

AUDIT REPORT

Audit of NRC's Oversight of Active Component Aging

OIG-14-A-02 –October 28, 2013



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**UNITED STATES
NUCLEAR REGULATORY COMMISSION**
WASHINGTON, D.C. 20555-0001

**OFFICE OF THE
INSPECTOR GENERAL**

October 28, 2013

MEMORANDUM TO: Mark A. Satorius
Executive Director for Operations

FROM: Stephen D. Dingbaum */RA/*
Assistant Inspector General for Audits

SUBJECT: AUDIT OF NRC'S OVERSIGHT OF ACTIVE COMPONENT
AGING (OIG-14-A-02)

Attached is the Office of the Inspector General's (OIG) audit report titled *Audit of NRC's Oversight of Active Component Aging*.

The report presents the results of the subject audit. The agency provided comments to the report on September 27, 2013. The agency's comments have been incorporated into the report at Appendix B.

Please provide information on actions taken or planned on each of the recommendations within 30 days of the date of this memorandum. Actions taken or planned are subject to OIG followup as stated in Management Directive 6.1.

We appreciate the cooperation extended to us by members of your staff during the audit. If you have any questions or comments about our report, please contact me at 415-5915 or R.K. Wild, Team Leader, Nuclear Reactor Safety Audits Team, at 415-5948.

Attachment: As stated

EXECUTIVE SUMMARY

BACKGROUND

The Atomic Energy Act and Nuclear Regulatory Commission (NRC) regulations limit commercial nuclear power reactor licenses to an initial 40 years. Due to this selected period, some components may have been engineered on the basis of an expected 40-year service life. Components degraded due to aging have caused reactor shutdowns, failure of safety-related equipment, and reduction in the safety margin of operating nuclear power plants. Therefore, effective and proactive management of aging of components is a key element for safe and reliable nuclear power plant operation.

NRC has established commercial nuclear power reactor industry requirements that exclude some components—referred to as active components—from a license renewal aging management review. Active components are those that perform their intended functions with moving parts or a change in state. Examples of active components include power supplies, motors, diesel generators, cooling fans, batteries, relays, and switches. According to NRC, active components are not subject to review as part of NRC's review of license renewal applications because of the existing regulatory process and existing licensee programs and activities.

The NRC Office of Nuclear Reactor Regulation and the regional offices provide regulatory oversight of industry's active component aging activities. NRC addresses aging active component issues through a number of different regulations and guidance, to include Title 10 Code of Federal Regulations (CFR), Part 50.65, *Requirements for monitoring the effectiveness of maintenance at nuclear power plants* (the Maintenance Rule, as amended), 10 CFR Part 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants*, and 10 CFR 50.36, *Technical specifications*.

OBJECTIVE

The objective of this audit was to determine if NRC is providing effective oversight of industry's aging component programs.

RESULTS IN BRIEF

Oversight of Active Component Aging Could Be Improved

Oversight of licensees' activities, including active component aging, should be structured and coordinated. However, NRC's approach for oversight of licensees' management of active component aging is not focused or coordinated. This has occurred because NRC has not conducted a systematic evaluation of program needs for overseeing licensees' aging management for active components since the establishment of the Reactor Oversight Process (ROP) in 2000, and does not have mechanisms for systematic and continual monitoring, collecting, and trending of age-related data for active components. Consequently, NRC cannot be fully assured that it is effectively overseeing licensees' management of aging active components.

RECOMMENDATIONS

This report makes two recommendations to improve the agency's oversight of aging active component activities.

AGENCY COMMENTS

During an August 20, 2013, exit conference and an August 26, 2013, staff meeting, agency provided informal comments, which OIG subsequently incorporated into the draft report as appropriate.

On September 27, 2013, NRC provided formal comments to the draft report. The agency's stated that its oversight of active component aging issues is being effectively dealt with under existing oversight procedures, and that its existing ROP provides the framework for ensuring that aging issues with the potential to impact safety are addressed in a timely manner.

OIG's central message is that because the agency uses regulations and inspections procedures for oversight of aging issues that predate the 2000

implementation of ROP and has not since evaluated whether this regulations and procedures still function as intended, the agency is not able to determine the effectiveness of aging component oversight.

Appendix A contains the audit Objective, Scope, and Methodology; Appendix B contains a copy of the agency's formal comments; and Appendix C contains OIG's analysis of the agency's formal comments.

