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UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555-0001

November 10, 1998

NRC GENERIC LETTER 98-05: BOILING WATER REACTOR LICENSEES USE OF THE BWRVIP-05 REPORT TO REQUEST RELIEF FROM AUGMENTED EXAMINATION REQUIREMENTS ON REACTOR PRESSURE VESSEL CIRCUMFERENTIAL SHELL WELDS

Addressees

All holders of operating licenses (or construction permits) for boiling water reactors (BWRs), except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

Purpose

The U.S. Nuclear Regulatory Commission NRC is issuing this generic letter to inform addressees that the NRC staff has completed its review of the "BWR Vessel and Internals Project [BWRVIP], BWR Reactor Pressure Vessel Shell Weld Inspection Recommendations (BWRVIP-05)," and that licensees of BWRs may request permanent (i.e., for the remaining term of operation under the existing, initial, license) relief from the inservice inspection requirements of 10 CFR 50.55a(g) for the volumetric examination of circumferential reactor pressure vessel (RPV) welds. No specific action or written response is required.

Background

By letter dated September 28, 1995, as supplemented by letters dated June 24 and October 29, 1996, May 16, June 4, June 13, and December 18, 1997, and January 13, 1998, the BWRVIP submitted the Electric Power Research Institute (EPRI) proprietary report TR-105697, "BWR Vessel and Internals Project [BWRVIP], BWR Reactor Pressure Vessel Shell Weld Inspection Recommendations (BWRVIP-05)." The BWRVIP-05 report evaluates the current inspection requirements for the reactor pressure vessel shell welds in BWRs, formulates recommendations for alternative inspection requirements, and provides a technical basis for these recommended requirements. It initially proposed to reduce the scope of inspection of the BWR reactor pressure vessel (RPV) welds from essentially 100 percent of all RPV shell welds to 50 percent of the axial welds and zero percent of the circumferential welds; however, as modified, it proposes to perform inservice inspections (ISI) on essentially 100 percent of the RPV axial shell welds, and essentially zero percent of the circumferential RPV shell welds, except for the intersections of the axial and circumferential welds. Approximately 2 - 3 percent of the circumferential welds will be inspected under this proposal.

On August 7, 1997, the NRC issued Information Notice (IN) 97-63, "Status of NRC Staff's Review of BWRVIP-05," regarding licensee requests for relief. IN 97-63 stated that the staff would "...consider technically-justified requests for reliefs from the augmented examination in accordance with 10 CFR 50.55a(a)(3)(i), 10 CFR 50.55a(a)(3)(ii), and 50.55a(g)(6)(ii)A(5) from BWR licensees who are scheduled to perform inspections of the BWR RPV circumferential shell welds during the fall 1997 or spring 1998 outage seasons. The staff issued scheduler reliefs for inspections of the BWR RPV circumferential shell welds due during the fall 1997 outage season for four units who submitted technically-justified requests, and has issued scheduler reliefs for two units during the spring 1998 outage season.

On May 7, 1998, the staff issued IN 97-63, Supplement 1, which informed BWR licensees that the staff was extending the period in which it would "...consider technically justified requests for relief from the augmented examination in accordance with 10 CFR 50.55a(a)(3)(i), 50.55a(a)(3)(ii), and 50.55a(g)(6)(ii)(A)(5) from BWR licensees who are scheduled to perform inspections of the BWR RPV circumferential shell welds during the fall 1998 or spring 1999 outage seasons. Acceptably justified relief would be considered for inspection delays of up to two operating cycles for BWR RPV circumferential shell welds only. Licensees will still need to perform their required inspections of 'essentially 100 percent' of all axial welds."

Discussion

The staff has completed its final review of the information submitted by the BWRVIP and the staff's safety evaluation (SE) was transmitted to Carl Terry, Chairman of the BWRVIP, in a letter dated July 30, 1998.

