License Renewal in the US – Where We Are and How We Got Here

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U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

OUTLINE

- License Renewal Basis and Process
- Development of SLR Guidance Documents
- Status of LR and SLR
- Today's Meeting

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

Legislation Provisions for Licensing of Nuclear Power Plants

Sec. 103. Commercial Licenses

a. The Commission is authorized to issue licenses to persons applying therefor to transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, use[100] import, or export under the terms of an agreement for cooperation arranged pursuant to section 123, utilization or production facilities for industrial or commercial purposes.[101] Such licenses shall be issued in accordance with the provisions of chapter 16 and subject to such conditions as the Commission may by rule or regulation establish to effectuate the purposes and provisions of this Act.

b. The Commission shall issue such licenses on a nonexclusive basis to persons applying therefor (1) whose proposed activities will serve a useful purpose proportionate to the quantities of special nuclear material or source material to be utilized; (2) who are equipped to observe and who agree to observe such safety standards to protect health and to minimize danger to life or property as the Commission may by rule

c. Each such license shall be issued for a specified period, as determined by the Commission, depending on the type of activity to be licensed, but not exceeding forty years from the authorization to commence operations[102] and may be renewed upon the expiration of such period.

- **Atomic Energy Act**
  - Plants licensed to operate for 40 years
  - Allows for license renewal
  - No restrictions on number of renewals

License Renewal Rule – 10 CFR Part 54 (1995)

- Rule provisions
  - Permits renewal for up to 20 years (54.31(b)) – e.g., 40 to 60 years
  - Can apply 20 years before license expiration per 54.17(c)
  - Must apply at least 5 years before expiration per 2.109(b) ("timely renewal" provision)
  - A renewed license may be subsequently renewed per 54.31(d)
  - No restrictions on number of subsequent renewals

- Focus is on demonstrating adequate management of the effects of aging for long-lived, passive structures and components important to plant safety
  - Other aspects of original license are not reconsidered
  - "A program based solely on detecting structure and component failures is not considered an effective aging management program"

License Renewal Safety Principles

- **Regulatory process** is adequate to assure plant safety
  - License renewal review to ensure that the effects of aging will be adequately managed in the period of extended operation.

- The plant's **current licensing basis (CLB)** to be maintained during the renewal term ("same manner and same extent")
  - Same plant operating rules for the renewal term
  - Accomplished through a program of age-related degradation management of passive, long-lived plant systems, structures and components identified as in-scope for license renewal

