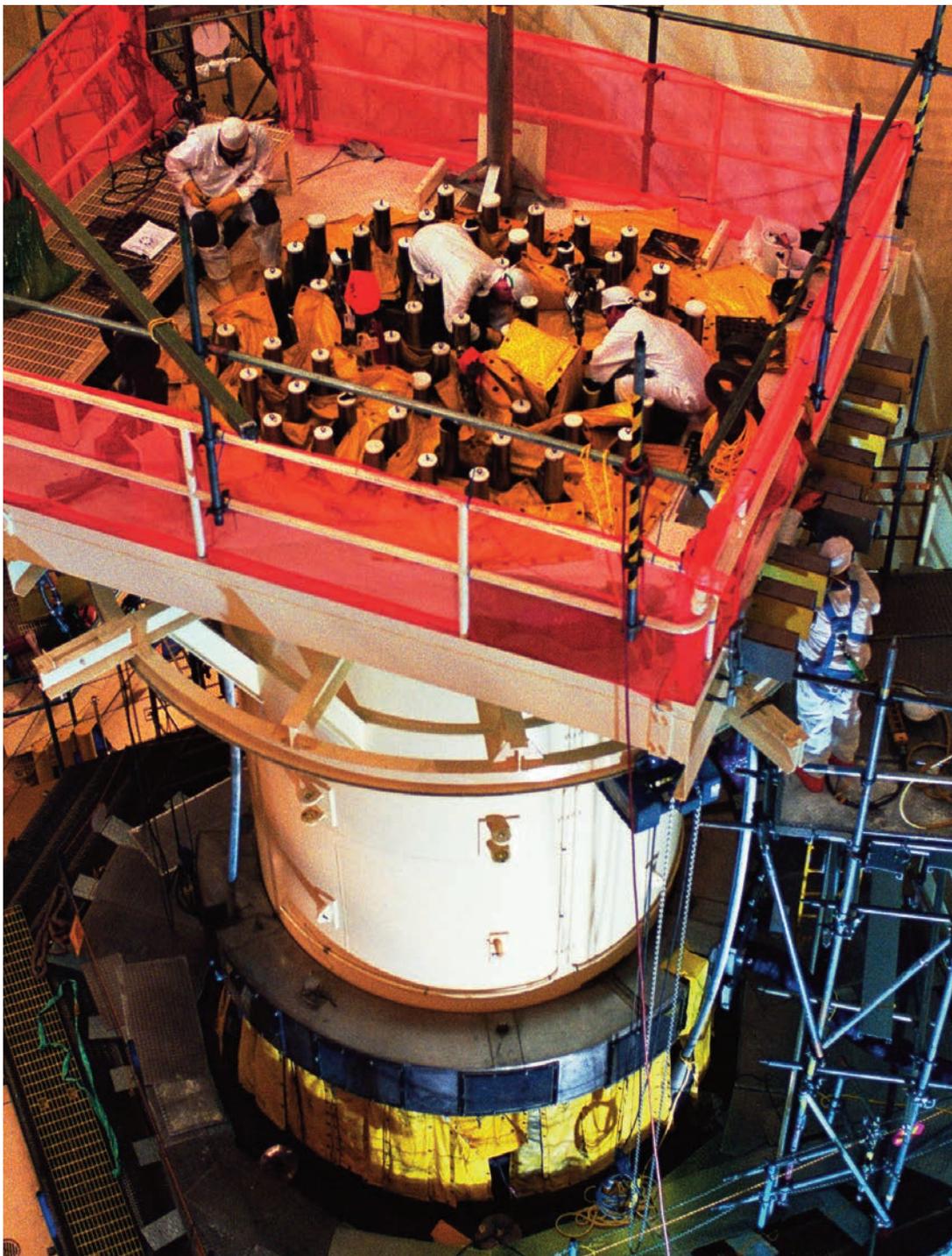


# Second License Renewal Roadmap

May 2015

Prepared by the  
Nuclear Energy Institute



NUCLEAR ENERGY INSTITUTE

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## Executive summary

By 2040, U.S. electricity demand is expected to increase 28 percent while half of the nation's nuclear power plants will have been operating for 60 years. As soon as 2030, the United States could experience electricity shortages if a significant number of nuclear plants are retired in a short period.

The Nuclear Regulatory Commission's (NRC) license renewal rule (10 CFR Part 54) has been used successfully to renew the licenses of the majority of U.S. commercial nuclear power plants for an additional 20 years of operation. More than 75 commercial nuclear reactors have had their licenses renewed, and 38 reactors have been producing electricity for more than 40 years.

One solution for avoiding a substantial retirement of nuclear power plant capacity in the coming decades is the option to renew their operating licenses a second time for an additional 20 years. The NRC calls this subsequent license renewal in most official regulatory documentation. However, second license renewal is a clearer term used in this roadmap and corresponding industry efforts.

Industry personnel constantly monitor nuclear power plant equipment as part of a detailed preventive maintenance program that continually upgrades and invests in plant systems. This program is overseen by on-site independent NRC inspectors at each nuclear power plant who inspect and monitor the facilities each day. If at any time a plant does not meet NRC safety requirements, the regulator has the authority to shut it down.

The Electric Power Research Institute and the U.S. Department of Energy have conducted scientific research to understand the technical issues associated with the long-term, safe operations of nuclear power plants. The industry will use this knowledge and apply these insights to second license renewal efforts. This research has shown that there are no generic technical issues that would prevent a well-maintained nuclear power plant from operating safely during this second license renewal period.

The industry agrees that the NRC's existing license renewal rule, together with updates to two industry documents—the Generic Aging Lessons Learned (GALL) report and the Standard Review Plan on license renewal—provide a sound licensing basis for a second renewal. This roadmap documents the industry's assessment of the milestones that must be reached so that the NRC can review second license renewal applications for the first companies seeking them.

### 1. Need for second license renewal

Nuclear power plants are a vital source of baseload power because they consistently generate electricity 24 hours a day and have the highest efficiency<sup>1</sup> among all domestic energy sources. Nuclear energy is also the single largest source of carbon-free electricity in the United States. In 2013, nuclear power plants produced 63 percent of all carbon-free electricity in the U.S. Hydropower produced 21 percent, and solar, wind and geothermal combined contributed 15 percent.

By 2040, half of the nation's nuclear power plants will have been operating for 60 years. As soon as 2030, the United States could experience electricity shortages if a significant number of baseload power plants, including coal and nuclear plants, are retired in a short period.

Replacing the nearly 100 gigawatts of electrical generating capacity would cost hundreds of billions of dollars and lead to significant increases in greenhouse gas emissions if fossil fuel plants replace nuclear plants. Coupled with reductions in coal-fired generation as a result of increasing environmental regulations, the retirement of nuclear capacity would leave the country heavily dependent on natural gas for baseload electrical generation.

One solution to a significant retirement of nuclear energy capacity is the option to continue operating nuclear power plants by renewing their operating licenses for an additional 20 years, known as second license renewal.

### 2. NRC's proven license renewal process

More than 75 commercial nuclear reactors have had their licenses renewed under the current NRC licensing process. 38 reactors have passed 40 years of operation and continue to operate safely and reliably.

