolution Analysts
 - Total of 5 Independent Analysis Groups
- **Analyst Selection**
 - Random Selection based on Availability
 - Spectrum of Experience
 - All QDA Certified
 - Duke, Rockridge and FTI



TEST STRUCTURE (cont)

- **Analyst Training and Testing**
 - Common OTSG Analysis Guideline
 - Analysis Guideline Training
 - Stressed Calling Individual Indications in Regions of Multiple Indications
- **Data Evaluation Protocol**
 - Individual Analyst Setup for Each Cal Group
 - Normal Field Analysis Process - Independent Primary and Secondary Analysis
 - Approximately 1 Week for Analysis Phase
 - Simulated Field Production Analysis Pressure



ECT DATA USED

- **Pulled Tube Data**
 - POD is based on Pulled Tube Samples Only
 - True Depth Based on Metallography
 - Data from Multiple OTSG Plants
 - Bobbin Coil Eddy Current Data Only
- **Flaw Mechanisms in Data Set**
 - Volumetric Intergranular Attack (IGA)
 - Axial IGA / SCC
 - Erosion / Corrosion
 - Wear

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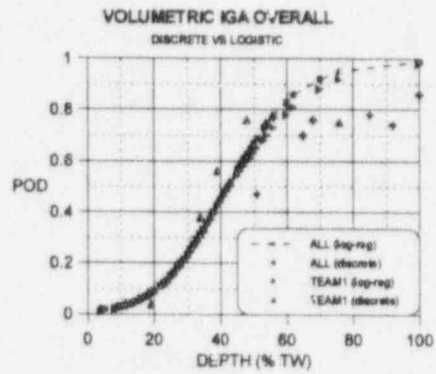
ECT DATA USED (cont)

- **Summary Of Eddy Current Data**
 - Data Sets Were Constructed from Original Field Cal Groups where possible
 - Included 169 indications with DE results
 - » Volumetric IGA 118
 - » Axial IGA / SCC 33
 - » Erosion / Corrosion 7
 - » Wear 11
 - Total of 796 Tubes
 - There were 26 Pulled Tubes with DE results
 - Representative spectrum of other signals
 - Approximately 65 % NDD tubes

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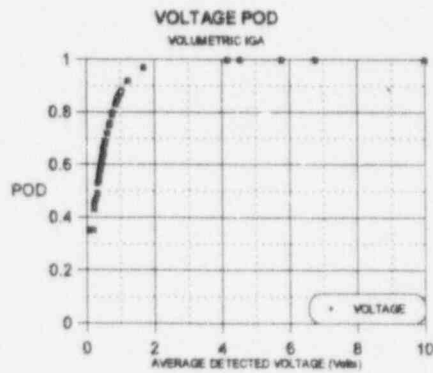
POD RESULTS



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POD RESULTS



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RESULTS EVALUATION

- **POD Evaluation**

- SSPD Was Not Used due to Data Format - No 'C' Files Supplied
- Detections Tabulated versus Max Depth, Average Depth, Voltage, and Burst Pressure
- POD Evaluated by discrete (EPRI Guidelines) and logistic regression (NUREG / CR-6227) methods

- **Performance Evaluation**

- Main Evaluation is Resolution Performance for Five Analysis Groups
- POD Calculated for each Defect Mechanism
- POD Project Statistics Similar to Field With a Few Exceptions



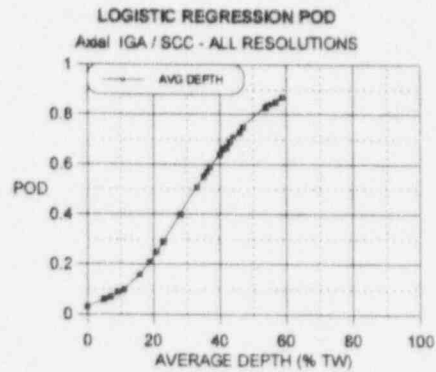
RESULTS EVALUATION

- **POD vs Field Analysis**

- Average Number of Calls in POD Analysis are consistent with Field Analysis
- POD Analysis had More calls in Several Cal Groups due to the Evolution of Recording Techniques



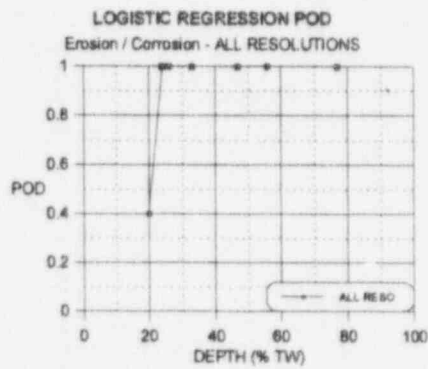
POD RESULTS



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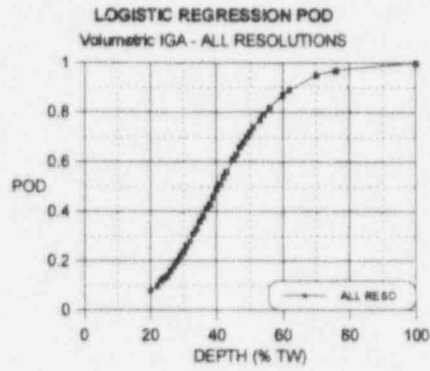
POD RESULTS



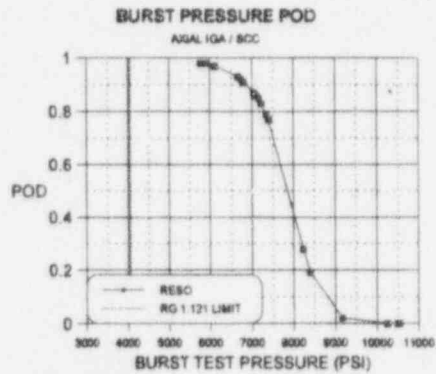
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POD RESULTS



POD RESULTS

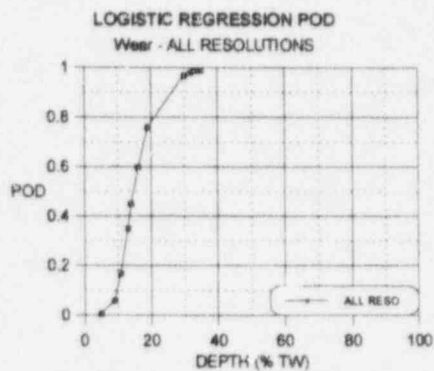


TUBE-TO-TUBESHEET ROLL TRANSITIONS ALTERNATIVES TO ADDRESS PWSCC

- **NDE RESULTS**
 - Axial Indications in Hot Leg Transitions at Four Plants
 - Confirmed via Tube Pull at Davis Besse
 - » 1 Tube, Spring 1996
 - Laboratory Exam of Additional Tubes in Progress
- **OPTIONS BEING CONSIDERED BY B&WOG**
 - Tubesheet Re-roll
 - » Now Under Development
 - Alternate Repair Criteria
 - » Based on Indicated Crack Length from NDE



POD RESULTS



SUMMARY

- Preliminary Results Indicate that Logistic Regression for Resolution Analysis Should be Used
- ARC Project Will Determine the Correct Parameter for Defect Severity
- Perform Additional Evaluation of Data for Axial IGA / SCC, Erosion / Corrosion, and Wear

