FPL

St. Lucie Nuclear Plant

Sea Turtle Refuge

Florida Power & Light Company
St. Lucie Nuclear Plant
UNIT 2

STEAM GENERATOR OPERATIONAL ASSESSMENT FOR CYCLE 13

PRESENTED TO NRR
MAY 2, 2002

ENCLOSURE 2

SL 2 EOC 12 (11/01) STEAM GENERATOR OPERATIONAL ASSESSMENT

AGENDA

Opening Remarks	Raj Kundalkar, VP Engineering
S/G Information Inspection Preparations Inspection Evolution	Gary Boyers, S/G Specialist
Operational Assessment	Brian Woodman, APTECH Eng.
Closing Remarks	Raj Kundalkar, VP Engineering

SL 2 EOC 12 (11/01) STEAM GENERATOR OPERATIONAL ASSESSMENT

OPENING REMARKS - Raj Kundalkar, VP Engineering

Meeting Objective

- Review S/G Operational Assessment for Cycle 13
- Demonstrate Inspection Results Support Full Cycle Operation

FPL Philosophy

- Committed to Safe Operation
- Implementation of NEI 97-06, S/G Program Guidelines
- Incorporate Industry Experience
- Conservative & Proactive Approach to S/G Management

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EOC 12 S/G Examinations

- 100% Bobbin Inspection Augmented by Extensive Plus Point Probe Inspections
- Preventatively Plugged the Most Susceptible Tubes with Dings

Post-Outage Work and Operational Assessment

- Historical Data Review Shows No Step Change in Degradation
- Multi-Cycle Model Successfully Benchmarks PSL-2 Experience
- Model Results Support Full Cycle Operation

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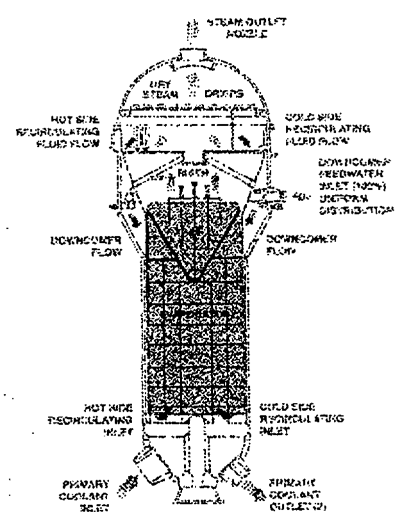
S/G Design

- CE Model 3410
- 8411 Tubes / SG
- ~16.8 EFPY @ EOC 13
- A-600 HTMA Tubing
- CS Lattice Support System
- Explosive Expansion Tubesheet Joint
- Tubes Plugged
  SG A - 474 (5.6%)
  SG B - 539 (6.4%)
- T-Hot ~600°F



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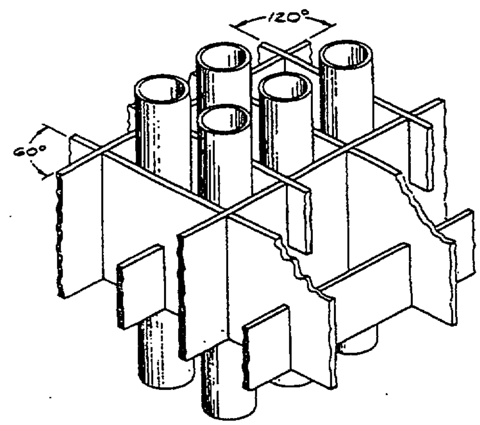
Horizontal Support Provided by Eggcrate Supports (lattice bar)



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Inspection Plan for EOC 12

Inspection Plan

- Bobbin Probe: 100% Bobbin Probe Full Length
- Plus Point Probe: 100% of Hot Leg Top of Tubesheet
  30% of Row 1 & 2 U-bends
  30% of Hot Leg Dings > 5 Volts
  Free Span Indications (New or Show Change)
- Plus Point Profile of All Potential Corrosion Indications
- Contingency Plan for Free Span Cracking
- In Situ Pressure Test as Required

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Inspection Preparations for EOC 12

Small Amplitude Axial Indications First Reported at Eggcrate Supports at EOC 11 were Incorporated into EOC 12 Inspection

