# Bottom Mounted Nozzle Strategic Plan

## July Update to NRC

Larry Mathews, Southern Nuclear

Chair, MRP Alloy 600 ITG

Mel Arey, Duke Energy

MRP Alloy 600 ITG

July 19, 2004

Conference Call

EPRI

# Meeting Agenda

- BM Nozzle NDE Demonstration Program
- BMN Safety Assessment Plan
- Integrated Inspection Plan
  - Planned Inspections
  - Callaway BM Nozzle Inspection Results
- BM Nozzle Strategic Plan
- Summary

# Bottom Mounted Nozzle Strategic Plan Elements

- BM Nozzle NDE Demonstration Program
  - MRP Alloy 600 ITG
- BMN Safety Assessment Plan
  - Combined effort of MRP Alloy 600 ITG, BWOG, and WOG
- Integrated Industry Inspection Plan
  - MRP Alloy 600 ITG and PWR Owners
- BMN Repairs
  - Commercial techniques available

# BMN NDE Performance Demonstration Program

Larry Mathews, Southern Nuclear

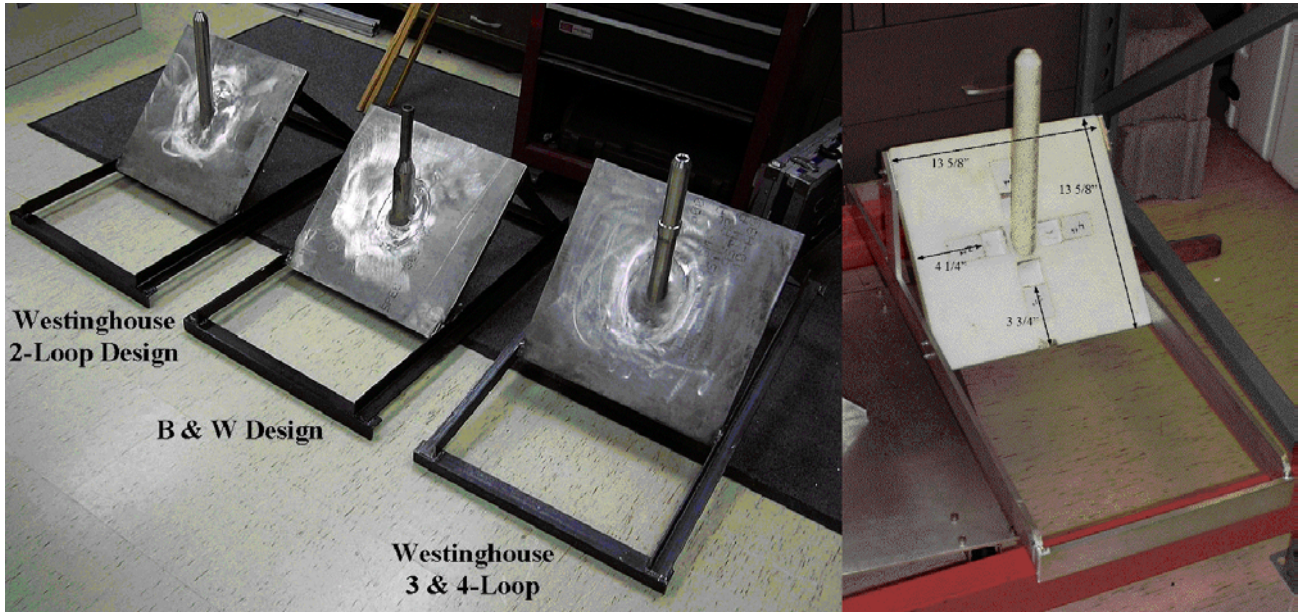
Chair, Alloy 600 ITG

# BMN Practice Mockups

- 4 Practice Mockups
  - 2 Westinghouse 3/4-Loop
  - 2 B&W Designs
    - Tube Only
    - Tube w/repair weld
- Made available in 2003

# BMN Blind Demonstration Mockups

- 7 Mockups for Volumetric and Surface Inspection
  - 6 Full-Scale Mockups
    - 2 Westinghouse 2-Loop Design
    - 2 B&W Design
    - 2 Westinghouse 3/4-Loop Design
  - 1 Plastic Mockup that holds coupons containing Laboratory-grown SCC

# Status of Demonstrations

- Demonstrations to-date
  - WesDyne International
  - AREVA (formerly known as Framatome)
  - Other inspection vendors have been invited to participate
- Techniques Demonstrated
  - Used currently available technology (best effort)
  - Demonstrations have been UT of nozzle base material: TOFD
- Future Demonstrations
  - Improved UT of nozzle base material
  - ET of the wetted surface of the J-groove weld

