Concrete and Civil Structures

Longer Term Operations

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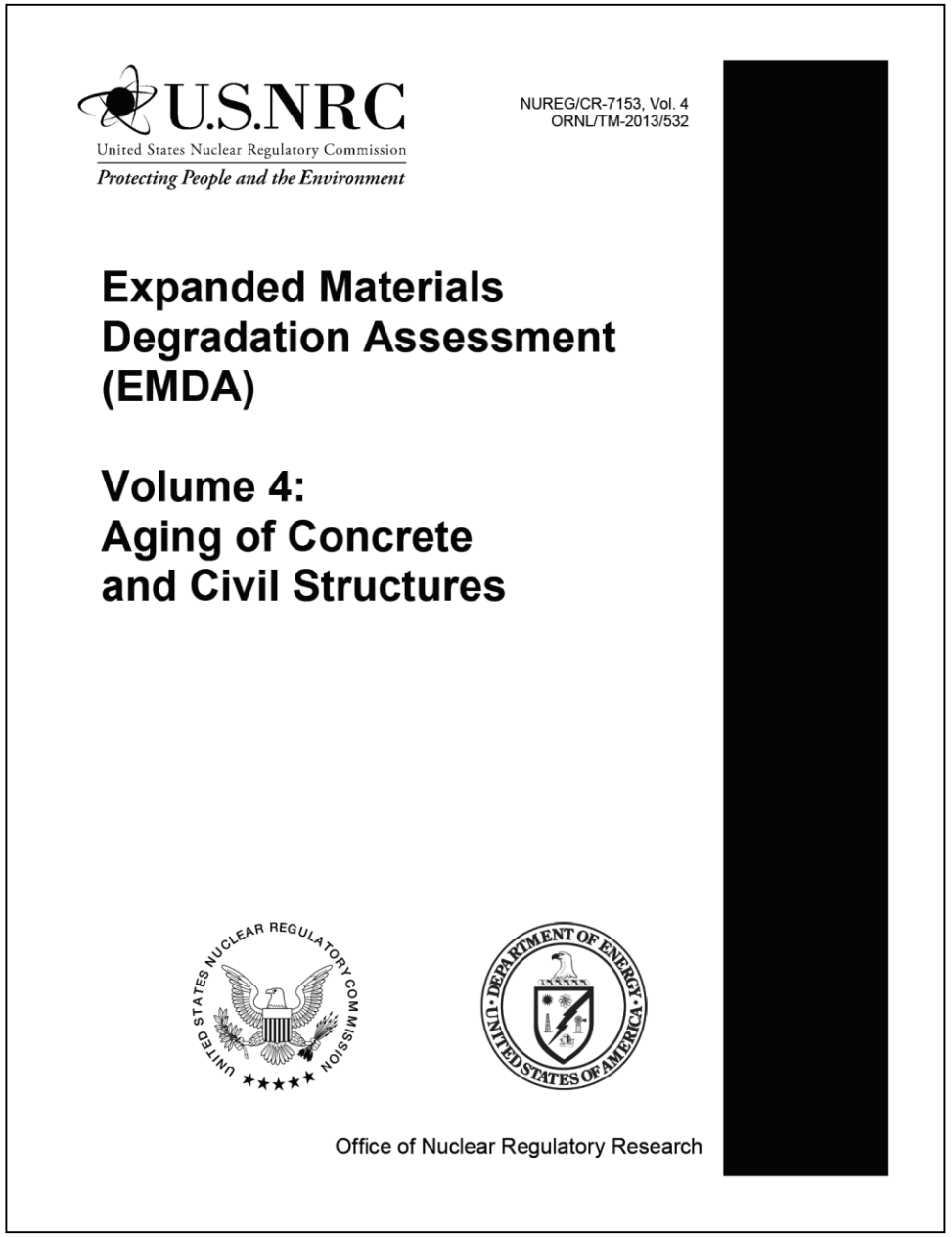
EMDA to Joint Roadmaps

- The EMDA (NUREG/CR-7153 Vol 4) identified the following as potential knowledge gaps for assessing concrete up to 80 years of operations
  - Alkali Silica Reaction
  - Concrete Irradiation
  - Creep of Post Tension Containments
  - Boric Acid Attack of Concrete
- EPRI, NRC, and DOE have maintained joint roadmaps of research for Alkali Silica Reaction, Concrete Irradiation, and Nondestructive Evaluation

