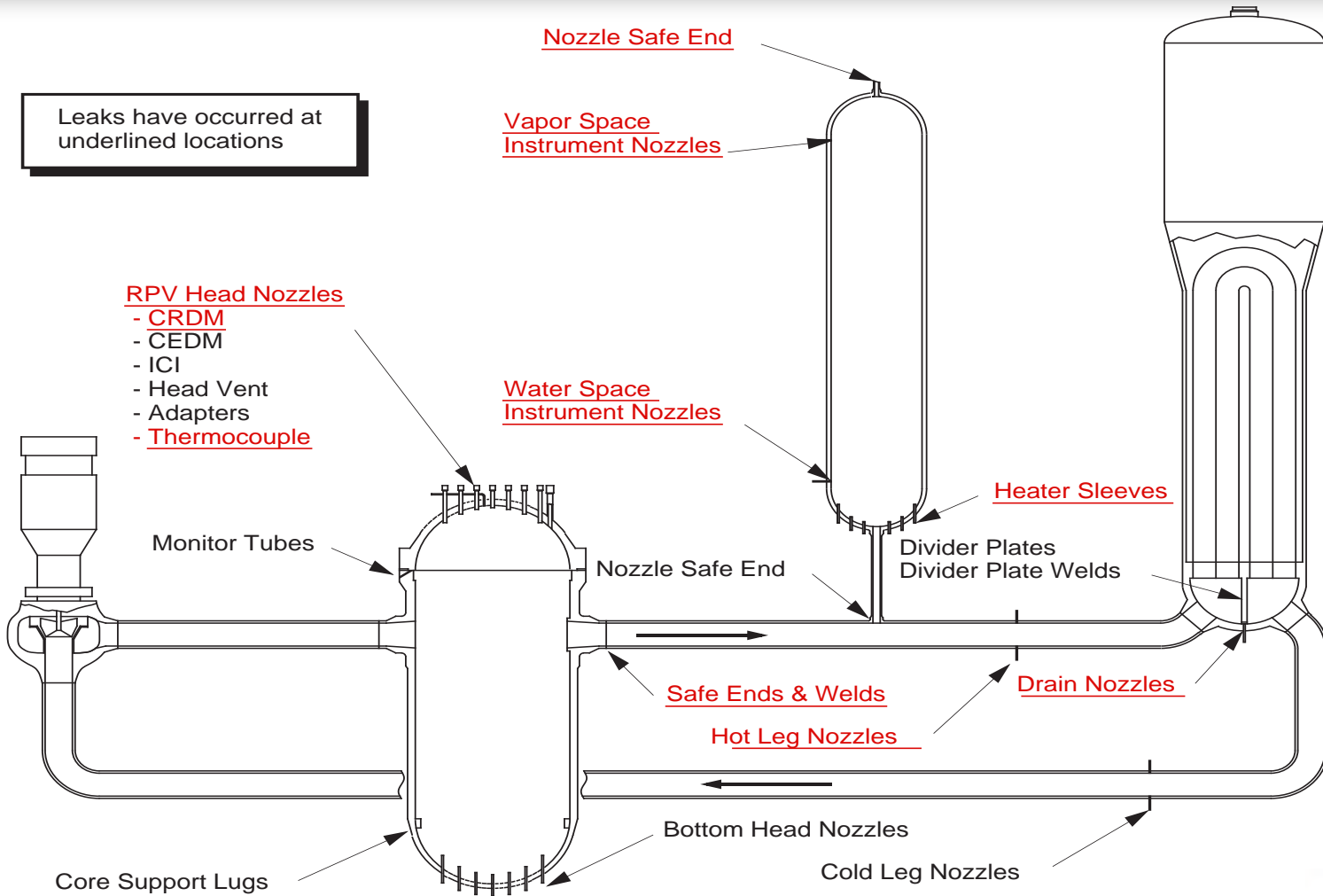


Alloy 600, 82/182 Weld Integrity Issue

Larry Mathews,
Southern Nuclear Operating Co.
MRP Senior Representatives' Meeting
August 15, 2001