Programs to ensure that plant components and systems continue to perform their function beyond 40 years have been implemented by each utility to identify, monitor and manage the effects of long-term operations.

<sup>1</sup> One hundred nuclear power plants operating in 31 states posted an estimated average capacity factor of 91.9 percent in 2014 date. <http://www.nei.org/News-Media/News/News-Archives/US-Nuclear-Plants-Post-Record-High-Efficiency-in-2>.

*One solution for avoiding a substantial retirement of nuclear power plant capacity in the coming decades is the option to renew their operating licenses a second time for an additional 20 years.*

Under these programs, plant operators continually replace and repair equipment and components, such as pumps and valves, and install updated safety systems. They also continuously monitor and inspect massive multi-ton components like reactor vessel heads and steam generators. These components may also be replaced to enhance performance and reduce maintenance.

Nuclear power plants also are subject to a systematic and thorough NRC oversight program to ensure plant equipment meets exacting safety standards. The NRC renews plant licenses only after a comprehensive review and approval of a complex application that justifies the safe operation of plant systems. In addition, the NRC performs safety inspections and has inspectors at each plant site to monitor the facilities and operations every day.

Continuous NRC oversight is further complemented by industry's commitment to learning and self-assessment programs, conducted by the Institute for Nuclear Power Operations and nuclear power plant owners' groups. These activities, taken together, ensure a reactor will operate safely throughout its licensed period.

### 3. Regulatory basis for second license renewal

The regulatory requirements for plant license renewal are provided in an NRC rule, 10 CFR Part 54<sup>2</sup>. In 2000, the first renewed license was issued under this regulation, and more than 75 nuclear power plants have had their licenses renewed since then. License renewals allow a plant to operate from 40 to 60 years. A second license renewal would allow a plant to operate to 80 years. Provided plant operators continually maintain, replace or repair equipment and components and make necessary upgrades, there is no operational reason that the second license renewal process should be different than the first license renewals.

The NRC's license renewal rule (10 CFR Part 54) provides a robust program of evaluation and assessment for applying for a renewed license and does not specify a particular limit to the number of times that a plant may apply for a renewed license. As long as a licensee first

satisfies NRC safety requirements, the decision to pursue license renewal is an economic one driven by the costs of continued operations, major component replacements, operations and maintenance costs, and local electricity markets.

It is anticipated that the cost and time required for application and review of a second license renewal would be similar to a first license renewal because the regulatory process would be essentially the same. Lessons learned from the first round of license renewals may allow for a more efficient preparation and review process for the industry and the NRC.

Furthermore, regulatory certainty will allow operators to perform more accurate cost estimates and provide a more realistic assessment of the value of long-term operations.

#### 3.1. Aging management programs

Plant operators have implemented aging management programs (AMPs) to evaluate the effects of long-term operations beyond 40 years on plant components. The NRC, with input from DOE, EPRI and industry stakeholders, are in the process of updating the Generic Aging Lessons Learned report<sup>3</sup> for second license renewal to describe acceptable component reliability programs based on extensive plant reviews, research and operating experience. Second license renewal—like first license renewal applications—will emphasize the importance of these programs for providing assurance of continued safe operation.

#### 3.2. Requirements for renewal of nuclear power plants' operating licenses

A license renewal application may be submitted no earlier than 20 years prior to the expiration of a plant's operating license. Only plants that have entered the period of extended operations (i.e., had their license renewed and operated more than 40 years) are allowed to submit a second license renewal application.

The most essential requirement for receiving a renewed license is for an applicant to demonstrate that plant structures, systems and components can be managed so that the current licensing basis can be maintained throughout the renewed license period. Quality assurance is an important aspect of a plant's licensing basis<sup>4</sup> and must be maintained throughout the period of extended operation.

The current licensing basis is the set of NRC requirements applicable to a specific plant and a licensee's written commitments for ensuring compliance with and operating within applicable NRC requirements and the plant-specific design basis. This includes all

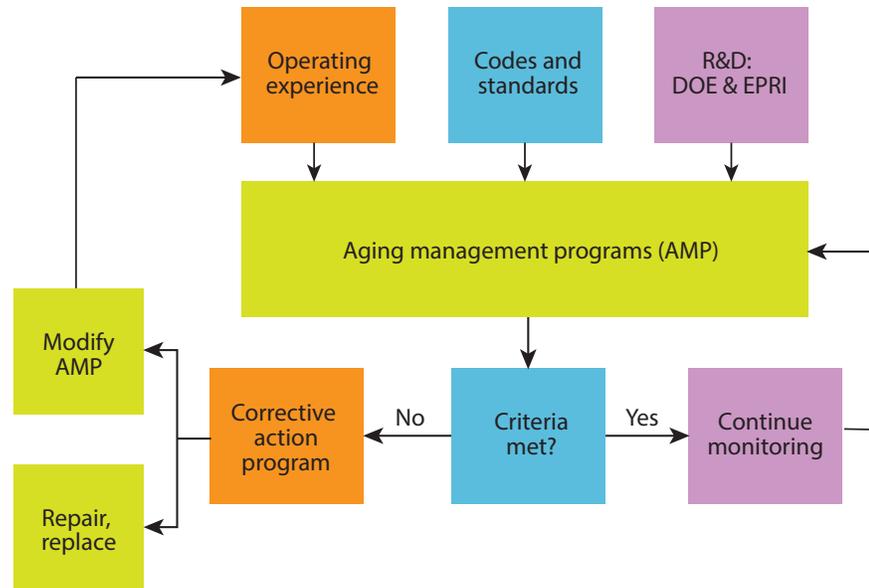
*There is no operational reason that the second license renewal process should be different than the first license renewals.*

<sup>2</sup> "PART 54—REQUIREMENTS FOR RENEWAL OF OPERATING LICENSES FOR NUCLEAR POWER PLANTS," U.S. Nuclear Regulatory Commission, Oct. 22, 2013, <http://www.nrc.gov/reading-rm/doc-collections/cfr/part054/>.

<sup>3</sup> "Generic Aging Lessons Learned (GALL) Report (NUREG-1801)," U.S. Nuclear Regulatory Commission, March 29, 2012, <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1801/>.

<sup>4</sup> "Appendix B to Part 50—Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," U.S. Nuclear Regulatory Commission, July 25, 2013, <http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-appb.html>.

## Continual Improvement of Aging Management Programs



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modifications and additions to such commitments over the license period. The current licensing basis also includes plant-specific design basis information documented in the continuously updated final safety analysis report and licensee's commitments made to the NRC.

Quality assurance is defined as all planned and systematic actions necessary to provide confidence that structures, systems and component will perform as intended in service. These actions include inspecting, testing, operating, maintaining, repairing and modifying safety-related functions of all structures, systems and components.

Structures, systems and components within the scope of the NRC's relicensing rule (10 CFR Part 54) include:

- safety-related structures, systems and components relied upon to remain functional during and following design-basis events
- all non-safety-related structures, systems and components whose failure could prevent functionality of safety-related structures, systems and components
- all structures, systems and components relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the NRC's regulations on fire protection, environmental qualification, pressurized thermal shock, anticipated transients without scram and station blackout.

