EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Long-Term Nuclear Operations

Executive Summary

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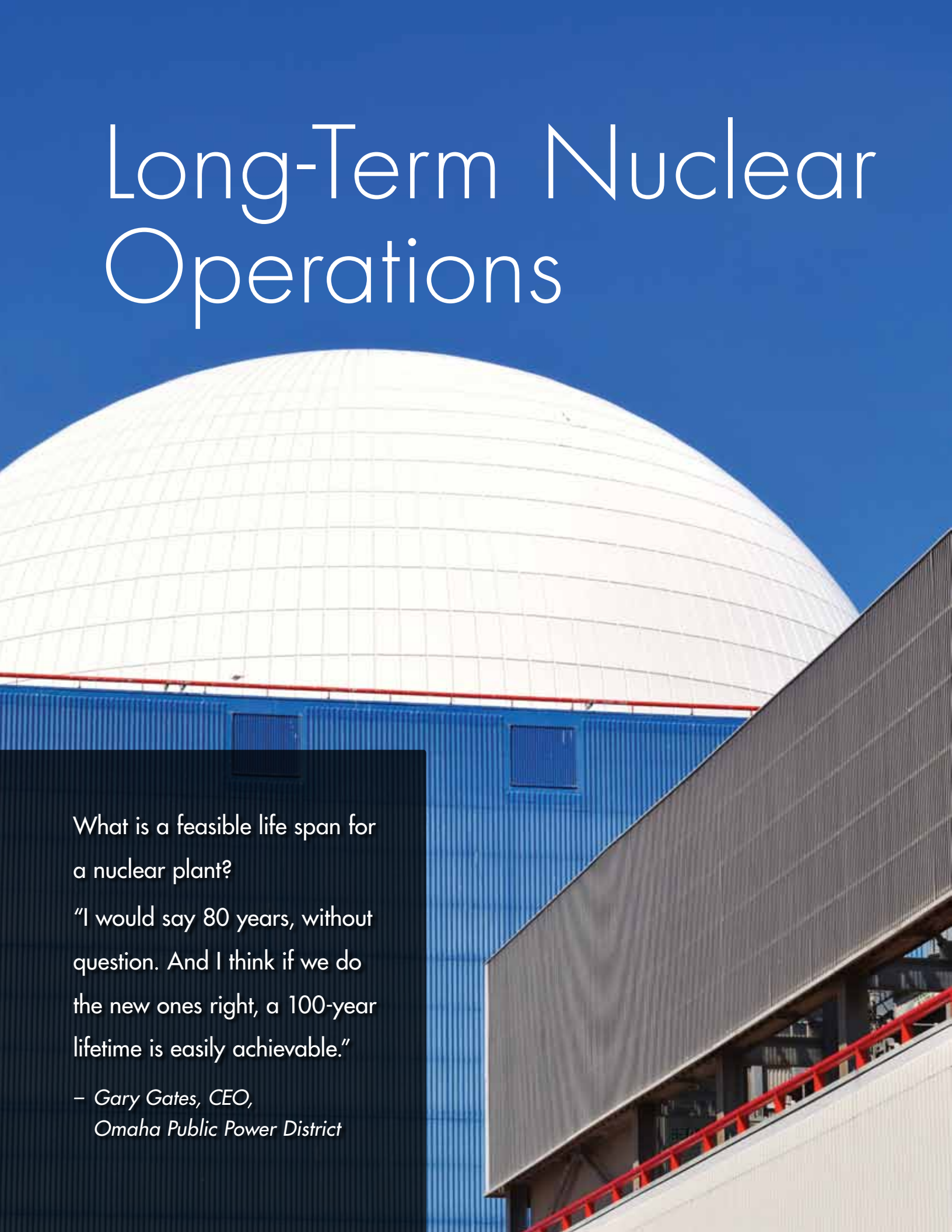


What is a feasible life span for a nuclear plant?

"I would say 80 years, without question. And I think if we do the new ones right, a 100-year lifetime is easily achievable."