Important Locations



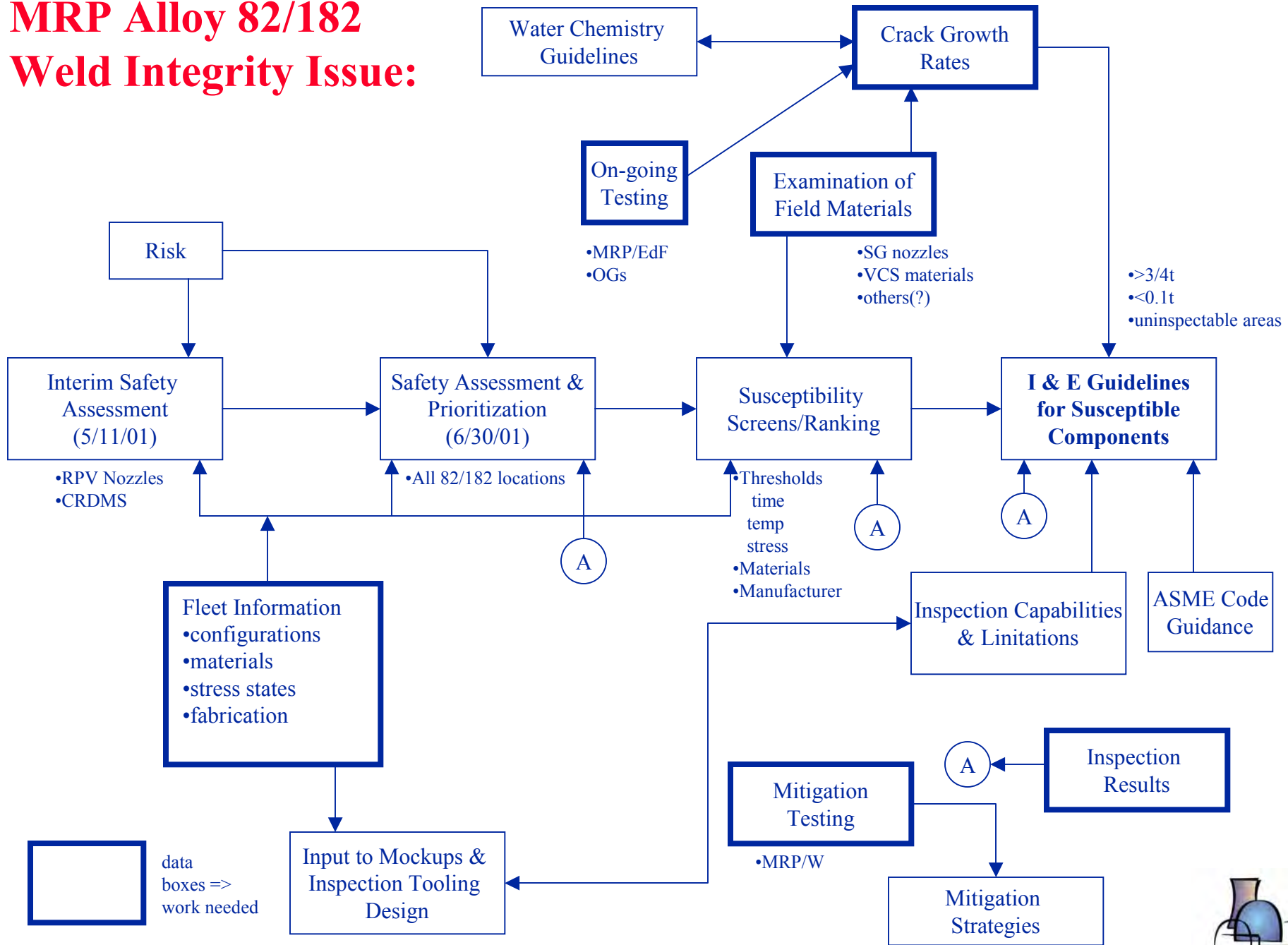
Industry Response

- Integrated effort is being coordinated through
 - EPRI Materials Reliability Program (MRP) - Alloy 600 ITG
 - Committees Under Alloy 600 ITG
 - Assessment
 - Inspection
 - Repair/Mitigation
 - NEI
 - Owners Groups
- Work is being performed by
 - Utilities
 - NSSS Vendors
 - Contractors

Industry Response

- Overall Scope of Alloy 82/182 Weld Integrity Activity
 - Safety Assessment and inspection development/support WITH
 - Comprehensive ‘Inspection and Evaluation Guidelines’
 - Similar to BWRVIP approach
 - Identify and rank all susceptible components
 - Provide hardware evaluation (component description and function)
 - Provide safety assessment for each (built from first activity above)
 - Provide ‘conclusions and actions’ recommendations/ management approach
 - Integrate with past, existing and future OG activities (no duplication)

