

BILATERAL REGULATORY INFORMATION EXCHANGE

AGING MANAGEMENT

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[PRESENTATION OVERVIEW]

- Aging Management
 - License Renewal: Process and Degradation Management
 - Quality Management Systems
 - Crack Detection and Measurement
 - Availability of Replacement Parts

AGING MANAGEMENT

LICENSE RENEWAL PROCESS

LICENSE RENEWAL PROCESS

- What is License Renewal?
 - Atomic Energy Act
 - Authorizes NRC to regulate the civilian use of nuclear material
 - 40-year license to operate
 - Allows for license renewal
 - Title 10 of the *Code of Federal Regulations* Part 54 allows a new license to be issued to operate for up to 20 years beyond the current term
 - Application submittal not earlier than 20 years before expiration of current license

LICENSE RENEWAL PROCESS

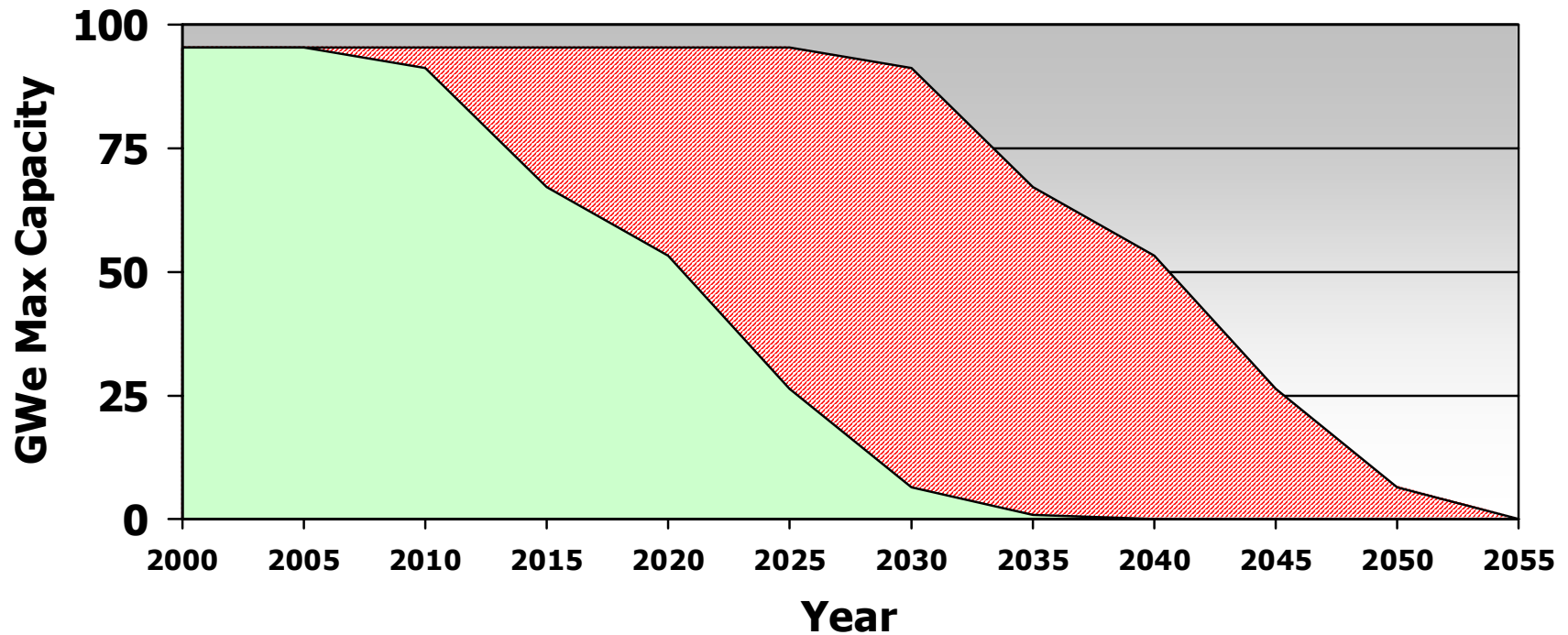
- Scope of License Renewal
 - Safety related systems, structures, and components relied upon to:
 - Maintain reactor coolant pressure boundary integrity
 - Ensure capability to shut down and to maintain safe shutdown condition
 - Prevent or mitigate offsite exposure
 - Non-safety related systems, structures, and components whose failure could prevent a safety-related function

