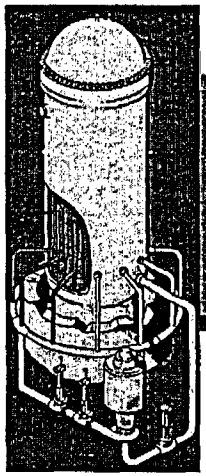
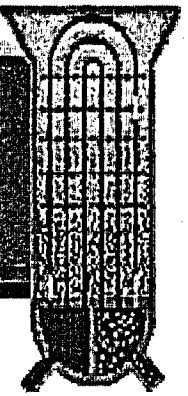


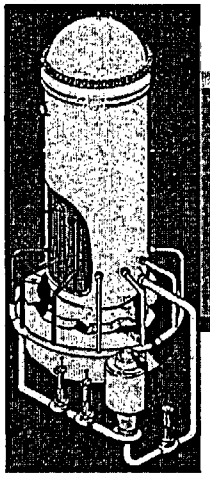
INPO-NRC Materials Meeting



INPO Materials Group

Steve Johnson

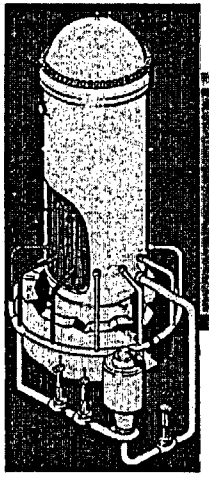
August 21, 2003



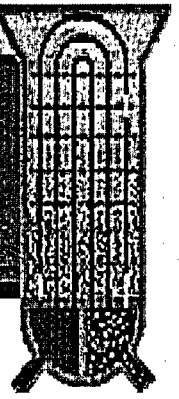
Meeting Purpose

- Exchange information with NRC about materials-related programs

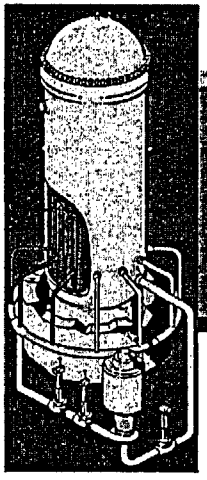
- Answer questions on INPO materials activities



INPO Materials Group



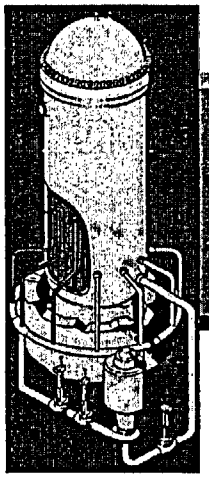
- New group formed July 2002
- Align with industry materials management improvement initiative
- Implement a boric acid leakage and corrosion management review visit program (now expanded to primary systems integrity)
- A key INPO initiative for 2003 and 2004



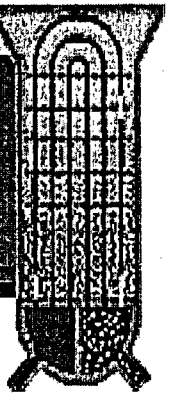
Focus Areas

Materials Review Visit Programs

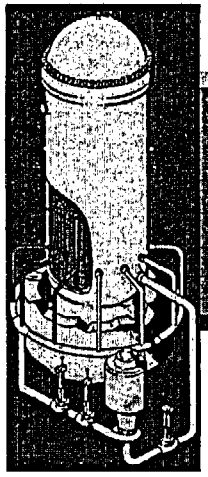
- Steam Generator Program – '95
- BWR Vessel and Internals Program – '01
- PWR Primary Systems Integrity – '03
- Future material review programs



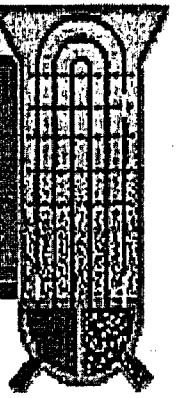
Review Visit Methodology



- Separate from INPO evaluation process
- Use best industry experts
- Focused, detailed review
- Review visit guidelines
- Standard of excellence for safety and reliability issues – not minimum compliance



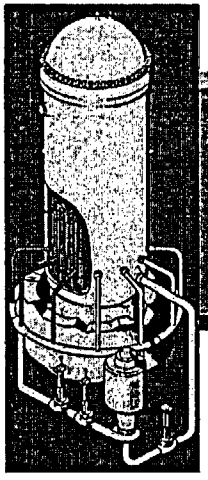
Review Visit Purpose



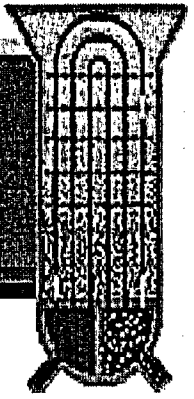
Big Picture

- **Ensure stations have material programs in place and being used to promote safe and reliable operation**

