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Davis-Besse Nuclear Power Station

Reactor Vessel Incore Nozzles

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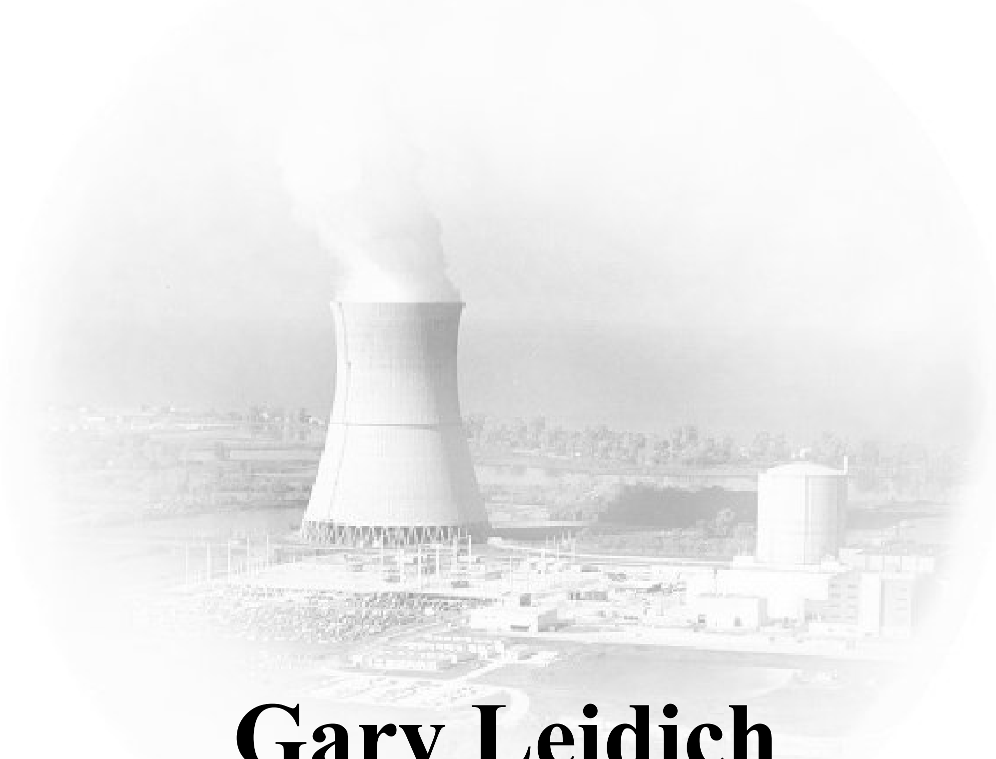
Opening Remarks . . . .Gary Leidich

Reactor Vessel Incore Nozzles……………… Bob Schrauder

- Incore Nozzle Configuration
- Recent Inspection and Evaluation at Davis-Besse
- Actions Prior to Returning the Plant to Service
- Contingency Repair Concept
- FLÜS Online Leak Monitoring System

Closing Comments………………………….. Gary Leidich

Opening Remarks



Gary Leidich
Executive Vice President - FENOC

Desired Outcome

- Brief the NRC Staff on the status of the Davis-Besse Reactor Vessel Incore Monitoring Instrumentation Nozzles and future plans

- Obtain NRC comments on Davis-Besse approach

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CEO of FirstEnergy has set the standard of returning Davis-Besse back to service in a safe and reliable manner.

We must do the job right the first time and regain the confidence of our customers, regulators, and investors in our nuclear program.

We are committed to meeting this challenge.

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Return to Service Plan

Restart Overview Panel

Reactor Head Resolution Plan
Bob Schrauder

System Health Assurance Plan
Jim Powers

Program Compliance Plan
Jim Powers

Restart Action Plan
Lew Myers

Restart Test Plan
Randy Fast

Containment Health Assurance Plan
Randy Fast

Management and Human Performance Excellence Plan
Lew Myers

Return to Service Plan

Inspection of the Incore Nozzles is part of the Containment Health Assurance Building Block in the Davis-Besse Return to Service Plan

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Reactor Vessel Incore Nozzles

Bob Schrauder
Director - Support Services

Incore Nozzles
Configuration

- Babcock & Wilcox reactor vessel has 52 Incore Nozzles
- Incore nozzles are ~ 1 inch in diameter
- Original incore nozzles fabricated from Alloy 600 material
- Welds - Alloy 182 (stress relieved)
- Incore nozzles modified following Oconee 1 1972 Hot Functional Testing Failure

Incore Nozzles at Bottom of Reactor Vessel (Post-cleaning)