MRP Alloy 82/182 Weld Integrity Issue:



PWSCC of Alloy 82/182 Pipe Butt Welds

Interim Safety Assessment for Alloy 82/182 Pipe Butt Welds (MRP 44, Part 1)

- Plants have adequate margin to continue operation
- Cracks expected to be predominantly axial due to stresses
- Axial cracks in butt welds bounded by resistant low alloy steel or stainless steel material
- Critical flaw size for rupture several times width of weld
- V.C. Summer leak discovered long before safety margins were compromised
- Through wall circ cracks will produce detectable leaks before exceeding available structural margins because of high ductility of Alloy 82/182 materials
- Defense in depth
 - These cracks do not significantly increase the core damage frequency
 - Primary pipe break is an analyzed accident per the FSAR

NDE Plan

- All Spring outage plants enhance 88-05 walkdowns considering lessons learned from VC Summer
- For 10 year ISI plants, EPRI mockup used to demonstrate techniques:
 - Changes made to enhance detection
 - Transducer packages/sled design
 - Equipment setup
 - Operator awareness
- Shop welds vs. field welds
 - Shop weld ID contours expected to be smoother
 - All Spring outages with 10 year ISI of vessels were shop welds
 - Some minor liftoff experienced, even on a shop weld

NDE Plan (continued)

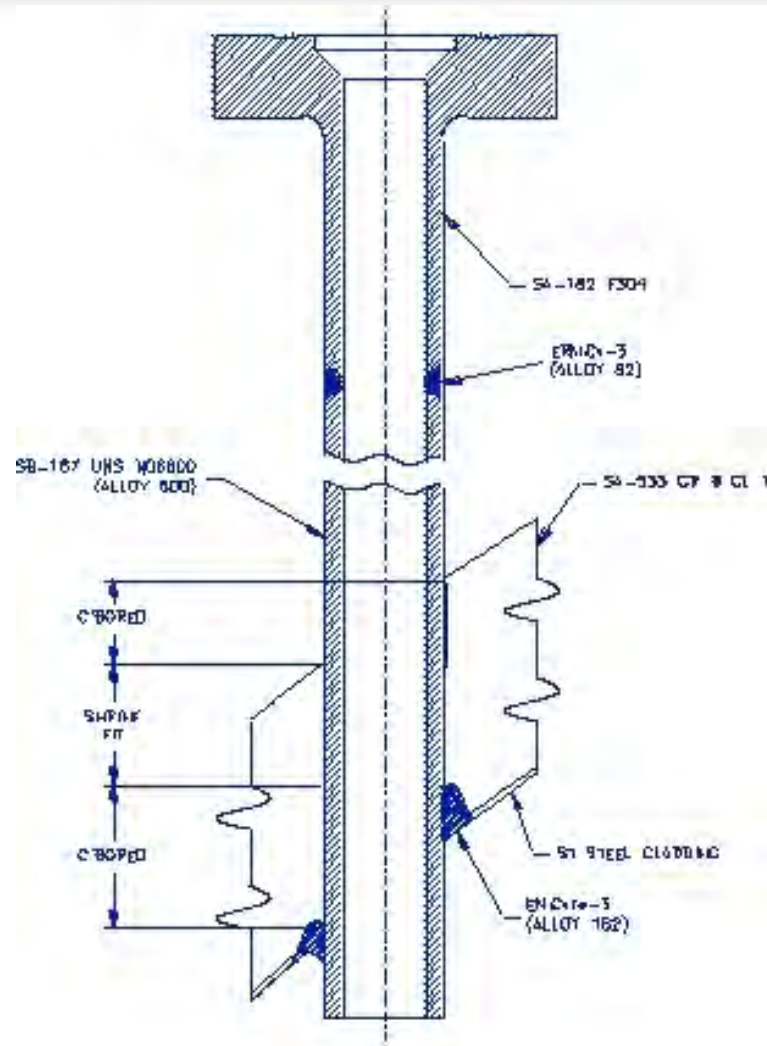
- Assess alternative techniques
 - UT still considered the best technique at present
- Appendix VIII qualification, both ID and OD exams, required after November 2002
 - Blocks and test protocols being developed by PDI