- **Ensure consistent interpretation and application of industry guidelines**

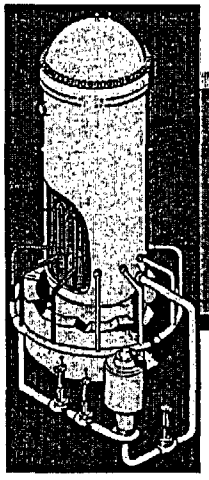


Review Visit Purpose

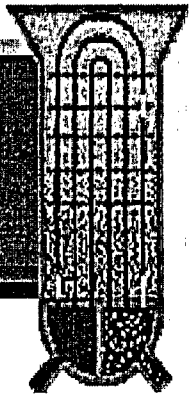


But also,

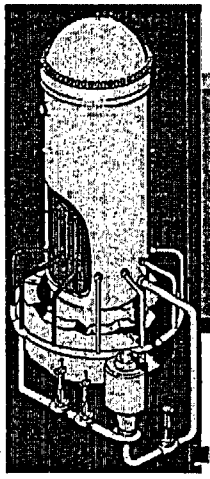
- **Identify outliers**
- **Make industry guidelines a living program – identify and promote changes to industry guidelines**
- **Resolve technical disagreements**
- **Promote best practices available**
- **Share results widely**



What does INPO add?



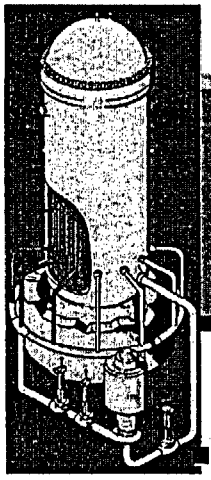
- Team leaders are experienced evaluators
- Formal, structured, proven evaluative process
- Senior management attention
- Continuous follow-up on important issues (boric acid programs being looked at on every INPO evaluation)



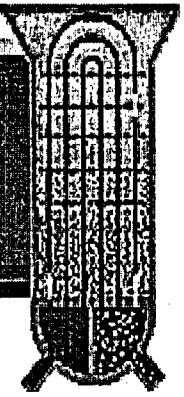
Depth of Review

On-site review includes:

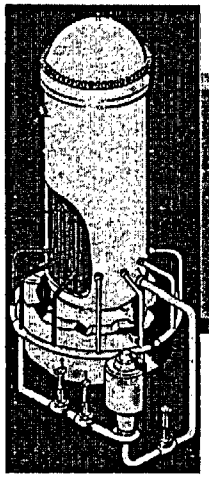
- > NDE review (eddy current, videotapes, UT scans)
- > Interviews (technician level to site management)
- > Walkdowns and observations
- > Documentation (process and results)



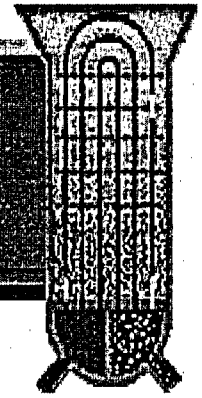
Review Visit Results



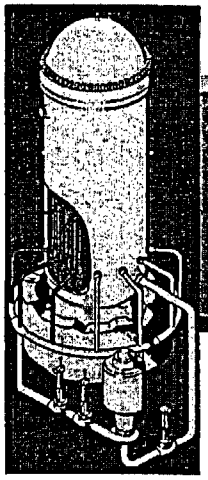
- Strengths and recommendations for improvement are discussed with site management
- Results are reviewed by INPO management and provided in a report to the site vice president
- Issues impacting safety and reliability require a written utility response and follow-up during next INPO evaluation



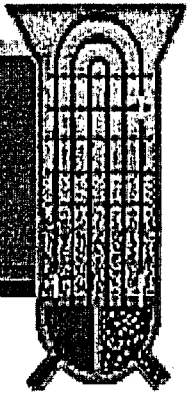
Program Scope



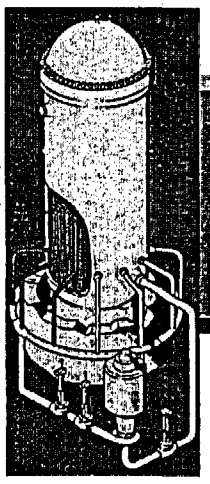
- Visit every station
- Targeted second round of visits
- Add to existing programs or implement new review programs based on industry needs and operating experience
- What additional material areas are of most concern to the NRC?



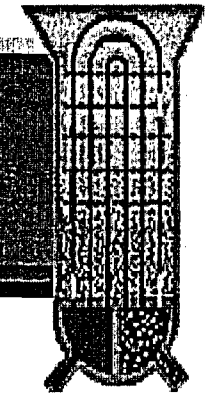
Program Trends



- Most steam generator programs mature
- BWR vessel and internals programs – good foundation of industry guidelines
- PWR primary system integrity – most programs in a state of change

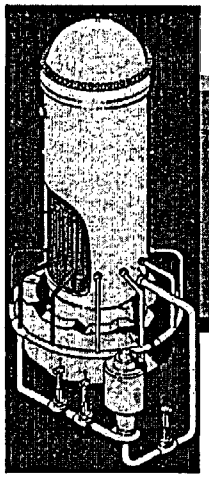


Industry Materials Initiative

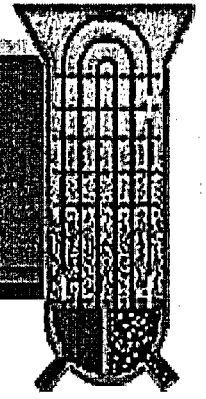


Roles and responsibilities of INPO as defined in NEI 03-08:

