

NRC Workshop on Structural Materials

Research for Beyond 80 Years Civil Structures

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Outline

- Overview
- Example Topics for Brainstorming
- Irradiation Effects and Other Topics – Harvesting
- Post-tensioned Containments
- Input from IAEA IGALL

Overview

Explore the state of knowledge (including operating experience, research activities, and associated engineering analyses) related to the performance of “passive,” “long-lived” structures and components (SCs) during long-term operations of existing light water reactors (i.e., > 80 years)

- Identify any research needs to provide assurance of the continued adequacy of existing aging management programs
- Focus on identifying new, or immature, or evolving research topics related to aging effects and aging mechanisms that may become important at such long operating times
- Such efforts are intended to be distinct from current and near-term research activities unless they have specific aspects that support extended operation.

Topics for Brainstorming Examples



Queries & Thoughts

- Recognition of importance on aging management and safety significance of aging effects and their aging mechanisms
 - Four types of Aging Management Programs (AMPs): (i) prevention, (ii) mitigation, (iii) condition monitoring, and (iv) performance monitoring (e.g., containment leak rate test, Time Limited Aging Analysis)
- Recognition of reliable knowledge base to inform aging management for more than 80 years of operation including industry and plant-specific operating experience and lessons learned
- Doing things in smarter and more efficient way, using proven technology
- Visual Inspection streamline in high stressed areas instead of ad-hoc inspections.
- Opportunities for planning and deploying novel inspection and monitoring technologies for detection, inspection, surveying and, if needed, diagnosis of aging effects and/or degradations

Topics for Brainstorming



- Condition monitoring using technology
 - Use of improved Non-Destructive Examinations (NDEs), Artificial Intelligence (AI) and Machine Learning (ML), drones, laser scanning 3-D image, photography, robotics for inaccessible or for not so easily accessible areas.
 - Use of sensors for strain, deformation, chemical, physical conditions, etc.
 - Integration of Building Information Model (BIM) technology with aging management data
- Reliability of those technologies and their integration with the plant modernization plans
- Feasibility of repair and replacements for beyond 80 years of operation
- What aging effects are likely to accumulate with time?
 - Irradiation on structures for Pressurized Water Reactor
 - Creep in post-tensioned containments
 - Corrosion
 - Other
- Synergist effects: Are they significant and, if so, under what conditions?

Irradiation Effects and Other Topics - Harvesting

- Irradiation effects on structures and Harvesting
 - Confirmatory testing and reducing uncertainties
 - Actual in-service plant operating conditions vs. accelerated irradiation and testing, including rate effects and free expansion vs. structural confinement
 - Impact of irradiation on degradation of concrete-steel interfaces
 - Evaluating concrete radiation gradients in the biological shield
 - Size/scale effects
- Other topics and harvesting
 - Verification of NDE and destructive testing (sampling)
 - Wall of the post-tensioned containments using NDE and destructive inspection
 - Inspection of areas not accessible to visual inspection
 - PWR spent fuel pool (SFP) concrete structure due to boric acid attack from the SFP leak chase channel leakage
 - Synergistic effects for corrosion development
 - Anchors testing
 - Others?

Post-tensioned Containments

- Creep in post-tensioned containments
 - Long-term effects of creep considering de-tensioning and re-tensioning of tendons including for plant modifications over long periods of operation
 - Conditions in which cracking from internal radial strains may develop and their impact
 - Monitoring and aging management strategies

Input from IAEA IGALL WG3

Input from IAEA IGALL WG3 Safety Officer Bryce Lehman

Action item list prepared by IGALL WG3 that may be relevant for possible research activities. This list was developed based on information IGALL members wanted to share with the larger group, and some areas where members are looking for additional guidance. None of it is specific to beyond 80 but most of it is in some way related to long term operation.

- Develop a new AMP on elastomers in civil structures
- Analyze the possibility to develop specific AMP or enhance existing AMPs for aggressive coastal environments
- Analyze the possibility to develop a specific AMP or enhance existing AMPs (AMP304) for estimating functional performance of concrete containment based on in-service leakage test.
- Develop a TECDOC (or other type of document) on implementation of TLAA305, Irradiation of concrete structures.

Thanks

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