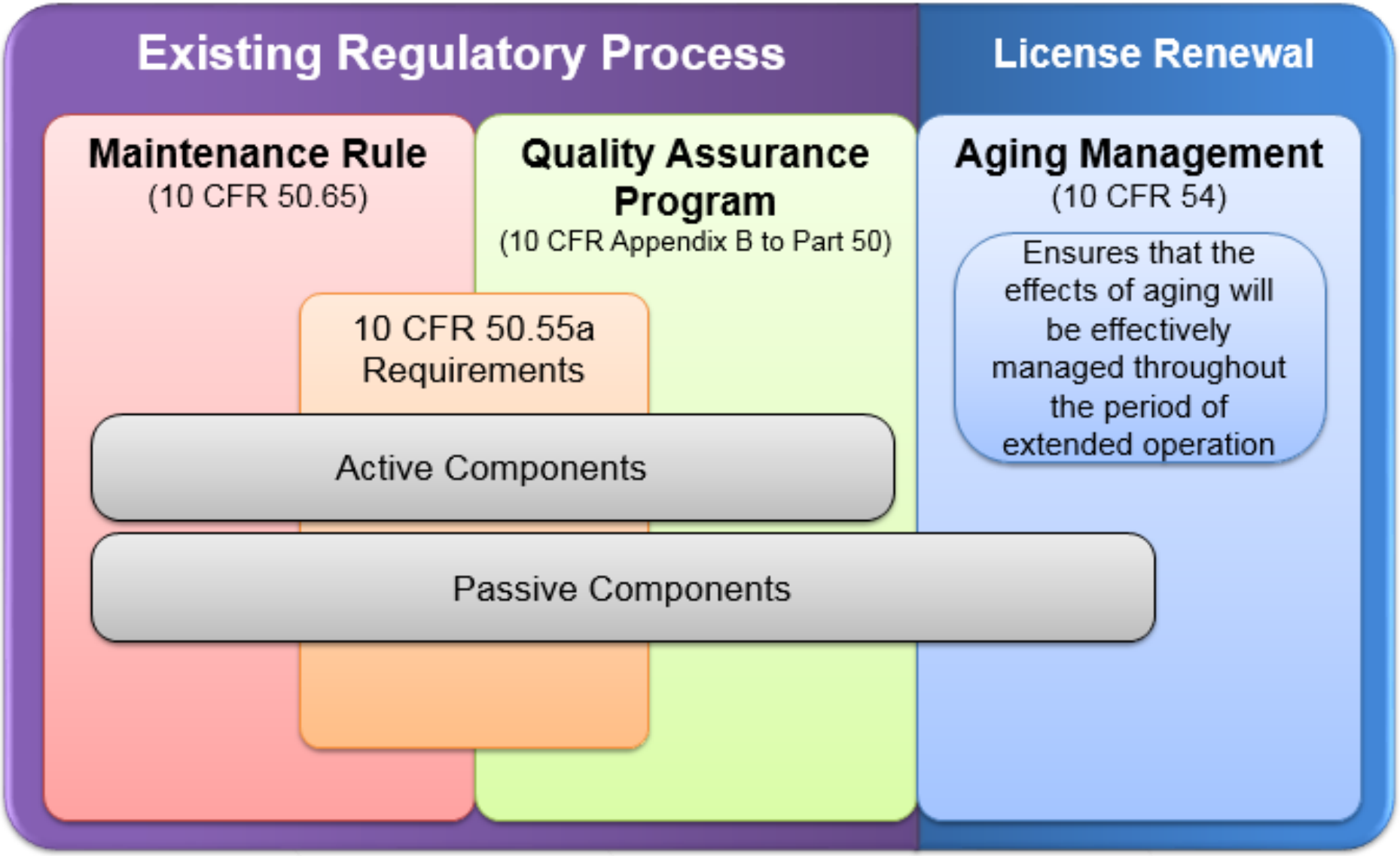
Regulatory Process Essential Elements

- Effective compliance with regulations
- On-site resident inspectors and specialized inspections
- Performance assessments of inspection findings
- Operating experience analysis and utilization
- Safety issue resolutions (generic and plant specific)
- Materials aging & degradation issues important to safety addressed by
  - Rule changes, generic communications, orders, voluntary actions

Part 50 Regulations

- 50.48 – Fire protection
- 50.49 – Environmental qualification of electric equipment important to safety for nuclear power plants
- 50.55a – Codes and standards
- 50.60 – Acceptance criteria for fracture prevention measures for lightwater nuclear power reactors for normal operation
- 50.61, 61a – Fracture toughness requirements for protection against pressurized thermal shock events (PTS Rule), and Alternate fracture toughness requirements
- 50.65 – Requirements for monitoring the effectiveness of maintenance at nuclear power plants (Maintenance Rule)
- Appendix B – Quality Assurance Criteria
- Appendix G – Fracture Toughness Requirements
- Appendix H – Reactor Vessel Material Surveillance Program Requirements
- Appendix J – Primary Reactor Containment Leakage Testing

Safety For License Renewal



Scope of License Renewal

- Safety-related systems, structures, and components (SSCs)
  - Maintain integrity of the reactor coolant pressure boundary
  - Ensure capability to shut down and maintain safe shutdown
  - Prevent or mitigate offsite exposures comparable to §50.34(a)(1), §50.67(b)(2), or §100.11
- Non-safety related SSCs whose failure could affect safety-related SSC functions
- SSCs relied upon for compliance with the Commission's regulations for:
  - Fire protection (10 CFR 50.48)
  - Environmental qualification (10 CFR 50.49)
  - Pressurized thermal shock (10 CFR 50.61)
  - Anticipated transients without scram (10 CFR 50.62)
  - Station blackout (10 CFR 50.63)

Issues Not in Scope of License Renewal Review

- Ongoing Regulatory Oversight Issues:
  - Emergency planning (10 CFR 50.47)
  - Security (10 CFR Part 73)
  - Current safety performance http://www.nrc.gov/NRR/OVERSIGHT/ASSESS/ index.html

Main Topics of Safety Review

- Scoping and screening of SSCs
  - Identify SSCs that are “in-scope” of license renewal
  - Identify structures and components (SCs) that are subject to aging management review (AMR)
- Aging management
  - AMR identifies relevant aging effects and aging management approach(es)
  - Aging management programs are specified to manage the effects of aging, with reasonable assurance
- Time-limited aging analyses (TLAAs)
  - Demonstrate that CLB analyses are acceptable or will be managed

