Age-Related Degradation

Inspector Training

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

Engineering Inspection Guidelines

- Maintain risk-informed focus.
- Identify deficient conditions that would not normally be readily identifiable through routine plant activities or performance indicators (e.g., monitoring during normal operation or surveillance tests).
- Allow inspections that are focused on recent plant changes and operating experience.
- Maintain the NRC's role as an independent regulator.

Why inspect ARD Next?

- Age-related degradation was identified as an overall gap in the engineering inspections by the Engineering Inspection Working Group (EIWG) formed in 2017 and provided the evaluation and recommendations that led to the recent changes in the engineering inspection program (SECY-18-0113 and SECY-22-0053).
- The EIWG also recommended aging management programs as a potential focused engineering inspection area.
- The ARD inspection was created to cover age-related degradation in both active and passive components and address the gaps and recommendations originally identified by the EIWG

What drove the EIWG recommendation?

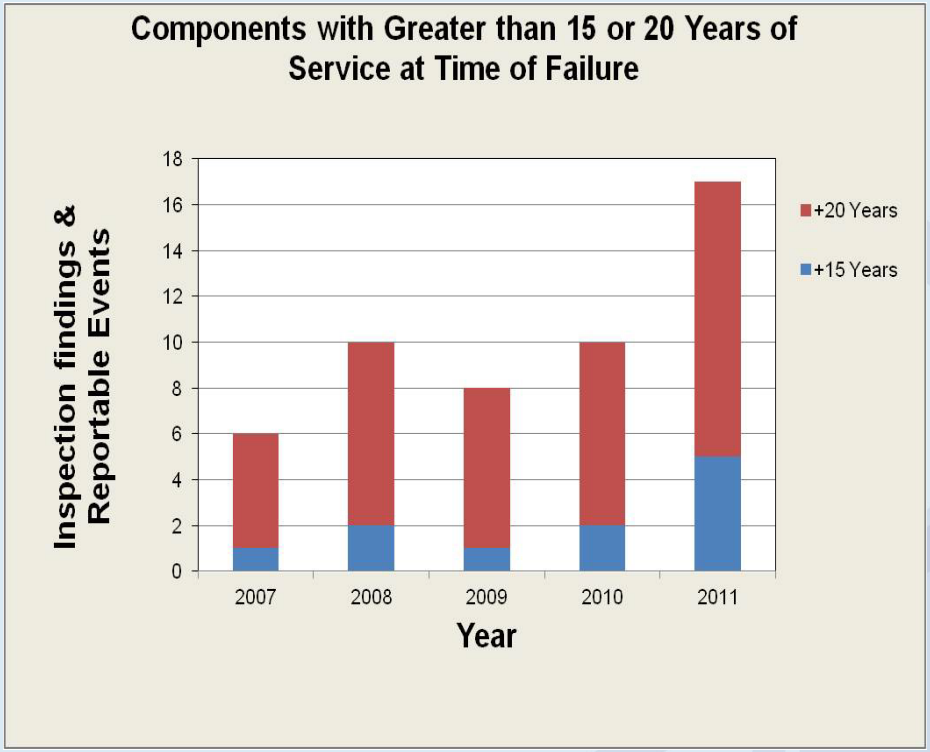
- The staff has noted multiple instances where non-conformances with the provisions of 10 CFR Part 50, Appendix B, TS, and other regulations, resulted from SSCs that were installed beyond their documented service life. In some cases, the licensee had no justification for continued service.
  - In some instances, end-of-life failures resulted.

Failed capacitor bank – end of life failures

Background

2012 IOEB Study

Study noted increase in the number of findings and reportable events involving licensees operating equipment beyond documented service life without an adequate justification.