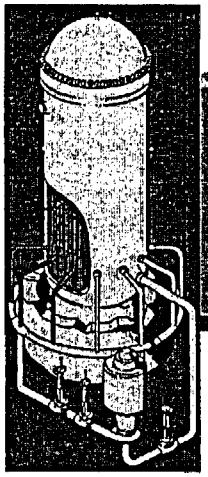
- > On-site evaluation of industry guidelines
- > Analysis of operating experience for emerging material issues
- > Communicate identified trends or emerging issues to industry
- > Participating at all levels of industry materials management initiative



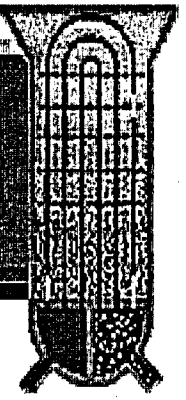
INPO Materials Group



Questions/comments?



INPO-NRC Materials Meeting

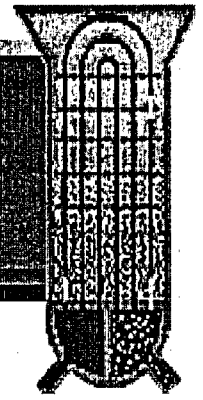


INPO Steam Generator Review Visits

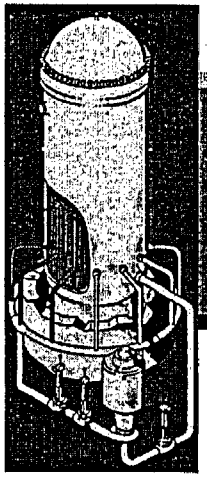
Jeff Ewin

August 21, 2003

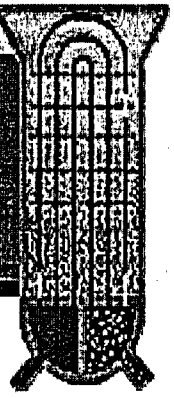
INPO Steam Generator Review Visits



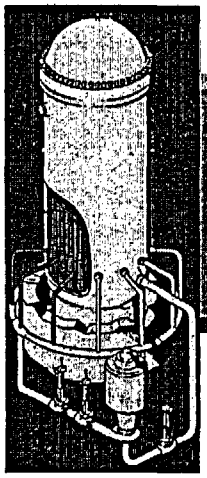
- Began mid-1995 at industry request
- Review visit guidance written with industry input
- NEI 97-06 and EPRI guidelines used as technical basis



INPO Steam Generator Review Visits

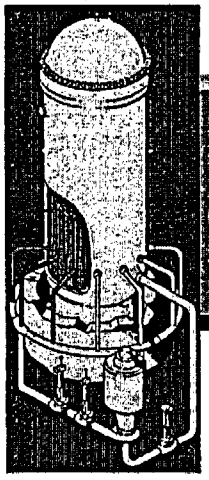


- 63 domestic visits
- 3 international visits
- All PWRs have had at least one visit
- 18 PWRs have had second visit



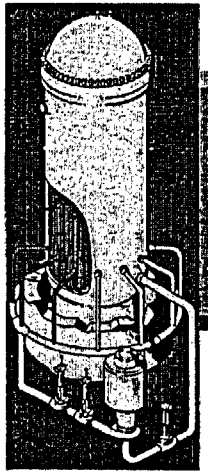
Team Composition

- INPO Team Lead
- Chemistry Evaluator
- Steam generator program manager or engineer
- Eddy-current Level III/QDA

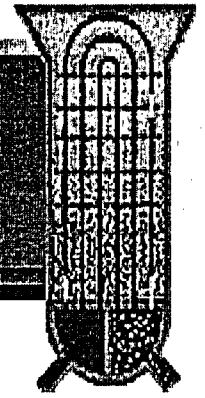


Review Visit Scope and Structure

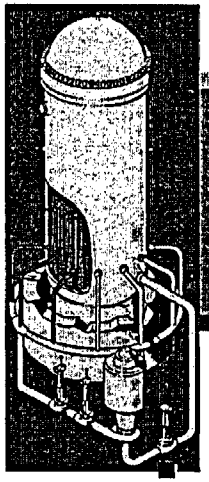
- Program management, self-assessment, and corrective actions
- Degradation assessments and inspection plans for tubing and secondary-side structures
- Integrity assessments – condition monitoring and operational assessments
- Response to inspection results – repairs or alternate repair criteria



Review Visit Scope and Structure

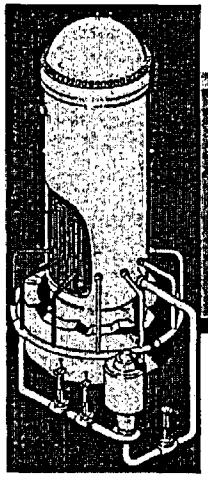


- NDE analyst and technique qualification
- NDE data acquisition, analysis, management
- Operations and chemistry procedures and practices for primary-to-secondary leakage monitoring and response
- Primary and secondary chemistry control