ABBREVIATIONS AND ACRONYMS

CFR	Code of Federal Regulations
IOEB	Operating Experience Branch
INL	Idaho National Laboratory
NRC	Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
OIG	Office of the Inspector General
ROP	Reactor Oversight Process

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I. BACKGROUND

The Atomic Energy Act and Nuclear Regulatory Commission (NRC) regulations limit commercial nuclear power reactor licenses to an initial 40 years. Due to this selected period, some components may have been engineered on the basis of an expected 40-year service life. However, components that have aged during the 40-year period can have impacts on both the safety and the performance of nuclear power plants. Components degraded due to aging have caused reactor shutdowns, failure of safety-related equipment, and reduction in the safety margin of operating nuclear power plants. Therefore, effective and proactive management of aging of components is a key element for safe and reliable nuclear power plant operation.

Aging is defined as a general process in which characteristics of components¹ gradually change with time or use. Some examples of aging mechanisms include wear, fatigue, erosion, microbiological fouling, embrittlement, and chemical or biological reactions, or combinations of these processes. Proactive aging management means management of the aging of components that is implemented with foresight and anticipation throughout the component's lifetime.²

NRC has established commercial nuclear power reactor industry requirements that exclude some components—referred to as active components—from a license renewal aging management review.³ Active components are those that perform their intended functions with moving parts or a change in state. Examples of active components include power supplies, motors, diesel generators, cooling fans, batteries, relays, and switches. According to NRC, active components are not subject to review as part of NRC's review of license renewal applications because of the existing regulatory process and existing licensee programs and activities.

¹ For the purposes of this report, the Office of the Inspector General (OIG) uses the term components in place of safety-related structures, systems, and components.

² *Proactive Management of Ageing for Nuclear Power Plants*, International Atomic Energy Agency, Vienna, 2009.

³ Commercial power reactor licenses can and have been renewed beyond 40 years. As part of license renewal, plants undergo an aging management review by the NRC that includes passive components. Passive components are components that perform an intended function (as described in Title 10 Code of Federal Regulations (CFR) Part 54.4) without moving parts or without a change in configuration or properties and include the reactor vessel, steam generators, and ventilation ducts.

Oversight Responsibility for Active Component Aging Activities

The NRC Office of Nuclear Reactor Regulation (NRR) and the regional offices provide regulatory oversight of industry's active component aging activities. Agency officials stated that NRC oversight of reactor licensees is conducted within the Reactor Oversight Process (ROP) framework. The ROP is the agency's program to inspect, measure, and assess the safety performance of commercial nuclear power plants and to respond to any decline in performance. OIG auditors did not review the entire ROP framework. OIG focused on NRC's active component aging-related oversight activities both within and outside the ROP framework.

Primarily, two branches in the NRR Division of Inspections and Regional Support—as well as the Divisions of Reactor Projects in NRC regional offices—have responsibility for regulatory oversight of licensee programs, which would include licensee management of active component aging. Within NRR, Reactor Inspection Branch responsibilities include providing programmatic leadership and support for activities associated with inspecting and assessing licensee performance at commercial nuclear power plants. This includes providing the necessary infrastructure for the inspection program in coordination with the regional offices, and supporting enhanced inspection teams and the ROP. The Operating Experience Branch (IOEB) collects, evaluates, and communicates information that may have caused domestic and international reactor events and provides lessons learned from those events to headquarters, the regions, and licensees. While not responsible for oversight, the Office of Nuclear Regulatory Research provides support that includes technical advice, technical tools, and information for identifying and resolving safety issues, including for aging phenomena.

Regulations Applicable to Active Component Aging Oversight

No Federal law or regulation that pertains to NRC specifically provides for the oversight of aging active components. However, NRC inspectors have used the following regulations to support a basis for age-related inspection findings and violations:

- 10 CFR Part 50.65, *Requirements for monitoring the effectiveness of maintenance at nuclear power plants* (the Maintenance Rule, as amended) was issued on July 10, 1991.

The Maintenance Rule requires, in part, that licensees:

...shall monitor the performance or condition of structures, systems, or components, against licensee-established goals, in a manner sufficient to provide reasonable assurance that these structures, systems, and components [...] are capable of fulfilling their intended functions. These goals shall be established commensurate with safety and, where practical, take into account industry-wide operating experience. [...] Monitoring [...] is not required where it has been demonstrated that the performance or condition of a structure, system, or component is being effectively controlled through the performance of appropriate preventive maintenance... .