LICENSE RENEWAL PROCESS

- Scope of License Renewal Continued
 - Systems, structures, and components relied upon for compliance with certain regulations:
 - Fire protection
 - Environmental qualification
 - Pressurized thermal shock
 - Anticipated transients without scram
 - Station blackout

LICENSE RENEWAL PROCESS

U.S. License Extension Capacity



LICENSE RENEWAL PROCESS

■ Principles of License Renewal

- Regulatory process adequate for ensuring safety of operating plants
- Current licensing basis adequate and carries forward into period of extended operation
- Safety focus is on aging management programs and long-lived passive components
- Environmental focus is on refurbishment and operational impacts during renewal period

LICENSE RENEWAL PROCESS

- License Renewal Regulations
 - Renewal Application (Title 10 of the *Code of Federal Regulations* Part 54)
 - Safety evaluation
 - Hearing opportunity
 - Advisory Committee on Reactor Safeguards review
 - Inspection verification
 - Commission or Director of Nuclear Reactor Regulation approval

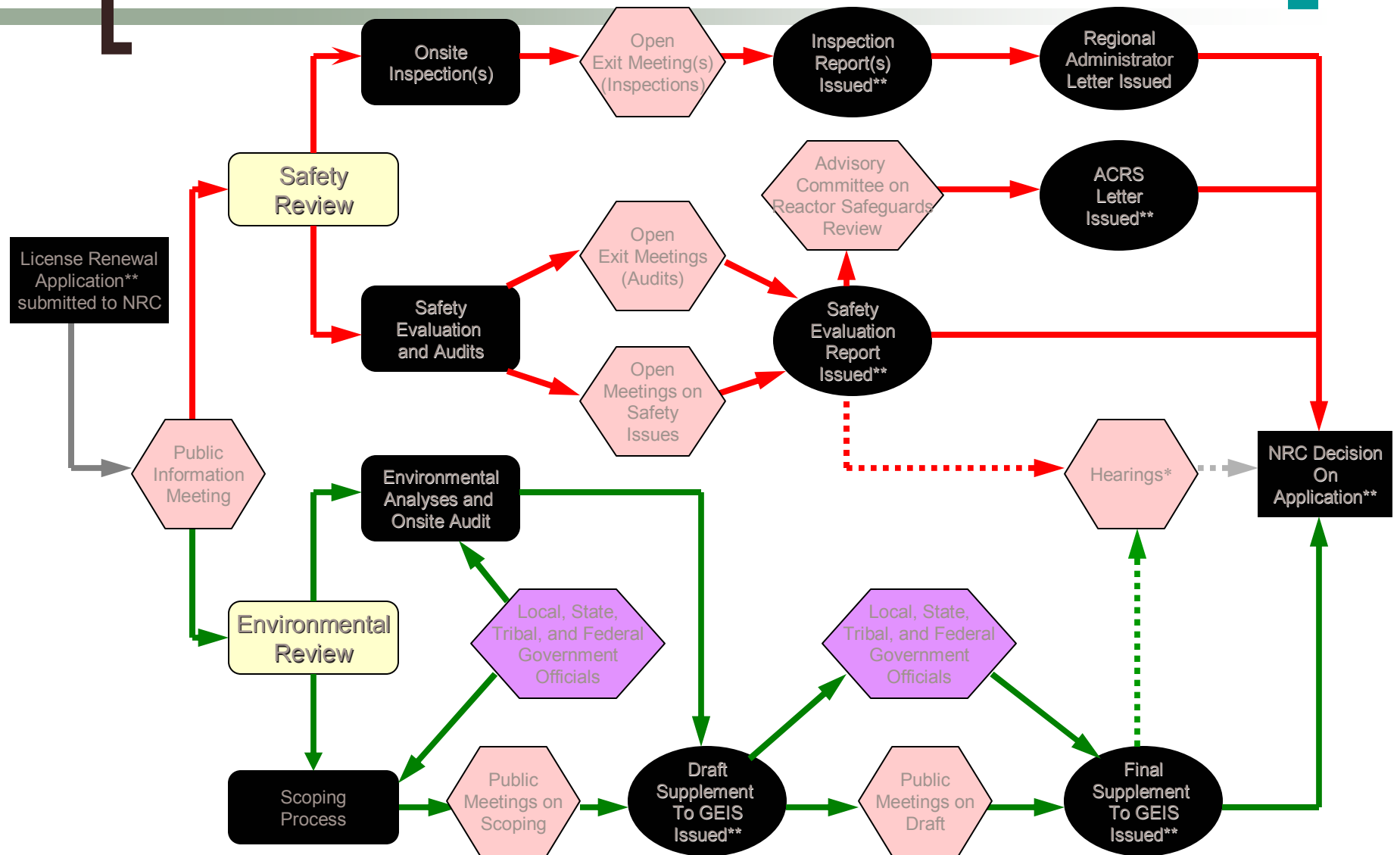
LICENSE RENEWAL PROCESS

- License Renewal Regulations Continued
 - National Environmental Policy Act
 - Requires federal agencies to use systematic approach to consider environmental impacts
 - Environmental Impact Statement
 - Required for major federal actions significantly affecting the quality of the human environment
 - Environmental Protection Rule (Title 10 of the *Code of Federal Regulations Part 51*)

LICENSE RENEWAL PROCESS

- Renewal Application
 - Integrated Plant Assessment (Safety)
 - Identify structures and components
 - Describe and justify scoping and screening methodology
 - Demonstrate aging effects will be managed
 - Evaluate time-limited aging analyses and exemptions
 - Final Safety Analysis Report supplement
 - Technical specification changes
 - Environmental report

LICENSE RENEWAL PROCESS



LICENSE RENEWAL PROCESS