- Updated Data Analyst Training & Performance Demonstration
- Refined Computer Data Screening (Secondary Analysis)
- 1 of 15 Indications Did Not Confirm on Alternate Bobbin Channel
- Confirmation on Alternate Bobbin Channels Eliminated for EOC 12

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Inspection Evolution for EOC 12

Number of Eggcrate Bobbin Indications Greater than Expected

- Over 900 Plus Point Diagnostic Examinations
  - Direct result from the guidelines change.
- Primarily at Lower Three Hot Leg Supports

Detection of Axial ODSCC at Dings

- Prompted Supplemental Training & Inspection Expansion
- 3 Periphery Tubes ~1" Above Hot Leg Tubesheet
- 3 Additional Tubes at Other Locations on Hot Leg

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Inspection Evolution for EOC 12

Plus Point Examinations at Dings

- All Dings Hot Leg Tubesheet to 1st Support
- All Dings in U-Bends and 90° Bends
- All Dings > 5 Volts 1st Hot Leg Support to the Diagonal Cold Leg Support
- All Dings >10 Volts in Cold Leg Straight Region

Bobbin Probe Qualified for Dings < 5 Volts

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In Situ Pressure Testing for EOC 12

27 Indications Tested With No Burst or Leakage

Mechanism	Tested	Pressure
Axial ODSCC at Eggcrates	9	4950 -5000 psi
Axial ODSCC at Dents	5	4950 -5000 psi
Axial ODSCC at TTS	6	4950 -5000 psi
Axial IDSCC below TTS	2	4950 -5000 psi
Circ ODSCC at TTS	4	5550 -5600 psi
OD Volumetric TTS	1	4950 -5000 psi

Selection Criteria Exceeded EPRI Minimum Guidance

- Mechanism & Location
- Calculated Burst Pressure & Leakage
- Maximum Voltage, Depth, Length & Percent Degraded Area

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Extensive Historical Reviews Show Flaws at Eggcrates Were Present in Prior Inspections

	INITIATION OF INDICATIONS				
	1997 EOC 9	1998 EOC 10	2000 EOC 11	2001 EOC 12	Total
S/G A	6	36	41	19	102
S/G B	35	68	69	39	211
Total	41	104	110	58	313*

*Note: 15 indications were initially reported at EOC 11
298 additional indications reported at EOC 12

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Conclusions from EOC 12 Historical Review Work

- Degradation Trend is Typical for Unit with A-600 MA Tubing
- Large Apparent Increase in ODSCC at Eggcrates is Due to Change in Data Analysis Reporting Criteria
- Growth of Axial Indications at Dings Occurred Over 2 or More Cycles
  - Preventatively Plugged the Most Susceptible Population of Dings
- Confirmation on Alternate Bobbin Data Channel is Inconsistent When Indication is at Edge of Eggcrate

Outline of Operational Assessment Discussion

- General Description of Operational Assessment Model
- Application to ODSCC at Eggcrates
- Application to ODSCC at Dings
  - Probability of Detection for ODSCC at Dings

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Operational Assessment

- Assessment Of Structural/Leakage Integrity Relative To NEI 97-06 At EOC 13
- Monte Carlo Simulation Of Steam Generator Degradation
  - Tracks Initiation, Evolution And Detection Of Simulated Flaw Population Over Several Cycles/Multiple Inspections
  - Structural And Leakage Integrity Evaluated For Each Simulated Flaw Throughout Period Of Analysis
  - Output Includes:
    - Risk Of Tube Burst
    - Risk/Statistics Of Leakage Under Accident Conditions

Basic Processes

- Initiation
  - Weibull Model
- Flaw Growth
  - Lognormal Model
- Detection
  - Logistic Model
- Repair on Detection
- Burst/Ligament Tearing
  - Framatome Model
- Leakage
  - PICEP Model with Fracture Mechanics Crack Opening Area

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Overview Axial ODSCC At Eggcrates

- Largest Number of Corrosion Indications in 2001
- Apparent Large Increase in Number of Indications
- Moderate Flaw Depth Distribution
- Extensive Profile Analysis Performed
- No In Situ Burst or Leakage Occurrences

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PSL2 Results of Historical Review ODSCC at Eggcrates

