

License Renewal in the United States - Status and Prognosis

A. L. Hiser, Jr.

U.S. Nuclear Regulatory Commission
Division of License Renewal
Washington, DC USA

Abstract. Renewal of licenses for operating nuclear power plants in the United States is a mature, stable process, with 59 out of 104 licenses having been renewed in the last 10 years. Current challenges facing the U. S. Nuclear Regulatory Commission include incorporating lessons learned and recent plant operating experience into license renewal guidance documents, evaluating aging management findings from plants that have entered into the renewed operating period, and preparing for consideration of a second renewed license for plants, out to a possible 80 years of operating time.

1. Background

In accordance with Section 103c of the Atomic Energy Act (AEA) of 1954, as amended, nuclear power plants in the United States are licensed for a term not exceeding 40 years, and may be renewed. This original 40-year license term for reactor licenses was based on economic and antitrust considerations – not on limitations of nuclear technology. Due to this selected period, however, some structures and components may have been engineered on the basis of an expected 40-year service life.

The NRC's regulations related to renewal of operating licenses for nuclear power plants are provided in Part 54 of Title 10 of the Code of Federal Regulations (10 CFR Part 54). 10 CFR 54.31(b) specifies that licenses may be renewed for a specified period not to exceed 20 years, with the renewed license term not to exceed 40 years. In addition, 10 CFR 54.31(d) states that a renewed license may be subsequently renewed in accordance with all applicable requirements, with no explicit limit to the number of "subsequent" renewals for each license.

2. License Renewal Review Process and Guidance

License renewal is focused on aging management of long-lived, passive structures and components in nuclear power plants, such as the reactor pressure vessel, steam generators, piping, seismic Category I structures, electrical cables and connections, among others. Items not included in the scope of license renewal are those that are active, such that their failure will be identified during surveillance and testing, or replaced on a fixed schedule. The scope of license renewal includes (1) safety-related systems, structures, and components (SSCs); (2) all nonsafety-related SSCs whose failure could adversely impact functionality of safety-related SSCs; and (3) all SSCs relied on in certain safety analyses or plant evaluations for specific NRC regulations.

The fundamental premise of the License Renewal Rule, provided at 10 CFR Part 54, is that the current licensing basis (CLB) for plants is adequate to ensure the safety of operating plants. In this case the CLB is the set of NRC requirements applicable to a specific plant; a

licensee's written commitments for ensuring compliance with and operation within the applicable NRC requirements and the plant-specific design basis; orders; license conditions; exemptions; technical specifications; the plant-specific design-basis information documented in the most recent final safety analysis report, and the licensee's commitments remaining in effect that were made in docketed licensing correspondence such as responses to NRC bulletins, generic letters, and enforcement actions, as well as licensee commitments documented in NRC safety evaluations or licensee event reports.

A basic aspect of the License Renewal Rule is a licensee's integrated assessment that demonstrates that a facility's SSCs requiring aging management review for license renewal have been identified and that the effects of aging on their functionality will be managed to maintain the CLB such that there is an acceptable level of safety during the period of extended operation. License renewal also involves applicant consideration of time-limited aging analyses (TLAAs), which are those licensee calculations and analyses in the CLB for the SSCs within the scope of license renewal, that (1) consider the effects of aging, (2) involve time-limited assumptions defined by the current operating term; (3) were determined to be relevant by the licensee in making a safety determination; and, (4) involve conclusions or provide the basis for conclusions related to the capability of the SSC to perform its intended functions.

The NRC has developed several documents to aid in effective and efficient evaluation of LRAs. A Standard Review Plan (SRP) for License Renewal, NUREG-1800, was developed to assure quality and uniformity of staff reviews and to present a well defined technical basis from which to evaluate a licensee's application. Availability of the SRP aids in the transparency of NRC staff reviews of LRAs such that applicants can understand the types and detail of information needed by the staff in its reviews. The SRP incorporates by reference the Generic Aging Lessons Learned Report (GALL) report (NUREG-1801 Volumes 1 and 2), which was first issued in 2001.

The GALL report provides generic evaluations of materials, environments, aging effects and aging mechanisms, along with acceptable aging management approaches (e.g., Aging Management Programs). Use of the GALL report by applicants and NRC staff facilitates NRC review of the LRA and provides for a stable review process, subject to findings such as emergent technical issues, described below. Both the SRP and the GALL report were initially issued in 2001 and Revision 1 was issued in 2005. The NRC plans to issue Revision 2 of each document by early 2011.

