



Leakage from BMI Nozzles

What do the findings from South Texas mean?

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Alloy 600 Issue Task Group

Materials Reliability Program



South Texas Project Unit 1 Inspections

- **Visual Examination**
 - Bare Metal Visual
 - Boron Deposits adjacent to Nozzle 1 & 46
 - Deposit Characterization
 - presence of boron, lithium, and cesium
 - No evidence of wastage
 - based on the lack of discoloration of the boric acid deposits
 - the small amount of boric acid accumulation.
- **Volumetric Inspections**
 - 57 BMIs inspected via
 - UT from ID of nozzle
 - Enhanced visual examination of the surface of J-groove weld
 - Nozzle 1 & 46
 - ET from tube ID and of J-groove weld surface
 - 8 other nozzles
 - ET from tube ID
 - ET of J-groove weld surface



South Texas Project Unit 1 Inspection Results

- Nozzle 1
 - 3 axial indications
 - One leak path (through wall)
 - No crack-like indications on J-groove weld
 - Visual grinding marks in side of tube
- Nozzle 46
 - Two axial indications
 - One leak path (through wall)
 - No crack-like indications on J-groove weld



STP-1 Planned Additional Testing & Repairs

- Helium Test of #1 and #46 annulus
- Visually examine inside bore #1 and #46
 - Perform after nozzle capped and separated
 - Possibly detect irregularities
 - Look for known through wall flaw in #1
- ECT profilometry of #1 and #46
- Metallurgical analyses of removed nozzle ends
- Boat samples from #1 and #46 flaw zones
- Nozzle #1 and #46 will be repaired with half nozzle repair
- Volumetrically interrogate vessel base metal for wastage
- Root Cause expected in October 2003
 - Probable Cause in July 2003



BMI Inspections in Industry

- Approximately 12 plants perform visual inspections of BMIs every refueling outage.
- 15 additional plants have performed visual inspection of BMIs either in the Fall or Spring refueling outages
- MRP recommending that all plants with BMIs perform visual inspections for future refueling outages
- EDF has performed 16 volumetric and surface inspections (> 500 nozzles) at 12 units since 1992.
 - No cracking has been discovered.
- Some inspections have been performed at other units in Europe and Japan.
 - One ID indication recently reported in Japan



Industry Actions

- MRP is lead for industry actions
- MRP working with the Owners Groups to develop the strategy to address possible degradation of BMIs.
 - Ensure safe operation of plants with BMIs
 - Determine the appropriate inspection type and frequency for BMIs
 - Possible elements: LOCA analysis, FMEA, Risk Assessment, Stress Analysis, etc.



Current Recommendation from MRP

- During the current or next refueling outage, a bare metal visual examination of any Alloy 600 nozzles penetrating the bottom head of the reactor vessel be performed.
 - Plants whose design significantly impedes access to perform the recommended examinations should initiate expedited actions, up to and including physical modifications, to allow implementation of the recommendation at the earliest possible scheduled outage opportunity.
- Non-visual NDE may ultimately be a prudent and necessary component in a comprehensive inspection plan to fully evaluate the condition of the BMI population of an RPV, particularly following visual detection of a leak.
- Will re-evaluate these recommendations following issuance of root cause by STPNOC.



Near- Term Owners Group Activities

- WOG IRG has authorized “Reasonable Assurance of Continued Operation” for Westinghouse and CE Fleet
 - Will be completed shortly

- BWOG LOCA analysis
 - complete





IMI Nozzle SBLOCA Analyses for B&W- Designed Plants

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B&W Plant IMI SBLOCA Analyses

- Framatome ANP performed two SBLOCA analyses for each plant type with a break area of
 - Inside diameter of the IMI tube with incore ejected (0.0021 ft^2), and
 - The RV IMI nozzle vessel bore inside diameter with incore ejected and nozzle not obstructing the break flow area (0.0060 ft^2).



B&W Plant IMI SBLOCA Conclusions

- Any break of a single IMI nozzle at a B&W-designed plant would produce results that remain within the 10 CFR 50.46 acceptance criteria.
- Operator initiated steam generator cooldown improves ECCS delivery. SG depressurization also creates primary side condensate that augments the HPI flow. These contributions increase the minimum core mixture level (decrease PCT) for the largest IMI nozzle break.