CONCLUSION

- Cracking of pipe welds is not a near term safety issue
 - There does not appear to be a widespread generic problem
 - Visual inspections for boric acid are effective in finding leaks
 - Previous ISI would have found major problems with pipe welds
 - Analyses show there is significant margin against failure
 - Pipe weld failures are covered by Defense-in-Depth (FSAR)
- Interim guidance was provided for Spring 2001 outages
 - UT methods have been improved and demonstrated on mockups
 - Awareness of operators and inspectors has been increased
- Significant ongoing actions in assessment, inspection and repair/mitigation to be completed
 - Must address 360° flaw possibility, LBB regulations and SER constraints, crack growth rates, risk assessment
- Long term management plan still needs more detailed development

PWSCC of RV Top Head Penetrations

Schematic View of B&W-Design CRDM Nozzle Area



Recent Experience

- Oconee 1 - a single CRDM and several T/C nozzles found leaking
- Oconee 3 - nine CRDM nozzles leaking, two with circumferential flaws above the weld
- ANO 1 - a single CRDM found leaking
- Oconee 2 - four CRDM nozzles leaking, one with small circumferential flaw above the weld

ONS-1 RV Head Showing Boric Acid At CRDM Nozzle 21



Generic Implications of Head Penetration Cracks

- Axial flaws not safety significant (covered by previous safety assessments), but . .
- Circumferential flaws above the weld, if large enough, could threaten rod ejection accident
- Cracked penetrations leaked VERY little
- Adequacy of visual inspections to detect cracks
 - Masking boron deposits
 - Interference fits on many plants tighter than Oconee/ANO
- Initial volumetric NDE did not call circumferential flaws at ONS 3

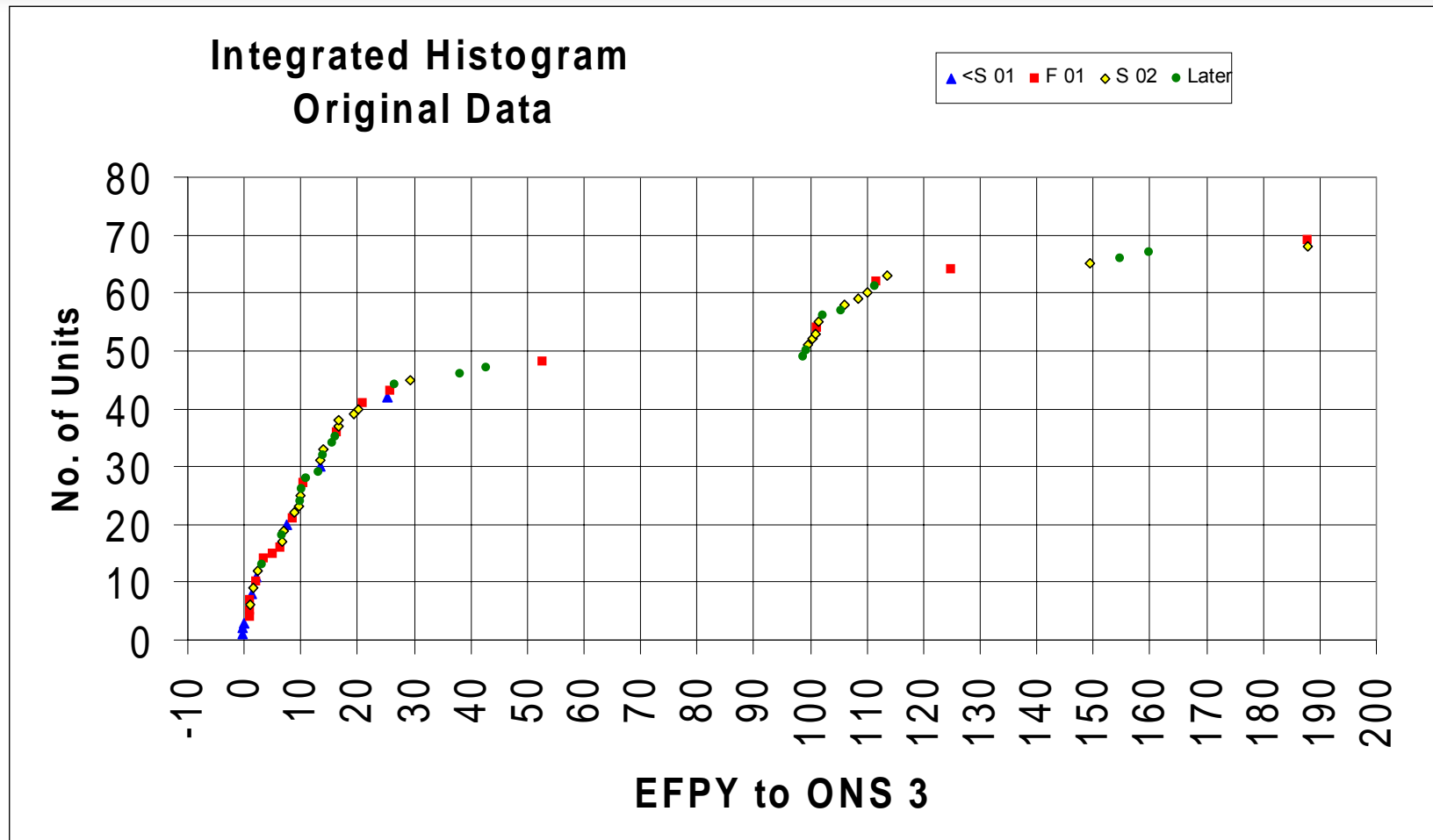
Generic Implications of Head Penetration Cracks (continued)