Incore Nozzle Modification

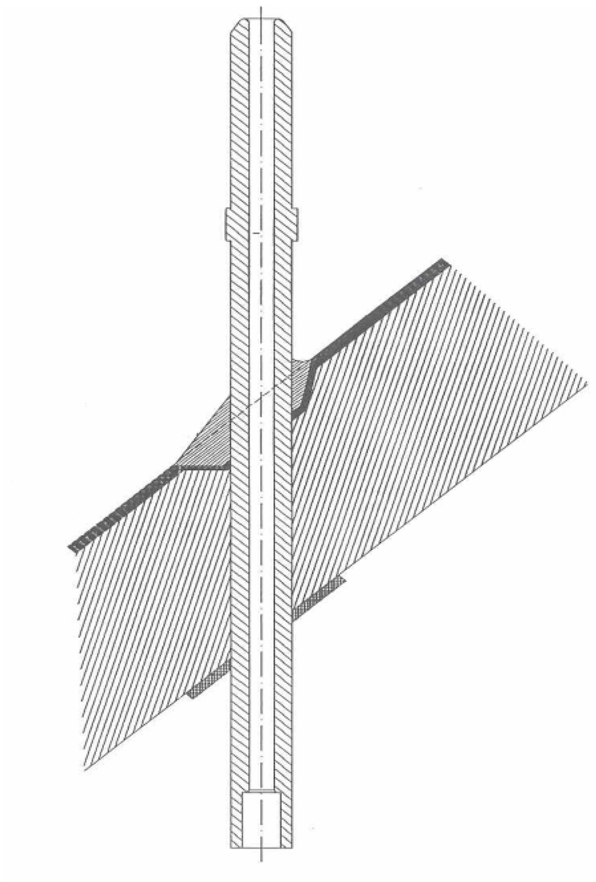
Repair in Process

Completed Repair

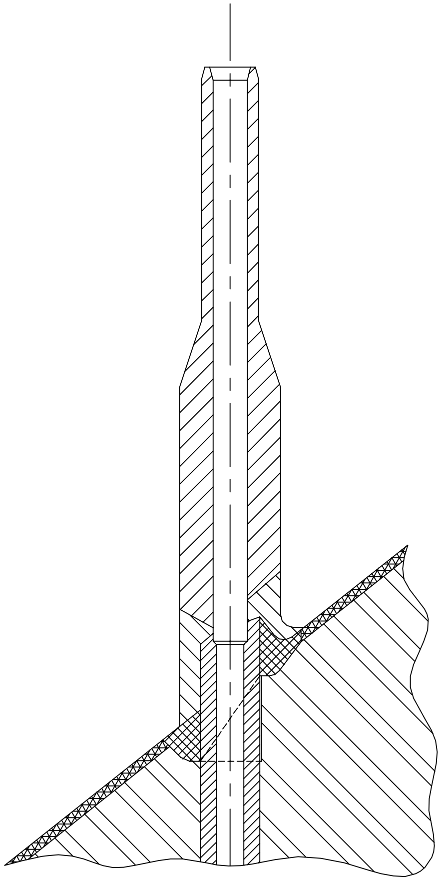
Industry Experience
Incore Nozzles

- Incore nozzles are exposed to lower temperature (558^{o}F) than Control Rod Drive Mechanism nozzles (605^{o}F) and are less susceptible to stress corrosion cracking
- Visual inspections of the incore nozzles have not been routinely conducted in United States plants
- Inspections/testing of incore nozzles at 13 French plants have not discovered cracking or leaking