Safety review relies on License Renewal Guidance Documents

Standards for Approval (10 CFR 54.29)

A renewed license may be issued if the Commission finds that:

- Actions have been identified and have been or will be taken such that there is **reasonable assurance** that the activities authorized by the renewed license will continue to be conducted in accordance with the CLB. The actions are with respect to
  - managing the effects of aging during the period of extended operation (PEO) on the functionality of structures and components
  - TLAAs
- Environmental review requirements have been satisfied
- Any consideration of Commission rules and regulations in adjudicatory proceedings has been resolved

License Renewal Guidance Documents

- Generic Aging Lessons Learned
  - Generic Aging Lessons Learned (GALL) report (NUREG-1801, Rev. 2) and GALL-SLR report (NUREG-2191)
  - Provides assessments for AMR, including identification of materials, environments and aging effects that require management
  - Identifies acceptable AMPs
- Standard Review Plan
  - Standard Review Plan (SRP) for License Renewal (SRP-LR) (NUREG-1800, Rev. 2) and SRP-SLR (NUREG-2192)
  - Guidance for staff review of: Scoping and Screening, Aging Management Review, TLAAs
- Amended through Interim Staff Guidance (ISG) process (LR-ISG or SLR-ISG), based on operating experience or lessons learned from LRA and SLRA reviews
- Regulatory Guide 1.188, Rev. 2, application format, endorses Nuclear Energy Institute (NEI) guidance NEI 95-10 (LR) and NEI 17-01 (SLR).

Subsequent License Renewal

- License for plant operation from 60 to 80 years
- Commission determined no rule changes needed (SRM-SECY-14-0016)
- Several generic technical issues identified
- Industry to resolve technical issues generically or through plant-specific SLR applications

SLR Technical Issues

- Reactor pressure vessel – neutron embrittlement
  - Trends for high fluence levels
  - Surveillance programs
- 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

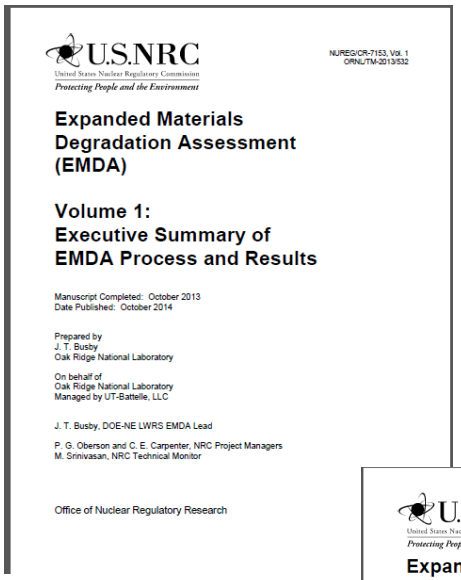
Concerns for Aging

- Identification of potential new aging phenomena
  - Known mechanisms
  - New phenomena
- Approaches for identifying potential aging phenomena
  - Expanded materials degradation assessment
  - Results from 1st renewal aging management programs
  - Domestic and international operating experience
  - Research findings

NRC Actions to Develop SLR Guidance Documents

- Expert panel process to identify potential materials degradation issues for 80 years of operation
- Audits to assess results from implementation of AMPs at three plants with renewed licenses
- Public meetings on technical issues, including operating experience and industry research activities
- NRC staff review of information and propose aging management approaches for 80 years of operation

Expanded Materials Degradation Assessment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NUREG/CR-7153, Vol. 1
ORNL/TM-2013/532

Expanded Materials Degradation Assessment (EMDA)

Volume 1: Executive Summary of EMDA Process and Results

Manuscript Completed: October 2013
Date Published: October 2014

Prepared by
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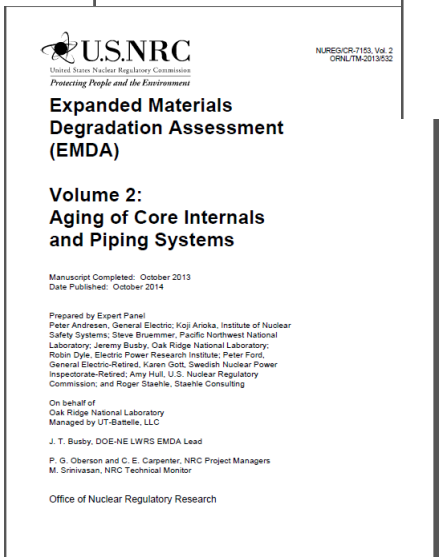
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NUREG/CR-7153, Vol. 2
ORNL/TM-2013/532