The plant licensee must identify structures, systems and

components that perform any of the functions defined above for monitoring to ensure they will perform reliably. The applicant must also include all of the following technical information in a license renewal application:

- an integrated plant assessment (IPA)
- any current license basis changes during NRC review of the application
- an evaluation of time-limited aging analyses (TLAAs)
- a final safety analysis report (FSAR) supplement.

The integrated plant assessment requires that a licensee:

- identify and list those structures, systems and components subject to aging management programs
- demonstrate that the effects of the period of extended operations will be adequately managed so that the intended function(s) will be maintained consistent with NRC requirements.

A TLAA is an analysis that is incorporated in the current licensing basis and must consider the effects of aging on structures, systems and components within the scope of a second license renewal application. A TLAA involves:

- time-limited assumptions defined by the current operating period
- conclusions related to the capability of a structures, systems and component to perform intended functions.

To get approval for a second license renewal, the applicant must:

- demonstrate that the TLAA's are valid for the period of extended operation

- project the TLAAs out to the end of extended operation
- show that the effects of aging will be adequately managed.

The FSAR must:

- describe the facility
- present the design basis and its limits
- include a safety analysis of the structures, systems and components and of the facility as a whole.

The FSAR must contain a summary description of the programs and activities for managing the effects of aging and a summary description of the evaluation of time-limited aging analyses.

#### 4. Second license renewal plan

As a starting point for this roadmap, an assessment was performed to identify the steps needed to successfully proceed to long-term nuclear plant operation. This assessment was broad in scope and covered all relevant areas, including research and development, operations, industry support, and the license renewal programs and processes already in place. The purpose of this roadmap is to document the results of these assessments and provide a plan that ultimately will result in the approval of the lead second license renewals by the NRC.

Following is a summary of these areas with a description of the activities required to complete each task.

#### 4.1 Assess regulatory changes needed for second license renewal

The NRC's license renewal rule (10 CFR Part 54) has been a successful regulatory process for license renewal. It is important to note that the NRC's license renewal rule provides requirements for submitting and obtaining a license for continued operation and adds to—but does not replace—the current licensing basis, the FSAR and other licensing documents. In addition, the NRC's Generic Actions Lessons Learned report provides guidance for ensuring the safe operation of plant structures, systems and components.

Plants that have entered operation beyond 40 years have not noted any anomalies or conditions that would call into question the robustness of the NRC's license renewal rule. Three NRC subsequent<sup>5</sup> license renewal audits have not noted any significant issues that would question the validity of the NRC's license renewal rule.<sup>6</sup> Furthermore, the NRC's license renewal rule itself does not limit its use to the first 20-year renewal, but allows the process to be used to evaluate any request for renewing a valid operating license.

<sup>5</sup>“Subsequent license renewal” is the NRC term for second license renewal.

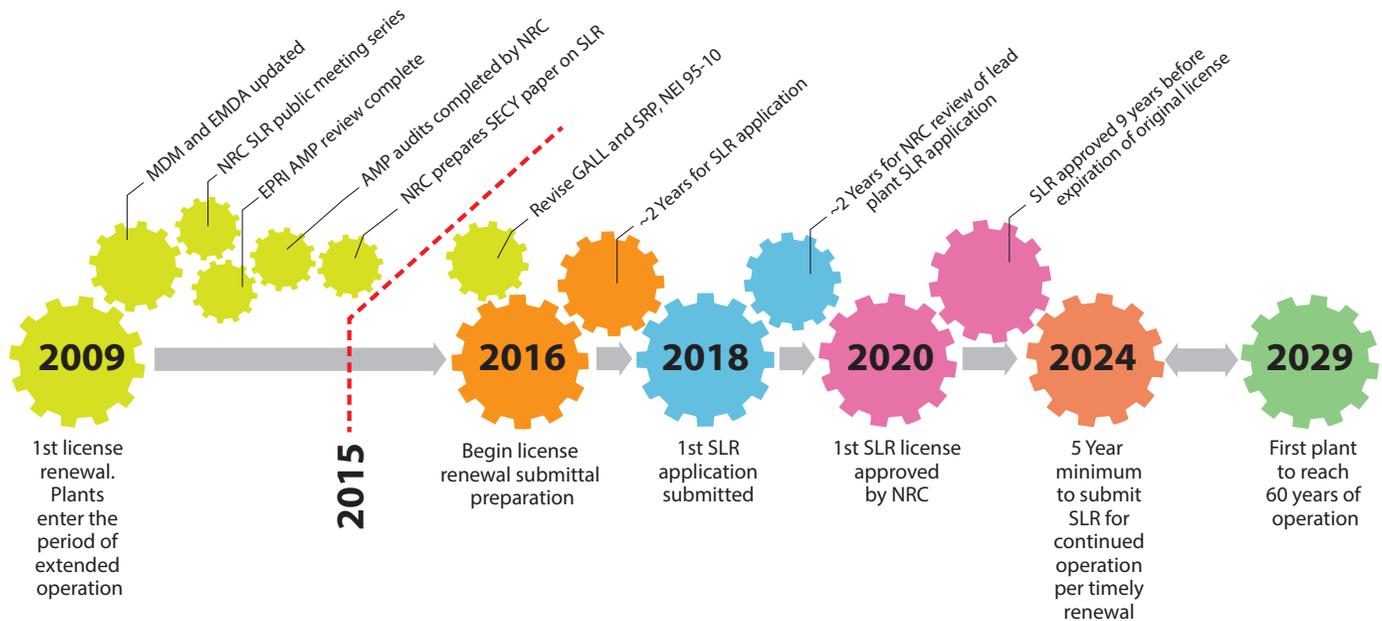
<sup>6</sup>“Technical Letter Report: A Summary Report of Aging Management Program Pilot Audits at Ginna and NMP-1 to Gather Information for Subsequent License Renewal,” U.S. Nuclear Regulatory Commission, September 2012, <http://pbadupws.nrc.gov/docs/ML1227/ML1227A090.pdf>.

*Key aspects of the current license renewal process are comprehensive upgrades, continual maintenance and implementation of aging management programs.*

*A nuclear technician training on the proper installation of steam generator water lancing equipment used for cleaning.*



## Second License Renewal Timeline



A series of NRC-sponsored public meetings to discuss the question of second license renewal raised no major issues that would call into question the validity of using the current license renewal rule for second license renewal.

In August 2014, the NRC determined that a new rulemaking was not required and confirmed that the existing license renewal rule provided a robust framework for second license renewal beyond the initial 20-year renewal term. In addition, as described in Section 6 of this report, no changes are needed to environmental regulations to allow for future license renewal activities.

To facilitate second license renewal, the NRC staff is proceeding with revisions to the Generic Actions Lessons Learned report and the license renewal Standard Review Plan to incorporate Interim Staff Guidance Documents (DLR-ISG) and operational experience gained since the last revision of the GALL report.

Second license renewal roadmap items:<sup>7</sup>

- hold public meetings to obtain stakeholder input for second license renewal – item 3
- perform aging management program effectiveness audits – item 4
- issue results of international periodic safety review licensing study – item 7
- provide industry input to the Standard

Review Plan and GALL report revision process – item 11

- revise the Standard Review Plan and GALL report – item 12
- complete continued storage rulemaking – item 13.

