Status of Subsequent License Renewal and Related Activities in the US

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U.S.NRC
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He received his master's degree in mechanical engineering and his doctorate in materials science and engineering. He has 45 years of experience in the nuclear industry, with a broad range of topics including reactor pressure vessel neutron embrittlement, cracking of vessel head penetration nozzles and vessel head corrosion.

From 2009 to 2021 he was the NRC's senior level advisor for license renewal aging management, having retired at the end of 2021 but returning to the NRC for a limited time, principally for knowledge management and knowledge transfer activities.

He served as the chairman of the International Atomic Energy Agency (IAEA) International Generic Aging Lessons Learned (IGALL) program from 2005 until 2021, and participated in six IAEA Safety Aspects of Long-Term Operation (SALTO) missions and numerous IAEA workshops related to long term operation and aging management.

OUTLINE

- Status of license renewal applications
- Impact of Commission decision on environmental reviews for SLR
- Technical challenges in the SLR reviews
- Consideration of license renewal for 40 years and technical issues for 100 years
- Plans for revision 1 of the GALL-SLR and SRP-SLR
- Considerations for risk-informing license renewal

LR is license renewal from 40 to 60 years
SLR is subsequent license renewal from 60 to 80 years

Background References on US Reactor License Renewal

- Nuclear Innovation Conference Webinar video
  https://www.nuclearinnovationconference.eu/webinars
- License Renewal Background and Status
  https://www.nrc.gov/docs/ML2101/ML21015A336.pdf
- Overview of Nuclear Power Plant License Renewal and Considerations for 40-Year Renewals
  https://www.nrc.gov/docs/ML2104/ML21042B879.pdf

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Status of Reactor Licenses in the US

- 92 operating reactor units in the U.S.
- Renewed licenses (to operate for 60 years) issued for 94 units (10 have ceased operations)
  - 8 units with 40-year licenses (Diablo Canyon will shutdown 2024/2025)
  - 78 units with 60-year licenses
  - 6 units with 80-year licenses (Turkey Point, Peach Bottom and Surry)
- 59 units (50 operating) have entered their 41st year of operation; first was in April 2009
  - More than 400 reactor-years of operation beyond the initial 40-year licenses

License Renewal and SLR Applications

- 4 SLR applications under review – 9 units
  - North Anna Power Station, Units 1 and 2 – received Aug 2020
  - Point Beach Nuclear Plant, Units 1 and 2 – received Nov 2020
  - Oconee Nuclear Station, Units 1, 2, and 3 – received June 2021
  - St. Lucie Nuclear Plant, Units 1 and 2 – received Aug 2021
- 3 SLR applications scheduled – 5 units
  - Monticello Nuclear Generating Plant, Unit 1 – Jan to Mar 2023
  - Browns Ferry Nuclear Plant, Units 1, 2 and 3 – Dec 2023
  - Virgil C. Summer Nuclear Station, Units 1 – Oct to Dec 2023
- 3 LR applications scheduled – 4 units
  - Comanche Peak Nuclear Power Plant, Units 1 and 2 – Oct to Dec 2022
  - Perry Nuclear Power Plant, Unit 1 – July to Sept 2023
  - Clinton Power Station, Unit 1 – Jan to Mar 2024

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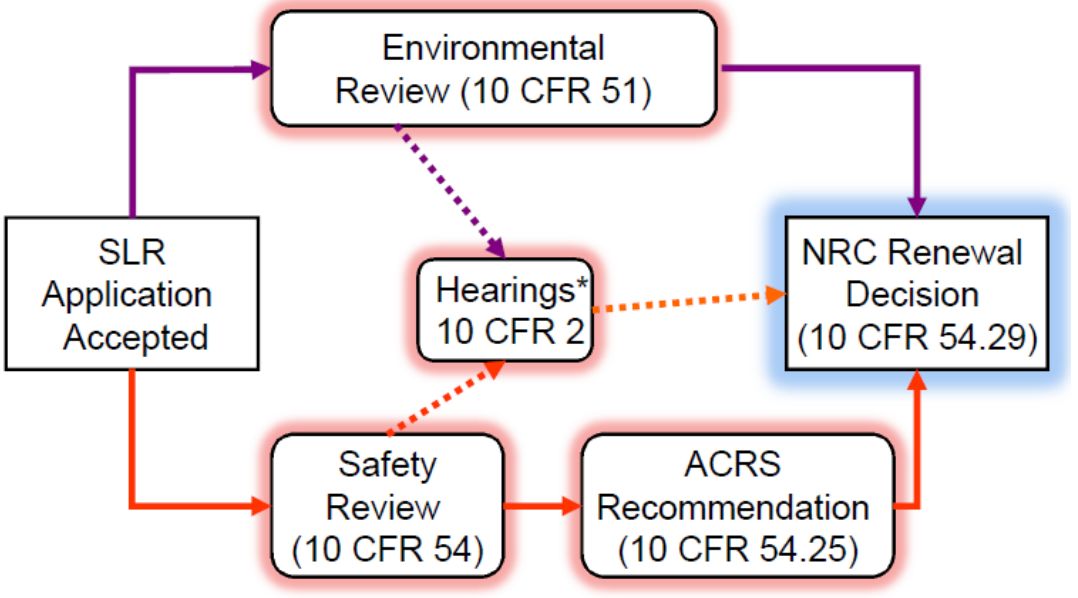
NRC License Renewal Overview