EDF vs. B&W Nozzle Configuration



EDF Nozzle Configuration



B&W Current Nozzle Configuration

Inspection of Reactor Vessel

Inspection of Bottom of Reactor Vessel

- Visual Inspections performed as part of the Extent of Condition Program

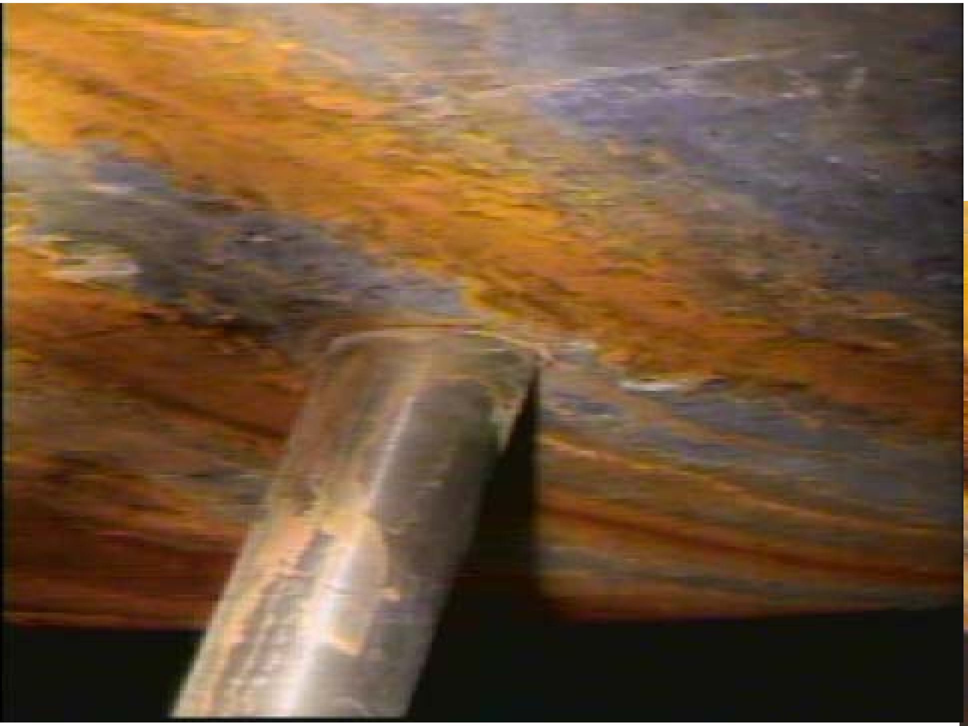
Inspection Conclusions

Bottom of Reactor Vessel

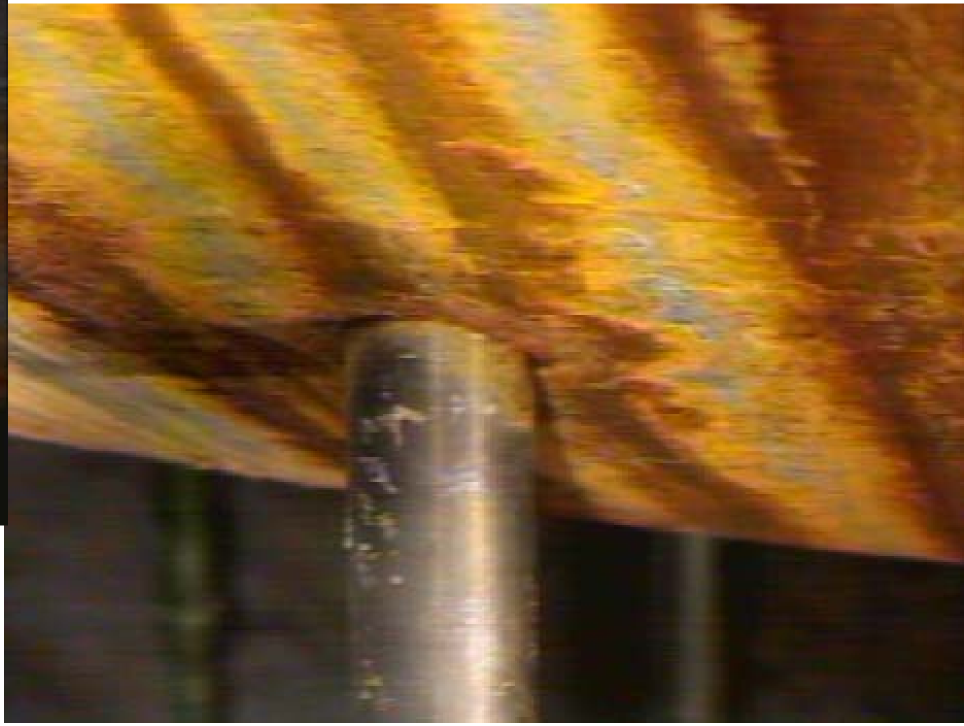
Inspection results:

- Boron and rust deposit trails were observed on the sides and bottom of the reactor vessel
- Similar deposits observed on several incore nozzles
- Tape remnants and residue observed on incore nozzles
- No build-up of boric acid or corrosion products on top of insulation
- No evidence of wastage on bottom of reactor vessel

Incore Nozzles



Incore Nozzle #42



Incore Nozzle #45

Deposit Sampling Summary

AREAS:

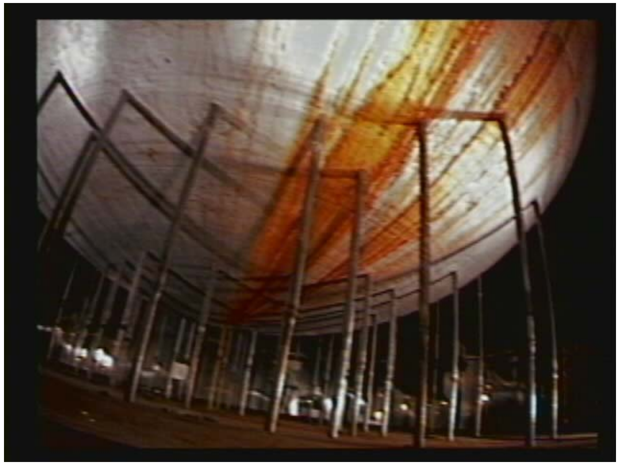
- Reactor vessel flow trail and incore nozzle deposits

OBJECTIVE:

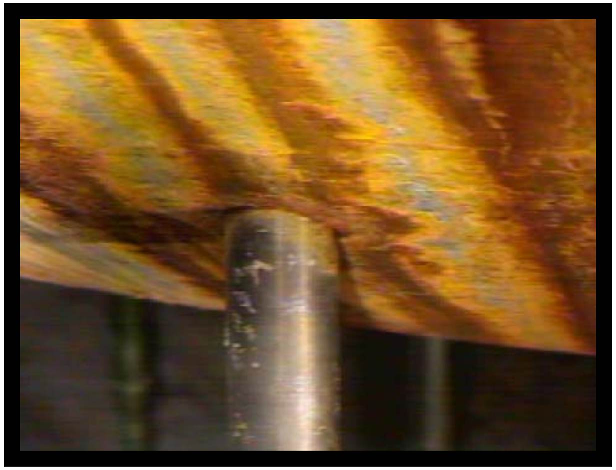
- Determine through chemical analysis whether flow trails and incore nozzle deposits had common source