3. Status of License Renewals

As of the end of 2009, licenses have been renewed for a total of 59 nuclear power plant units in the U.S. out of a population of 104 operating units, including 39 for pressurized water reactors (PWRs), out of a population of 69 PWRs, and 20 for boiling water reactors (BWRs), out of a population of 35 BWRs. The NRC is currently reviewing applications from 19 units, including 13 from PWRs and 6 from BWRs. Licensees for an additional 13 units have provided dates when applications are expected for their units.

In 2009 four U.S. units entered the period of extended operation. In 2010 an additional three units will enter the period of extended operation.

4. Emergent Technical Issues

Recent reviews of license renewal applications have identified certain plant conditions and operating experiences that have warranted additional NRC attention. These issues are described in the following sections.

Integrity of Buried Piping: Findings of leakage from buried piping, including identification of tritium in some cases, have focused some public attention on the integrity of this piping. Although it may not be a significant challenge to plant safety and not a challenge to off-site release limits, the findings have provided a unique regulatory challenge to the NRC in maintaining public confidence. As described in SECY-09-0174, dated December 2, 2009, the industry has recently developed the Buried Piping Integrity Initiative to address aging management of buried piping. The NRC staff is monitoring industry activities, has increased inspection oversight, and will take other actions as necessary in this area.

Containment Liner/Drywell Corrosion: For both BWR and PWR plants, recent operating experience has identified cases of degradation of the steel containment liner. These cases have included through wall corrosion at PWR plants, with the root causes identified as corrosion due to foreign objects at the exterior surface of the liner plate. In addition, several BWRs have identified external surface corrosion due to water being trapped on the exterior surface of the drywell due to the presence of sand or other materials. The NRC is undertaking a research activity to assess potential vulnerabilities to containment liner corrosion and recommend any needed guidance changes.

Inaccessible Medium Voltage Electrical Cables: During aging management program audits at several plants, walk-downs of manholes containing medium voltage electrical cables resulted in the identification of water in the man-holes, such that either the cables were submerged or that the cables had been submerged over extended periods of time. These findings have resulted in greater emphasis by applicants and licensees to minimize medium voltage cable exposure to significant moisture through improved management of electrical vault and manhole water collection and drainage. An assessment of the aging due to the cables being exposed in an environment that they were not specifically designed for must be understood. In addition, NRC and industry have initiated activities to develop and assess electrical cable test techniques to improve cable condition monitoring assessments.

Leakage from Spent Fuel Pools and Refueling Cavities: License renewal reviews have identified that some applicants have experienced and/or continue to experience leakage from their spent fuel pool and/or their refueling cavity. The principal concern from such leakage is potential degradation of the surrounding concrete and structural steel elements by borated water in PWRs or the water in BWRs. In these cases applicants have taken measures to eliminate or limit the leakage and to provide assurance that the functionality of the surrounding concrete and steel will not be adversely affected by the leakage during the renewed license period.

Degradation of Spent Fuel Pool Neutron Absorbers: NRC Information Notice 2009-26, issued on October 29, 2009, described plant operating experience with degradation of the Carborundum neutron-absorbing materials used in a spent fuel pool (SFP) and the deformation of Boral® panels used in SFPs. Implementation of this operating experience in the license renewal process was accomplished through the issuance of License Renewal Interim Staff Guidance (LR-ISG) 2009-01, which highlighted the need for applicants to manage aging of their neutron absorbing materials used in their SFPs, and included a draft aging management program.

5. Prognosis for “Life Beyond 60”

As described previously, the License Renewal Rule explicitly allows subsequent renewal of a renewed license. In such cases, the period of time to be covered by this subsequent renewed license could encompass 60 to 80 years of operation. Based on public meetings with the Nuclear Energy Institute (NEI), some licensees in the U.S. are considering submitting applications for a subsequent renewal period within the next 5 to 10 years.