– *Gary Gates, CEO, Omaha Public Power District*

Major economic, environmental, and operational issues drive the need for long-term operations

Nuclear power's high capacity factors and low operating costs make it economically competitive and a cornerstone of electric system reliability. Nuclear power's zero-emissions profile also makes it an attractive option for addressing growing concerns about climate and the costs of meeting CO_2 emission targets.

These and other attributes can potentially justify the continued operation of existing nuclear plants beyond 60 or 80 years, even when major plant components must be upgraded. The decision to extend nuclear plant life, however, involves many interrelated technical, economic, regulatory, and public policy issues.

The industry needs workhorse baseload plants

The existing nuclear fleet provides reliable, affordable baseload power — a foundation for economic growth and the financial health of utilities. With global electricity demand expected to rise more than 85% by 2035 (Energy Information Administration), the industry must maintain the availability of "workhorse" nuclear plants. Extending the life of existing plants secures a low-cost generation asset, strengthens the grid, and supports the introduction of renewable resources.

Nuclear plants can help strengthen the balance sheet

In most cases, nuclear plant owners have paid off the debt associated with capital investment in existing plants. Continued operation of these plants enables owners and their customers to derive even greater value by avoiding significant capital outlays for new generation.

Long-term operation keeps options open

Power generation requires high-dollar investments over long planning and development horizons. The availability of multiple options increases strategic flexibility and reduces risks. Pursuing long-term operation enables generation fleet owners to manage assets more effectively in meeting demand while complying with economic, financial, regulatory, and technical requirements. Also, because generation options must compete with one another, the consumer ultimately benefits.

Technical requirements constitute a "heavy lift"

License renewal in the United States, periodic safety reviews in many countries, and other formal life extension processes prompt tremendous technical work to prepare for the regulatory scrutiny associated with long-term operations. By identifying and addressing the range of technical issues, nuclear plant owners and their corresponding regulators can engage in more timely and fruitful discussions of potential barriers to extended operation.

Curb emissions with proven technology

National and international targets to reduce CO_2 emissions will drive utilities to build low-emission technologies, requiring substantial capital expenditures and time. Extending the life of nuclear plants during and beyond the transition to low-emission technologies can deliver significant carbon reductions, reinforcing nuclear's leading position as a source of zero-carbon electricity.

Research and development can reduce uncertainty related to long-term operations

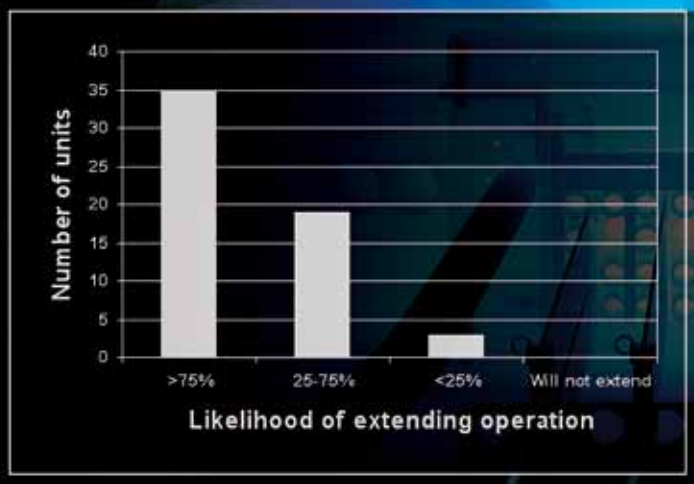
Research and development can effectively inform decision making regarding long-term operations. Replacing reactor internals, for example, might be easier to justify if confidence is high that the plant will operate for another 30 rather than 10 years. To make this decision, plant owners and operators require comprehensive, objective technical information.

Better understanding of aging mechanisms will add certainty to extended-life decisions

The plant's physical condition provides the most tangible challenge to long-term operations. A better understanding of physical degradation mechanisms will enable plant owners to monitor the condition of a given component, determine when intervention might be necessary, and develop and implement any necessary mitigation.