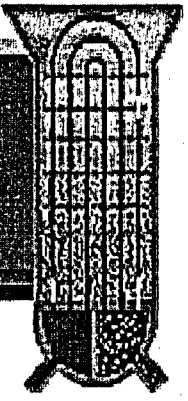


Typical Strengths

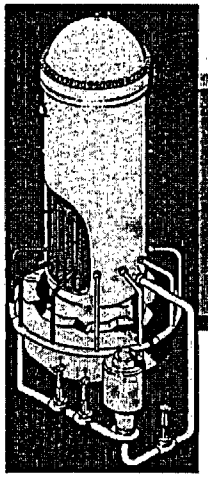
- Management support of program
- Knowledge and experience of personnel
- Participation in industry groups
- Long-term strategies for steam generator health
- Robust program procedures
- Improved quality of degradation, condition monitoring and operational assessments



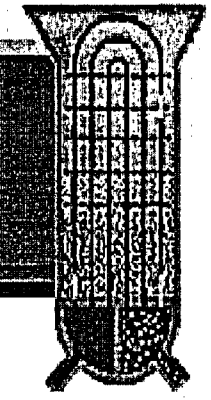
Typical Recommendations



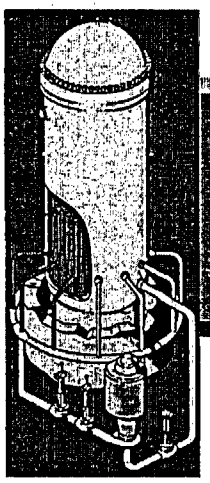
- Implementation of industry guideline requirements
- Deviation justifications and level of approval
- Inspection scope (critical areas/buffer zones)



Typical Recommendations

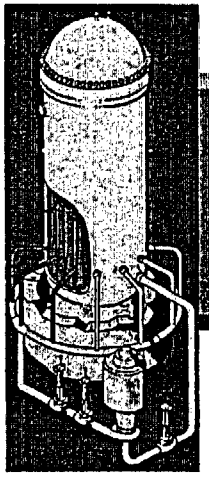


- Primary-to-secondary leak monitoring and response
- Evaluation and response to industry operating experience
- Accuracy of program procedures and documents

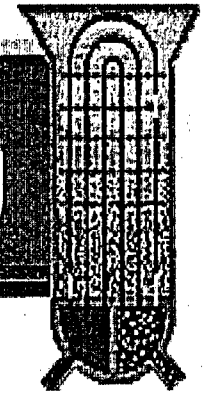


INPO Steam Generator Review Visits

Questions/comments?



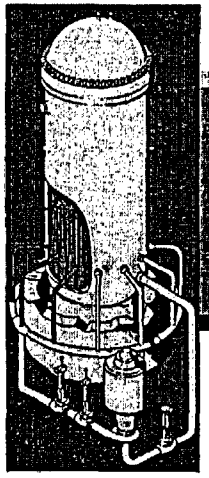
INPO-NRC Materials Meeting



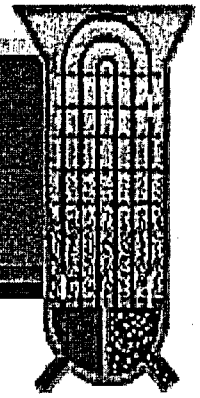
INPO BWRVIP Review Visits

David Berko

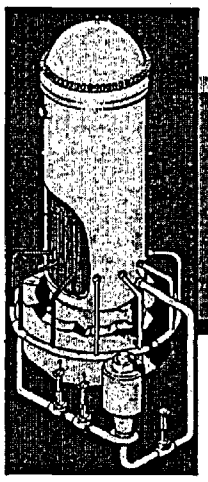
August 21, 2003



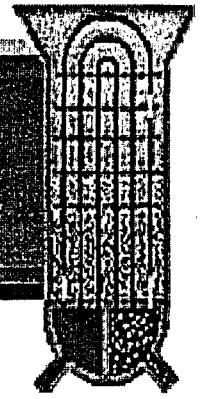
INPO BWRVIP Review Visits



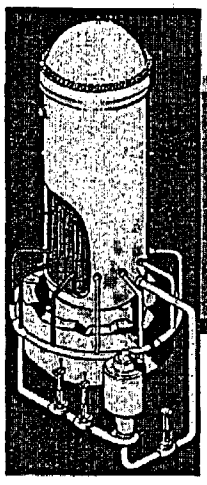
- Began July 2001 at industry request
- Modeled after steam generator review program
- BWRVIP guidelines provide technical basis
- 18 of 23 sites visited to date
- Complete all U.S. plants by 2003