SAMPLE POPULATION:

- 2 from flow trails observed on under reactor vessel sides
- 12 from incore nozzles
- Analysis by Framatome-ANP



Bottom of Reactor Vessel



Incore Nozzle #45

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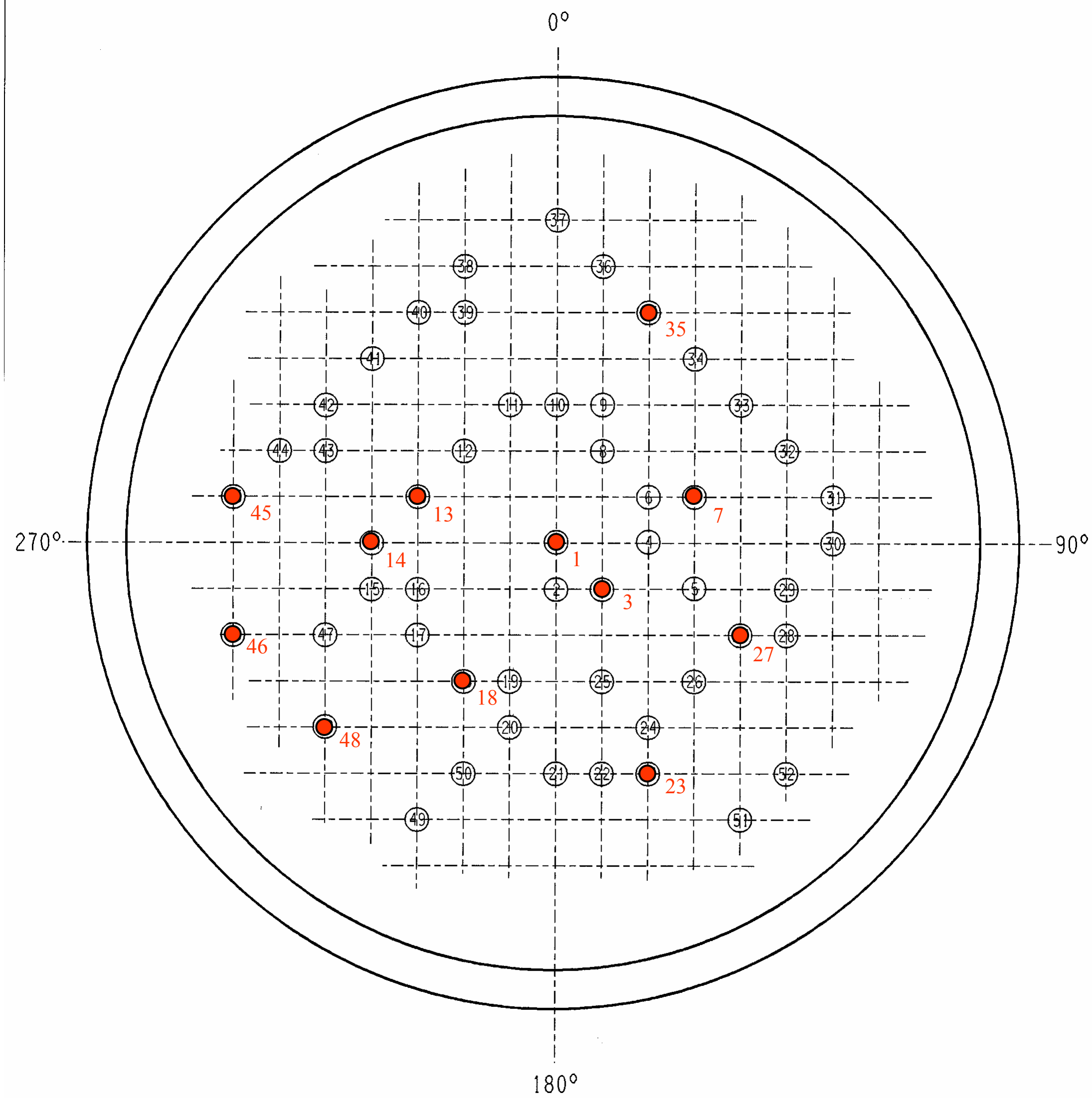
Sampling of Deposits