A life-cycle approach supports long-term health management

Nuclear systems and components can be actively managed over their life cycle to increase the likelihood of safe and reliable operation. Replacing one component, for example, should not be undertaken without assessing whether greater value could be realized by replacing a different component. Refined methodologies and tools can improve the life-cycle cost and performance of plant components and support optimized refurbishment and uprate plans.



A 2010 EPRI survey revealed strong support for long-term nuclear plant operations. The survey polled senior executives at companies representing 57 of the 104 nuclear units in the United States. Of the 57 units represented, 35 stated a greater than 75% likelihood of extending operation from 60 to 80 years, and 19 more put the likelihood at 25-75%. Less than 3% of units represented put the likelihood at less than 25%.

Modern technology capabilities are under-used in the nuclear power industry

Nuclear plants set a high bar for safety when introducing advanced technologies. As a result, however, the nuclear industry might not take full advantage of modern technology. Through the successful development and demonstration of diagnostic, prognostic, and other "smart" technologies, existing nuclear plant owners could prevent component failure, optimize performance, improve asset planning, and avoid long repair outages.

Capital investment decisions hinge on technical information

The allocation of capital to plant refurbishment, uprate, or modernization hinges on the expected remaining life of the plant. Such decisions demand detailed knowledge of technical issues and awareness of potential consequences if capital is not available. Nuclear plant owners can establish confidence in the prudence of potentially billion-dollar investments through robust decision-support models based on sound technical data.

Regulatory questions must be addressed

Establishing the technical rationale for long-term operations to satisfy regulatory requirements might introduce additional challenges and prompt new technical questions. Research and development can identify potential issues of regulatory concern, collect data to characterize potential problems posed by the issue, and devise approaches for mitigating or eliminating any degradation that could compromise the plant's safe operation.

Charting a technical path to long-term operations

EPRI's Long-Term Operations Project provides plant owners with information and research findings on which they can base objective assessments regarding long-term operations. Research results will directly inform decisions on whether life extension for a plant is technically sound and whether the benefits and costs of modernization and advanced technology could justify investment for long-term operation.

The Long-Term Operations Project is based on several guiding principles.

Broad stakeholder collaboration

Multiple stakeholders must be engaged to effectively address issues impacting long-term operations. Such engagement ensures alignment on R&D priorities, reduces duplication of effort, and optimizes available research funding. To coordinate research activities, EPRI maintains close communication with its global membership, the U.S. Nuclear Regulatory Commission, the Department of Energy (DOE), the Nuclear Energy Institute, and international entities such as the Materials Aging Institute.

Transparent issue identification and tracking

Research projects conducted through the Long-Term Operations Project are defined using the "Issues Tracking Table," a living document that EPRI developed to monitor the status of all identified issues and their priorities. The technical barriers and opportunities identified and addressed through this tracking target generic nuclear industry issues and reflect input from nuclear plant owners worldwide.