- 10 CFR Part 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants* (10 CFR Part 50, Appendix B), requires licensees to maintain a quality assurance program for the design, fabrication, construction, and testing of the structures, systems, and components of the facility.
- 10 CFR Part 50.36, *Technical specifications*, requires licensees to maintain administrative controls, including procedures for maintenance, to assure operation of the facility in a safe manner. Inspectors sometimes cite licensees for inadequate procedures that led to age-related degradation under this regulation.

Additionally, there are ROP and other inspection procedures, as well as industry operating experience that offer NRC inspectors and staff flexibility when used for active component aging oversight. Some, but not all, relevant inspection procedures, reports, and studies are listed in Appendix A of this report.

II. OBJECTIVE

The objective of this audit was to determine if NRC is providing effective oversight of industry's aging component programs.

Appendix A of this report contains information on the audit scope and methodology.

III. FINDING

OVERSIGHT OF ACTIVE COMPONENT AGING COULD BE IMPROVED

Oversight of licensees' activities, including active component aging, should be structured and coordinated. However, NRC's approach for oversight of licensees' management of active component aging is not focused or coordinated. This has occurred because NRC has not conducted a systematic evaluation of program needs for overseeing licensees' aging management for active components since the establishment of ROP in 2000, and does not have mechanisms for systematic and continual monitoring, collecting, and trending of age-related data for active components. Consequently, NRC cannot be fully assured that it is effectively overseeing licensees' management of aging active components.

Structured Oversight

Oversight of licensee's activities should be structured, coordinated, and based on the best available knowledge from research and operational experience. Commonly accepted, formal approaches to planning of Government programs include establishing an overall strategy and goals, establishing methodologies for setting priorities, identifying program-specific performance metrics, and managing resources. Additionally, *NRC Principles of Good Regulation* require that NRC manages and administers its regulatory activities cooperatively and efficiently, that regulatory decisions should be made without undue delay, and that regulations should be based on the best available knowledge from research and operational experience.

Furthermore, current and former NRC Commissioners, senior management officials, and managers have expectations that the agency is providing effective oversight of industry's active component aging programs and have repeatedly emphasized the importance of aging oversight. During the 2013 NRC Regulatory Information Conference, the current NRC Chairman noted that despite an established rigorous program for aging management, NRC and industry must be prepared to contend with unknowns. Former NRC Commissioners, senior management officials, and managers have also expressed the importance of strong aging management programs, including those for active components, and one senior manager stated that NRC currently has programs in place to monitor aging of active components. Agency managers have also emphasized the importance of oversight for active component aging activities. However, current and former managers having expectations for effective oversight of industry's aging plants generally did not make a distinction between active components and those passive components covered by license renewal aging management reviews.

Oversight Structure for Aging Active Component Activities Is Not Focused or Coordinated

NRC's approach for oversight of licensees' management of active component aging is not focused or coordinated. This approach includes staff-initiated projects and inspection activities using regulations to cite licensees for age-related degradation of active components that are not specific to aging. This challenge is compounded by agency senior managers who are not aware of these uncoordinated activities.

Staff-Initiated Projects

NRC program offices in headquarters and the regions have undertaken staff-initiated projects to evaluate age-related active component failures. Specifically, the staff-initiated projects have been for data collection, analysis, and inspection.

Independent of any specific management direction, NRC staff have initiated efforts to obtain data for addressing the subject of aging active

components because operating experience data is not routinely evaluated for information pertaining to the aging of active components. In 2012, NRR's Operating Experience Branch (IOEB) published the *IOEB Component Aging Study 2007-2011 — Insights from Inspection Findings and Reportable Events*, July 24, 2012 (*IOEB Study*).⁴ The *IOEB Study* focused on safety-related and important-to-safety active component failures attributed to age-related degradation. In part, the *IOEB Study* noted that the number of occurrences involving age-related active component failures has increased since 2009. The *IOEB Study* concluded that some licensees do not have effective life-cycle preventive maintenance programs for some components where industry and vendor experience has suggested this is necessary. Furthermore, the *IOEB Study* concluded that NRC oversight programs may not be focused on aging management of active components and these programs could be better prepared to deal effectively with an industry that potentially is experiencing notable occurrences of age-related component failures.