Although the legal requirements for a subsequent renewal of a license and a renewed license are the same, the applicant will be required to provide adequate information (backed up by the appropriate research or testing) for the subsequent renewal in order to provide reasonable assurance that the effects of aging will be adequately managed during the period of extended operation such that there is assurance of the functionality of the SSCs within the scope of license renewal activities. In particular, the effectiveness of the aging management programs that have been implemented for the initial renewal should be considered to provide guidance on the structure and parameters of such AMPs that may be necessary for a subsequent license renewal period. In addition, the possibility of new aging phenomena that could initiate or become significant during the subsequent renewal period should be considered.

The burden is on the industry to demonstrate through their research and engineering activities that an applicant for a subsequent license renewal can safely manage the effects of aging on SSCs that are within the scope of license renewal. However, the NRC must be prepared to review applications for subsequent renewals. Therefore, to provide a firm technical basis for the feasibility of subsequent license renewal applications, the NRC has begun a process that will ensure a firm technical basis for the review of applications for a subsequent renewed license period. As described below, the first tasks of activity have been initiated to ensure that there is a firm technical basis for review of such an application. One natural outgrowth of these first tasks will be the identification and initiation of needed confirmatory research related to a subsequent license renewal operating period (i.e., beyond 60 years).

The NRC and industry have already expended considerable resources over the last several decades to better understand the safety implications and risk associated with aging of SSCs. Key activities have included an assessment of the technical basis for revising the pressurized-thermal shock (PTS) screening limit in the PTS rule (10 CFR 50.61), aging of electrical cables, and environmentally-assisted cracking (EAC) of pressure boundary and internals materials. In February 2008, the NRC and the Department of Energy (DOE) co-sponsored a “Workshop on U.S. Nuclear Power Plant Life Extension Research and Development,” which requested stakeholder input into aging management research areas for “Life Beyond 60.” Based on the results of this workshop, and the staff’s long-term research plan, potential additional areas of focus for a subsequent license renewal include aging management of reactor vessel and internals materials, cable insulation, buried/submerged structures, and concrete exposed to high temperature and radiation. The NRC Office of Nuclear Reactor Regulation and the Office of Nuclear Regulatory Research have initiated several activities.

Recurrent NRC/Industry Workshops: This task initiates a series of recurrent workshops, similar to the 2008 workshop, to address the status of operating experience from the initial renewal term, and industry research activities to address aging management technical issues for a subsequent license renewal operating period. These workshops will provide a regularly-scheduled forum for discussions by the domestic nuclear industry and other industries, DOE and other federal organizations, academia, international partners, and interested public stakeholders.

Expanded Materials Degradation Assessment (EMDA) for a Subsequent License Renewal Period: NUREG/CR-6923, "Expert Panel Report on Proactive Materials Degradation Assessment," dated February 2007, identified materials and components where future degradation could occur in specific light water reactor (LWR) systems. This task builds upon the work of NUREG/CR-6923 to consider a subsequent period of extended operation (i.e., 60 to 80 years) for all of the SSCs that are within the scope of license renewal, with a plan to update this work periodically consistent with updates to the GALL report and the license renewal SRP.

Assess Results from License Renewal Aging Management Programs and Recommend Improvements for a Subsequent License Renewal Period: As a part of the initial license renewal review process, applicants have committed to AMPs consistent with the GALL Report or other plant-specific AMPs. This task will collect, evaluate and assess operating experience from these AMPs to inform regulatory decisions on the need to modify or increase requirements for monitoring or inspections, and in determining areas for additional research, for operation during a potential subsequent license renewal period.

Develop Domestic and International Partnerships to Share Expertise, Capabilities and Resources Related to Aging Management Research for Long-Term Operations: In this task the NRC will work to develop and continue domestic and international research partnerships in order to evaluate domestic and relevant international operating experience and research, in order to leverage resources and minimize unnecessary duplication of efforts. One goal of these partnerships is to ensure coordinated and focused activities on common high-priority needs.

6. Conclusions

The License Renewal Program has successfully evaluated and renewed licenses for 57% of the fleet of nuclear power plants in the United States. These reviews have focused on ensuring that licensees have adequate aging management programs in place. Several technical issues have been identified during the license renewal reviews, for which corrective actions have been taken industry-wide (e.g., buried piping degradation).

Current challenges facing the U. S. Nuclear Regulatory Commission in the license renewal area include incorporating lessons learned and recent plant operating experience into license renewal guidance documents, evaluating aging management findings from plants that have entered into the renewed operating period, and preparing for consideration of a second renewed license for plants, out to a possible 80 years of operating time.