Expanded Materials Degradation Assessment (EMDA)

Volume 2: Aging of Core Internals and Piping Systems

Manuscript Completed: October 2013
Date Published: October 2014

Prepared by Expert Panel
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NUREG/CR-7153, Vol. 3
ORNL/TM-2013/532

Expanded Materials Degradation Assessment (EMDA)

Volume 3: Aging of Reactor Pressure Vessels

Manuscript Completed: October 2013
Date Published: October 2014

Prepared by Expert Panel
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U.S. Nuclear Regulatory Commission: Mark T. Kirk
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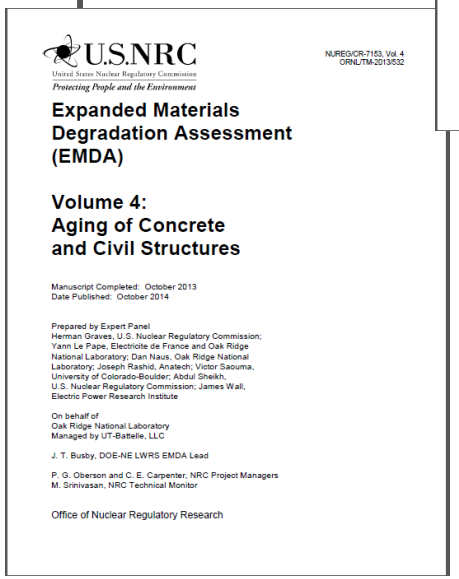
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NUREG/CR-7153, Vol. 4
ORNL/TM-2013/532

Expanded Materials Degradation Assessment (EMDA)

Volume 4: Aging of Concrete and Civil Structures

Manuscript Completed: October 2013
Date Published: October 2014

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NUREG/CR-7153, Vol. 5
ORNL/TM-2013/532

Expanded Materials Degradation Assessment (EMDA)

Volume 5: Aging of Cables and Cable Systems

Manuscript Completed: October 2013
Date Published: October 2014

Prepared by Expert Panel
Robert Bernstein, Sandia National Laboratory; Sue Burnay, John Knott Associates; Clifford Doutt, U.S. Nuclear Regulatory Commission; Ken Gillen, Sandia National Laboratory-Retired; Robert Konnik, Marmon Innovation and Technology Group; Sheila Ray, U.S. Nuclear Regulatory Commission; Kevin Simmons, Pacific Northwest National Laboratory; Gary Toman, Electric Power Research Institute; Gregory Von White II, Sandia National Laboratory

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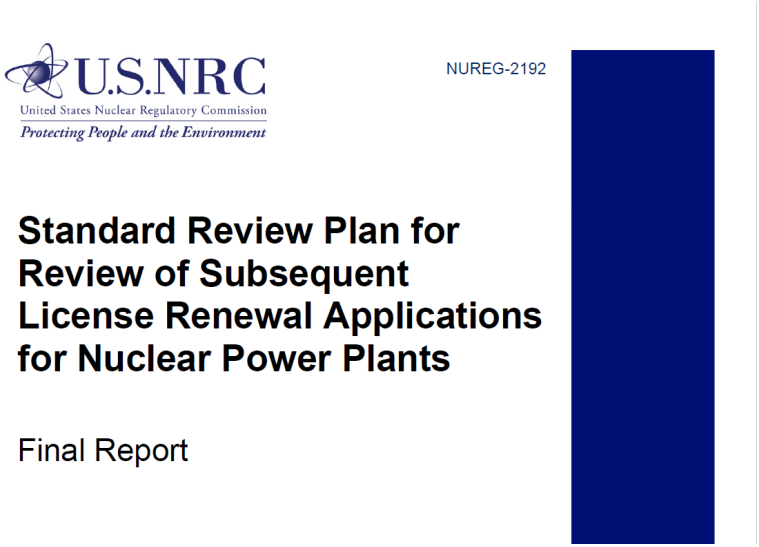
Basis for Changes to Develop GALL-SLR