IOEB Study - ADAMS Accession No.: ML13044A469

Objectives

- Understand the regulatory requirements and guidance regarding ARD
- Understand ARD inspection requirements, guidance and implementation
- Discuss ARD inspection planning, logistics, implementation guidance and support during inspections
- Review EQ and POV inspection lessons learned

Agenda

- Regulatory Requirements
- Inspection Preparation and Key Points
- Inspection Sample Selection
- Inspection Procedure
- Inspection Implementation Support

Regulatory Requirements

10 CFR Part 50 Appendix B

- Measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected. In the case of significant conditions adverse to quality, the measures shall assure that the cause of the condition is determined and corrective action taken to preclude repetition. The identification of the significant condition adverse to quality, the cause of the condition, and the corrective action taken shall be documented and reported to appropriate levels of management.

10 CFR Part 50.65

- The NRC regulations in 10 CFR 50.65, “Requirements for monitoring the effectiveness of maintenance at nuclear power plants,” (also known as the Maintenance Rule) help to assure proper plant maintenance and enhanced plant safety, particularly as plants age.

10 CFR 50.65

- The Maintenance Rule (MR) has a role in monitoring trends and preventing adverse performance in SSCs.
- While the MR is a requirement, compliance with it does not relieve licensees of the need to screen information that may impact how long SSCs can remain in service.
- The MR is not intended to prevent all failures. It is intended to address licensee-set performance monitoring goals and standards.
- A misconception of the MR is that compliance with the rule (alone) will alert licensees as to when an SSC needs refurbishment or replacement.

10 CFR 50.65

- Absent a performance history, the MR does not mandate licensees to do anything different just because equipment is old. However, the MR does set expectations for periodically reviewing established performance goals and consideration of industry-wide operating experience. (see 50.65(a)(3)).

- The determination of what operating experience needs to be incorporated is up to the licensee.

- Note that some SSCs do not exhibit adverse performance before failure. Thus, licensees should not rely only on the MR to inform them of when to refurbish or replace equipment.

10 CFR 50.65

- On a case by case basis, licensees can determine through evaluation that certain SSCs may be designated as “run-to failure” (also known as run-to-maintenance) if they meet specific criteria as outlined in NUMARC 93- 01, and as endorsed by RG 1.160 (e.g., the failure provides little or no contribution to system safety function) (“run-to maintenance” is another related term used by the industry)

- Inspectors should understand and be familiar with a licensee’s specific criteria for determining how SSCs can be run-to-failure relative to the staff-endorsed procedural guidance (e.g., NUMARC 93-01).

Inspection Key Points

- We are looking at how licensees handle ARD through performance-based inspection:
  - Select risk-informed samples
  - Select samples at risk/history of age-related degradation
    - Understand the licensee engineering involvement in maintenance changes

Inspection Key Points

- **Are Licensees Required to Define a Service Life for all Safety-Related SSCs?**

No, there is no regulatory requirement to define replacement/refurbishment intervals for all safety-related SSCs.

However, some exceptions/additional requirements exist:

- 10 CFR 50.49 (qualified life of electrical equipment in harsh environment)
- Other licensing bases (e.g., UFSAR) that define or list replacement/refurbishment intervals
- Aging management programs that are incorporated into a plant's licensing basis

Inspection Key Points

– **Other considerations include:**

- There are SSCs installed during original plant licensing that were procured without service life documentation. However, it is the responsibility of the licensee to provide assurances that safety-related SSCs can perform their function over the life of the plant.

- However, many SSCs **<u>are</u>** installed in the plant with a documented service life. This documentation may be vendor, licensee, or industry-generated and may be contained or referenced in plant procedures, vendor manuals*, UFSAR, or other licensee documents.

*Vendor recommended replacement/maintenance is not a regulatory requirement

Inspection Key Points

- **Other considerations include: (cont.)**

- On a case by case basis, licensees can determine through evaluation that certain SSCs may be designated as “run-to-failure” if they meet specific criteria as outlined in NUMARC 93-01, and as endorsed by RG 1.160 (e.g., the failure does not result in a scram, transient, or loss of safety function)

- Inspectors should evaluate all safety-related SSCs that have been designated as run-to-failure to ensure that staff-endorsed procedural guidance (e.g., NUMARC 93-01) is met.

Inspection Preparation

- Review OpE for potential issues at the site you are inspecting.