### 4.2 Assess the state of materials knowledge to support aging management programs

Key aspects of the current license renewal process are comprehensive upgrades, continual maintenance and implementation of aging management programs.

These require inspections, monitoring, testing, evaluations and related actions to assure that structures, systems and components that may be subject to degradation in harsh environments over time are able to fully perform their intended functions. Effective programs require a technical understanding of aging effects, inspection and assessment techniques, mitigation measures, and guidance on repairs or replacements.

The industry and federal government's national laboratories conduct continuous scientific research to enable the safe long-term operations of nuclear power plants. The industry has developed a comprehensive program to manage and coordinate materials research. This program, known as "Guideline for the Management of Materials Issues" (NEI 03-08), has been adopted by all U.S. nuclear power plant operators.

Individual research programs that are coordinated by Electric Power Research Institute (EPRI) under the program include:

- EPRI Boiling Water Reactor (BWR) Vessel and Internals Program

<sup>7</sup> Refer to Appendices A, B and C of this plan for additional discussion on the "Subsequent License Renewal Roadmap Items" listed here and in other paragraphs of Section 4.



*Nuclear workers and supervisors conducting a pre-job brief to ensure the safe and accurate completion of the task.*

- EPRI Pressurized Water Reactor (PWR) Materials Reliability Program
- EPRI Steam Generator Management Program
- EPRI Primary System Corrosion Research
- EPRI Nondestructive Examination
- EPRI Water Chemistry Control Program
- the industry’s Pressurized Water Reactor Owners Group program’s materials management activities (PWROG Materials Subcommittee).

EPRI maintains an index of all relevant nuclear plant metal materials used in steam supply system components. The matrix is updated periodically to reflect current information and was updated in 2010 to include materials effects related to plant operation from 60 to 80 years.

The EPRI index was used as a source document for the development of the NRC’s Expanded Materials Degradation Assessment (EMDA) and EPRI’s Issue Management Tables (IMT). These tables relate plant components, materials, degradation mechanisms and potential consequences of failure. They are grouped into two documents, one for pressurized water reactors and one for boiling water reactors.

These documents help prioritize the most important areas of study for long-term plant operation.

Second license renewal roadmap items:

- develop a pressurized water reactor long-term operations reactor vessel surveillance program – item 14
- extend the Integrated Surveillance Program from 60 to 80 years – item 15.

**4.2.1 Issue Tracking Table**

Another important tool that EPRI uses to organize and prioritize long-term operations research and development projects is the Issue Tracking Table (ITT). Separate EPRI and DOE task forces examining reactor operations over 60 years created the Issue Tracking Table to identify materials knowledge gaps for 60 to 80 years of plant operations.

This document is reviewed annually by an expert panel to ensure that needed R&D projects are being properly prioritized. R&D projects are prioritized in three categories in the Issue Tracking Table. Category A is of most interest for second license renewal.

The categories are defined as:

- category A – industry-developed program or R&D needed for a second license renewal application
- category B – projects that support the technical basis for aging management programs but are not needed for second license renewal
- category C – projects that prevent obsolescence and

support that economic improvement during long-term operations.

The three items in Category A are:

- reactor vessel surveillance programs for PWRs
- reactor vessel surveillance programs for BWRs
- updating EPRI's Materials Degradation Matrix for operation to 80 years.

#### 4.2.2 Aging management program review project

EPRI recently conducted an assessment of aging management programs to discern whether any research and development gaps existed for structures, systems and components operating past 60 years. The activity included a review of EPRI research and development efforts on components and systems used during a plant's license renewal period. The purpose of the review was to confirm that research and development programs are well-matched to industry needs and to identify potential gaps in research and development projects.

The types of aging factors considered include the impacts of time and additional exposure to heat, pressure, radiation and neutron fluence. EPRI is planning new R&D projects to further inform the technical basis of the aging management programs. Details on the R&D programs are covered in EPRI's final report.<sup>8</sup>

Second license renewal roadmap items:

- revise EPRI's Materials Degradation Matrix for the 60- to 80-year operation time frame – item 1
- complete assessment of research and development projects supporting materials safety assurance for long-term operations – item 2
- revise Expanded Materials Degradation Assessment to incorporate latest materials information for long-term operations – item 6
- update long-term operations Issue Tracking Table to identify critical research gaps for second license renewal – item 8.

#### 4.3 Assess the programs and processes used to identify, manage and mitigate the effects of materials aging

The industry has worked with the NRC and EPRI to develop guidance for implementing the requirements of the first round of license renewal.

Various documents were developed or have been updated to improve the process of preparing a license renewal application as a result. These documents include the GALL report, which is a compilation of generic programs that the NRC has found to be effective in aging management

for structures, systems and components at nuclear power plants. The GALL report has been updated twice to incorporate operating experience, lessons learned and plant reviews and forms the basis for most plant-specific AMPs. NRC plans to revise the GALL report for second license renewal based on additional operating experience, lessons learned and input from the industry.

Other documents developed include NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54 – The License Renewal Rule." This document provides detailed instructions on how to prepare a license renewal application and technical guidance on the scope, content and structure of necessary aging management programs. Rev. 6 of this document was endorsed by the NRC by Regulatory Guide 1.188. NEI 95-10 will be revised to incorporate new information, lessons learned and revised guidance emerging from the Standard Review Plan and the GALL report. It is also expected that the NRC would review and endorse such a revision of NEI 95-10 as an aid to companies that are expected to seek second license renewal for their reactors.

EPRI developed a series of technical tools to provide information and guidance to plant staff preparing AMPs.

These tools provide guidance for performing aging management reviews to support long-term operations. The need to update these tools will be evaluated based on lessons learned and operating experience.

The industry has also evaluated the process used to obtain and use industry operating experience related to structures, systems and components in the scope of license renewal and determined that improvements in the process could be made. Specifically, structures, systems and component aging information that does not rise to the level of a significant event typically is not captured by the INPO Consolidated Event System (ICES) program. NEI led the development of a guideline document (NEI 14-13) and will work with INPO to implement changes in the ICES program that will allow more efficient operating experience data collection and sharing. This program will increase the availability of operating experience information on aging management.

*NEI 95-10 provides detailed instructions on how to prepare a license renewal application and technical guidance on the scope, content and structure of necessary aging management programs.*

<sup>8</sup>"Long-Term Operations Program: Assessment of Research and Development Supporting Aging Management Programs for Long-Term Operation," Electric Power Research Institute, Aug. 29, 2013, <http://www.epri.com/search/Pages/results.aspx?k=3002000576>.

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of those surveyed in a nationwide poll agreed that electric utilities should renew the license for nuclear power plants that continue to meet federal safety standards.<sup>10</sup>

NEI also developed a guideline (NEI 14-12) for performing aging management program self-assessments. This guideline will help ensure consistency and provide overall principles for periodically assessing aging management programs' effectiveness. It has been approved for implementation by plants operating beyond 40 years.