- NRC regulations (10 CFR Part 54) include:
  - Safety review (aging management, time-limit aging analyses, etc.)
  - Environmental review



* If a Request for Hearing is Granted

Environmental Impact Statement (EIS)

- Regulations for EIS are in Part 51 to Title 10 of the Federal Code of Regulations – relate to National Environmental Policy Act (NEPA) of 1969
- Environmental issues are binned:
  - Category 1: apply to all or a subset of plants
    - Evaluated in NUREG–1437, Revision 1, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (June 2013) – called “LR GEIS”
  - Category 2: additional plant-specific review is needed
    - Evaluated in environmental report in the application
    - NRC staff prepares a site-specific Supplemental EIS (SEIS), e.g., NUREG-1437 Supplement XX

Commission Orders

On February 24, 2022, the Commission issued three orders (CLI-22-02, CLI-22-03 (for example), and CLI-22-04):

- LR GEIS does not apply to SLR; therefore, environmental review is incomplete (regulation states applicable to "initial" renewal)
- Renewed licenses rolled back 20 years
  - Peach Bottom Units 2 and 3
  - Turkey Point Units 3 and 4
- Cannot publish final SEIS documents
  - North Anna Units 1 and 2
  - Point Beach Units 1 and 2
- Cannot publish draft SEIS documents
  - Oconee Units 1, 2, and 3
  - St. Lucie Units 1 and 2

Response to Commission Direction

- Staff plans
  - Remove the word “initial” from Part 51
  - Update NUREG-1437, Revision 1
  - Thorough analysis of the environmental impacts of subsequent license renewal
- Result would be GEIS applicable to subsequent license renewal
- Effect on issuance of subsequent renewed licenses
  - Use of LR GEIS would result in a delay of ~2 years
  - Applicants can provide a plant-specific assessment of the Category 1 topics that are addressed in the GEIS (NUREG-1437)

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SLR Technical Issues

- Reactor pressure vessel – neutron embrittlement
  - Trends for high fluence levels
  - Sufficiency of reactor vessel material surveillance program capsules
- Reactor vessel internals - high fluence effects
  - Irradiation-assisted stress corrosion cracking
  - Loss of fracture toughness
  - Void swelling
- Concrete and containment performance
  - Long-term radiation and high temperature exposure
  - Alkali-silica reaction (ASR)
- Electrical cables
  - Environmental qualification
  - In-service testing of cables
  - Long-term submersion of low and medium voltage cables

Technical Challenges from SLR Application Reviews

- Neutron embrittlement of steel reactor pressure vessel supports
  - Low operational temperatures
  - Evaluated for 60 years but not 80 years
- PWR reactor vessel internal components
  - Approved program is for 60 years
  - Plant-specific analysis needed, using a “gap analysis” to address aging differences from 60 to 80 years
- Buried piping fabricated from gray cast iron material
  - Brittle material with cracking due to cyclic loading

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Consideration of 40-Year License Renewal Terms and Plant Operation to 100 Years

- License Renewal for an Additional 40 years
  - Motivated by a plant with a 40-year license operating near the end of that license
  - Looked at legal/regulatory aspects, environmental review, safety review, and inspection/oversight aspects
  - Public meeting on February 18, 2021 – ADAMS ML21070A117
  - Industry stated not on their radar right now
  - Public comments generally not supportive
- Technical Issues for 100 years of Operation
  - Public meeting on January 21, 2021 – ADAMS ML21078A453
  - Industry stated prudent to continue relevant research
  - Public comments generally not supportive
- Closure Memo dated June 22, 2021 (ADAMS ML21117A007)
  - Both of the above activities were discontinued
  - Considered extension of on-going research for 60 years