- Sample locations (•) chosen were nozzles

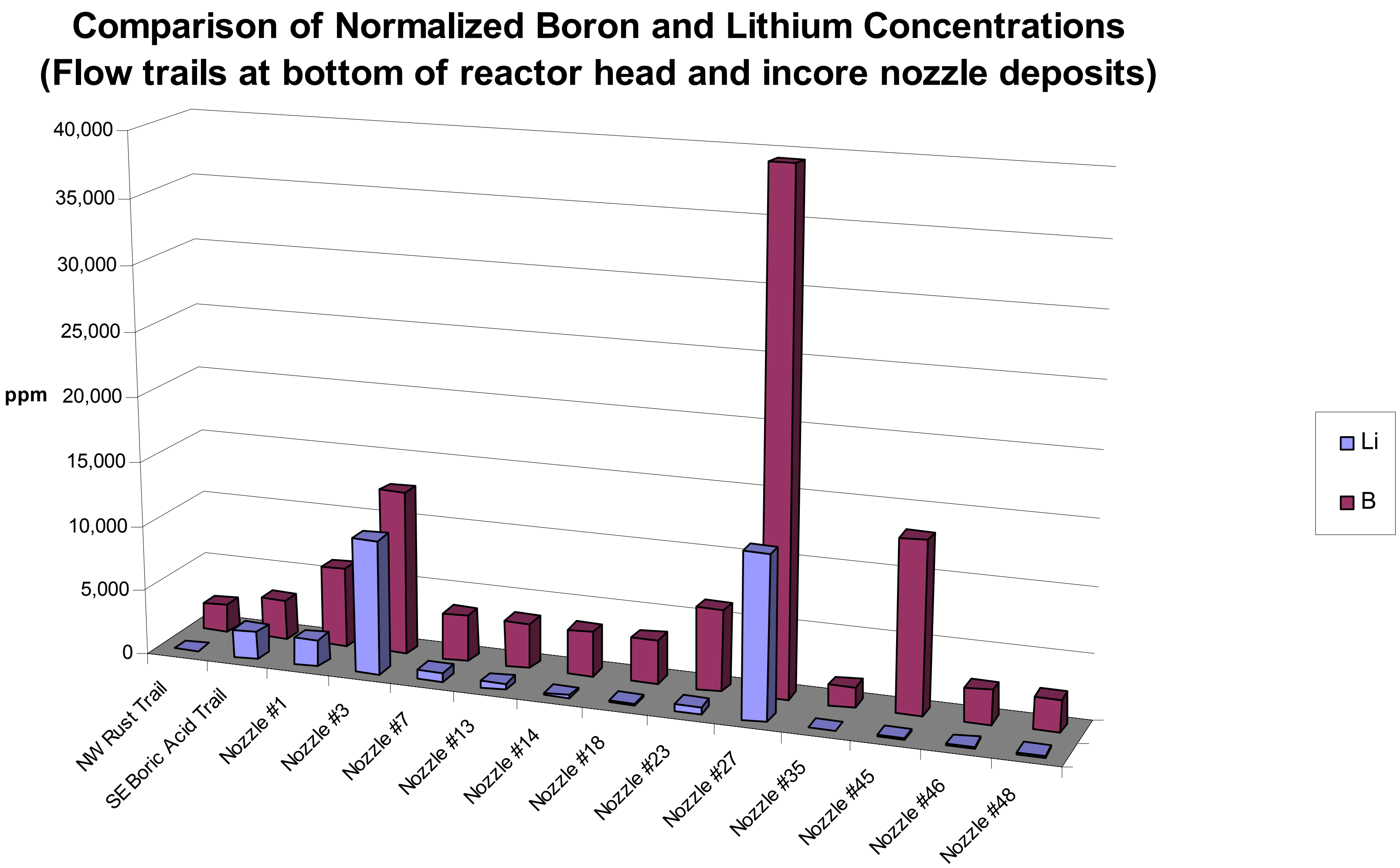


INCORE INSTRUMENT CORE LOCATION MAP
BOTTOM HEAD INSIDE VIEW

Deposit Characterization Summary

- Boron and Lithium were higher at several incore nozzle locations than in flow trails and more comparable with previously analyzed upper head deposit samples (shown next slide)
- Minor species (Uranium, Barium, Thorium, Strontium, & Zirconium) were higher at several incore nozzle locations than in the flow trails. However, the lack of activity associated with these species did not support reactor coolant as the source
- Cobalt (Co^{60}) and Iron (Fe^{59}) were higher in the flow trails than at the incore nozzle locations
- Inconsistent concentration gradients along possible flow trail paths