- Guidance Documents
 - Regulatory Guide 1.188
 - Standard Review Plan (NUREG-1800)
 - Generic Aging Lessons Learned Report (NUREG-1801)
 - Inspection guidance (Manual Chapter 2516)

LICENSE RENEWAL PROCESS

- Guidance Document Update
 - Scope
 - Update Generic Aging Lessons Learned (GALL) and Standard Review Plan
 - Component consolidations, reformatting, and incorporating approved staff positions (precedents and Interim Staff Guidance)
 - Industry proposed changes
 - Regulatory Guide
 - Endorse NEI 95-10 revision

LICENSE RENEWAL PROCESS

- Guidance Document Update Continued
 - Schedule
 - January 30, 2005: Drafts for public comment issued
 - September 30, 2005: Publish final version
 - Database development

LICENSE RENEWAL PROCESS

- Standards for Issuance of Renewed License
 - Actions have been or will be taken to
 - Manage the effects of aging during the period of extended operation on the functionality of structures and components
 - Evaluate time-limited aging analyses
 - Reasonable assurance that activities authorized by the renewed license will continue to be conducted in accordance with the current licensing basis

LICENSE RENEWAL PROCESS

■ Logistics

- Approximately 20,000 staff-hours per review
- 22-month review schedule (without hearing)
- Continuously monitor effort to identify process improvements
- Improved review process being piloted

LICENSE RENEWAL PROCESS

- Improved Review Process
 - Efficiencies through standardization
 - Multi-discipline onsite audit teams
 - Assesses 70-95% of aging management reviews
 - Reviews based on Generic Aging Lessons Learned Report and previously approved programs
 - Review efficiencies
 - Three pilot reviews

LICENSE RENEWAL PROCESS

■ Program Status

- Out of the current 103 operating units, 30 units at 17 sites have submitted license renewal applications
- Reviewing applications for 18 units at 10 sites
- Expect approximately 6 applications per year