	INITIATION OF INDICATIONS				
	1997	1998	2000	2001	
	EOC 9	EOC 10	EOC 11	EOC 12	Total
S/G A	6	36	41	19	102
S/G B	35	68	69	39	211
Total	41	104	110	58	313*

*Note: 15 indications were initially reported at EOC 11
298 additional indications reported at EOC 12

THE RATE OF INCREASE IN INDICATIONS IS CONSISTENT WITH INDUSTRY EXPERIENCE

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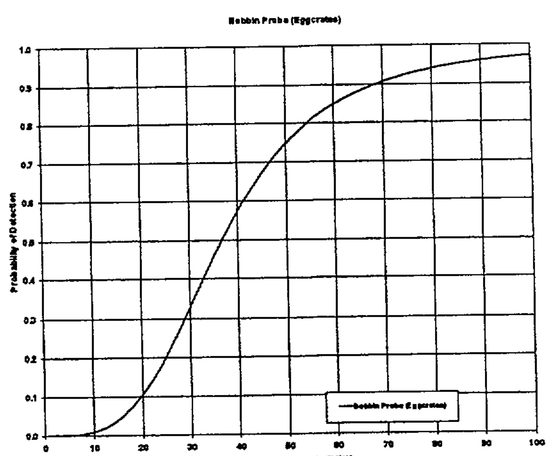
Axial ODSCC at Eggcrates - Bobbin Probe POD Model

- Basis for model
  - Multiple analyst site-specific performance demonstration using pulled tube data base
  - NRC ANL round robin results based on multiple analyst participation
  - Supported by PSL 1 pulled tubes



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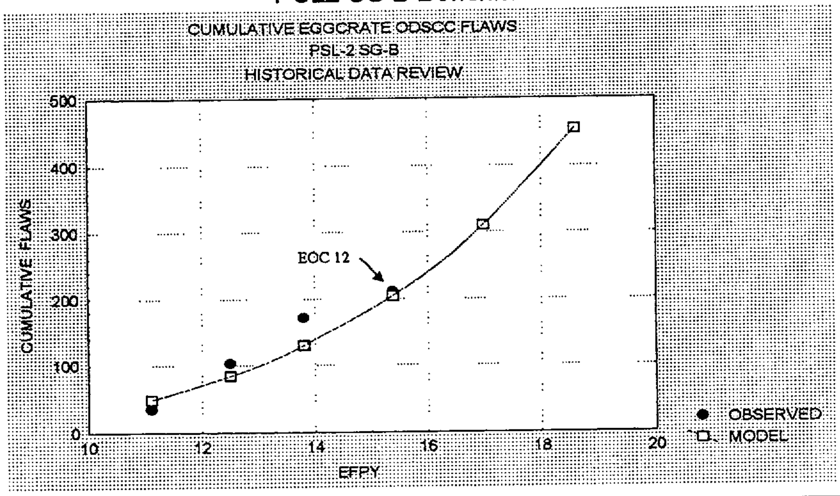
PSL2 SG B Benchmark



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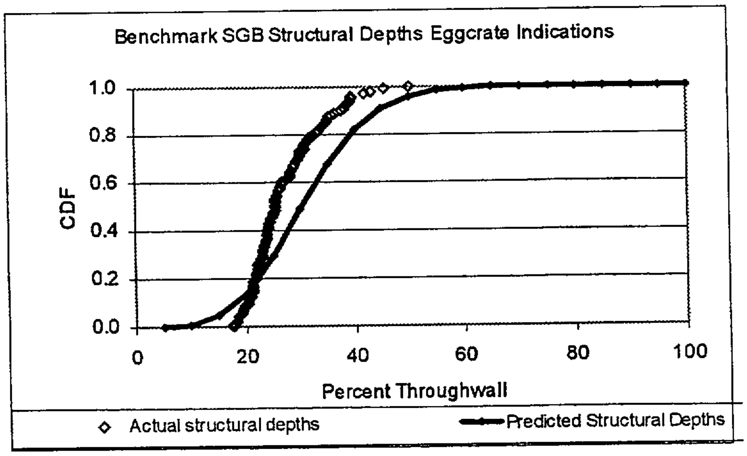
PSL2 SGB Benchmark



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Results Of Eggcrate Evaluation