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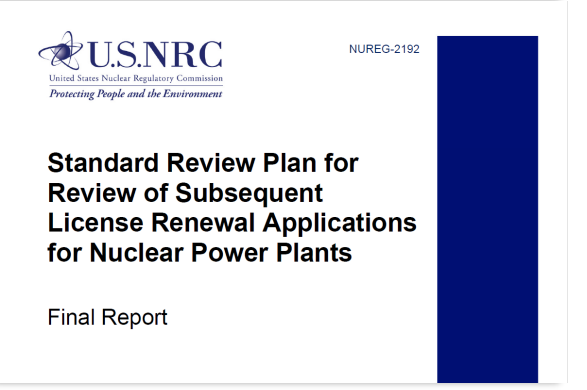
GALL Report and SRP-LR Versions

- Generic Aging Lessons Learned (GALL) Report (NUREG-1801) and SRP-LR (Standard Review Plan for License Renewal) (NUREG-1800)
  - Revision 0 – issued July 2001
  - Revision 1 – issued September 2005
  - Revision 2 – issued December 2010
  - Interim changes made using License Renewal - Interim Staff Guidance (LR-ISG) process
    - 10 LR-ISGs apply to Revision 2
- GALL-SLR (NUREG-2191) and SRP-SLR (NUREG-2192)
  - Issued July 2017
    - 4 SLR-ISGs apply to SLR documents

Basis for Development of GALL-SLR

- To reflect expected aging differences for increased operating time from 60 to 80 years
- New plant operating experience since GALL Rev. 2
- Gaps identified in current guidance
- Improvements in efficiency and effectiveness of applications and NRC reviews
- Corrections to GALL Rev. 2 and SRP-LR Rev. 2
- Incorporate Interim Staff Guidance since GALL Rev. 2



Revision of GALL-SLR and SRP-SLR

- 4 SLR-ISGs have been issued
  - SLR-ISG-2021-01: Aging Management Criteria for Reactor Vessel Internal Components of Pressurized Water Reactors
  - SLR-ISG-2021-02: Aging Management Criteria for Mechanical Portions
  - SLR-ISG-2021-03: Aging Management Criteria for Structures Portions
  - SLR-ISG-2021-04: Aging Management Criteria for Electrical Portions

Development of Revision 1 of GALL-SLR

- Public meeting held June 1
  - Need for the revision
  - Limited scope of the revision
  - Process
  - Timeline
- Products:
  - Revision 1 of GALL-SLR, SRP-SLR and technical basis
  - New document on resolution of public comments
- A multi-year process – finalize end of 2024/2025

Basis for GALL-SLR Revision 1 Changes

- Focus is topics previously identified as possible SLR-ISGs; not a comprehensive review of the documents
- Basis for updates
  - Revised and new guidance based on:
    - New or updated industry guidance, and Codes and standards
    - Plant operating experience
    - To fill gaps or make technical revisions in guidance identified from previous SLR reviews
  - Substantive corrections
  - Incorporate completed SLR-ISGs since initial GALL-SLR

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Risk-Informing License Renewal

- Part 54 is largely a deterministic rule
  - Scoping and Screening, aging management review, TLAAs
  - 54.21(a)(3) - For each structure and component identified . . . , demonstrate that the effects of aging will be adequately managed so that the **intended function(s)** will be maintained consistent with the CLB for the period of extended operation.
- Current use of risk in guidance documents
  - GALL-SLR XI.M41: Piping inspection locations are selected based on risk (i.e., susceptibility to degradation and consequences of failure).

Risk-Informed Aging Management Programs

- Submitted by NEI on February 18, 2022
- Proposed (pilot) AMPs: GALL-SLR XI.M33 (selective leaching) and XI.E3 (non-EQ inaccessible power cables)
- Public meeting held June 2
- If approved will add to GALL-SLR Revision 1

Risk-Informing LR and SLR

- Public meeting tentative early July
- Follow-up to March 2022 Regulatory Information Conference (RIC) session
- Consider items that can be implemented now consistent with Part 54, or could require rulemaking

Contact Information

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Related Links

- Reactor License Renewal
  https://www.nrc.gov/reactors/operating/licensing/renewal.html
- Reactor License Renewal Guidance Documents
  https://www.nrc.gov/reactors/operating/licensing/renewal/guidance.html
- Guidance for License Renewal and Subsequent License Renewal
  https://www.nrc.gov/reactors/operating/licensing/renewal/slr/guidance.html
- LR and SLR Interim Staff Guidance (ISG)
  https://www.nrc.gov/reading-rm/doc-collections/isg/license-renewal.html
- Status of Initial License Renewal Applications
  https://www.nrc.gov/reactors/operating/licensing/renewal/applications.html
- Status of Subsequent License Renewal Applications
  https://www.nrc.gov/reactors/operating/licensing/renewal/subsequent-license-renewal.html