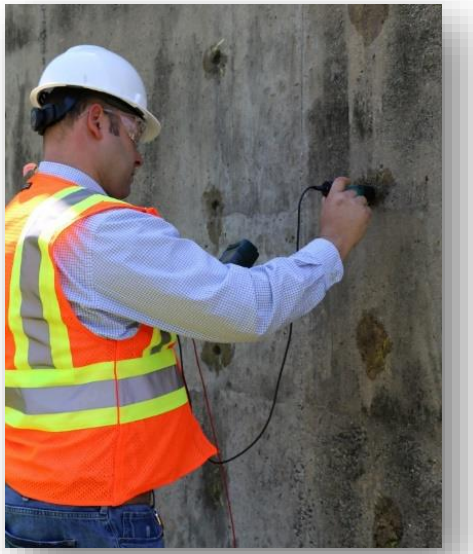


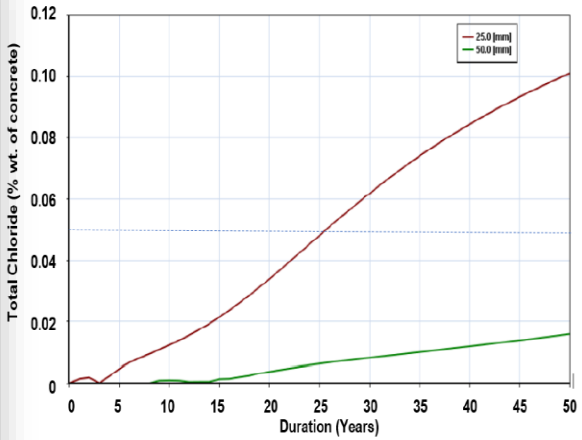
Highlights of EPRI Research on Concrete Aging Management

Topic	Title
Structures Monitoring	Structures Monitoring Program Guidelines: Best Practices and Example Procedure
	Structures Monitoring Best Practices: Personnel Qualifications
	Long-Term Operations: Subsequent License Renewal Aging Effects for Structures and Structural Components (Structural Tools)
	Field Guide: Visual Inspection of Concrete Structures
	Materials Reliability Program: EPRI Review of the Kansai Takahama Units 1 and 2 Aging Evaluations for Extending Operational Periods (MRP-429)
Reinforcement Corrosion	Field Guide: Corrosion Inspection of Reinforced Concrete Structures in the Nuclear Fleet
	Nondestructive Evaluation Inspection of Concrete Structures Subjected to Corrosion
	Tools to Develop Aging Management Programs for Corrosion-Affected Concrete Structures
	Modeling Platforms for Chloride-Induced Corrosion of Concrete Structures
	Guidelines for Selecting Remediation Strategies for Corrosion Control of Reinforced Concrete Structures
	Program on Technology Innovation: Corrosion Mitigation of Conventionally Reinforced Concrete Structures
Alkali Silica Reaction	Long-Term Operations: Aging Management of Concrete Structures Affected by Alkali-Silica Reaction
	Evaluation of Laboratory Tests to Detect Up-to-Date Expansion and Remaining Expansion in Concrete Structures Affected by Alkali Silica Reaction
	Tools for Early Detection of ASR in Concrete Structures
	Modeling Concrete Structures Affected by Alkali Silica Reaction: Hydro-Quebec Approach for Hydraulic and Nuclear Power Plants
Concrete Irradiation	Irradiation Damage of the Concrete Biological Shield – Example Evaluation of Concrete Biological Shield Wall for Aging Management
	Structural Model of PWR Concrete Reactor Pressure Vessel Supports – Effects of Chronic Radiation Exposure on Margin
	Structural Disposition of Neutron Radiation Exposure in BWR Vessel Support Pedestals
	Long-term Operations: Estimation of Gamma Dose in Boiling Water Reactor Concrete Biological Shield Walls

Aging Management Activities

Inspection / Monitoring → Analysis / Evaluation → Mitigation / Modernization → Repair / Replacement





Concrete and Civil Structures Beyond 80 Years

- Current aging management activities are independent of service life and based on relevant parameters
- Likelihood of degradation is dependent on environmental conditions and exposure time
- Mitigation Strategy
  - Cathodic Protection Systems
- Modernizations
  - Enhanced Inspection and Monitoring (e.g., Drones, Structural Health Monitoring)

The Path Forward – Enhancements and Optimization

Enhanced Inspections

- Advanced Visual Data
- Monitoring technologies
- Advanced Nondestructive Evaluations

Data Management

- Electronic Database
- Data Visualization
- Digital Twin

Data Utilization

- Risk Informed
- Predictive Analysis

Trending Across the Industry

- Increased Communication between Utilities, Regulators, and Research