The results of the *IOEB Study* prompted other NRC offices to generate active component age-related projects, again, without top agency management oversight and without any coordination. The Office of Nuclear Regulatory Research reviewed available active component age-related data⁵ contained in the Idaho National Laboratory (INL) report, *Component Age Traits from EPIX*, July 3, 2012. The INL report also evaluated the extent to which age-related active component failures were increasing, but Office of Nuclear Regulatory Research staff could not determine from the INL report if that was the case, due to limitations with the available data.

In another active component age-related project, regional office inspection staff familiar with active component aging problems and the *IOEB Study* conducted what staff described as an inspection to determine if active component aging could be addressed through existing inspection procedures. Accordingly, a Problem Identification and Resolution inspection was scheduled and conducted in November 2012 with the objective of gathering information to determine if a licensee had a periodic, time-based replacement program for aging active components.

⁴ This study is publically available; see ADAMS accession number ML13044A469.

⁵ These data were originally sourced from the Institute for Nuclear Power Operations Equipment Performance and Information Exchange database.

Regulations Used for Citing Licensees for Age-Related Degradation

Inspectors can use various NRC regulations to cite licensees for age-related degradation of active components that are not specific to aging. These regulations do not establish limits on the age of active components in commercial nuclear power plants, or prohibit degradation of active components by aging. Instead, NRC has regulations that establish equipment performance requirements that may not be met by components that have degraded due to aging. Inspectors said that they use the following regulations for inspections to meet the challenge of identifying aging active components and citing licensees for age-related violations:

- 10 CFR 50.65, *Requirements for monitoring the effectiveness of maintenance at nuclear power plants* (the Maintenance Rule).
- 10 CFR Part 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants*.
- 10 CFR 50.36, *Technical specifications*.

The Maintenance Rule

NRC inspectors' experience with citing licensees for violations of the Maintenance Rule for age-related active component failures varies because—as NRR and regional inspection staff explained—the Maintenance Rule is not well understood by less experienced NRC staff. Furthermore, NRR and regional staff said that there are not enough NRC staff with Maintenance Rule experience who can use it to cite licensees for age-related failures within the performance-based ROP framework. NRC management and staff also conveyed that an experienced inspector may cite a licensee for age-related inspection findings and violations under the Maintenance Rule Section (a)(3) when the licensee has not taken into consideration applicable operating experience, whereas less experienced inspectors are less likely to do so. Other NRC staff voiced a similar concern regarding a lack of inspectors with experience using the Maintenance Rule. OIG noted that inspectors have rarely used the Maintenance Rule to cite licensees for failure of safety-related components due to aging. Of the 105 age-related active component failures and reportable events from 2007 to 2011 identified in the *IOEB Study*, only 3 were cited for violations of the Maintenance Rule. Although Maintenance Rule violations do include some findings attributed to aging,

most Maintenance Rule violations do not include end of life aging as defined by the *IOEB Study*.

The following table provides additional details relating to the three Maintenance Rule violations noted above. In each case, the licensee left active components in service until they failed through shortcomings in preventive maintenance activities.

Figure 1: Three NRC Maintenance Rule Citations, 2007-2011

Date	Plant	Type of Age-Related Failure	Cause
2011	Waterford	Electronic control components for cooling towers failed after operating for 25 years.	Aging. The maintenance to replace the components was deleted from preventive maintenance activities.
2009	Catawba	Auxiliary feed water sump valves important to plant safety failed.	Aging. No maintenance was performed on the valves since plant startup in 1985.
2007	Brunswick	A relay for controlling an emergency diesel generator failed.	Aging. The relay's coil failed due to the deferral of maintenance.

Source: *IOEB Study*

According to agency staff, the ROP's emphasis on performance-based and risk-informed oversight limits their ability to evaluate licensee preventive maintenance programs. This limitation exists because NRC does not perform programmatic inspections of licensees' preventive maintenance programs. For example, a regional senior management

official described how there were aging problems found at Fort Calhoun by the inspectors during additional inspections after a flood, but routine ROP inspections are not structured to focus inspection resources on active component age-related issues. Another regional senior management official confirmed that the ROP does not have provisions to look at a licensee's preventive maintenance programs, but focuses on performance and evaluates licensee response to failures after the fact—that is, after a component failure—and how the licensee addresses the cause of the failure as part of its Corrective Action Program.

Several NRC staff with inspection experience stated that the Maintenance Rule as currently in use is not structured to address aging active components.