Deposit Characterization Summary



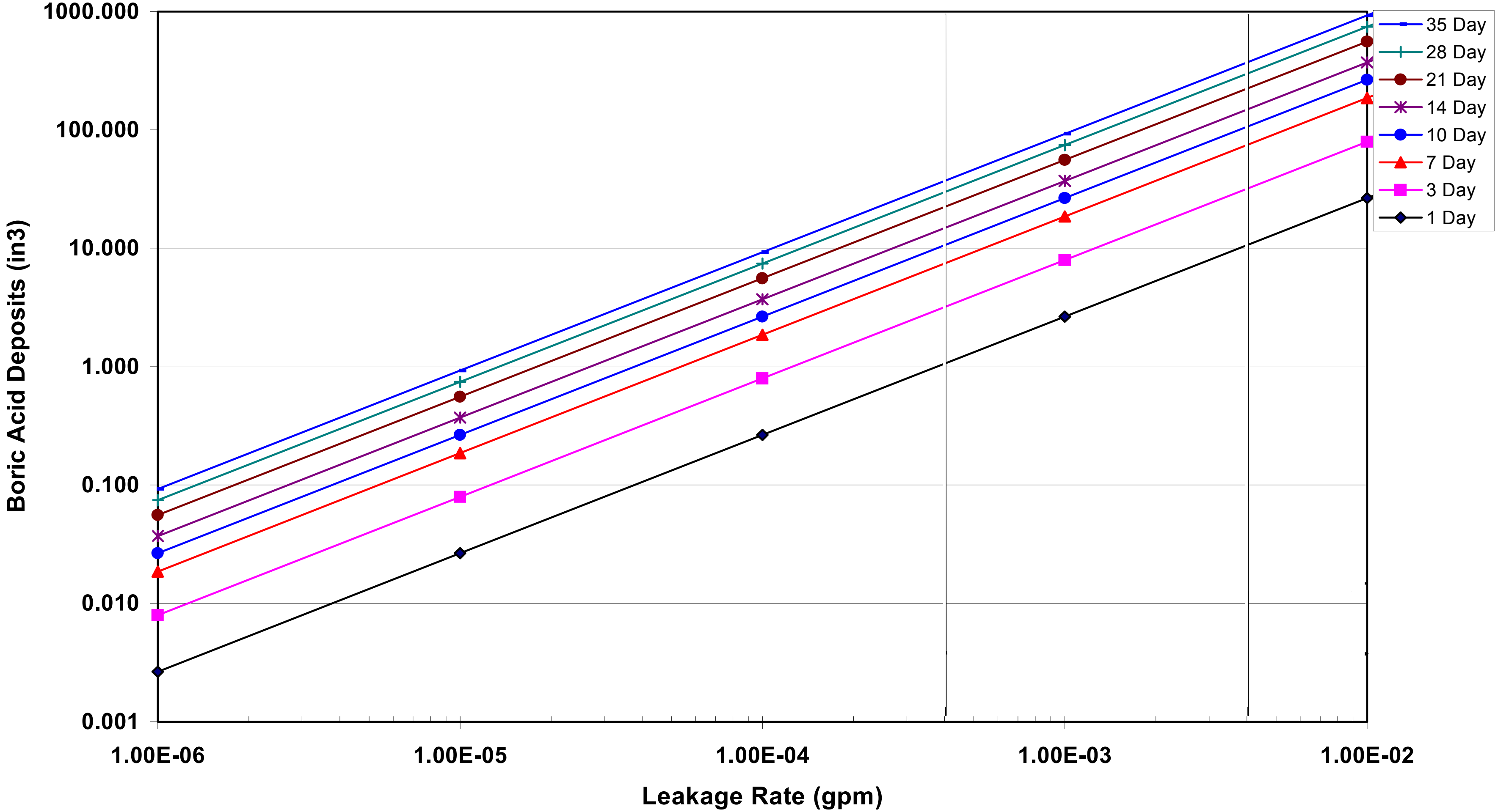
Deposit Characterization
Conclusion

From the results of the analysis,
it is inconclusive whether the flow trails at the bottom of the reactor head and nozzle deposits had a common source

Reactor Vessel Bottom Inspection Plan

- FENOC and Framatome-ANP developed inspection plan
- Bottom of reactor vessel thoroughly cleaned 9/2002
- Planned visual inspections prior to startup:
  - Raise Reactor Coolant System to normal operating pressure and temperature (hold for 3-7 days)
  - Potential use of hot optics (visual inspection aid)
  - Lower temperature and pressure
  - Perform bare metal reactor vessel visual inspection
  - Perform bare metal reactor vessel visual inspection during the next scheduled outage

Boron Deposit Rate For 2000 ppm Boron Reactor Coolant Leakage (Unchoked Flow) 100% Deposition Rate For a Given Number of Days



Reactor Vessel Bottom Inspection Plan

- Inspections will be sufficient to detect leakage
- Absence of boric acid will confirm that the deposits found in in 2002 were not from incore nozzle leaks

Laboratory Leak Rate Testing

- Program Objectives
  - Measure leak rate as a function of simulated and/or actual flaw geometry
    - Benchmark analytical models for bounding leak rate calculations
    - Identify residue deposit chemistry and any volatile chemicals that exit the crevice
    - Investigate effect of annulus on leakage rates
  - Verify methods for detecting very small leaks
    - Visible evidence of boron residue
    - In-situ monitoring techniques

Technical Approach

- Framatome-ANP Hot Leak Test Facility will be used to provide primary fluid:
  - T_c = 558º F; p = 2200 psig
  - Primary chemistry (boron & lithium concentration)
- Mockup assembly will be connected to existing high temperature/ high pressure supply system
- Leak rates measured from 10^{-6} to 0.25 gpm