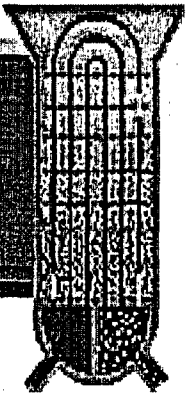
Team Composition



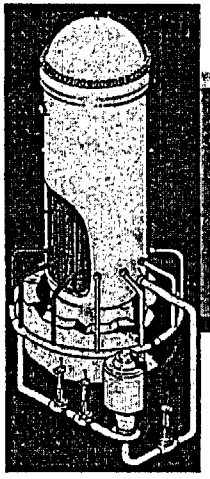
- INPO Team Lead
- Chemistry Evaluator
- Level III NDE (Visual and UT)
- 1-2 Program Owners
- EPRI team member



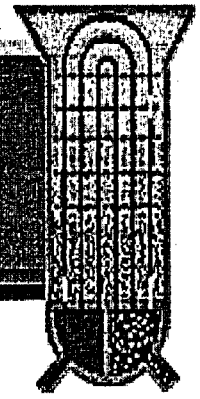
Review Visit Scope and Structure



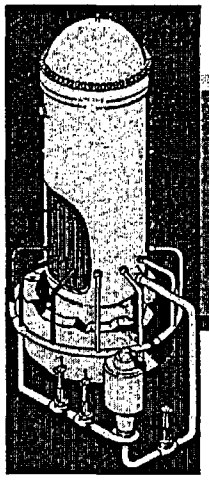
- Weld-by-weld review all 12 BWRVIP components
- 2-3 components per day
- For dual-unit sites, focus on unit with upcoming outage, but review aspects of alternate unit as well
- Two sets of eyes on major components
- Look beyond BWRVIP components (steam dryer, head bolts, dry-tubes, foreign material)



Review Visit Scope and Structure

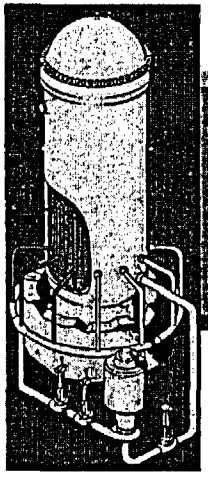


- Peers selection based on station history
- Review visit information sources:
  - > Vendor inspection reports (baseline and re-exams)
  - > Program guidelines
  - > Nondestructive evaluation data (UT, visual)
  - > Chemistry trends and parameters
  - > Operating parameters (jet pumps, etc.)
  - > Interviews



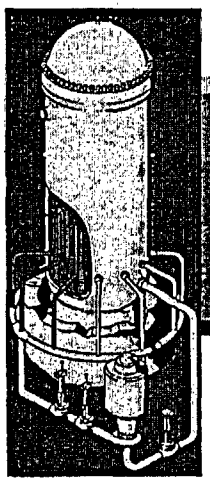
Typical Strengths

- **Proactive towards understanding material condition of vessel internals**
  - > **UT applications, aggressive scope, inspection coverage**
- **Plant-specific applications**
  - > **Fluence profile, analysis, labyrinth seals, NDE remote viewing**
- **Program Elements**
  - > **Implementation plan, self-assessment**

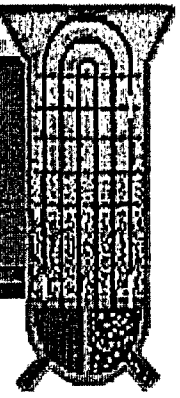


Typical Recommendations

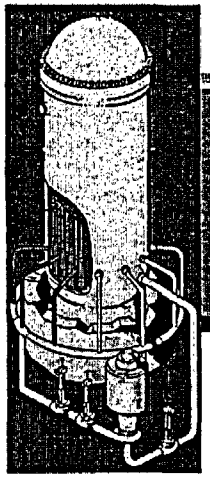
- **Guideline requirements**
  - > Management oversite, quality of technical justifications
- **Bow-wave effect for inspections**
- **Component-specific vulnerabilities**
  - > Shroud, core spray, jet pumps, steam dryer



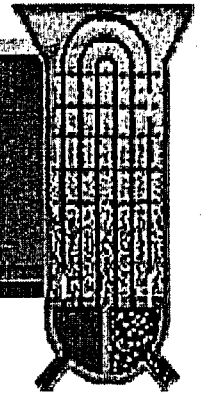
Typical Recommendations



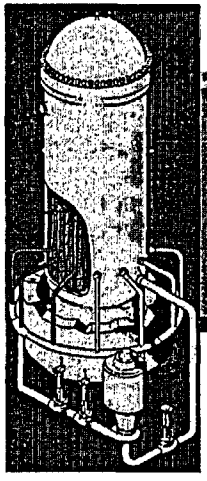
- Effects of power uprate
- Quality of nondestructive evaluation (visual, UT)
- Mitigation (+/Δ)
  - > Hydrogen availability, aggressive ion intrusion events
- Operational considerations
  - > Jet pump performance monitoring, drywell leakage detection



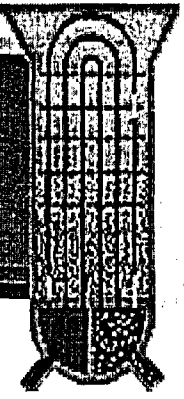
INPO BWRVIP Review Visits



Questions/comments?