Other Regulations Used for Citing Licensees for Age-Related Failures

Inspectors are likely to use other regulatory provisions—specifically, 10 CFR Part 50, Appendix B, and plant technical specifications—for citing licensees for age-related failures because findings can be supported and justified more readily than by using the Maintenance Rule. According to NRC staff, using 10 CFR Part 50, Appendix B, provisions to cite licensees for quality assurance shortcomings related to component design, fabrication, construction, operation, and testing is easier than using the Maintenance Rule. Similarly, NRC inspectors have cited licensees for violating plant technical specifications, specifically for lacking adequate justification for running active components beyond vendor recommended life and not having appropriate maintenance procedures in place. However, 10 CFR Part 50, Appendix B, and 10 CFR 50.36, *Technical specifications*, do not contain age-related criteria for supporting age-related findings.

Management Not Always Cognizant of Active Aging Component Activities

Agency managers are not always cognizant of the staff's activities related to active component aging. NRR senior managers were not aware of the status of staff implementation of the *IOEB Study* conclusions and recommendations. Although senior managers indicated that NRC has robust programs in place that address active component aging and that staff were following up on the *IOEB Study* conclusions and recommendations, neither was the case during the course of the audit.

Staff indicated that the agency is taking action to follow up on the results of the aging component study, but the agency's plan for considering and implementing the *IOEB Study* conclusions and recommendations is unclear.

Although the *IOEB Study* was peer-reviewed and issued internally via OpE COMM⁶ in June 2012 and presented to an ROP enhancement group in March 2013, a number of senior managers and program office and regional staff having active component aging responsibilities were unfamiliar with the status of staff implementation of the *IOEB Study* conclusions and recommendations. One NRR senior manager indicated that the *IOEB Study* was an important effort and thought that agency staff were following up on the study's conclusions and recommendations. However, the NRR senior manager's direct report and regional senior managers that the NRR senior manager identified as familiar with the *IOEB Study* were not aware of the details of the study or proposed followup actions.

NRR senior management also indicated that regional office management officials would provide insight on aging active component efforts and follow up on the *IOEB Study* conclusions and recommendations. However, of the two regional management officials to whom NRC staff had provided copies of the report, one noted that the *IOEB Study* was for informational purposes only and did not require action. Furthermore, neither was aware of the details of the *IOEB Study* and therefore was not able to offer insight on aging active component efforts and staff followup on the *IOEB Study* conclusions and recommendations.

Furthermore, agency managers and staff have conflicting understandings of and did not coordinate how a biennial ROP enhancement effort⁷ may incorporate changes to active component aging oversight. Specifically, senior managers indicated that *IOEB Study* conclusions and

⁶ OpE COMMs (Operating Experience Communications) contain preliminary information in the interest of timely internal communication of operating experience. OpE COMMs may be predecisional and may contain sensitive information. They are not intended for distribution outside the agency.

⁷ The biennial ROP review allows NRC to evaluate licensee performance on a regular, recurring basis. In 2013, NRC undertook to enhance the review by taking additional measures as part of the review. During the review, named ROP Enhancement—Baseline Inspection Program, champions and key staff will make changes to the inspection procedures based on analysis completed by the inspection procedure owners, information and knowledge from inspectors, special groups and reports, lessons learned, and recent events and inspections.

recommendations will likely be included in the 2013 ROP enhancement effort. However, a key NRR staff member involved with the review said that ROP enhancement will not include active component aging because the Maintenance Rule, in the staff's opinion, already addresses active component aging. Yet staff in the IOEB stated that, as far as they were aware, there had been no official coordination between the operating experience and the inspection branches for including active component aging oversight. Nonetheless, NRC staff were unable to provide any specific documentation of the agency's plan for including the *IOEB Study* conclusions and recommendations in the ROP enhancement effort. Consequently, OIG could not independently confirm the extent to which the subject of active component aging is being considered for inclusion in the review.

NRC Has Not Evaluated or Analyzed the Need for a Formal Program and Has Not Systematically and Continually Collected or Evaluated Active Component Age-Related Data

The unfocused and uncoordinated approach NRC uses in its oversight of licensees' active aging component activities is occurring because NRC:

- Has not conducted a systematic evaluation of program needs for overseeing licensees' aging management for active components.
- Does not have mechanisms for systematic and continual monitoring, collecting, and trending of age-related data for active components.