Second license renewal roadmap items:

- revise the INPO operating experience process to support aging management data and document this as an NEI guideline – item 9
- develop a standardized AMP effectiveness self-assessment NEI guideline – item 10
- revise NEI 95-10 – item 16
- evaluate the need to update EPRI aging management tools for second license renewal – item 17.

### 4.4 Develop nuclear industry organizations and structures to support second license renewal

The industry, through NEI, has an active second license renewal task force. This group meets quarterly to manage license renewal issues and guide progress in preparing for second license renewal applications. In addition, the task force meets with the NRC division of license renewal staff on a quarterly basis in a public meeting to share information on license renewal and second license renewal issues. Four sub-groups support the task force on these issues: implementation, civil/structural issues, electrical and mechanical.

Second license renewal roadmap item:

- form an executive second license renewal working group at NEI – item 5.

### 4.5 Provide support for the development and approval of the lead second license renewal application(s)

The goal of the second license renewal roadmap is to support the second license renewal(s) issued to a lead plant(s) for an additional 20 years of operation. Having one or more plants serve as lead plants will provide the opportunity to apply improvements made to the relevant guidance documents and to work out any issues in the application, review and approval process.

Second license renewal roadmap items:

- identify second license renewal lead plant(s) – item 18
- assist in preparing lead plant(s) second license renewal application – item 19
- review and provide NRC acceptance of lead plant(s) second license renewal application package – item 20
- obtain approval of second license renewal application for lead plant(s) – item 21.

## 5. Advanced materials research

The nuclear energy industry has long used research and development programs to support safe and efficient plant operation. While research and development continues on a variety of issues, there are two main organizations conducting research to support second license renewal:

- EPRI's Long-Term Operations (LTO) program
- DOE's Light Water Reactor Sustainability (LWRS) program.

### 5.1 EPRI's Long-Term Operations program

EPRI's Long-Term Operations program was started in 2010 to support developing the technical basis for safe, reliable and economic reactor operations beyond 60 years<sup>9</sup>. The EPRI program is an international program that addresses:

- the technical basis for extended operation of systems, structures and components that could limit plant operations (i.e., reactor pressure vessel and large structures)
- advances and opportunities for modernization of instrumentation and control systems
- enhanced safety and risk analysis methods
- enabling technologies, such as integrated life-cycle management and plant demonstration projects.

EPRI R&D publications provide a technical basis and acceptable approaches for aging management programs during the license renewal period as noted in the GALL report.

### 5.2 DOE's Light Water Reactor Sustainability program

Through DOE's Light Water Reactor Sustainability program, DOE interacts with industry and the NRC to support and conduct the long-term research needed to inform major component refurbishment and replacement strategies, performance enhancements, plant license renewal, and age-related regulatory oversight decisions.

The program has the following goals:

- developing the fundamental scientific basis for understanding, predicting and measuring changes in materials and structures, systems and components as they age in environments associated with continued long-term operations of existing plants
- applying this fundamental knowledge to develop and demonstrate methods and technologies that support safe and economical long-term operations of existing plants

<sup>9</sup>"Long-Term Operations," Electric Power Research Institute, <http://portfolio.epri.com/Research.aspx?sid=NUC&rid=244>.

<sup>10</sup>Bisconti Research Inc with Quest Global Research. Survey of 1,000 U.S. adults, Feb. 18-March 1, 2015. Margin of error ± 3 percent.



*Crew inspecting reactor vessel internal components, part of an extensive maintenance program.*

- researching new technologies to address enhanced plant performance, economics and safety.

DOE's role focuses on the fundamental science affecting aging phenomena and issues that require long-term research and are generic to reactor type. Additional information on the program can be found on the DOE or Idaho National Laboratory websites.<sup>11</sup>

### 5.3 EPRI and DOE collaboration

A memorandum of understanding was signed in 2010 between EPRI and DOE to ensure proper coordination between the two programs and to establish guiding principles under which research activities could be coordinated to the benefit of both parties.

The memorandum calls for a coordinated plan to be updated annually. The plan integrates the EPRI and DOE programs and shows project scope, schedule, budgets and key interrelationships between the two, including possible cost-sharing. The most recent joint research and development plan was released in 2014 and is available on the DOE's Light Water Reactor Sustainability program website.<sup>12</sup>

## 6. Environmental protection

For the first round of license renewal, each applicant prepared environmental reports analyzing the environmental impacts of extended operation requiring plant specific review. The reports also identified any new and significant information that might affect NRC conclusions on those impacts previously assessed in the NRC's generic environmental impact statement (GEIS).

Using this information, the NRC prepared plant-specific supplements to the GEIS for each license renewal application analyzing the environmental impacts of license renewal in accordance with National Environmental Policy Act (NEPA) and the requirements of 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." The purpose of the proposed license renewal action under NEPA is to provide an option to continue plant operations beyond the current licensing term.

### 6.1 Generic environmental impact statement

The generic environmental impact statement examines the environmental consequences of renewing the licenses of nuclear power plants and operating the plants for an additional 20 years beyond the current license term.

The environmental inquiry is therefore the same regardless of whether the application is for a first or second license renewal. For each type of environmental impact, the GEIS attempts to establish generic findings covering as many plants as possible as opposed to site-specific findings.

<sup>11</sup> "LIGHT WATER REACTOR SUSTAINABILITY (LWRS) PROGRAM," U.S. Department of Energy, <http://energy.gov/ne/nuclear-reactor-technologies/light-water-reactor-sustainability-lwrs-program>. "LIGHT WATER REACTOR SUSTAINABILITY PROGRAM: INTRODUCTION," Idaho National Laboratory, [https://inlportal.inl.gov/portal/server.pt/community/lwr\\_sustainability\\_program/442/introduction](https://inlportal.inl.gov/portal/server.pt/community/lwr_sustainability_program/442/introduction).

<sup>12</sup> "LWRS PROGRAM AND EPRI LONG-TERM OPERATIONS PROGRAM - JOINT R&D PLAN," U.S. Department of Energy, April 2013, <http://energy.gov/ne/downloads/lwrs-program-and-epri-long-term-operations-program-joint-rd-plan>.

*The license renewal process provides stakeholders with a well-defined process for evaluating the potential impacts of continued operation of a nuclear energy facility.*

## **6.2 Plant-specific supplemental environmental impact statements**

In individual proceedings, a scoping process is conducted to define the proposed action, to determine the scope of the generic environmental impact statement and to identify the significant issues to be analyzed in-depth. A draft plant-specific supplement to the GEIS is released for comment and the NRC holds a public meeting to discuss the findings. Importantly, this plant-specific supplement identifies and evaluates any new and significant environmental information not considered by the GEIS. After comments are addressed, the NRC staff publishes a final plant-specific supplement to the GEIS and provides a final recommendation regarding the license renewal application to the NRC commissioners.

The process provides regulatory stability that is necessary, yet it is by no means a stagnant process. It is a dynamic process that expands to address emergent situations and to incorporate lessons learned. Every 10 years, the NRC reviews and, if necessary, updates the license renewal NEPA regulations, GEIS and regulatory guidance. New information, operating experience and industry events are incorporated to help ensure the most meaningful review of potential environmental impacts during extended operation. This periodic review helps to identify any changes needed to accommodate second license renewal.