	ADDITIONAL NUMBER OF INDICATIONS PREDICTED	PROBABILITY OF BURST AT 3xNODP
	EOC 13	EOC 13
S/G A	60	0.010
S/G B	100	0.036

Steam Generators Projected to Meet NEI 97-06 Requirements at EOC 13

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Overview - ODSCC At Dings

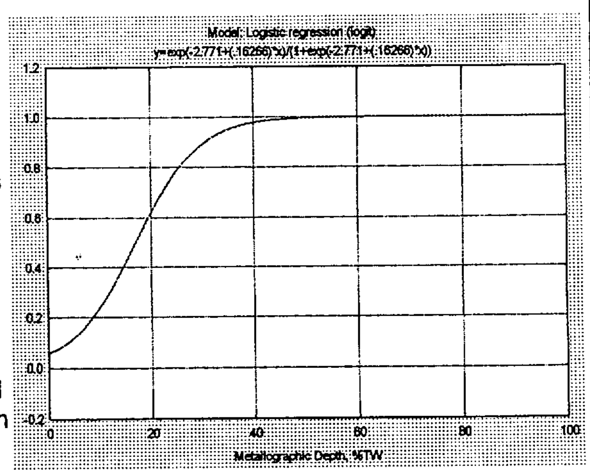
- First Reported in 2001
- Small Number of Flaws [6]
- Non-random Distribution of Dings Near Tubesheet
  - Most High Amplitude Dings at Peripheral Locations Based on Bobbin Probe
- Largest Flaws in Dings Near Tubesheet
- Thorough Look Back Evaluation
- No In Situ Burst or Leakage Occurrences

Critical Model Elements

- Probability of Detection Model
  - Plus Point
  - Bobbin
  - Simulation Process
- Initiation of ODSCC In Dings
- ODSCC Flaw Growth Rate
- Flaw Length

+Pt POD Model Development for Axial ODSCC in Tube Dings

- Starting Point
  - Free-span +Pt Detection Performance for Free-span Cracking
  - This Performance Is the Limiting Upper Bound in the Absence of Tube Indentations
- Free-span Performance Is Then Degraded Based on the Estimated Impact of Tube Dings on Detection



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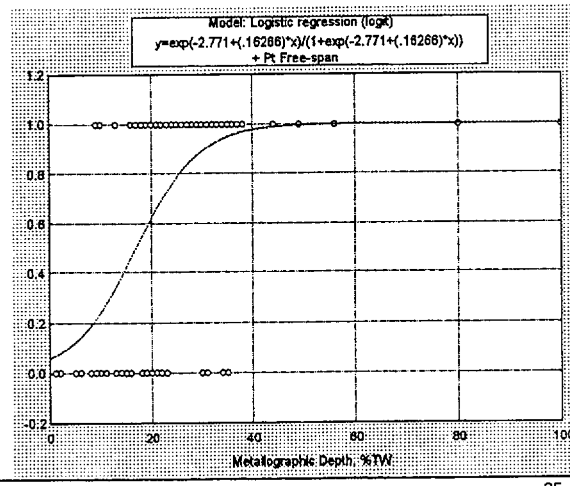
+Pt POD Model Development for Axial ODSCC in Tube Dings

- Free-span "Misses" are Retained
  - Missed in the Absence of Tube Indentations
- Free-span Hits are Excluded
  - Detected in the Absence of Tube Indentations
- Hit/miss Data from Signal Superposition Study Added
  - Upper Extremes of the Explanatory Variable



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Westinghouse Ding/Defect Superposition Study

- In Situ pressure tested indications with a range in depths were superimposed on Unit 2 ding signals using eddy current analysis software
- Overall detection performance for the various test conditions is summarized below in a Hit / Miss table

Estimated Met Depth, %TW	R89L57 Largest V_{VM}	R12L28 Largest V_{PP}	R126L48 Median	R88L148 Mean
R8L144 – 33%	Miss	Hit	Hit	Hit
R47L51 – 42%	Miss	Hit	Hit	Hit
R133L91 – 42%	Hit	Hit	Hit	Hit
R53L137 – 47%	Hit	Hit	Hit	Hit
R109L65 – 54%	Hit	Hit	Hit	Hit
R118L64 – 73%	Hit	Hit	Hit	Hit
R117L61 – 82%	Hit	Hit	Hit	Hit