# Status of Demonstrations (cont'd)

- Demonstration Results
  - Both vendors experienced false calls on UT of nozzle base material
    - Seeing improvement in second round
  - Due to geometry of repair configurations, UT inspections did not cover 100% of targeted inspection area
  - Initial ET efforts on J-groove weld experienced delivery system limitations

- Future Activities
  - WesDyne UT & ET Demo - August 2004
  - AREVA ET Demo - January 2005

# Bottom Mounted Nozzle Safety Assessment Plan

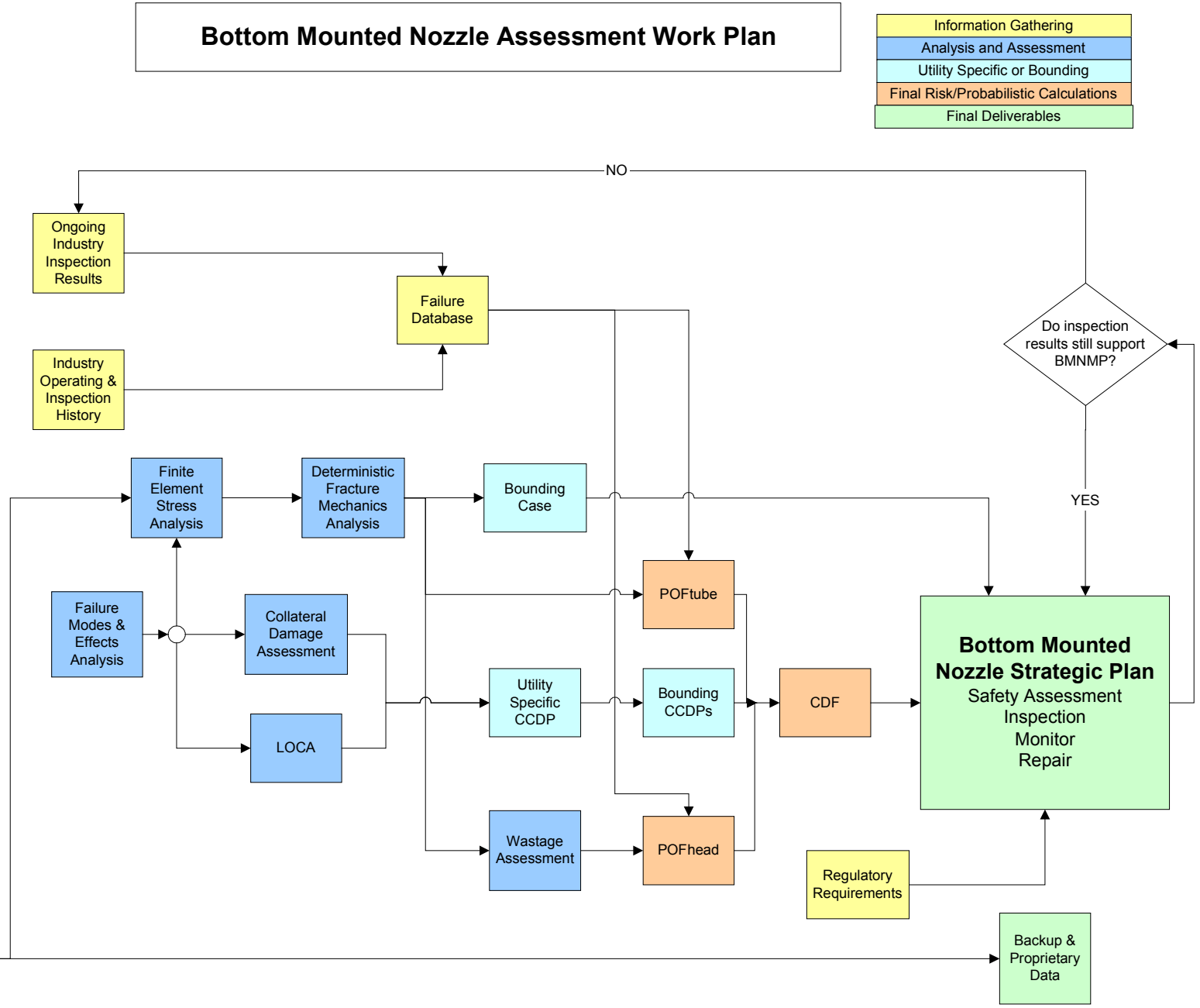
WOG, Dave Bajumpaa, Dominion

B&WOG, Bill Gray, AREVA

# Industry BMN Safety Assessment Plan

- Primary Elements of Plan
  - Failure Modes and Effects Analysis
  - Review of Design and Manufacturing Data
  - LOCA Analysis
  - Stress Analysis & Fracture Mechanics Analysis
  - Collateral Damage Assessment
  - Wastage Assessment
  - Inspection History and Ongoing Results
  - Core Damage Frequency
  - Long Term Inspection Recommendations
  - Repair Recommendations