- NDE techniques
 - Only qualified for ID initiated flaws (ET detection/UT sizing)
 - Volumetric of nozzle tubes not yet qualified
 - Volumetric of welds difficult and not yet qualified
 - Other techniques (ET of OD/weld surface) also not yet qualified
- Crack growth rate uncertainties
 - Annulus environment unknown
 - Effect on growth rate not demonstrated
- Visual examinations can be dose intensive (3-5 Rem)
 - Insulation issues MUCH worse at some units
- Manual repairs were extremely costly (Time, \$, Dose)

MRP Interim Safety Assessment

- Interim safety assessment submitted May 18, 2001
- Developed a histogram of time for each unit to reach the equivalent time at temperature as ONS 3 (normalized to 600F)
- Recommended plants <10 EFPY from ONS 3 with Fall outages perform visual inspections
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 -
- Had already recommended <10 EFPY plants with Spring outages perform a “best effort” at visual examination

Time-Temperature Histogram



Visual Inspections Spring 2001

- Several plants performed visual inspections during Spring outages
 - Robinson 2
 - Salem 1
 - Farley 2
 - Prairie Island 1
 - McGuire 1 (partial)
 - SONGS 3 (partial)
 - Others (limited)
- Heads reasonably free of masking boric acid deposits
- No evidence of leakage found

MRP Interim Safety Assessment

- Bases for no significant near-term impact on plant safety:
 - The three Oconee units and ANO-1 are among the lead units in the US based on time at temperature
 - Leaks were found by careful visual inspections
 - Structural integrity evaluations showed the nozzles and welds were well within required margins
 - Leakage should also be detectable in other plants
 - Interference fits at other plants are only slightly larger than Oconee and ANO-1
 - Operating conditions tend to reduce interference fit (open gaps)
 - Several other lead units had already performed inspections from above and below the head without any significant findings
 - A CRDM nozzle ejection is an analyzed event in plant FSARs
 - Existing symptom based EOPs and operator training adequate

Bulletin

- NRC issued NRC Bulletin 2001-01 on 8/3/01, 30 day response
 - One time information request:
 - Plant specific data and ranking
 - Volumetric exams by EOY for units with cracking
 - “Plant specific qualified” visual by EOY if <5 EFPY from ONS 3
 - “Qualified VT-2” (effective visual) if <30 EFPY at next refueling outage
- OR
- demonstration of how regulations are met

Bulletin Response

- MRP preparing generic submittal:
 - Tabulation of data and ranking information
 - Basis for regulatory compliance
 - Inspection capability description
- Templates for utilities to use in preparing plant specific responses

Other Ongoing MRP Activities

- Assessment (focus - safety assessment/response to Bulletin)
 - Risk assessments
 - Probabilistic fracture mechanics
 - Scope expansion criteria
 - Flaw evaluation guidelines
- NDE (focus 2001 and Spring 02 outages)
 - Mockup design and fabrication
 - Technique development and demonstration
 - Information and training package for visual examination
- Repair/Mitigation
 - Review of strategies
 - Development of generic relief requests where needed

Schedule

- Revised Inspection Recommendations - August
- Expert Panel on Crack Growth - First Meeting 8/10/01
- Inspections during Fall 2001 outages
- Final Safety Assessment - Spring 02
- Reassessment of Inspection Recommendations - 2/02