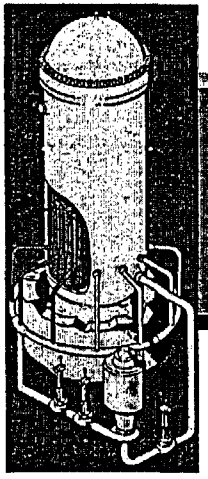
INPO-NRC Materials Meeting



INPO Primary System Integrity Review Visits

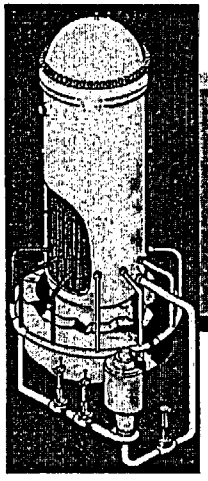
John Makar, Russ Warren

August 21, 2003



Primary Systems Integrity Review Visits

- MRP and industry recognized need for independent review
- Decision to begin INPO review visits 2002
- Several meetings held with industry peers
- INPO guideline developed with industry input



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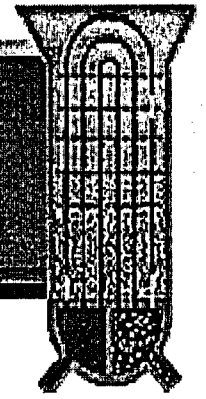
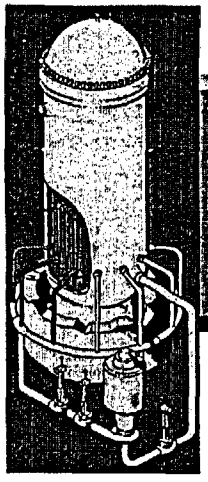


- Modeled after Steam Generator and BWRVIP review visit programs
- Industry peers provide technical expertise
- EPRI and WCAP guidelines provide technical basis
- Review to standards of excellence



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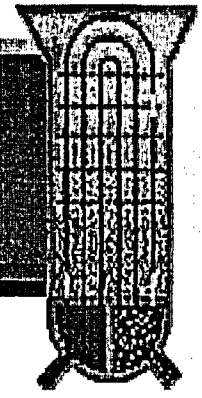
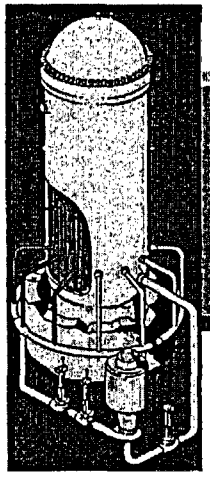
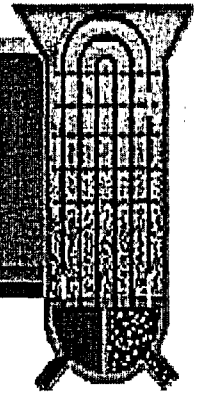


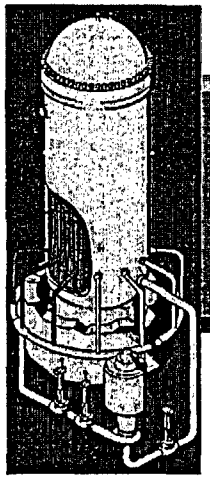
- First two pilots completed 2002
- Ten visits complete October 2002 - July 2003
- Seven more visits scheduled August - December 2003 - schedule to complete all US plants by end of 2005



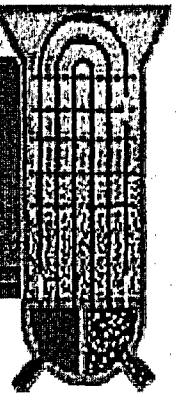
Team Composition



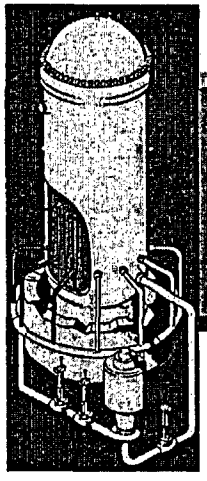
- INPO Team Leader
- 2-3 peers knowledgeable of guidelines, selected based on plant-specific needs
- ISI / NDE expertise



Review Visit Scope and Structure



- Scope includes:
  - Management Oversight and Involvement
  - Program Scope
  - Implementation
  - Interfaces with Other Programs
  - Training and Qualification



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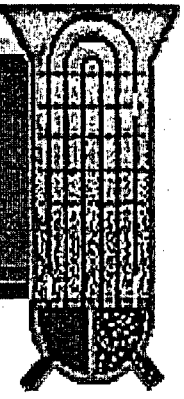
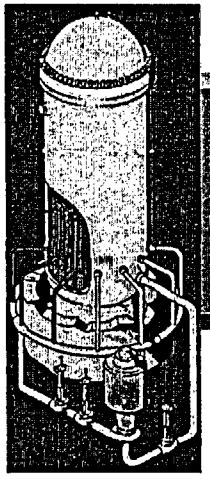
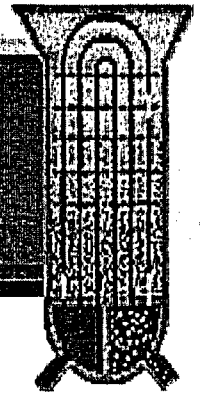