NRC Has Not Conducted a Systematic Program Needs Evaluation and Analysis

Since the ROP was initiated in 2000, NRC has not conducted an evaluation and analysis that would systematically determine whether the need exists for a formal active aging component oversight program. NRC has not systematically evaluated the need for specific program policies, goals, and objectives, and the need for program feedback and corrective actions for continual improvement, all within the context of the current ROP environment.⁸ The most recent evaluation of the agency's regulatory

⁸This is not to suggest that NRC inspection procedures have remained static over the years. For example, according to agency staff, Inspection Procedure 71111.21, *Component Design Bases Inspection*, was updated in August 2012

oversight of active component aging was in 1996⁹—which pre-dates the ROP—and stressed the importance of aging studies as an important part of efforts to identify and solve potential aging problems.

In addition, nuclear plants have aged almost 20 years since the most recent evaluation of the agency's regulatory oversight of active component aging in 1996. The report that resulted from this evaluation asserted that,

...active components generally do not present a significant aging problem in nuclear power plants. Design criteria and effective preventative maintenance programs, including timely replacement of components, are effective in mitigating potential aging problems... .

However, NRC does not inspect preventive maintenance programs directly and comprehensively to ensure they are effective. Aging can cause active component degradation and failure resulting in unexpected reactor power changes, failures of components to perform their safety function, and adverse effects to the safety margin. For example:

- OIG identified an unexpected reactor power change and automatic reactor shutdown that occurred at a commercial power reactor in 2012. The shutdown was due to a failed switch which had been in service over 40 years with no preventive maintenance performed.
- The *IOEB Study* reported an incident from 2010 whereby a relay failed after not being replaced or monitored at the required periodicity, resulting in the failure of an emergency diesel generator to provide power to safety systems when it was called upon to do so during a partial loss of electrical power at the plant.

to include the statement "...inspectors should try to determine through review of these corrective work maintenance activities whether licensee's preventive maintenance or other programs such as aging management are being reasonably effective in preventing component failures." OIG's wider point is that activities—such as inspection procedure changes—have been undertaken without the benefit of a systematic program needs evaluation and analysis.

⁹ NUREG/CR-6442, *Evidence of Aging Effects on Certain Safety-Related Components*, NRC and Idaho National Laboratories, 1996.

- The *IOEB Study* also reported that in 2010, an age-related failure of a pressure switch caused an unexpected reactor power change and automatic reactor shutdown. This pressure switch had been installed for 39 years.

Other active component aging studies conducted both in the United States and internationally offer examples of qualitative and quantitative data related to active component failures. In general, these studies all emphasize the importance of having a continual awareness of potential aging problems.

NRC Has Not Systematically and Continually Collected or Evaluated Active Component Age-Related Data

NRC has not developed and incorporated within policy and guidance the existing mechanisms used for systematic and continual monitoring, collecting, and trending of age-related data for active components. Age-related studies have emphasized the importance of continual monitoring, collecting, and trending of age-related data for active components in an ever changing environment. Yet, NRC has not systematically and continually collected or evaluated age-related data to determine if a specific oversight program is needed or what type of program would be necessary. Currently, NRC may identify data on active component aging intermittently during ROP inspections, but not through any methods of systematic data collection, analysis, and trending. Although the *IOEB Study* and the INL report identified age-related data from existing reports and evaluated it based on types of failure and age-related causes, discussions with NRC staff revealed that at present, age-related failures are not consistently identified in existing reporting mechanisms, when they are identified at all. An experienced NRR staff member told OIG that there could be a rise in the number of identified age-related events if the proper regulatory tools were in place to identify them.

NRC Cannot Be Fully Assured of Effective Oversight

Despite management's belief that active component aging issues are being satisfactorily addressed, NRC is not in a position to draw any conclusions one way or the other. If NRC's unfocused and uncoordinated approach for oversight of licensees' active component aging activities

continues, NRC will not be fully assured that it is effectively overseeing licensees' aging active component programs. Specifically, the agency will not be in a position to:

- Identify and evaluate trends that have safety implications.
- Proactively identify active components subject to age-related failure before they are run to failure.
- Provide complete inspector training and guidance.
- Close the performance gap between experienced inspectors who know how to identify active components that are run beyond their reasonably expected service lives and less experienced inspectors who must evaluate active component failures where age degradation may have been a significant factor.