■ Further Information

- www.nrc.gov/reactors/operating/licensing/renewal.html

AGING MANAGEMENT

LICENSE RENEWAL DEGRADATION MANAGEMENT

LICENSE RENEWAL DEGRADATION MANAGEMENT

- Management of Aging Effects
 - Aging management reviews: Title 10 of the *Code of Federal Regulations* Part 54 requires that long-lived, passive, in-scope components be reviewed to identify all of the aging effects that are applicable to the components
 - Once the aging effects are identified in aging management reviews, the rule requires applicants for renewal to demonstrate how they will manage the aging effects during the extended periods of operation for their units:
 - Use of aging management program
 - Use of time-limited aging analyses

LICENSE RENEWAL DEGRADATION MANAGEMENT

- Use of Aging Management Programs
 - Aging Management Programs credited for aging management may be existing programs, existing programs that have been enhanced to address recent industry experience, or new programs
 - Management Strategies Include:
 - Prevention or mitigation of aging effects
 - Inspections for aging effects or their mechanisms
 - Other types of Monitoring and Testing Programs

LICENSE RENEWAL DEGRADATION MANAGEMENT

- Use of Aging Management Programs Continued
 - Aging Management Program Attributes
 - Scope
 - Preventive actions
 - Parameters monitored or inspected
 - Detection of aging effects
 - Monitoring and trending
 - Acceptance criteria
 - Operating experience

LICENSE RENEWAL DEGRADATION MANAGEMENT

- Examples of Aging Management Programs
 - Inservice Inspection Program
 - Existing aging management program for American Society of Mechanical Engineers Boiler and Pressure Vessel (ASME) Code Class 1, 2, and 3 components, component supports, and containment structures, per Title 10 of the *Code of Federal Regulations* Part 50.55a
 - Monitors for loss of material, loose parts, cracking, corrosion, etc.

LICENSE RENEWAL DEGRADATION MANAGEMENT

- Examples of Aging Management Programs Continued
 - Inservice Inspection Program
 - Relies on requirements of ASME Code Section XI
 - Applies to piping, vessels, supports, containments, bolting, valve and pump bodies
 - Inspection techniques are visual, surface, and volumetric

LICENSE RENEWAL DEGRADATION MANAGEMENT

- Examples of Aging Management Programs Continued
 - Reactor Vessel Surveillance Program
 - Existing aging management program implemented per the reactor vessel material surveillance program requirements of 10 CFR Part 50, Appendix H
 - Appendix H requires licenses to place surveillance capsules inside reactor and to remove them at periodic intervals based on the schedule requirements of American Society for Testing and Materials Standard Procedure E-185
 - Appendix H requires ferritic base-metal and weld materials in the capsules be Charpy-impact tested; measure shift in adjusted reference temperature and drop in USE value

LICENSE RENEWAL DEGRADATION MANAGEMENT

- Examples of Aging Management Programs Continued
 - Reactor Vessel Surveillance Program
 - Staff evaluates impact of extending license life from 40 to 60 years on the projected withdrawal schedule times for the remaining reactor vessel surveillance capsules
 - Evaluation ensures projected fluences for the final capsules will bound the limiting fluence projected for the reactor vessel at 60 years

LICENSE RENEWAL DEGRADATION MANAGEMENT

- Examples of Aging Management Programs Continued
 - Boiling Water Reactor (BWR) Vessel Internals Inspection Program
 - Applicants use BWR Vessel Internals Program inspection and evaluation documents developed by General Electric and the BWR Owners Group, and approved by the NRC
 - Volumetric inspection or enhanced visual inspection techniques believed to be necessary in many cases

LICENSE RENEWAL DEGRADATION MANAGEMENT

- Examples of Aging Management Programs Continued
 - Steam Generator (SG) Tube Inspection Program
 - Scope – SG tubes and secondary side structures that could affect the tubes
 - Preventive Action – water chemistry programs and foreign material / loose parts monitoring
 - Parameters Monitored or Inspected – cracking, wear, general corrosion
 - Detection of Aging Effects – eddy current, visual inspection, leak monitoring.
 - Monitoring and Trending – condition monitoring to determine if performance criteria satisfied during past operation; operational assessment to determine if performance criteria projected to be satisfied until subsequent inspection