Mockup Design & Test Description

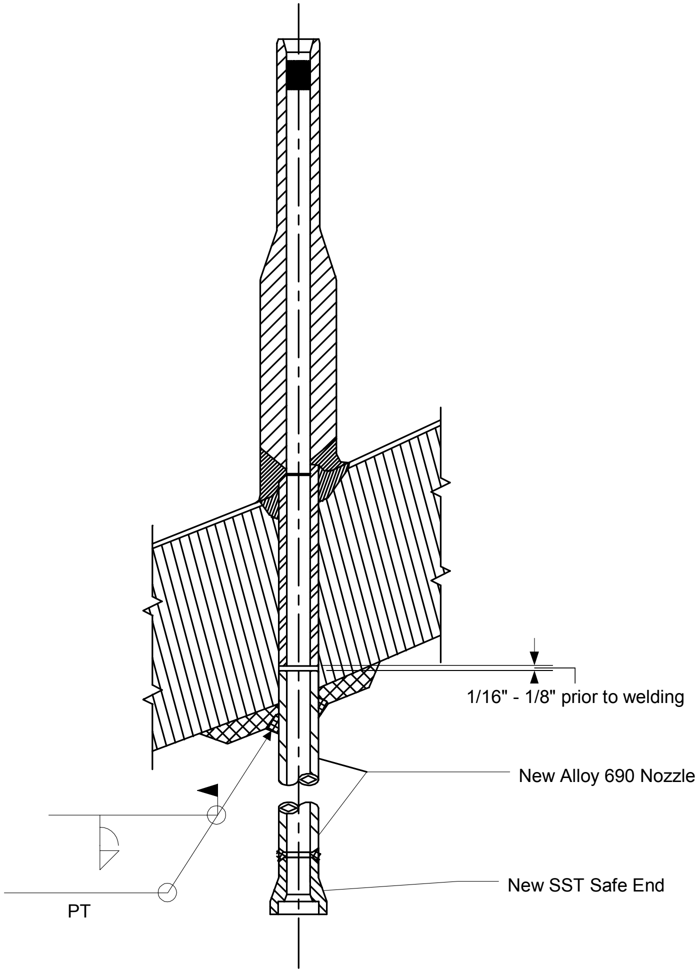
- Mockup is being designed and built to measure leak rates through simulated (SCC) flaws

- Leak rate bounding tests will be conducted for 8 hours each

- Final test with a selected leak rate will be run for 5 days

Contingency Repair Concept

- Insert mechanical plug and cut existing incore nozzle
- Deposit 1/2” - 5/8” weld pad
- Bore out incore nozzle remnant into reactor vessel to 1” maximum depth
- Fit-up replacement nozzle and complete new weld
- Remove mechanical plug



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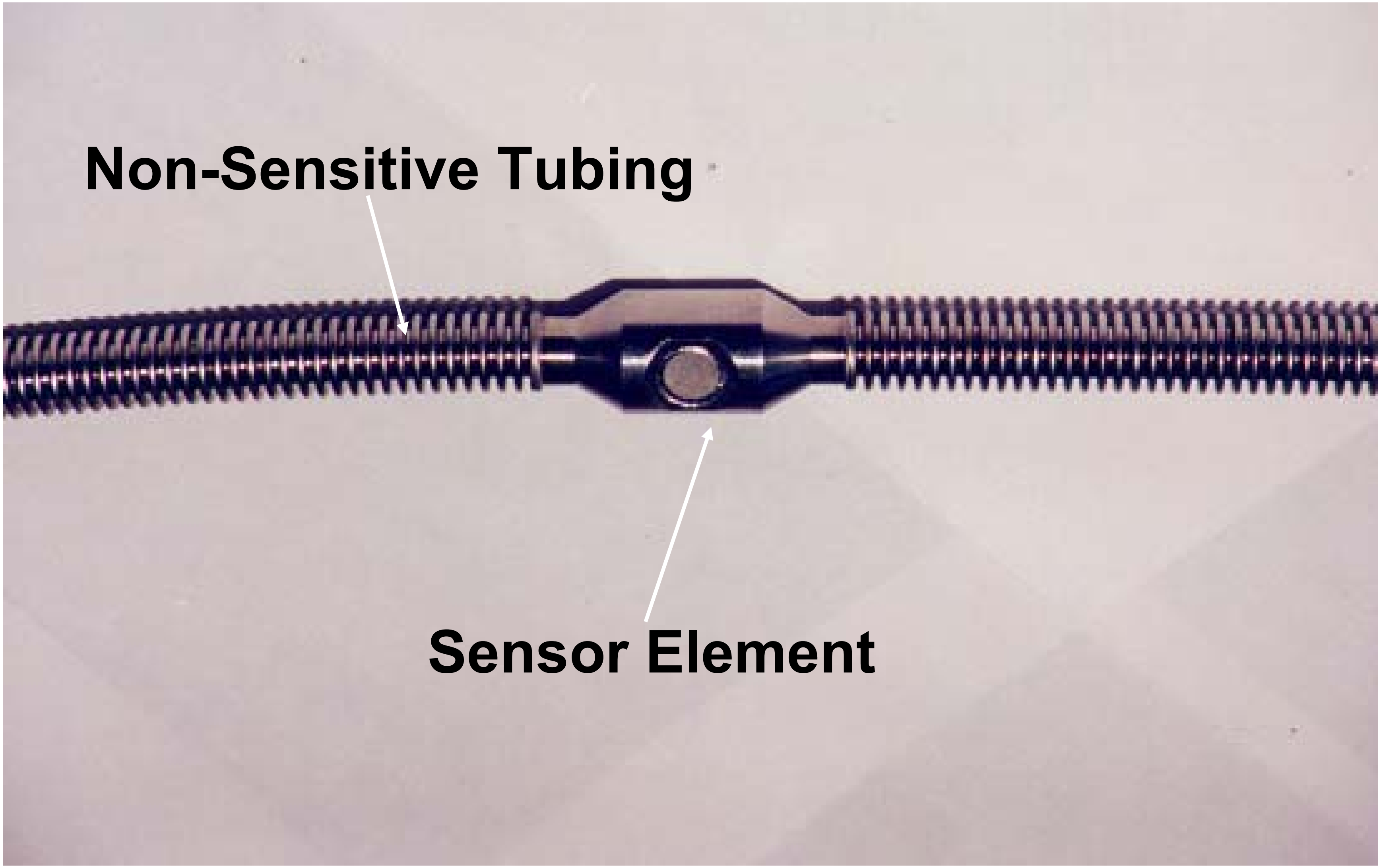
Additional Regulatory Interfaces