# Bottom Mounted Nozzle Assessment Work Plan



# Westinghouse Owners Group
# BMN Safety Assessment Program

- Program is funded
- Work initiated Summer 2003
- All deliverables are currently on schedule to support overall program

# WOG BMN Safety Assessment Program

- Design Basis Investigation and Inspection Summary
  - Complete
- Design and Fabrication of BM Nozzles
  - Draft report completed
  - Comments received
  - Final report pending
- Failure Modes and Effects Analysis
  - Draft issued for WOG review
  - Comments received and being resolved
  - Final report expected Fall 2004

# WOG BMN Safety Assessment Program

- Integrity Evaluation
  - Finite element analysis draft reports received
  - Fracture mechanics work is in progress
  - Two additional configurations need to be addressed based on fabrication history search
- Risk Evaluation
  - Small break LOCA analyses are in progress to support risk evaluation

# B&W Owners Group
# BMN Safety Assessment Program

- Program is funded
- Work initiated March 2004
- All deliverables are currently on schedule to support overall program

# B&W Owners Group
# BMN Safety Assessment Program

- Design and Manufacturing Data
  - Draft issued for B&WOG review
  - Comments received
  - Final report pending
- LOCA Analysis
  - Draft issued for B&WOG review
  - Comments received
  - Final report pending

# B&W Owners Group
# BMN Safety Assessment Program (cont'd)

- FMEA Support (WOG lead)
  - Reviewed initial draft
  - Working with WOG to resolve comments
- Collateral Damage
- Stress Analysis

# Integrated Industry Inspection Plan

Mel Arey, Duke Energy

# Integrated Industry Inspection Plan

- Purpose
  - Perform selected volumetric inspections while the work progresses to determine long term inspection and monitoring strategy.
  - Gather additional data to determine extent of the problem.
  - Develop a proactive industry management program that assures safe and reliable operation.

# Integrated Industry Inspection Plan

- Potential Inspections:
  - BMV of lower vessel head
  - UT of nozzle base material
  - Enhanced visual of j-groove weld or ET of j-groove weld
- Inspection results will be reviewed to determine if a susceptibility model could/should be developed
- Supports development of a long-term BMN inspection strategy

# Industry Communications

- June 2003, MRP Letter
  - Perform bare metal examination of any Alloy 600 nozzles on bottom head
  - Non-visual NDE may ultimately be a prudent and necessary component in a comprehensive inspection plan
- August 2003, NRC Bulletin 2003-02
  - NRC recommendations consistent with MRP guidance
- May 2004, MRP Letter
  - Continue with bare metal visual inspections per previous recommendations
  - Utilities with an upcoming 10-year reactor vessel ISI should plan volumetric inspections

# Planned BMN Volumetric Inspections[note]

- Spring 2004
  - Callaway
- Fall 2004
  - Watts Bar 2
  - Turkey Point 3
  - Oconee 3
  - Catawba 2
- Spring 2005
  - Turkey Point 4
  - Prairie Island 2
  - STP 2
  - Catawba 1
  - McGuire 2

Note: Performance of inspection is predicated on the successful completion of the BMN NDE demonstrations

# Callaway BM Nozzle Inspection

- Performed in conjunction with the 10-year vessel examination
- Inspected 58 nozzles
  - 2 Time of Flight Diffraction (TOFD) probes
    - One axially oriented for circ flaws
    - One circumferentially oriented for axial flaws
  - 30 degree dual element probe to interrogate the weld interface
  - Eddy current probe for surface breaking flaws
- No indications were noted

# BMN Repairs

- Commercial techniques are currently available
- Industry identified the attributes of an ideal repair
  - Prioritized for use in evaluating available commercial techniques or new designs.
  - Listed the various strengths and weaknesses of each attribute.

# Summary and Wrap-Up

Larry Mathews, Southern Nuclear

Chair, Alloy 600 ITG

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# Project Activities

- Summer 2004
  - NDE Demonstration Program
    - On-going with periodic reports
- Fall 2004
  - Failure Modes and Effects Analysis
- Fall 2005
  - Wastage Assessment
  - LOCA Analysis
  - Fracture Mechanics and Deterministic Calculations
  - Core Damage Frequency
- Spring 2006
  - Final BMN Inspection Strategy
  - Final BMN Assessment

# Summary and Conclusions

- NDE demonstrations are underway
- Safety assessment work is underway
- Bare metal visual inspections have not identified indications of leakage
- Multiple volumetric examinations are planned for upcoming outage seasons

- There continues to be no immediate safety concern

# Wrap-up

- NRC Comments?
  - Discussion





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