LICENSE RENEWAL DEGRADATION MANAGEMENT

- Examples of Aging Management Programs Continued
 - Steam Generator (SG) Tube Inspection Program
 - Acceptance Criteria – technical specifications define tube plugging criteria; licensing basis defines acceptance criteria for secondary side structures
 - Operating Experience
 - Failure to detect certain flaws at tube U-bends
 - Inability to detect certain flaws at dented tube locations
 - Many license renewal applicants have replaced SGs with improved designs and materials

LICENSE RENEWAL DEGRADATION MANAGEMENT

- Examples of Aging Management Programs Continued
 - One Time Inspection Program
 - Verifies effectiveness of an aging management program
 - Confirms the absence of an aging effect
 - Verifies slow progression of a plausible aging effect
 - Examples of One Time Inspections
 - Inspection activities of low-flow/stagnant areas in components
 - Inspection of above ground tanks
 - Opportunistic inspection of buried piping and tanks
 - Volumetric inspections of Class 1 small-bore pipe
 - Enhanced visual inspection techniques of pressurizer spray head

AGING MANAGEMENT

QUALITY MANAGEMENT SYSTEMS

QUALITY MANAGEMENT SYSTEMS

■ Overview

- NRC compared Title 10 of the *Code of Federal Regulations* Part 50 Appendix B quality requirements to the International Organization for Standardization (ISO) 9001-2000, “Quality Management System (QMS) - Requirements”
- The comparison is documented in NRC SECY Paper SECY-03-0117, “Approaches for Adopting More Widely Accepted International Quality Standards,” dated July 9, 2003

QUALITY MANAGEMENT SYSTEMS

- Overview Continued

- NRC concluded that supplemental quality requirements would need to be applied when implementing ISO 9001 within the existing regulatory framework. In addition, considerable actions have already been taken or are in progress to reduce unnecessary regulatory burden on licensees resulting from compliance with Appendix B requirements
 - Similarly, all regulated industries that have adopted ISO 9001 have developed sector-specific programs that supplement ISO 9001 requirements
 - ISO standards are considered management standards that are universally applicable and do not differentiate between business size, business type, product or service.
 - ISO 9001 is not a safety standard

QUALITY MANAGEMENT SYSTEMS

- Examples of shortcomings of ISO 9001 when considered for use in the nuclear industry, which are present in current regulatory framework (a complete list is available in SECY-03-0117)
 - ISO 9001 does not require independent verification of the adequacy of a design
 - ISO 9001 does not require suppliers to pass requirements consistent with ISO 9001 to sub-suppliers
 - ISO 9001 does not require that inspections be performed by individuals other than those who performed an activity (i.e., independent inspections)

QUALITY MANAGEMENT SYSTEMS

- Examples of ISO 9001 Shortcomings Continued
 - ISO auditors have no direct liability for defective components delivered to operating nuclear plants
 - The ISO standards body and process do not meet the ANSI definition of a consensus standard development organization because there is not a broad cross-section of stakeholders involved in the review/modification process
 - ISO 9001 does not have equivalent requirements to those in Title 10 of the *Code of Federal Regulations* Part 21, “Reporting of Defects and Noncompliances”

AGING MANAGEMENT

CRACK DETECTION AND MEASUREMENT

CRACK DETECTION AND MEASUREMENT

- Background

- U.S. NRC has conducted research in the area of assessment and reliability of non-destructive evaluation and environmentally assisted cracking since 1977
- Current NRC Non-Destructive Examination Programs
 - Evaluation of the reliability of non-destructive examination techniques
 - Piping and vessel integrity
 - Non-destructive examination and destructive evaluation of salvaged control rod drive mechanisms and J-welds from North Anna 2
 - Steam generator tube integrity program

CRACK DETECTION AND MEASUREMENT

- Purpose of Evaluation of the Reliability of Non-Destructive Examination Techniques
 - Determine accuracy and reliability of ultrasonic testing methods for in-service inspection
 - Provide technical bases and improved in-service inspection programs for important reactor systems & components
 - Evaluate impact of in-service inspection reliability on system integrity
 - Provide recommendations to ASME Code to improve effectiveness, reliability and adequacy of in-service inspection methods and programs

