Long Term Operations (QA)

Program Overview

Program Description

High capacity factors and low operating costs make nuclear power plants some of the most economical power generators available. Even when major plant components must be upgraded to extend operating life, these plants often represent a cost-effective, low-carbon asset. The decision to extend nuclear plant life involves a host of interrelated technical, economic, regulatory, and public policy issues. Unknown or uncertain technical inputs impact the decision-making process both directly and indirectly: directly, through design and operational contingencies; and indirectly, through impacts on regulatory actions and public policy.

Recognizing the many technical challenges confronting extended nuclear plant operations, the Long-Term Operations Program is conducting an array of research and development activities to ensure the public, nuclear plant owners, regulatory agencies, and all interested stakeholders have the information needed to make sound decisions regarding the ability of a nuclear plant to sustain safe, reliable, economic operations.

Research Value

The Long-Term Operations Program will develop the technical information on which to base decisions regarding extended nuclear plant life. Research results will not only inform those plant owners considering life extension past 40, 50, or 60 years, but also those with relatively younger plants considering the long-term impacts of aging. Participants gain access to technical solutions and information to support the following needs:

- Identifying and overcoming key technical barriers that may be potentially life limiting
- Investigating cost-effective modernization opportunities
- Informing potential regulatory issues
- Defining the technical basis for aging management programs that can support safe, long-term operations

Approach

The factors driving interest in long-term nuclear plant operations correspond to specific challenges where technical insight can effectively inform decision making. Although these challenges touch different aspects related to long-term operations—from the physical condition of the plant to the allocation of capital budgets for plant refurbishment—they all require focused research and development to ensure technical constraints and opportunities are fully understood. The Long-Term Operations Program is designed to address these constraints and opportunities, encompassing activities facing extended operation through 30 or 40 years, all the way up through 60 or more years.

The program accomplishes its objectives through an integrated strategy that involves research defined by the Electric Power Research Institute (EPRI) and its participants, collaboration on complementary research activities with the Department of Energy's (DOE) Light Water Reactor Sustainability Program, and engagement with other key stakeholders such as the Materials Aging Institute.

The activities conducted through the Long-Term Operations Program are identified and prioritized in association with nuclear plant owners, regulators, and other key stakeholders. The project also builds on the technical experience and expertise accumulated through EPRI leadership in the U.S. license renewal effort in the 1990s and early 2000s.

Research activities are focused in seven technical areas:

- Primary system materials aging
- Concrete and containment aging
- Risks and safety analysis methods
- Instrumentation and control and information technology
- Life-cycle management
• Cable aging
• Plant demonstration and pilot projects

Pilot demonstrations play an important role in characterizing issues impacting long-term operations and, subsequently, in demonstrating mitigating actions and new technology capabilities. For example, EPRI, DOE, and Constellation Energy Nuclear Group have a multi-year collaborative effort in progress to investigate aging concerns at the Ginna and Nine Mile Point nuclear plants, which are both more than 40 years old. Containment inspection and reactor vessel internals examinations have been completed at Ginna and Nine Mile Point.

Accomplishments

EPRI's Long-Term Operations Program has grown into a large research effort with broad collaboration across multiple countries and entities. Key results include:

• Identified and prioritized long-term operations issues in a Long-Term Operation Issue Tracking Table. This table is the basis for collaborative R&D programs at the DOE and EPRI and is periodically updated to reflect the current state of knowledge.
• Performed a concrete containment examination at the Ginna nuclear plant to evaluate two new approaches for assessing the condition of concrete containment structures: tendon load monitoring and surface strain monitoring.
• Demonstrated the use of an integrated asset management tool to develop an optimized life cycle strategy for 31 large power transformers across the Constellation Energy Nuclear Group fleet. The tool can help determine the most appropriate combination of repair and spare procurement actions to minimize costs while maintaining high reliability.
• Published a knowledge basis report on the effects of high fluence long-term radiation exposure on concrete structures.
• Issued a report documenting good practices, barriers, and gaps related to the use of information technology for driving improvements in equipment reliability.
• Initiated research to develop and validate an integrated framework and advanced tools that will enable accurate characterization and visualization of nuclear power plant safety margins. Completed a pilot application on a typical 4-loop Westinghouse plant during a power uprate to identify potential cliff-edge effects.
• Continued work on a flexible functional requirements strategy for control room and underlying instrumentation and information technology infrastructure, architecture, and associated capabilities that will support plants throughout extended operating life.
• Developed principles for welding repair of highly irradiated materials with either a hybrid laser or friction stir weld technique.

Current Year Activities

Long-Term Operations research for 2014 will focus on the following:

• Continue R&D with DOE and international entities on the effects of high fluence on concrete structures and containments. Develop a mechanistic model of the radiation effects on concrete and support testing of concrete in test reactors.
• Collaborate with the Materials Aging Institute on a study to model and predict the effects of boric acid leakage on spent fuel pools long-term on the support concrete and rebar.
• Continue R&D efforts on characterization, modeling, and mitigation of intergranular stress corrosion cracking in nickel alloys and irradiation-assisted stress corrosion cracking in stainless steel.
• Develop a cable vulnerability assessment guideline that can be used to identify, monitor, and possibly replace the cables that may not have sufficient remaining life for LTO.
• Incorporate the existing cable management and aging knowledge basis into the Integrated Life-Cycle Management project to develop remaining useful life algorithms.
• Continue developing the diagnostic and prognostic abilities of centralized online monitoring through pilot projects at Duke on step-up transformers and at Exelon on emergency diesel generators.
• Release Integrated Life-Cycle Management software tool based on results of pilot demonstrations at South Texas Project and Exelon.
• Demonstrate the hybrid laser and friction stir advanced welding techniques for issues impacting long-term operations, including testing in the ORNL hot cell in collaboration with DOE.
• Review the technical basis for Aging Management Programs (AMP) to inform the development of AMPs for subsequent license renewal and future revisions to the Generic Aging Lessons Learned report and the International Generic Aging Lessons Learned report.

Selected reports and products may be prepared in whole or in part in accordance with the EPRI Quality Program Manual that fulfills the requirements of 10CFR50 Appendix B and 10CFR21. The QA status of reports and products will be marked and identified.

Estimated 2014 Program Funding
$4.0M

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