The license renewal process has proven to be thorough, well-reasoned and effective in ensuring that the potential environmental impacts of continued operation are evaluated in a consistent and transparent way. Nuclear plant owners and other stakeholders need regulatory requirements to be clearly laid out and the expectations for meeting those regulations to be unambiguous.

Based on the success of the first round of license renewal and the lack of significant issues in the environmental area, the environmental review process for second license renewal should be consistent with the current license renewal process.

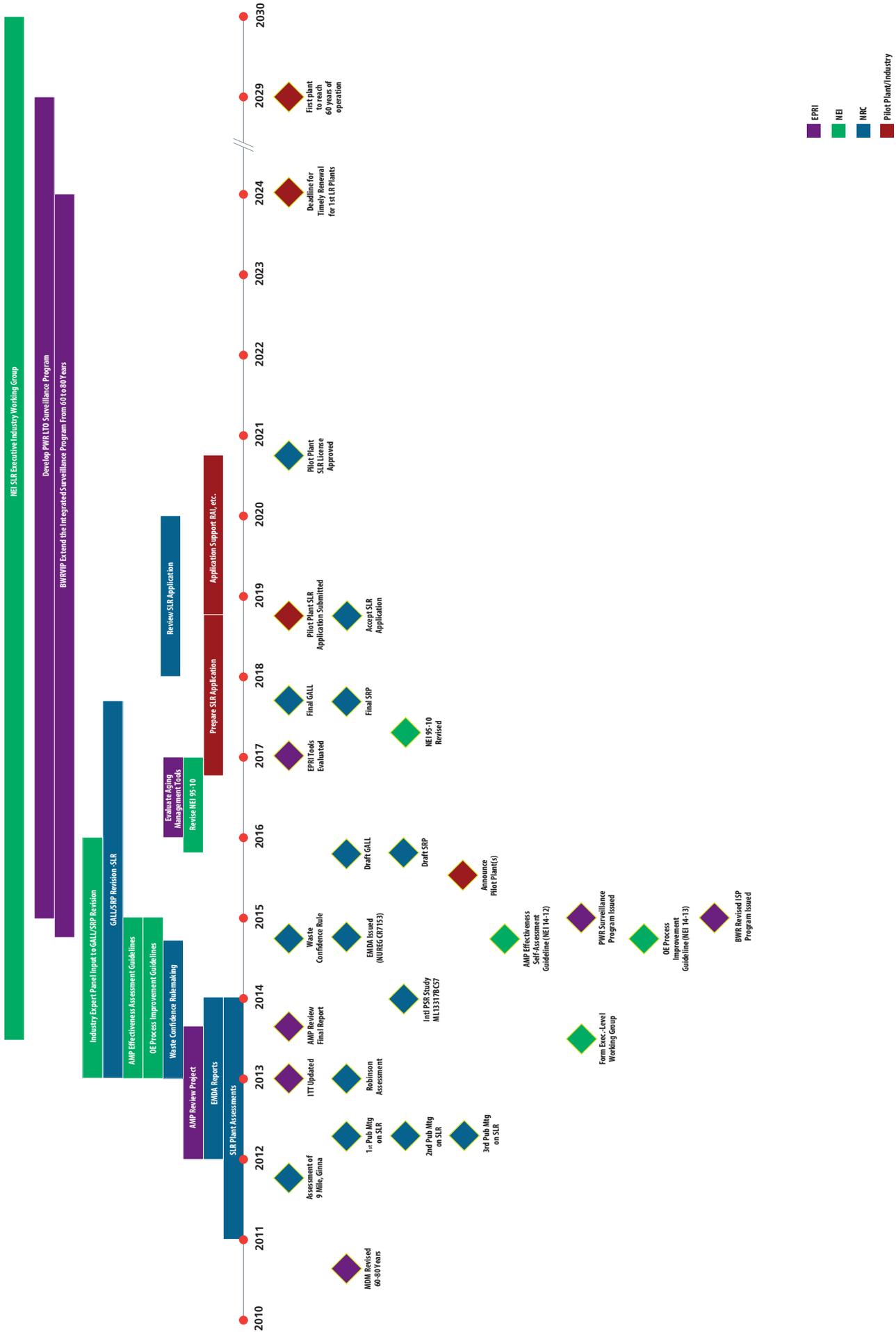
## **7. Conclusion**

The NRC's license renewal rule, used to extend plant operations 20 years, together with an update to the Generic Aging Lessons Learned report and the Standard Review Plan, provide a sound, proven basis for second license renewal.

The license renewal process provides stakeholders with a well-defined process for evaluating the potential impacts of continued operation of a nuclear energy facility. Continued application of this process through the second license renewal period can help ensure safety and provide regulatory stability for all stakeholders.

Continuous upgrading and replacement of nuclear power plant components, parts and systems, rigorous oversight by the NRC, and learnings gleaned from research and development and operating experience will augment the industry's commitment to operate nuclear power plants safely through a second license renewal period.

# Appendix A: Second license renewal roadmap



Supporting Programs/DOE Light Water Reactor Sustainability Program

NEI 03-08 "Guideline for the Management of Materials Issues"/EPRI MRP, BWR/WVP, SGMP, NDE, Primary Systems Corrosion Research, Water Chemistry Control/PWR/BOG Materials Subcommittee

## Appendix B: Second license renewal roadmap items index

	<b>Item</b>	<b>Responsible</b>	<b>Status</b>
1	Revise Materials Degradation Matrix for 60-80 years	EPRI	Complete
2	Complete assessment of research and development projects supporting materials safety assurance for long-term operations	EPRI	Complete
3	Hold public meetings to obtain input for second license renewal	NRC	Complete
4	Perform aging management program effectiveness audits to inform second license renewal	NRC	Complete
5	Form an executive second license renewal working group at NEI	NEI	Complete
6	Revise Expanded Materials Degradation Assessment to incorporate latest assessment of materials information for long-term operations	NRC	Complete
7	Issue results of international periodic safety review licensing study	NRC	Complete
8	Update long-term operations issue tracking table to identify critical research gaps for second license renewal	EPRI/Industry	Complete
9	Revise the INPO operating experience process to support aging management data and document as an NEI guideline	NEI/INPO/Industry	In Progress
10	Develop a standardized AMP effectiveness self-assessment NEI guideline	NEI/Industry	Complete
11	Provide industry input to the standard review plan and Generic Actions Lessons Learned report revision process	NEI/Industry	In Progress
12	Revise the standard review plan and Generic Actions Lessons Learned report for second license renewal	NRC	In Progress
13	Complete continued storage rulemaking	NRC	Complete
14	Develop a pressurized water reactor long-term operations reactor vessel surveillance capsule program	EPRI – MRP	In Progress
15	Extend the integrated surveillance program from 60 to 80 years	EPR – BWRVIP	In Progress
16	Revise NEI 95-10	NEI/Industry	Not Started
17	Evaluate the need to update EPRI aging management tools for second license renewal	EPRI/Industry	Not Started
18	Identify second license renewal lead plant(s)	NEI/Industry	In Progress
19	Assist in preparing lead plant(s) second license renewal application	Lead Plant(s)	Not Started
20	Review and provide NRC acceptance of lead plant(s) second license renewal application package	NRC	Not Started
21	Obtain approval of second license renewal applications for lead plant(s)	NRC	Not Started

## Appendix C: Second license renewal roadmap items

**Second license renewal item 1:** Revise Materials Degradation Matrix for 60-80 years.

**Responsible organization:** EPRI

**Current status:** Complete

**Task start:** 2010

**Task end:** April 2014

**Description:** The Materials Degradation Matrix documents, a comprehensive review of degradation mechanisms applicable to pressurized water reactors, boiling water reactors and CANDU plants, assesses the extent to which these degradation mechanisms are understood and evaluates the state of industry knowledge worldwide. The Materials Degradation Matrix is a living document that is reviewed and updated approximately every two to three years via an expert solicitation process. Revision 4 was issued in April 2014.