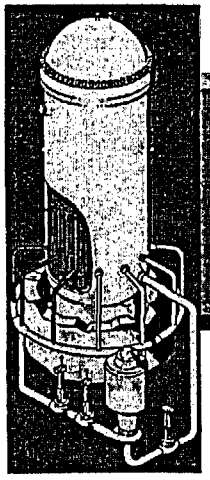
- Review all Alloy 600 components
- Thorough Auxiliary Building walkdown
- Review of containment conditions, potential indications of leakage over several years
- Strong focus on vessel penetrations, condition of upper head and vessel bottom
- Interviews with station personnel (Program Owners, Engineering, Maintenance, Operations, Chemistry, and Health Physics)



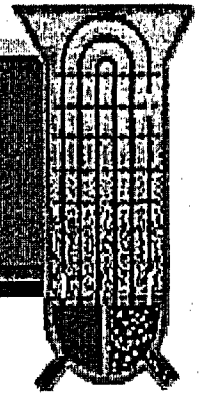
Typical Strengths



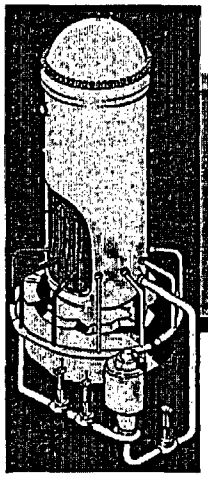
- Commitment to vessel upper head exams
- Comprehensive Alloy 600 program plans
- Sensitivity to minor leakage
- Eddy Current Testing techniques



Typical Recommendations



- Program implementation
- Vessel lower head exams
- Alloy 600 susceptibility analysis and bare metal examination
- Threshold for reporting leakage



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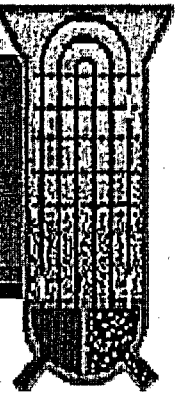
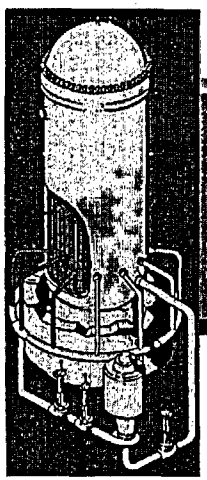
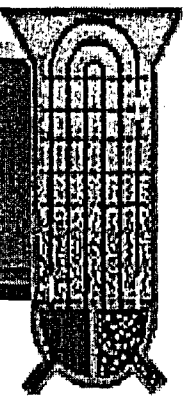


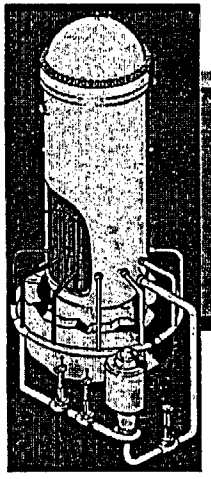
- Carbon steel component replacement
- Shutdown inspections
- Reactor Coolant System leakage indicators



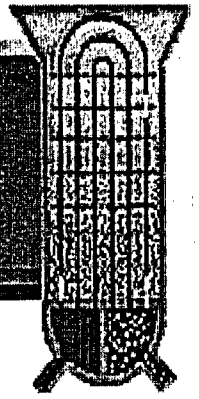
Primary Systems Integrity Review Visits



Questions/comments?



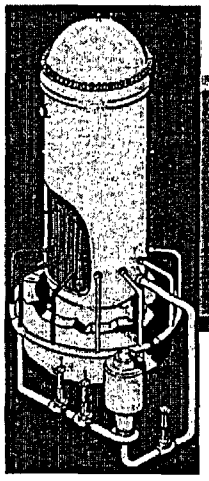
INPO-NRC Materials Meeting



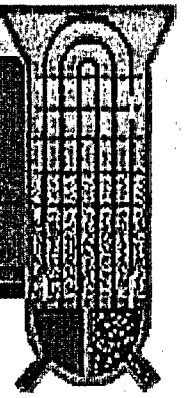
International Operating Experience

Francois
Chapelier

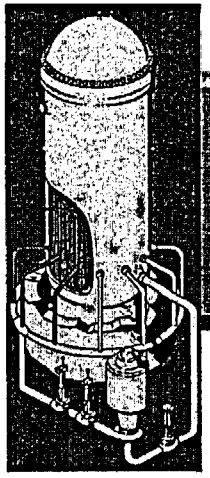
August 21, 2003



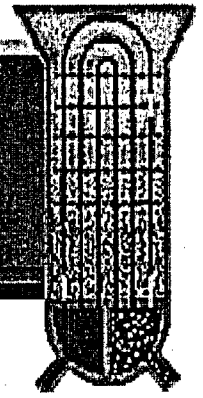
Materials Group Interaction with EDF



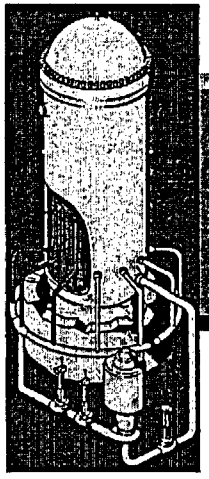
- January 2003 meeting between INPO, US industry and EDF focused on operating experience feedback and identification of potential industry issues
- Share operating experience
- INPO/EDF have established a framework for future meetings on shared materials issues



