

**4rd NRC – AERB Nuclear Safety Projects Meeting  
August 30 – September 3, 2004**

# **Non-Destructive Examination (NDE) – Regulatory Perspectives**



Edmund Sullivan, Senior Level Advisor  
U. S. Nuclear Regulatory Commission  
Office of Nuclear Reactor Regulation  
Email: [EJS@nrc.gov](mailto:EJS@nrc.gov) Phone: 301-415-2796



## United States Nuclear Regulatory Commission

### Overview of Presentation

- Industry Examiner Training / Qualification
- Non-UT Performance Demonstration Topics
- Steam Generator (SG) Analyst and Technique Qualification
  - NRC Perspectives



## United States Nuclear Regulatory Commission

### ASME Code Qualification of NDE Personnel

- Section XI, IWA-2300 governs personnel training and qualification for exams performed to prescriptive procedures
  - ANSI/ASNT SNT-TC-1A for Section XI through 1992 Edition
  - ANSI/ASNT-CP-189 for Section XI, 1992 Addenda and later
  - Alternative to CP-189 - ASNT Central Certification Program; provides independent transportability of NDE certification
  - App VII for qualification of UT personnel



## United States Nuclear Regulatory Commission

### ASME Code Qualification of NDE Personnel

- Sec XI, App VIII, governs personnel and procedure qualification for performance-based (P-B) UT exams
  - Required for reactor vessel and Class 1, 2, and 3 piping
  - Training per IWA-2300
  - Statistically based
  - Includes sizing tolerances
  - Annual training and re-cert to Sec XI, App VII



## United States Nuclear Regulatory Commission

# Future ASME Code Direction for Qualification of NDE Personnel

- Section V working on an article to establish P-B qualifications for all **non**-App VIII UT
- Section XI working on proposal to use ACCP program for all NDE methods
  - Performance-based qualification
  - Re-cert by practical examination
  - Annual training/practice
- P-B direction consistent with Commission direction on P-B regulation
- P-B direction may facilitate eventual interchange of U.S. and overseas examiners



## United States Nuclear Regulatory Commission

# Vessel Bottom Head Penetrations (VBHP)

- Leakage found in VBHPs at South Texas Project, Unit 1 (STP 1) in 2003
- UT of all STP 1 VBHPs
- UT relied on TOFD and  $0^0$  L-wave probe
- Found cracks in 2 VBHPs and lack of fusion (LOF) in all penetration to weld interfaces
- LOF determined to be a contributing factor to cracking



## United States Nuclear Regulatory Commission

# Vessel Bottom Head Penetrations (VBHP)

- Industry Materials Reliability Project (MRP) performing a safety assessment on VBHPs to develop recommended long-term inspections
- MRP considering inclusion of LOF reflectors in mockups, demonstrate capability to detect LOF – short-term
- MRP expressed goal of transitioning from demonstrations to performance-based qualification program for inspections – long-term



## United States Nuclear Regulatory Commission

# SG Analyst Qualification

- Conducted by industry in accordance with EPRI SG Examination Guidelines - **Appendix G**
  - Industry standard
  - Requires written program for control and admin
  - Requires minimum of 40 hours training
  - Requires written and practical examination
  - Requires 8 hours of annual training and requal every 3 to 5 years





## United States Nuclear Regulatory Commission

# SG Analyst Qualification - Written

- Written examination based on:
  - Known tube degradation
  - B&W, Combustion Engineering and Westinghouse SG operating experience
  - Tube examination techniques
- Passing grade of 80% required to proceed to practical examination



## United States Nuclear Regulatory Commission

# SG Analyst Qualification - Practical

- Practical examination based on:
  - All known damage mechanisms – thinning, pitting, wear, ODSCC, PWSCC, impingement
  - Test data is from actual SGs examinations using techniques acquired by Appendix H techniques



## United States Nuclear Regulatory Commission

# SG Analyst Qualification - Practical

- Requires evaluation of approx. 5000 intersections
- Correct answer based on expert opinion
- Passing grade on each mechanism required to be considered a Qualified Data Analyst
- Criteria on POD and CL on indications, on RMS sizing error, on orientation, and on overcall rate



## United States Nuclear Regulatory Commission

# SG Technique Qualification

- Conducted by industry in accordance with EPRI SG Examination Guidelines-**Appendix H**
  - industry standard
  - Provides performance demonstration qualification requirements



## United States Nuclear Regulatory Commission

# SG Technique Qualification

- Sample sets may be fabricated using mechanical or chemical methods – similar signals to those observed in field
- EDM notch samples are replaced with crack samples as they become available (can result in a technique becoming unqualified)
- Flaw dimensions for samples must be verified



## United States Nuclear Regulatory Commission

# SG Technique Qualification

- Detection – minimum of 11 flawed grading units " 60% TW
  - Provides 80% POD @ 90% CL " 60% TW
- Sizing
  - Minimum of 5 additional flaws 20 – 59% TW



## United States Nuclear Regulatory Commission

# NRC Perspectives

- NRC's SG regulatory framework is largely performance-based with prescriptive elements
- NRC provides comments on but does not approve EPRI SG guidelines
- NRC focuses attention on inspection qualification if likely to or shown to contribute to failure to meet performance criteria