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**Second license renewal item 2:** Complete assessment of research and development projects supporting materials safety assurance for long-term operations.

**Responsible organization:** EPRI

**Current status:** Complete

**Task start:** 2012

**Task end:** Third quarter 2013

**Description:** Achieving safe and reliable operation for long-term operations will require a comprehensive technical understanding of the effects of aging on nuclear plant structures, systems and components. EPRI research projects have long been focused on aging degradation modes, root causes, mitigation options and repair options. This report presents the results from an assessment of research and development projects related to aging management needs for a period of extended operation longer than 60 years.

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**Second license renewal item 3:** Hold public meetings to obtain input on second license renewal.

**Responsible organization:** NRC

**Current status:** Complete

**Task start:** 2012

**Task end:** 2013

**Description:** The NRC held a series of public meetings to collect input related to second license renewal. The first meeting was held on May 9, 2012, and focused on the overall idea of second license renewal and any associated general concerns. On Nov. 13, 2012, the NRC held a subsequent meeting on second license renewal concerning specific licensing topics discussed in the statements of considerations for 10 CFR Part 54. The following day, Nov. 14, a webinar was held primarily concerning environmental issues related to second license renewal.

**Second license renewal item 4:** Perform AMP effectiveness audits to inform second license renewal.

**Responsible organization:** NRC

**Current status:** Complete

**Task start:** 2011

**Task end:** 2014

**Description:** To ensure its readiness to review possible second license renewal applications for nuclear power plants to operate beyond 60 years, the NRC is developing guidance documents for the technical review of applications for second license renewal. The guidance documents used for the review of license renewal applications for operation up to 60 years are the “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants” (NUREG-1800) and the GALL report (NUREG-1801). An important part of this guidance document development activity is the identification of the aging effects for structures, systems and components within the scope of the license renewal rule that would be important to consider for plant operation beyond 60 years, along with development of AMPs that will be effective in managing the identified aging effects.

As part of its efforts to develop guidance, the NRC has performed “AMP Effectiveness Audits” to provide an understanding of how AMPs have been implemented by nuclear power plants during the period of extended operation and the degradation that may have been identified by the AMPs. The results from these audits will provide key information to aid the NRC in identifying needed changes to AMPs and identifying new AMPs that may be needed to provide assurance of safe plant operation during a second license renewal operating period.

The NRC staff, with assistance from Argonne National Laboratory, conducted on-site AMP audits for Ginna during August and September 2011 and Nine Mile Point Unit 1 in November 2011. The audit at H.B. Robinson was conducted in January 2013. The audit reports for Ginna, Nine Mile Point and Robinson are available online.<sup>13 14</sup>

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**Second license renewal item 5:** Form an executive second license renewal NEI working group.

**Responsible organization:** NEI

**Current status:** Complete

**Task start:** 2013

**Task end:** 2013

**Description:** NEI has formed an executive-level second license renewal working group consisting of senior industry leaders involved and planning for second license renewal. This working group will interface with senior NRC leadership and NRC commissioners to resolve issues as the nuclear industry prepares to enter the next phase of license renewal. The second license renewal working group will provide direction and work in conjunction with the second license renewal task force and issue working groups.

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<sup>13</sup> “Technical Letter Report: A Summary Report of Aging Management Program Pilot Audits at Ginna and NMP-1 to Gather Information for Subsequent License Renewal,” U.S. Nuclear Regulatory Commission, September 2012, <http://pbadupws.nrc.gov/docs/ML1227/ML12277A090.pdf>.

<sup>14</sup> H.B. Robinson Steam Electric Plant, unit 2, Aging Management Program effectiveness audit, (TAC No. ME6075). Aug. 5, 2014. ADAMS Accession Number: ML14017A289.

**Second license renewal item 6:** Revise Expanded Materials Degradation Analysis (EMDA) to incorporate latest materials information.

**Responsible organization:** NRC

**Current status:** Complete

**Task start:** 2012

**Task end:** 2014

**Description:** The EMDA report consists of separate documents describing how key structures, systems and components perform during long-term operations. This includes documents covering core internals and primary and secondary piping, reactor pressure vessel, concrete civil structures, and electrical power and instrumentation and control cabling and insulation. The EMDA report was published in five volumes in October 2014.

The NRC will use the EMDA report to inform the regulatory framework.

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**Second license renewal item 7:** Issue results of international periodic safety review licensing study.

**Responsible organization:** NRC

**Current status:** Complete

**Task start:** 2013

**Task end:** December 2013

**Description:** The NRC obtained copies of Periodic Safety Reviews from European utilities to assess the effectiveness of the Periodic Safety Review process as compared to the NRC's 10 CFR Part 50 and 10 CFR Part 54 licensing processes. The NRC has completed a final report on this topic.<sup>15</sup>

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**Second license renewal item 8:** Update long-term operations Issue Tracking Table to identify critical research activities and programs for second license renewal.

**Responsible organization:** EPRI/Industry

**Current status:** Complete

**Task start:** 2012

**Task end:** 2013

**Description:** The EPRI Issue Tracking Table is a summation of the research activities and programs that are relevant to long-term operations.

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<sup>15</sup>“Technical Letter Report: Evaluation and Analysis of A Few International Periodic Safety Review Summary Reports,” U.S. Nuclear Regulatory Commission, December 2013. ANL-13/18.

**Second license renewal item 9:** Revise the INPO operating experience process to support aging management data and document as an NEI guideline.

**Responsible organization:** NEI/INPO/Industry

**Current status:** In progress

**Task start:** 2013

**Task end:** 2016

**Description:** Develop an industry approach with INPO for more effectively reviewing and sharing age-related degradation operating experience that promotes the effectiveness of AMPs. NEI 14-13, "Use of Industry Operating Experience for Age-Related Degradation and Aging Management Programs," has been developed and is in the process of being implemented.

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**Second license renewal item 10:** Develop a standardized AMP effectiveness self-assessment NEI guideline.

**Responsible organization:** NEI/INPO/Industry

**Current status:** Complete

**Task start:** 2013

**Task end:** 2014

**Description:** Develop an industry guideline for standardization of the self-assessment process for periodically evaluating the effectiveness of AMPs (as described in the FSAR) to provide useful documentation needed for second license renewal applications. NEI 14-12, "Aging Management Program Effectiveness," on this topic is available.