- If repairs are necessary, a meeting to discuss final design will be held with the NRC
- 10CFR50.55a alternative code (ASME Code Section XI) requests will be necessary to permit implementation of repairs
- Alternative code request will be similar to those submitted to NRC for the repair of Control Rod Drive Mechanism nozzles at other plants

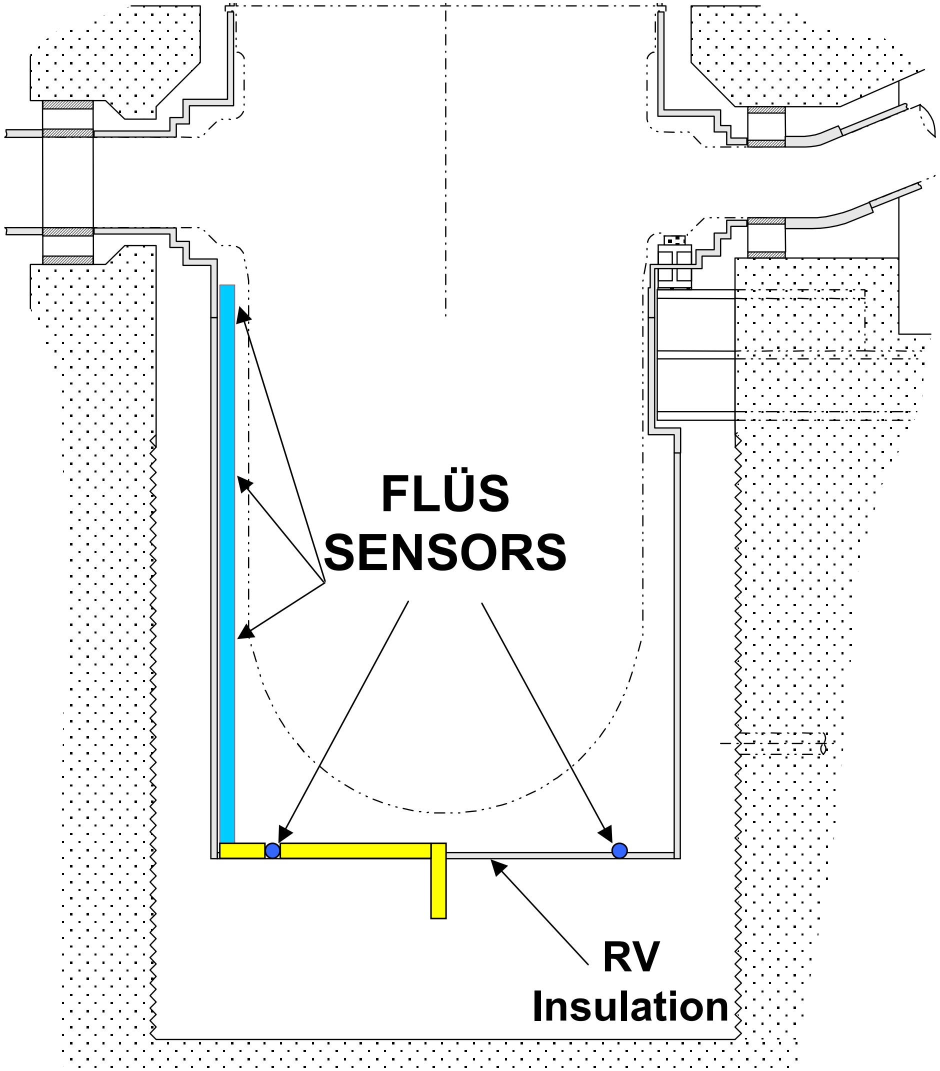
FLÜS Online Leak Monitoring

- Davis-Besse plans to install FLÜS Online Leak Monitoring System
- Ability to detect and locate leakage with significantly higher sensitivity than other available systems
- Leak detection system measures the moisture penetrating a sensor tube
- Installed or being installed in 12 units in a variety of European countries and Canada
- Operational history of 10 years

FLÜS Sensor Tube



Proposed FLÜS Installation



- Install sensor tube between the reactor vessel insulation and reactor vessel
- Simple installation
- Expected sensitivity of approximately 4E-3 to 2E-2 gpm
- System sensitivity is dependent on the air tightness of reactor vessel insulation

Closing Comments

Gary Leidich
Executive Vice President - FENOC