- NRC Generic Communications (Bulletins, Generic Letters, Information Notices, etc.) for equipment failures associated with degradation mechanisms.
- Industry operating experience associated with age-related degradation (Team leads should consult with the Generic Communications and Operating Experience Branch (IOEB) to identify potential samples).
- Industry operating experience associated with abnormal/accelerated wear or other degradation.
- Part 21 Reports applicable to the site.

Inspection Team

- 3 NRC inspectors
  - 2-week onsite inspection with an in-between week.
- Inspection team make-up
  - Primarily engineering inspectors
    - Resident and other ROP inspectors can be considered
    - Inspection samples may call for regional cross-branch expertise. (i.e. electrical inspector)

Are You and Your Team Ready to Inspect?

- Have you received the required training? (this!)
- Do you have enough knowledge and information to select samples and plan the inspection?(applicable industry OpE, and known site issues/weaknesses with ARD)
- If the answer to the above questions is “No,” stop and contact your supervisor for guidance.

ARD Inspection Procedure

IP 71111.21N.04 Objectives

- To verify that engineering performance and maintenance activities to address age-related degradation for structures and components (SCs) are being conducted in a manner that provides reasonable assurance of the safe operation of the plant.

- To verify that age-related degradation for plant SCs are appropriately identified, addressed, and corrected.

Content

- IP 71111 Attachment 21.N.04 specifies ARD inspection requirements.
- Appendix A - provides background.
- Enclosure 1 - provides guidance on the information request.
- Attachment 1 - inspection notification template for your option.

Inspection Requirements

- For each inspection sample, determine the intended safety functions of the SC and identify maintenance and engineering activities (preventative, corrective, testing, inspection, and condition monitoring procedures) credited to address age-related degradation.
- Verify and evaluate the maintenance and engineering activities credited to identify, monitor, and/or assess degradation (preventative, corrective, testing, engineering evaluations, inspection, and condition monitoring) are being completed with standards and procedures, at an appropriate interval, and acceptance criteria are appropriate.
- Verify that issues identified during the performance of maintenance, surveillance, testing, inspection, and condition monitoring are appropriately addressed, if applicable.
- Verify whether periodic evaluations of maintenance effectiveness, feedback and process adjustments, and on-going reviews of operating experience are performed.

02.01 Sample Selection

- A given sample should be at the component/structure level focusing on the sub-components that have a higher potential to be susceptible to the effects of aging. Both active and passive components within the component/structure may be reviewed in each sample.

- A given sample may consist of a component that has a higher potential to be susceptible to the effects of aging and is installed in multiple systems.

- The inspection team leaders should ensure that a mix of active and passive SCs are reviewed and that the plan is not overly focused on either active or passive SCs.

- The sample selection process should use a risk-informed, performance- or results-based approach to identify risk informed SCs susceptible to age-related degradation. Team leaders should focus on engineering and maintenance activities credited to maintain SC functionality.

02.01 Sample Selection

- NRC Generic Communications (Bulletins, Generic Letters, Information Notices, etc.) for equipment failures associated with degradation mechanisms.
- Industry operating experience associated with age-related degradation (Team leads should consult with the Generic Communications and Operating Experience Branch (IOEB) to identify potential samples).
- Industry operating experience associated with abnormal/accelerated wear or other degradation.
- Part 21 Reports applicable to the site.
- Site specific functional failures.
- Site specific performance indicators.
- Site specific corrective actions associated with component failures.

02.01 Sample Selection

- Site specific corrective actions associated with aging-related degradation.
- Site specific corrective actions associated with abnormal/accelerated wear or other degradation.
- Walkdowns performed as part of the site visit.
- Resident inspector input.
- Samples should comprise a balanced selection of single components and subsystem samples that involves both active and passive functions.

