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Materials Reliability Program: Aging Management Strategies for Westinghouse and Combustion Engineering PWR Internal Components (MRP-232, Revision 2-NP)

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Westinghouse Electric Company LLC

NOTE

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PRODUCT DESCRIPTION

This report summarizes the development of updated aging management and asset strategies for Westinghouse and Combustion Engineering (CE) reactor vessel internals to cover both the first period of extended operation (PEO) and subsequent license renewal (SLR). This report provides the technical basis for the aging management requirements as well as recommendations for asset management of Westinghouse and CE reactor internals for the Electric Power Research Institute (EPRI) report, *Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227, Revision 2)*.

Background

Demonstration that the effects of aging degradation in pressurized water reactor (PWR) internals are adequately managed is essential for maintaining a healthy fleet and ensuring continued functionality of the reactor internals. This approach evaluated reactor internals components susceptible to aging-related degradation from a safety standpoint, as well as those components whose failure would have a significant economic impact. The current inspection and evaluation (I&E) guidelines are a living document, so the goal of updating these strategies was to incorporate the latest operating experience for first PEO, and then expand the applicability of the guidelines to SLR. The program to develop guidelines has been underway for more than a decade; it is organized around a framework and strategy for managing the effects of aging in PWR internals and depends on a substantial database of material data, operating experience, and supporting evaluation results.

Objective

- To provide aging management strategies and asset management recommendations for Westinghouse and CE reactor internals for use in the PWR Internals I&E Guidelines.
- To update the strategies for recent reactor vessel internals operating experience and for subsequent license renewal.

Approach

The aging management strategy development combined the results of functionality assessment with component accessibility, operating experience, existing evaluations, and prior examination results to determine the appropriate methodologies for maintaining the long-term functions of PWR internals safely and economically. For components that were determined to require aging management, this process permitted further categorization of PWR internals into functional groups: Primary, Expansion, Existing Programs, and No Additional Measures groups, with appropriate recommendations to support aging management program (AMP) development. For components that were determined be susceptible to aging-related degradation, and whose failure would cause significant economic impact, asset management recommendations were provided to

assist the plant in developing strategies to detect aging degradation earlier when repairs may be easier, or to allow time to plan for more costly repairs or replacements.

Through this process, a team of experts from Westinghouse Electric Company evaluated the reactor internals for the Westinghouse and CE designs and made appropriate recommendations for aging management and asset management actions specific to each component.

Results

The final classification of components, which provides the basis for the recommended aging management program, is provided in this report. Inspection of the Primary components should provide adequate monitoring of aging degradation in the reactor internals. The recommendations are structured to link all of the Expansion components to the Primary components that provide leading indicators of degradation. These inspections, combined with the existing American Society of Mechanical Engineers (ASME) Code Section XI program and other previously established plant programs, provide the basis for a comprehensive aging management program. The recommendations identify all the degradation mechanisms being monitored and the appropriate inspection method for each. The recommendations for the Primary components also identify timelines for their inspection.

Components were also classified based on the aging degradation mechanisms and recommendations provided for asset management. The recommendations may include alternate inspection techniques, increased examination coverage, or alternative timelines for inspections. These recommendations are intended to assist the plant in identifying aging-related degradation earlier when repairs are easier, or when there is ample time for planning replacement strategies.

This revision includes updates to the aging management recommendations reported in Section 4. Operating experience and interim guidance since the release of the previous revision were included in the evaluations and recommendations. Section 5 was added to provide asset management recommendations for components whose failure would have a significant economic impact to the plant.

Application, Value, and Use

These aging management strategies are based on a broad set of assumptions about plant operation, which encompass the range of current plant conditions for the U.S. fleet of PWRs. The functional evaluations that support these strategies were based on representative configurations and operational histories. The evaluations were generally conservative, but not necessarily bounding in every parameter. These assumptions are a conservative representation of U.S. PWR operating plants, all of which implemented low-leakage core loading patterns early in operating life. The aging management strategies in this report are thus relevant to all U.S. Westinghouse and CE operating plants as of November 2017.

Keywords

Aging management
Asset management
Categorization
Combustion Engineering design
Degradation mechanism
Westinghouse-design PWR internals