The staff previously concluded that beyond design-basis events occurring during plant shutdown could lead to cold over-pressure events that could challenge vessel integrity. The industry's response concluded that condensate and control rod drive pumps could cause conditions that could lead to cold over-pressure events that could challenge vessel integrity. The BWRVIP's estimate of the frequency of over-pressurization events that could challenge the RPV is 9.5×10^{-4} /yr for BWR-4 facilities and 9×10^{-4} /yr for other than BWR-4 facilities. After accounting for actual injections which were not included in the BWRVIP analysis, the staff conservatively estimates that the total frequency could be as high as 1×10^{-3} /yr (a point estimate).

The initial industry review determined that the failure frequency of circumferential welds was 2.2×10^{-41} /yr. This frequency was determined using importance sampling, generic weld variables and design basis events. Subsequent analyses using "Monte Carlo" calculation methods, plant-specific weld variables and pressures and temperatures associated with cold over-pressure events, determined that the limiting plant specific conditional probability of vessel failure, P(F|E), for circumferential welds at 32 effective full power years (EFPY) were 1×10^{-6} from the BWRVIP's re-analysis and 8.2×10^{-5} from the staff's analysis. Combining the frequency of cold over pressure events with the P(F|E), the BWRVIP failure frequency for the limiting circumferential welds was 9.0×10^{-10} /yr [$(9 \times 10^{-4}$ /yr event frequency for a BWR-3) \times (1.0×10^{-6} conditional probability of failure)]. The limiting plant specific failure frequency for circumferential welds at 32 EFPY was determined by the staff to be 8.2×10^{-8} /yr [$(1 \times 10^{-3}$ /yr event frequency) \times (8.2×10^{-5} P(F|E))]. As depicted in NUREG 1560, Vol. I, core damage frequencies (CDF) for BWR plants were reported to be approximately 10^{-7} /yr to 10^{-4} /yr. In addition, Regulatory Guide (RG) 1.154 indicates that PWR plants are acceptable for operation if the plant-specific analyses predict the mean frequency of through-wall crack penetration for pressurized thermal shock events is less than 5×10^{-6} /yr. The failure frequencies of circumferential welds in BWR vessels are significantly below the criteria specified in RG 1.154.

RG 1.174 provides guidelines as to how defense-in-depth and safety margins are maintained, and states that a risk assessment should be used to address the principle that proposed increases in risk, and their cumulative effect, are small and do not cause the NRC Safety Goals to be exceeded. The estimated failure frequency of the BWR RPV circumferential welds is well below the acceptable core damage frequency (CDF) and large early release frequency (LERF) criteria discussed in RG 1.174. Although the frequency of RPV weld failure can not be directly compared to the frequencies of core damage or large early release, the staff believes that the estimated frequency of RPV circumferential weld failure bounds the corresponding CDF and LERF that may result from a vessel weld failure. On the above bases, the staff has concluded that the BWRVIP-05 proposal, as modified, to eliminate BWR vessel circumferential weld examinations, is acceptable.

Permitted Action

BWR licensees may request permanent (i.e., for the remaining term of operation under the existing, initial, license) relief from the inservice inspection requirements of 10 CFR 50.55a(g) for the volumetric examination of circumferential reactor pressure vessel welds (ASME Code Section XI, Table IWB-2500-1, Examination Category B-A, Item 1.11, Circumferential Shell Welds) by demonstrating that: (1) at the expiration of their license, the circumferential welds will continue to satisfy the limiting conditional failure probability for circumferential welds in the staff's July 30, 1998, safety evaluation, and (2) licensees have implemented operator training and established procedures that limit the frequency of cold over-pressure events to the amount specified in the staff's July 30, 1998, safety evaluation. Licensees will still need to perform their required inspections of "essentially 100 percent" of all axial welds.

This generic letter requires no specific action or written response. Any action on the part of addressees to request relief from the inservice inspection requirements of 10 CFR 50.55a(g) for the volumetric examination of the circumferential reactor pressure vessel welds, in accordance with the guidance of this generic letter, is strictly voluntary. If you have any questions about this matter, please contact one of the contacts listed below.

/s/'d by

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