02.01 Sample Selection

- The sample selection preference, from most preferred to least preferred, is as follows:

  1. Risk-significant SCs with prior history of failures or inoperability potentially due to age-related degradation.
  2. Risk-significant SCs exposed to environments that could cause age-related degradation based on condition monitoring or no replacement interval (i.e., corrosive environment, radiation, vibration, elevated temperature, etc. not under 10 CFR 50.49 requirements).
  3. Risk-significant SCs exposed to environments that could cause age-related degradation (i.e., corrosive environment, radiation, vibration, elevated temperature, etc. not under 10 CFR 50.49 requirements) with replacement intervals that differ from vendor input or operating experience.
  4. Risk-significant SCs with engineering evaluations that accepted the use of degraded or non-conforming components.
  5. RISC-3 SCs (for licensees that implement 10 CFR 50.69).
  6. Non-safety-related SCs within the scope of 10 CFR 50.65 or 10 CFR 54.

OpE Website Walkthrough

- Operating Experience Hub

Sample Components

Based on operating experience searches these are a sampling of components that could be inspected.

- Relays
  - Agastat
  - Stuck contactors on RCR, RX and FCR relays
  - RPS timing relays
- Breakers
  - Molded case circuit breakers – such as hardening of lubricate used in the breaker
  - Breaker motor contactor
  - Interlock switches
- UPS
  - Tachometer coupling constructed of elastomer (polyurethane body)
- Capacitors
  - Electrolytic (such as in EDG governor systems)
- Switches
  - Rotary-style key switch assembly that consists of wafer-style deck layers
- Bus ducts/Cable trays
  - Connectors
  - Insulators

Sample Components

- **Based on operating experience searches these are a sampling of components that could be inspected (continued).**

- Dampers
  - Swivels
- Strainers
  - Motor coupling connections such as a rubber sleave
- Valves
  - Air operated valve positioners
  - Diaphragm (AOVs, PCVs and air regulators)
  - Electromatic Relief Valves internal guide posts
- EDGs
  - Flexible hoses
  - Jacket water pump seals (elastomer)
  - Fan shaft
  - Couplings such as a rubber gland
  - Electrical connects such as lug nuts
- Flood seals
- Steam bellows expansion joints

02.02 Site Visit

- It is recommended that the TL perform this trip at least one month prior to the onsite portions of the inspection. The TL shall make arrangements to transfer inspection-related information to other NRC staff assigned to the inspection.

During/After the inspection

- All findings are processed through normal ROP/enforcement processes.
  - Just like all previous engineering inspections.
- Following the exit, will hold cross-regional panels to ensure consistency and allow for information sharing between regions. (First 6 months, then as needed)
- Follow all normal guidance for inspection exit, inspection report timing, etc.

EQ/POV Inspection Lessons Learned

FEI Inspection Enhancements

- Training for inspectors developed and provided (technical and process focused).
- Identification of singular technical and programmatic points-of-contact.
- Tabletop Dry Run scenarios included as part of training including Minor/more-than-minor examples .
- Technical and Programmatic leads provide support for inspections as needed.
- Findings Review Panel established for at least first 6 months of implementation.

Points of Contact

- Technical POCs (For Aging Management, License Renewal):
  - John Wise – Senior Technical Advisor for License Renewal and Aging Management

    NRR/DNRL
  - Andy Johnson – Senior Materials Engineer NRR/DNRL/NCSG

Points of Contact

- Programmatic POCs:
  - Doug Bollock – Senior Reactor Operations Engineer NRR/DRO/IRIB
  - Amar Patel – Reactor Operations Engineer NRR/DRO/IRIB

Inspection Support

Technical POCs

- Communicate with as much as needed for Aging Management or License Renewal questions

Inspection Support

Programmatic POCs

- Communicate with as much as needed
  - Before the inspection: any questions on inspection preparation
  - During the inspection: for any inspection implementation questions
  - After the inspection: in helping develop any findings or violations

Inspection Support

POCs will observe the first inspection in each region:

- Provide immediate feedback to inspectors on any implementation issues or questions.
- Answer any programmatic questions the licensees may have.
- Field industry observer questions so the inspection team can focus on implementation
- Note feedback from the inspections to make timely changes to the IP if needed.

Q&A Session

Future questions

Programmatic POCs:

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