Key Material Issues



- BMI
- CVCS charging line nozzle
- Boric acid injection nozzle
- Surge line nozzle
- Tee upstream of RHR pump
- Tee connecting feed flow and AFW
- CCW



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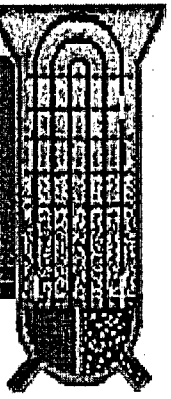

Questions/comments?

NRC
DOCUMENTS

RECENT STEAM GENERATOR ISSUES

NRC/INPO Meeting

August 21, 2003

Louise Lund

U.S. Nuclear Regulatory Commission

(301) 415-3248

SG PERFORMANCE

- Forced Outages
  - Wolf Creek – no leakage - primary side loose part
  - Byron 2 – 75 to 80 gpd leak – secondary side loose part
  - Comanche Peak 1 – 50 gpd leak – SCC in U-bend
- Most forced outages in a single year since 1994
- Performance criteria not met
  - Comanche Peak 1 – Structural / Accident Leakage
  - Oconee 2 – Structural
- Meeting performance criteria is another measure of plant performance

COMANCHE PEAK 1

- Axial ODSCC at dinged location in U-bend
- Accident and structural performance criteria not met
- Issues:
  - Overly restrictive phase angle response reporting criteria
  - Presence of artifact signals (dents , dings, probe wobble, etc.)
  - Automated data screening threshold criteria
  - Detecting long freespan indications
  - Use of "Judas" tube

OCONEE 2

- Flaw coincident with 2 volt dent (industry calibration) and a manufacturing burnish mark which caused the tube to not meet structural performance criteria

- Dent and MBM in close proximity are precursor and masking combination that affects flaw detectability

- Observations

  --Inspect dents and MBMs with qualified techniques

  --Certain artifact types, or combinations thereof, may pose significant challenge for detection of flaws

OTHER SG ISSUES

- Diablo Canyon – degradation in unexpected location/unexpected high voltage indications
- Seabrook – first domestic incident of cracking in thermally treated Alloy 600 tubing
- Beaver Valley 2 – implementation of GL 95-05
- Tubesheet Inspections – inspections to evaluate circumferential cracking in lower tubesheet regions

DIABLO CANYON 2

- Secondary side pressure test performed based on operational leakage

- Circumferential cracks (ID initiated) in U-bend – Rows 1 through 10
  - Met performance criteria
  - Cracking may not progress sequentially row by row
  - Experience should be factored into degradation assessments

DIABLO CANYON 2 (cont'd)

- Axial ODSCC at tube supports (GL 95-05)

- Large voltage indication – 19.5 volt increase in one cycle
  - NDE indicated flaw nearly through-wall during previous inspection
  - Review rotating probe profiles for indications less than repair limits
  - Unexpected number of large voltage indications
  - Voltage dependent growth rate methodology should result in conservative estimates of voltage growth

SEABROOK

- First domestic incident of confirmed ODSCC at tube support plate elevations in 15 Alloy 600 thermally treated tubes

- Cracking unexpected based on tube material, plant age, and operating conditions at plant (e.g., temperature)

- Observations:
  - Manufacturing/fabrication anomalies can lead to unanticipated degradation mechanisms
  - Abnormal trends in eddy current data may indicate potential problem
  - ISI programs – intended to manage known degradation as well as promptly detect unanticipated degradation

BEAVER VALLEY 2

- Spring 2003 outage – licensee may not be following Generic Letter 95-05 (voltage based repair limit) guidance concerning large mix residuals

- Technical Issue: Mix residuals can mask indications and may affect the bobbin voltage response of the indications

- Observations/Issues
  - Critical evaluation of inspection results is important
    - Is criteria for identifying large mix residuals supported by inspection results (i.e., finding >1.0 volt flaws near lower range of screening criteria may question adequacy of screening criteria)
    - Are large mix residuals consistently called from outage-to-outage?

TUBESHEET INSPECTIONS

- Draft generic letter issued for public comment
- Staff position and expectations discussed
- Questions developed based on review of licensee's technical basis (ADAMS Accession Numbers: ML031270287, ML030350719, and ML022980486)
- Licensee submittals should address these issues

RECENT NRC GENERIC COMMUNICATIONS ON SG OPERATING EXPERIENCE

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- IN 2002-21 - Cracking Affecting Thermally Treated Alloy 600 Steam Generator Tubes
- IN 2003-05 - Failure to Detect Freespan Cracks in SG Tubes - Comanche Peak 1
- Draft GL, Requirements for Steam Generator Tube Inspections – May 14th Federal Register, Pages 25909-25912 (ML031270171)
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