X.S1 CONCRETE CONTAINMENT TENDON PRESTRESS

Program Description

This aging management program provides reasonable assurance of the adequacy of prestressing forces in prestressed concrete containment tendons during the period of extended operation under 10 CFR 54.21(c)(1)(iii). The program consists of an assessment of inspections performed in accordance with the requirements of Subsection IWL of the American Society of Mechanical Engineers (ASME) Code, Section XI, as supplemented by the requirements of 10 CFR 50.55a(b)(2)(viii). The assessment related to the adequacy of the prestressing force establishes (a) acceptance criteria in accordance with U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide (RG) 1.35.1 and (b) trend lines based on the guidance provided in NRC Information Notice (IN) 99-10.

As evaluated below, this time-limited aging analysis (TLAA) is an acceptable option to manage containment tendon prestress forces. However, it is recommended that the staff further evaluate an applicant's operating experience related to the containment tendon prestress force. Programs related to the adequacy of prestressing force for containments with grouted tendons are reviewed on a case-by-case basis.

Evaluation and Technical Basis

1. ***Scope of Program:*** The program addresses the assessment of containment tendon prestressing force when an applicant performs the containment prestress force TLAA using 10 CFR 54.21(c)(1)(iii).

2. ***Preventive Actions:*** Maintaining the prestress above the minimum required value (MRV), as described under the acceptance criteria below, ensures that the structural and functional adequacy of the containment are maintained.

3. ***Parameters Monitored:*** The parameters monitored are the containment tendon prestressing forces in accordance with requirements specified in Subsection IWL of Section XI of the ASME Code, as incorporated by reference in 10 CFR 50.55a.

4. ***Detection of Aging Effects:*** The loss of containment tendon prestressing forces is detected by the program.

5. ***Monitoring and Trending:*** The estimated and measured prestressing forces are plotted against time, and the predicted lower limit (PLL), MRV, and trending lines are developed for the period of extended operation. NRC RG 1.35.1 provides guidance for calculating PLL and MRV. The trend line represents the trend of prestressing forces based on the actual measured forces. NRC IN 99-10 provides guidance for constructing the trend line.

6. ***Acceptance Criteria:*** The prestressing force trend lines indicate that existing prestressing forces in the containment tendon would not be below the MRVs prior to the next scheduled inspection, as required by 10 CFR 50.55a(b)(2)(viii)(B). The acceptance criteria normally consists of PLL and the minimum required prestressing force, also called MRV. The goal is to keep the trend line above the PLL because, as a result of any inspection performed in accordance with ASME Section XI, Subsection IWL, if the trend line crosses the PLL, the existing prestress in the containment tendon could go below the MRV soon after the inspection and would not meet the requirements of 10 CFR 50.55a(b)(2)(viii)(B).

7. ***Corrective Actions:*** If acceptance criteria are not met, then either systematic retensioning of tendons or a reanalysis of the containment is warranted to ensure the design adequacy of the containment. As discussed in the Appendix for GALL, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions.

8. ***Confirmation Process:*** The confirmation process ensures that preventive actions are adequate and that appropriate corrective actions have been completed and are effective. The confirmation process for this program is implemented through the site's quality assurance (QA) program in accordance with the requirements of 10 CFR Part 50, Appendix B.

9. ***Administrative Controls:*** The administrative controls for this program provide for a formal review and approval of corrective actions. The administrative controls for this program are implemented through the site's QA program in accordance with the requirements of 10 CFR Part 50, Appendix B.

10. ***Operating Experience:*** The program incorporates the relevant operating experience that has occurred at the applicant's plant as well as at other plants. The applicable portions of the experience with prestressing systems described in NRC IN 99-10 could be useful. Additional industry operating experience has been documented in NUREG/CR-4652 and in the May/June 1994 *Concrete International* publication by H. Ashar, C. P. Tan, and D. Naus. However, tendon operating experience may be different at plants with prestressed concrete containments. The difference could be due to the prestressing system design (e.g., button-headed, wedge, or swaged anchorages), environment, and type of reactor (i.e., pressurized water reactor and boiling water reactor). Thus, the applicant's plant-specific operating experience should be further evaluated for license renewal.

References

10 CFR Part 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants*, Office of the Federal Register, National Archives and Records Administration, 2009.

10 CFR 50.55a, *Codes and Standards*, Office of the Federal Register, National Archives and Records Administration, 2009.

10 CFR 54.21, *Contents of Application-Technical Information*, Office of the Federal Register, National Archives and Records Administration, 2009.

ASME Section XI, *Rules for In-Service Inspection of Nuclear Power Plant Components, Subsection IWL, Requirements for Class CC Concrete Components of Light-Water Cooled Plants*, 1992 Edition with 1992 Addenda, The ASME Boiler and Pressure Vessel Code, The American Society of Mechanical Engineers, New York, NY.

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Cooled Plants, 2004 edition, The ASME Boiler and Pressure Vessel Code, The American Society of Mechanical Engineers, New York, NY.

H. Ashar, C.P. Tan, D. Naus, *Prestressing in Nuclear Power Plants*, Concrete International, Detroit, Michigan: ACI, May/June 1994.

NRC Information Notice 99-10, *Degradation of Prestressing Tendon Systems in Prestressed Concrete Containments,* U. S. Nuclear Regulatory Commission, April 1999.

NRC Regulatory Guide 1.35.1, *Determining Prestressing Forces for Inspection of Prestressed Concrete Containments,* U. S. Nuclear Regulatory Commission, July 1990.

NUREG/CR-4652, *Concrete Component Aging and its Significance to Life Extension of Nuclear Power Plants*, Oak Ridge National Laboratory, September 1986.