RG 1.99 Revision Evaluation Effort – Status Update

Materials Information Exchange Meeting
July 14, 2020

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Events to Date

- Technical letter report[1] (TLR) identified several deficiencies in RG 1.99, Rev. 2.
  - Most significant is non-conservatism of ΔRT_{NDT} at high fluence ≥ $6x10^{19}$ n/cm^2 (some PWRs reach during SLR)
- TLR reviewed by ACRS Subcommittee on August 22, 2019 (ML19260E007) and Full Committee November 6, 2019.
- ACRS issued letter to staff on November 27, 2019, supporting revision of RG.

1 - Assessment of the Continued Adequacy of Revision 2 of Regulatory Guide 1.99 - Technical Letter Report, July 31, 2019, ADAMS Accession Number ML 19203A089

NRC Staff Actions to Date

- Formed working group and oversight group to address TLR recommendations and evaluate a potential revision or alternative to RG 1.99, Rev. 2.
- Held public meeting on May 19, 2020 to present results of the evaluation effort, including:
  - Motivation for revision evaluation effort
  - Framework of alternative RG
  - Fleet impact smart sample results
  - Safety/risk analysis results
  - Implementation aspects
- Meeting summary is at ML20168A009.

Key Messages – Public Meeting

- Conducted risk analysis based on 80-year operating period (RG 1.99, Rev. 2 and ASTM E900-15).
- Results: Fleetwide implementation of a revised RG may not be necessary.
- Questions for certain transients (PWR cooldowns on licensed P-T limits and BWR leak tests with higher cooldown rates) – industry input could help.
- Framework of a potential alternative to RG 1.99 has been developed.
- Potential burden reduction for some plants – could benefit from industry and licensee input.

Framework of Potential Alternative RG

- Staff presented a framework of alternative RG based on the ASTM E900-15 embrittlement trend correlation (ETC)
- The framework also addresses aspects not fully addressed by the E900-15 standard including:
  - Use of plant-specific surveillance data.
  - Margins
  - Default values
  - Limitations

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Fleet Impact Study

- Smart sample of 21 plants.
- Used licensing basis materials inputs.
- Determined “embrittlement shift delta” (ESD), the change in adjusted reference temperatures that would result from switching from RG 1.99 ETC to E900-15 ETC (implementing all elements of alternative RG framework).
- ESDs tend to increase, particularly for base materials.
- Only a few ESDs for limiting materials > 50 °F, and these tend to be at fluences ~ $6x10^{19}$ n/cm^2
- A few (~20%) of plants had a change in limiting material.

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Safety/Risk Analysis Study

- Determine safety impact of a potentially nonconservative material reference temperature (ART or RT_{PTS}) associated with normal cooldown and leak test transients and PTS transients.
- Evaluated potential ETC non-conservatism by calculating the change in the conditional probability of failure (CPF) as a function of the ESD.
- Range of ESDs informed by fleet impact study.
- Both 1/4T and shallow flaws were modeled.

Safety/Risk Analysis Results

- Based on an 80-year analysis of a smart sample of plants, potentially nonconservative reference temperatures do not represent a significant safety issue in most cases for normal cooldowns, leak tests and PTS transients.
- Higher CPF calculated for the following transients:
  - Licensed P-T limits for plants with high ESDs.
  - BWR leak tests with high ESDs.
    - Lower actual cooling rates are expected to result in lower CPF values.
- Additional information desired to help confirm that the risk (TWCF) is low for the high ESD plants.
- Safety analysis results (to date) do not justify generic implementation of a revised RG based on ASTM E900-15.

Public Meeting Feedback

- Staff received feedback on the following topics:
  - Reduced margins for well-behaved surveillance data.
  - Use of sister plant data
  - Difficulty of obtaining Mn and P values needed for E900-15 ETC.
  - Consider increasing margin to allow use of ETC below minimum temperature limits.
  - Event frequencies for exceeding licensed P-T limits are extremely low. System and operational constraints described in technical report MRP-437/BWRVIP-328.
  - Assumption of 1/4T flaw in safety/risk analyses
  - Not clear the potential alternative RG would increase safety or reduce cost, e.g., probably no reduction in burden
- The staff appreciates the feedback.

Next Steps (NRC staff)

- Based on the results of the staff's evaluation and considering public meeting feedback, NRC has decided not to pursue an alternative to RG 1.99 Rev. 2 at this time.
- Formally document technical work completed under the RG evaluation effort, in two reports.
  - Technical basis for proposed alternative
  - Safety/Risk Analysis
- Complete a holistic evaluation of RPV integrity, considering both the RG evaluation and RPV surveillance programs, using the principles of risk-informed decision making from RG 1.174.
- Continue engagement with industry to get more information – to confirm risks are low for plants with high ESDs.
  - Review the MRP-437/BWRVIP-328 report – insights on event frequencies.