Meeting with Industry on Advanced Analyses

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Background

- Public meetings held on November 16, November 30, and December 20, 2006
- February 2, 2007 ACRS briefed on Wolf Creek pressurizer nozzle welds
  - Inspection findings,
  - NRC fracture mechanics analysis results,
  - NRC conclusions

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NRC Conclusions

- NRC staff does not consider Wolf Creek indications anomalous
- Inspections/mitigations need to be accelerated for some plants
- Enhanced RCS leakage monitoring with action levels to shut down and visually inspect welds necessary until inspections/mitigations completed

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NRC Analyses

- NRC staff analyses provide the technical basis for the staff's conclusions
- These analyses were presented in detail at a March 6, 2007 ACRS Subcommittee Meeting

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Regulatory Activities

- PWRs fall in following categories
  - Plants without Alloy 82/182 pressurizer nozzle welds
  - Plants that have already inspected or mitigated
  - Plants that plan to inspect or mitigate in 2007 outages
  - Plants that planned to inspect or mitigate in 2008 outages

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Regulatory Activities

- Agreements reached with licensees to:
  - Implement enhanced leakage monitoring until nozzles inspected or mitigated
  - Complete inspection/mitigation during 2007
    - Plants may inspect in 2008 pending results of advanced industry analyses

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Additional Regulatory Activities

- If industry's advanced analyses provide reasonable assurance to NRC staff that PWSCC will remain stable and not lead to rupture without significant time from the onset of detectable leakage, plants with 2008 outages will not have to shutdown in 2007

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Additional Regulatory Activities

- Licensee agreements contained in commitment letters
- Commitments will be confirmed through NRC Confirmatory Action Letters

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NRC Comments on Advanced Industry Analyses

- NRC provided comments to industry by letter dated March 5, 2007
- NRC staff will actively interact with industry to provide timely input on plans and progress

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NRC Comments on Advanced Industry Analyses

- Benchmarking
  - NRC contractor will modify fracture mechanics software to parallel changes in industry software
  - NRC software usable for benchmarking industry software
- Validation
  - Need to compare physical test results and operational data with analytical model results

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NRC Comments on Advanced Industry Analyses

- Safety Factor
  - ASME requires use of safety factors
  - Consider use of a safety factor to cover uncertainties in analyses, including estimation of leakage

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NRC Comments on Advanced Industry Analyses

- Weld Residual Stresses
  - Need to demonstrate that results will not be significantly affected by other reasonable residual stress distributions that could be assumed
- Multiple flaws and flaw size
  - Need to bound types of flaws found at Wolf Creek, account for possibility of multiple crack initiation and linkage in all nozzles
  - Need to take into account uncertainty of depth sizing

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NRC Comments on Advanced Industry Analyses

- Crack growth rates
  - Different crack growth rates can result in different crack profiles
  - Need to address effect of crack growth variability on crack profile
- Predicting growth by K
  - Evidence that in-service growth of stress corrosion cracks does not match fracture mechanics predictions
  - Difference may be attributed to insufficient welding residual stress predictions, non-idealized crack growth, or a fundamental issue with the crack driving force
  - Need to address predicting crack growth by K

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NRC Comments on Advanced Industry Analyses

- Non-idealized surface and through-wall crack stability
  - Crack stability methodologies assume either semi-elliptical or constant depth surface crack and an idealized through-wall crack
  - A methodology for calculating stability of non-idealized surface and through-wall cracks needs to be included in the analyses for accurate leakage and rupture predictions.