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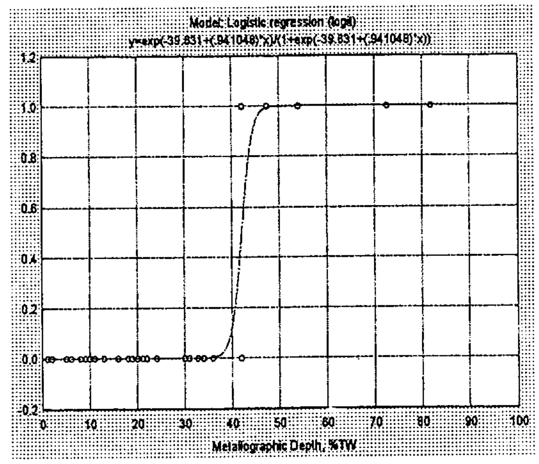
+Pt POD Model for Axial ODSCC in Tube Dings

- Worst Case Hit/Miss Data Used
  - Added to Free-span Miss Data as Input for Tube Ding POD
- Bootstrap Estimates to Study Sensitivity of Uncertainties in POD
- Best Estimate POD Justified for Input to the Operational Assessment



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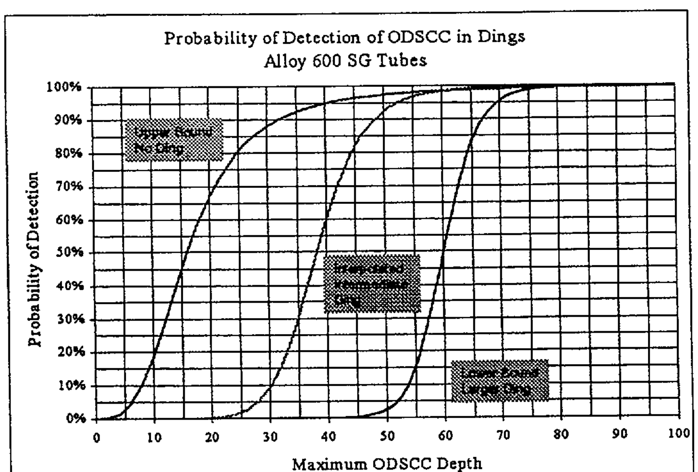
Bobbin Coil Voltage Based POD Model



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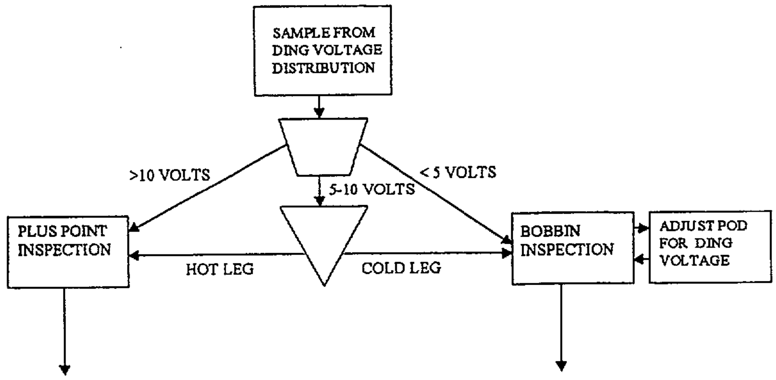
SIMULATION LOGIC FOR ODSCC AT DINGS : INSPECTION



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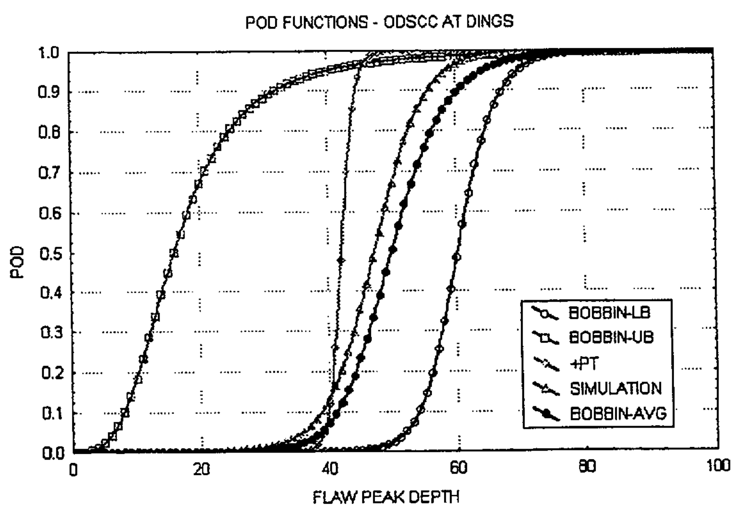