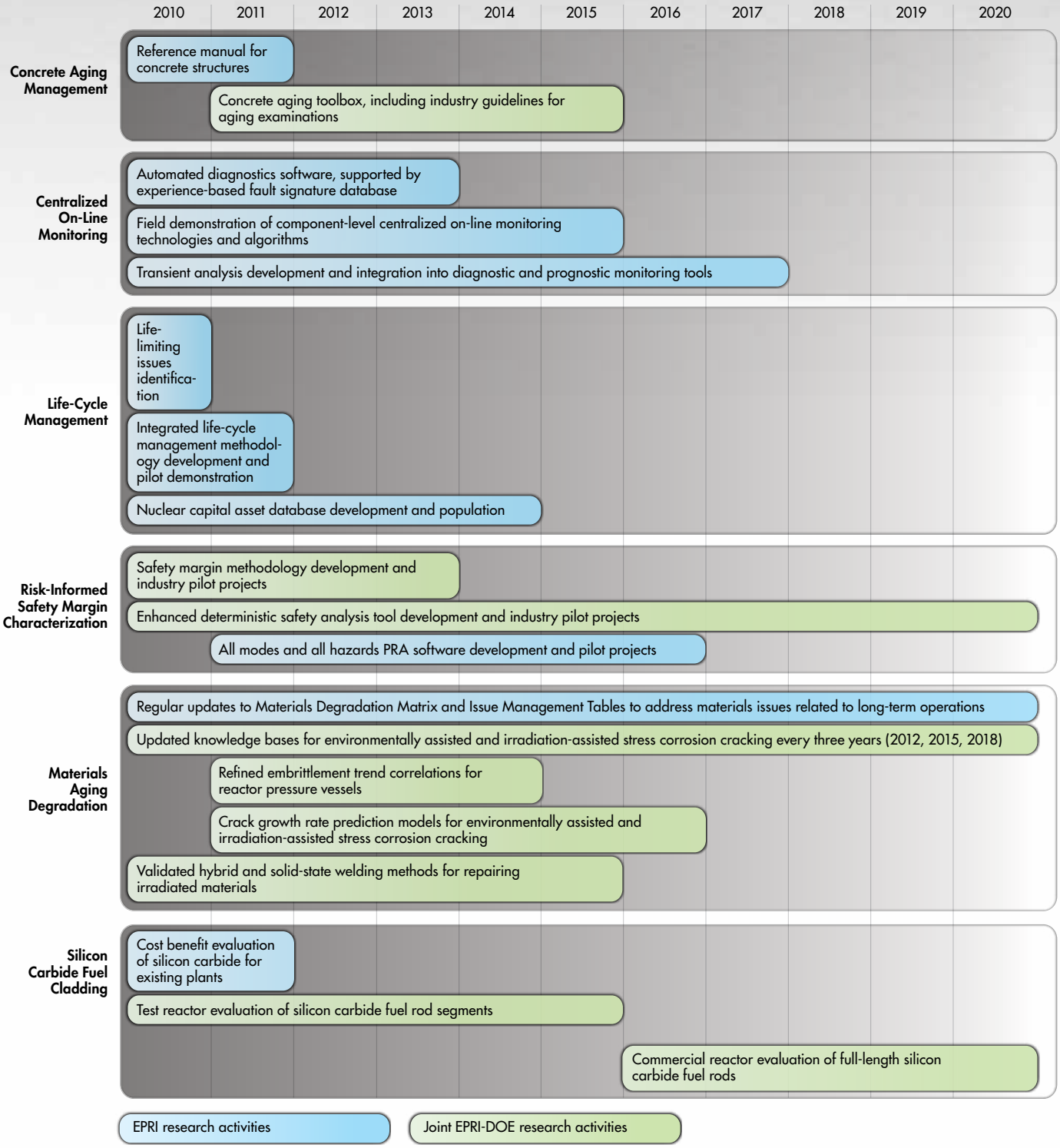
Resource utilization across EPRI's nuclear research programs

A multidisciplinary effort encompassing nuclear plant operations, maintenance, engineering and planning is required to address the issues confronting long-term operations. The Long-Term Operations Project taps into personnel and expertise across EPRI programs such as the Materials Reliability Program and the Instrumentation and Control Program.

Demonstration of key technologies in the field

Plant demonstrations will serve an important role in characterizing issues related to long-term operations and in demonstrating mitigation actions and new technology capabilities. EPRI, DOE, and Constellation Energy Nuclear Group have established a multi-year collaborative effort to investigate aging concerns at the Ginna and Nine Mile Point Unit 1 nuclear plants, which are both more than 40 years old. The initial assessments will include a comprehensive concrete containment examination and an incremental reactor internals inspection for aging issues expected beyond 60 years.

The timeline below defines key milestones in EPRI's Long-Term Operations Project that will support enhanced decision-making related to long-term operations. Additional milestones have been defined within each technical area to advance the knowledge base underpinning long-term operations.



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