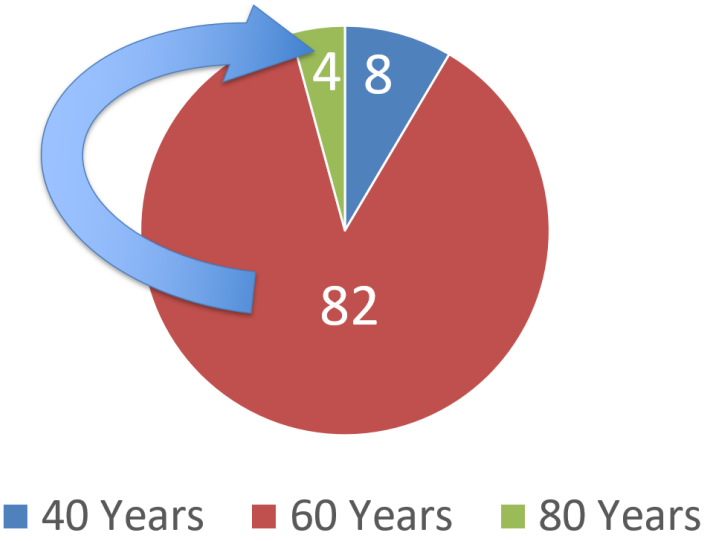
- To reflect expected aging differences for increased operating time from 60 to 80 years
- New plant operating experience since GALL Rev. 2
- Gaps identified in current guidance
- Improvements in efficiency and effectiveness of applications and NRC reviews
- Corrections to GALL Rev. 2 and SRP-LR Rev.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

SLR Guidance Documents



License Renewal Status

- 94 operating reactor units in the U.S.
- Renewed licenses issued for 94 units (8 have ceased operations)
  - 8 units with 40-year licenses (Diablo Canyon will shutdown 2024/2025)
  - 82 units with 60-year licenses
  - 4 units with 80-year licenses (Turkey Point and Peach Bottom)
- 55 units (48 operating) have entered their 41st year of operation; first was in April 2009
  - more than 350 reactor-years of operation beyond the initial 40-year licenses
- SLR application status
  - 3 applications under review
    - Surry Power Station, Units 1 and 2
    - North Anna Power Station, Units 1 and 2
    - Point Beach, Units 1 and 2
  - 1 expected application
    - Oconee Nuclear Station, Units 1, 2, and 3 – by the end of 2021



Today's Meeting

Purpose: public dialogue related to the need (and timing) for the NRC to consider the potential technical issues and guidance document development related to license renewal that would authorize operation for up to 100 years

- Should the NRC begin to consider the potential technical issues and the development of guidance documents to support license renewal to authorize operation for up to 100 years, and if so, when?
- What are the technical issues that could be potential challenges for license renewal to 100 years?
- What approaches should be used to optimize the development of data to address potential technical challenge areas, if any, for operation up to 100 years?

Presenters/Organizations

- Beyond Nuclear (Paul Gunter)
- Electric Power Research Institute (Emma Wong)
  - Michael Burke
  - Sam Johnson
  - Andrew Mantey
- Nuclear Energy Institute (Christopher Earls)
- Oak Ridge National Laboratory/DOE (Thomas Rosseel)
  - Michael Sokolov
  - Yann Le Pape
- Pacific Northwest National Laboratory/DOE (Leo Fifield)
- Texas A&M/DOE (Frank Garner)
- University of Colorado-Boulder (Victor Saouma, C-10 Tech. Advisor)
- NRC
  - Carol Moyer
  - Mita Sircar
  - Darrell Murdock

Meeting Flow

- For each topic:
  - NRC presentation regarding on-going research
  - Presentations from invited speakers
  - Public comment period
  - Roundtable discussion in any remaining time
- Following the four topics:
  - Final discussion and summary
  - Closing remarks – Anna Bradford

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

Acronyms and Initialisms

AMP	Aging management program
AMR	Aging management review
ASR	Alkali-silica reaction
CFR	Code of Federal Regulations
CLB	Current licensing basis
GALL	Generic Aging Lessons Learned
ISG	Interim Staff Guidance
LR	License renewal
NEI	Nuclear Energy Institute
NRC	Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
PEO	Period of extended operation
PNNL	Pacific Northwest National Lab.
PTS	Pressurized Thermal Shock
SCs	Structure and components
SECY	NRC Commission paper
SLR	Subsequent license renewal
SRM	Staff Requirement Memoranda
SRP	Standard Review Plan
SSCs	Systems, structures and components
TLAA	Time-limited aging analysis