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Initiation of ODSCC in Dings

- Weibull Model Used for Initiation Process in Ding Population
  - Limiting Slope Parameter of 4 Assigned
    - Exceeds EPRI Comprehensive Report of Observations of Field Data
  - Scale Parameter Estimated Using OA Model
    - Scale Parameter Adjusted to Agree with EOC 12 Results

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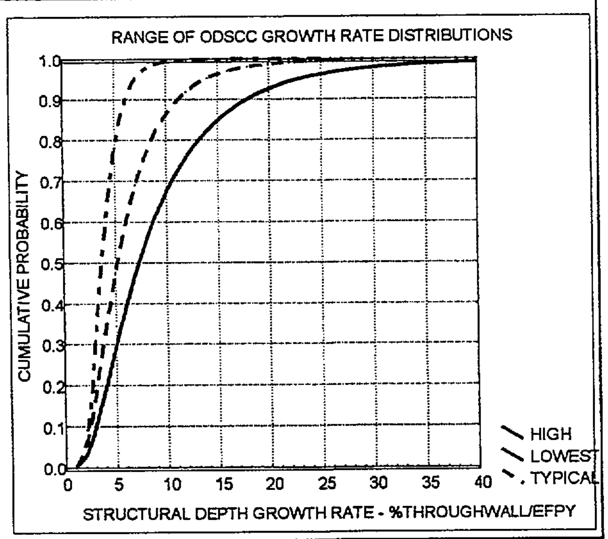
Growth Rates

- Growth Rate Based On Extensive Field Observations
- Range Of Growth Rate Distributions Illustrated
- High Growth Rate Curve Used In ODSCC At Dings Evaluation



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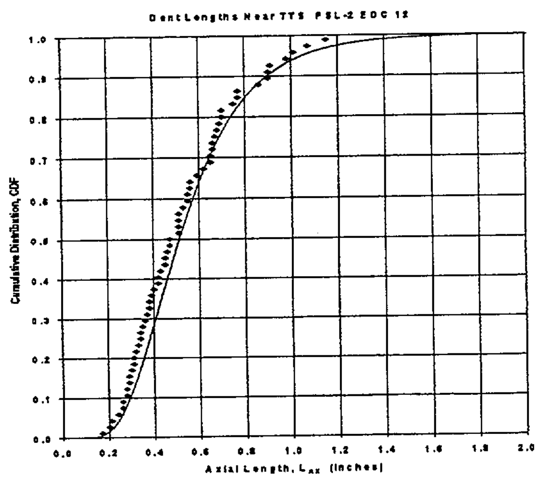
Potential Flaw Length Distribution

- Flaw Length Distribution Determines Fraction Of Deep Flaws That Are Potential Burst Candidates
- Developed From PSL-2 2001 Ding Length Measurements



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Results of ODSCC at Dings Evaluation

	ADDITIONAL NUMBER OF INDICATIONS PREDICTED	PROBABILITY OF BURST AT 3xNODP
	EOC 13	EOC 13
S/G A	4	0.033
S/G B	1	0.007

- Conservative Model Elements
  - Growth
  - Burst Model
  - Flaw Length
  - No Credit Taken for Ligaments
  - Initiation
- Accommodates Risk Associated With New Mechanism

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Summary of Operational Assessment

Steam Generator Predicted to Meet NEI 97-06 Performance Criteria at EOC 13

- Predicted Leakage at MSLB << 1 GPM
- Predicted POB < 0.10

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CLOSING REMARKS - Raj Kundalkar, Engineering VP

Our Operational Assessment Demonstrates:

- EOC 12 Inspections Provide a Thorough Assessment of S/G Condition
- The Rate of Increase in Indications is Consistent with Industry Experience
- Strong Assurance of Safe Operation Through the End of Cycle-13 Demonstrated by the Application of a Benchmarked Multi-Cycle Model.

Questions?