CRACK DETECTION AND MEASUREMENT

- Specific In-Service Inspection Reliability Activities
 - Human factors reliability studies
 - Evaluation of international studies
 - Development of surface roughness requirements for ultrasonic Testing/in-service inspection
 - Stress corrosion cracking in reactor internals
 - Inspection of the Network Examination of Steel Components (NESC)
 - Evaluation of performance demonstration

CRACK DETECTION AND MEASUREMENT

- Human Factors Reliability Studies
 - Review and evaluate studies on human factors impact on in-service inspection reliability conducted throughout the world. Develop a model for applying these results in in-service inspection
 - Examined human factors for impact on non-destructive evaluation reliability
 - NUREG/CR-6605 “An Evaluation of Human Factors Research for Ultrasonic In-service Inspection”

CRACK DETECTION AND MEASUREMENT

- Evaluation of International Studies
 - Participation in Programme for the Inspection of Steel Components
 - International cooperation on stainless steel reliability studies
 - Participation in Structural Mechanics in Reactor Technology

CRACK DETECTION AND MEASUREMENT

- Development of Surface Roughness Requirements for Ultrasonic Testing/In-Service Inspection
 - Determine how an ultrasonic in-service inspection is affected when the transducer is scanned over a rough surface. Develop recommendations for the ASME Code to ensure that a reliable inspection can be performed
 - NUREG/CR-6859 “The Effects of Surface Condition on an Ultrasonic Inspection: Engineering Studies Using Validated Computer Model

CRACK DETECTION AND MEASUREMENT

- Inspection for Stress Corrosion Cracking in Reactor Internals
 - Assess non-destructive evaluation technology for reactor internals
 - Report on state of technology for non-destructive evaluation of reactor internals
 - Further studies on improving non-destructive evaluation / in-service inspection for reactor internals

CRACK DETECTION AND MEASUREMENT

- Inspection of the NESCS
 - Perform a non-destructive examination of the crack growth in the Network Examination of Steel Components cylinder using Synthetic Aperture Focusing Technique-Ultrasonic Testing. Evaluate the reliability of the inspection methods.
 - Documented in a report published by the European Commission: Network Examination of Steel Components DOC DEAG (99)04

CRACK DETECTION AND MEASUREMENT

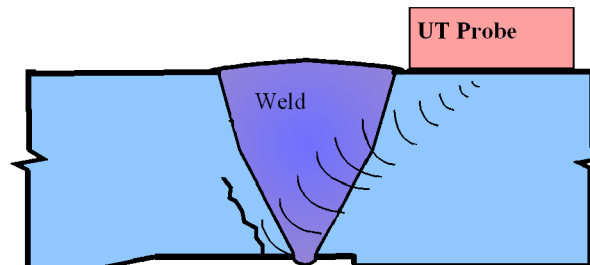
- Evaluation of Performance Demonstration
 - Appendix VIII of ASME Section XI has Performance Demonstration requirements for performing ultrasonic inspection
 - Support the analysis required to evaluate the changes industry is proposing to Appendix VIII

CRACK DETECTION AND MEASUREMENT

- Inspection of Cast Stainless Steel, Dissimilar Metal Welds and Assessment of Advanced Non-Destructive Evaluation Methods
 - Determine the effectiveness and reliability of improved ultrasonic inspection techniques on components with coarse-grained material structures including austenitic and corrosion-resistant clad piping welds
 - Evaluate far-side weld examination methods, inspection of control rod drive mechanism components, and visual testing

CRACK DETECTION AND MEASUREMENT

- Far-Side Examinations on Wrought Stainless Steel Piping, Phased Array Ultrasonic Testing
 - Phased Array (PA) is conventional ultrasonic testing, but is an array of small elements that can be controlled independently
 - Probe modifications are performed by introducing time shifts in the signals sent to (pulse) and received from (echo) individual elements of an array probe
 - Access to both sides may be limited
 - Welds absorb and re-direct acoustic energy
 - Ultrasonic responses from weld root and counter-bore may mask flaws
 - PA enables sweeping through multiple angles on a single line scan to discriminate flaws from geometry