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**Second license renewal item 11:** Provide industry input to the Standard Review Plan and GALL report revision process.

**Responsible organization:** NEI/Industry

**Current status:** In progress

**Task start:** 2013

**Task end:** 2017

**Description:** NEI formed a GALL update expert panel consisting of the chairs of the electrical, civil/structural, mechanical and implementation working groups along with other senior industry experts associated with second license renewal. This expert panel will meet with the NRC to provide input on the process used to update the GALL as well as provide technical comments on the content and format.

**Second license renewal item 12:** Revise the Standard Review Plan and GALL report for second license renewal.

**Responsible organization:** NRC

**Current status:** In progress

**Task start:** 2013

**Task end:** 2017

**Description:** The NRC is revising the GALL report and the Standard Review Plan with input from the industry and the public. GALL Rev. 2 will remain in place to be used in conjunction with the interim staff guidance (ISG) for licensees that have yet to seek a first license renewal. The second license renewal GALL report will incorporate all ISG and other insights gained from the International GALL (IGALL) and other sources.

The NRC is scheduled to issue a draft SRP and GALL report in December 2015 and to issue a final SRP and GALL report in 2017.

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**Second license renewal item 13:** Complete continued storage rulemaking.

**Responsible organization:** NRC

**Current status:** Complete

**Task start:** 2013

**Task end:** 2014

**Description:** In August 2014, the U.S. Nuclear Regulatory Commission affirmed a final rule addressing the continued storage (formerly known as waste confidence) of used nuclear fuel between the end of reactors' licensed terms and its ultimate removal for disposal.

The NRC's affirmation supports the position that used nuclear fuel from commercial reactors can be safely managed in specially designed fuel pools in the short term and in steel and concrete storage containers for longer time frames. This confirms the safety and security of used nuclear fuel under the multilayered protective strategies used at commercial nuclear energy facilities.

Issuance of this rule will maximize efficiency in the licensing and relicensing processes while ensuring the agency complies with the requirement of the National Environmental Policy Act to disclose the environmental impacts of used fuel storage. The D.C. Circuit and other courts have also specifically approved this approach which will avoid duplicative and inefficient site-specific reviews.

**Second license renewal item 14:** Develop a pressurized water reactor long-term operations reactor vessel surveillance capsule program.

**Responsible organization:** EPRI - MRP

**Current status:** In progress

**Task start:** 2015

**Task end:** 2029

**Description:** The goal of this task is to provide adequate surveillance capsule data to confirm embrittlement performance of operating plants through 80 years of service. Reactor vessel surveillance programs are in place to monitor materials aging and degradation, but surveillance data is needed at higher fluence levels to support accurate embrittlement predictions for the period of operations relevant to second license renewal. EPRI has two programs to address this issue. First, the Coordinated PWR Reactor Vessel Surveillance Program (CRVSP) will have 13 pressurized water reactors defer the withdrawal of remaining capsules in order to test the capsules at higher fluences. Second, the PWR Supplemental Surveillance Program (PSSP) will design, fabricate, irradiate and test one or two supplemental capsules containing previously irradiated PWR materials.

The CRVSP will operate from 2015 to 2029, and the PSSP will operate from 2015 to 2024. Together, these two programs will generate high-fluence PWR surveillance data. The implementation of these programs will be necessary in order to support the submittal of a second license renewal application and the programs will inform reactor operations throughout the extended period of operations.

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**Second license renewal item 15:** Extend the Integrated Surveillance Program (ISP) from 60 to 80 years.

**Responsible organization:** EPRI - BWRVIP

**Current status:** In progress

**Task start:** 2015

**Task end:** 2018 (development phase); 2030 (implementation phase)

**Description:** The goal of this task is to ensure management and monitoring of reactor pressure vessel embrittlement through the period of extended operation to confirm embrittlement performance of operating plants through 80 years of service. The BWRVIP manages an Integrated Surveillance Program to provide reactor pressure vessel specimens supporting operation of the BWR fleet for 60 years of operation. A strategy for management of BWR embrittlement will be developed for 60 to 80 years.

**Second license renewal item 16:** Revise NEI 95-10.

**Responsible organization:** NEI/Industry

**Current status:** Not started

**Task start:** First quarter 2015

**Task end:** Second quarter 2016

**Description:** NEI 95-10 provides an NRC-endorsed acceptable approach for implementing the requirements of 10 CFR Part 54. The guideline is founded on industry experience in implementing the license renewal rule and offers a stable and efficient process, resulting in the issuance of a renewed license. NEI will revise NEI 95-10 based on lessons learned, operating experience and the outcome of the second license renewal GALL report and Standard Review Plan revision. This revision could assist with the drafting of the first second license renewal application.

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**Second license renewal item 17:** Evaluate the need to update EPRI aging management tools for second license renewal.

**Responsible organization:** EPRI/Industry

**Current status:** Not started

**Task start:** 2016

**Task end:** 2017

**Description:** To support the first round of license renewal, EPRI developed a series of technical “tools” to provide materials aging information and guidance to the plant staff involved in preparing AMPs. These tools cover electrical, mechanical, civil and structural components and have formed the technical basis for developing generic and plant-specific aging management reviews.

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**Second license renewal item 18:** Identify second license renewal lead plant(s).

**Responsible organization:** NEI/Industry

**Current status:** In progress

**Task start:** 2014

**Task end:** 2015

**Description:** In order to pave the way for future second license renewal applications, one or more lead plants will be identified to prepare and submit the initial second license renewal applications.

**Second license renewal item 19:** Assist in preparing lead plant(s) second license renewal application.

**Responsible organization:** Lead Plant(s)

**Current status:** Not started

**Task start:** 2016

**Task end:** 2016

**Description:** It is assumed that the first plant operator to decide to submit a second license renewal application will begin preparing the application in 2016. The lead plant operator will take approximately two years to prepare the application and submit the application to the NRC by 2018. The lead plant(s) will work closely with the NRC, EPRI and the NEI second license renewal working group to resolve issues as they arise and capture lessons learned.

The first set of renewed license terms will end in 2029. Submitting the second license renewal application by 2018 will provide enough lead time for the NRC to review and approve the application in advance of the operating license expiration date. The first second license renewal application also will provide an example for other plant operators to follow.

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**Second license renewal item 20:** Review and provide NRC acceptance of lead plant(s) second license renewal application package.

**Responsible organization:** NRC

**Current status:** Not started

**Task start:** 2018

**Task end:** 2018

**Description:** Once the NRC receives the second license renewal application, they will conduct an acceptability and completeness review to determine if the application is sufficient for the full review process. This initial review generally takes a couple of months. Assuming no change in the license renewal process for second license renewal applications, once the second license renewal application has been accepted by the NRC, the plant may continue to operate under its existing license independent of any delays incurred by review or hearings.

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**Second license renewal item 21:** Obtain approval of second license renewal applications for lead plant(s).

**Responsible organization:** NRC

**Current status:** Not started

**Task start:** 2018

**Task end:** 2020

**Description:** The NRC will review the applicant's second license renewal application according to a schedule published early in the process.