CRACK DETECTION AND MEASUREMENT

- Reactor Pressure Vessel Integrity
 - Develop validated flaw density and distribution data for reactor pressure vessels as input to fracture mechanics codes
 - Previous flaw density and distribution (Marshall) input to fracture mechanics codes was developed and revised in the early 1980's
 - Current work is providing data that shows large flaws are associated with weld repairs
 - Acquired reactor pressure vessel material from 5 cancelled nuclear power plants
 - Verification and validation of FAVOR flaw distribution model

CRACK DETECTION AND MEASUREMENT

■ Piping Integrity

- Develop fabrication flaw density and distribution functions for flaws in piping welds including dissimilar metal welds
- Compile knowledge base of cracking in Alloy 600 (and related materials)
- Determine the relationship between important variables such as welding processes and the likelihood of cracking
- Document the morphology of primary water stress corrosion cracking cracks and their relationship to the non-destructive evaluation responses

CRACK DETECTION AND MEASUREMENT

- Piping Integrity Continued
 - Assess non-destructive evaluations techniques employed to detect, characterize and distinguish primary water stress corrosion cracking from other types of flaws
 - Assess methods of manufacturing test blocks and mockups with realistic flaws simulating primary water stress corrosion cracking

CRACK DETECTION AND MEASUREMENT

- North Anna Unit 2 Control Rod Drive Mechanisms
 - Examine the nozzles and J-groove welds (buttering) from North Anna Unit 2 for better characterization of the cracking, using both non-destructive evaluation and destructive evaluation
 - Examine the low alloy steel around a nozzle from the Davis-Besse head for evidence of boric acid corrosion, leak path development – evidence of annulus plugging

CRACK DETECTION AND MEASUREMENT

- North Anna Unit 2 Destructive Examination Activities
 - Use a variety of destructive techniques to interrogate and characterize the indications detected using non-destructive evaluation
 - Examine “blank” areas where the non-destructive evaluation did not detect any indications.
 - Determine the type of defect that caused the non-destructive evaluation indication
 - Characterize crack morphology
 - Use fractography to determine the cause of the defect
 - Measure the ultrasonic testing response of flaws in the coupons

AGING MANAGEMENT

AVAILABILITY OF REPLACEMENT PARTS

AVAILABILITY OF REPLACEMENT PARTS

■ Issue

- Plants may have difficulty readily obtaining replacement parts that are in full compliance with the stamping and documentation requirements of the ASME code
- May 14, 1984
 - Any components or parts required by the procurement document to meet the requirements of Section III of the ASME Code, Code Class 1, 2, or 3 must meet all the requirements of Section III, including stamping
- Some companies that previously provided nuclear-grade components in accordance with Section III of the ASME Code allowed their Certificates of Authorization to expire and have not maintained their related agreements with the Authorized Inspection Agencies.

AVAILABILITY OF REPLACEMENT PARTS

■ NRC Position

- Generic Letter 89-09, ASME Section III Component Replacements
 - May 8, 1989
- Licensee must first establish that an equivalent Section III stamped replacement is not available (cost cannot be used as a justification when replacements are required in accordance with Article IWA-7000 of Section XI)
- If N-stamped part is not available, licensee can procure replacement parts under the utility's Quality Assurance Program (in conformance with 10 CFR 50, Appendix B)

AVAILABILITY OF REPLACEMENT PARTS

■ NRC Position Continued

- These replacements should meet all other applicable requirements of Section III, including third party inspection by an Authorized Nuclear Inspector endorsed by NRC regulations except that the N-symbol need not be applied
- Need to document such replacements in the Final Safety Analysis Report Annual Update
- Staff concludes that this guidance provides an acceptable level of quality and safety.

[SUMMARY]

- The U.S. NRC actively reviews operating experience, conducts independent research, and oversees license renewal to evaluate management of aging effects.
- ANY QUESTIONS?