Conclusions

NRC's unfocused and uncoordinated approach for oversight of active aging component activities is characterized by staff-initiated projects and inspection activities, and incognizant managers. Without direction from senior management, staff are conducting work to heighten awareness of active component aging and senior management is not aware of various active component aging oversight activities that are underway.

Despite concerns of component aging in nuclear power plants that are growing older, the agency does not routinely collect and monitor instances of active component failures due to aging. Indeed, the very act of inspecting for these aging effects *before* failures occur appears to be difficult for the agency to undertake under ROP. This failure to routinely collect and monitor such data runs counter to the need to do so for the agency to maintain and adjust its approach to active component aging oversight.

Recommendations

OIG recommends that the Executive Director for Operations:

1. Perform and document a thorough and systematic evaluation of the need for an NRC program to oversee the management of active component aging activities, all within the context of the current ROP environment. Evaluation elements are to include, but should not be limited to, the need for:
 - (a) Program policies, goals, and objectives.
 - (b) Program feedback and corrective actions for continual improvement.
2. Develop and incorporate the mechanisms for monitoring, collecting, and trending age-related data for active components within NRC policy and procedures.

IV. AGENCY COMMENTS

On July 22, 2013, OIG issued the discussion draft of this report to the Executive Director for Operations. OIG met with NRC management and staff on August 20, 2013, at an exit conference and on August 26, 2013 at a staff meeting to discuss the draft report content. At these meetings, the agency provided informal comments, which OIG subsequently incorporated into the draft report as appropriate.

On September 27, 2013, NRC provided formal comments to the draft report that indicated their disagreement with the audit report content. The agency's formal comments state, in part, that NRC disagrees that it needs to perform a thorough and systematic evaluation to determine the need for a specific NRC program to oversee the management of active component aging activities, because the ROP performs this task by providing a framework for ensuring that both active and passive aging issues are addressed. OIG auditors concluded that the agency is not in a position to determine the effectiveness of active component aging oversight. This is because the agency uses regulations and inspection procedures for oversight of active component aging that were established prior to the implementation of ROP in 2000 and has not, since ROP implementation, evaluated whether those regulations and inspection procedures work the same way as intended in the pre-ROP regulatory environment.

Appendix A contains the audit Objective, Scope and Methodology; Appendix B contains a copy of the agency's formal comments; and Appendix C contains OIG's analysis of the agency's formal comments.

OBJECTIVE, SCOPE, AND METHODOLOGY

OBJECTIVE

The audit objective was to determine if NRC is providing effective oversight of industry's aging component programs.

SCOPE

We conducted this performance audit at NRC headquarters in Rockville, MD, and collected information from the regional offices via telephone and in conjunction with the Audit of NRC's Support for Resident Inspectors, from October 2012 through May 2013. The audit scope was limited to NRC's regulatory responsibilities as they pertain to aging active component programs at commercial nuclear power plants. Internal controls related to the audit objectives were reviewed and analyzed.

METHODOLOGY

To address the audit objective, OIG interviewed agency senior management officials, and headquarters and regional staff. OIG also reviewed NRC regulations and guidance, as well as domestic and international operational experience reports pertaining to active aging components. OIG subsequently compared the information provided during the interviews with staff actions. Throughout the audit, auditors were aware of the possibility or existence of fraud, waste, or misuse in the program. Some of the key documents referred to in this report include the following:

Regulations:

- 10 CFR Part 50.65, *Requirements for monitoring the effectiveness of maintenance at nuclear power plants.*
- 10 CFR Part 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.*
- 10 CFR Part 50.36, *Technical specifications.*

Inspection Procedures:

- Inspection Procedure 71111.21, *Component Design Bases Inspection*.
- Inspection Procedure 71152, *Problem Identification and Resolution*.

Operating Experience Reports:

- *IOEB Component Aging Study (2007-2011) – Insights from Inspection Findings and Reportable Events*, July 24, 2012.
- *IOEB Analysis Team Study on Recent Operating Experience Ineffective Use of Vendor Technical Recommendations*, June 6, 2011.
- Idaho National Laboratories, *Component Age Traits from EPIX*, July 3, 2012.
- International Atomic Energy Agency Safety Report Series, No. 62, *Proactive Management of Ageing for Nuclear Power Plants*, 2009.
- European Commission Joint Research Center, *Ageing Related Events Topical Study*, 2011.
- NRC and Idaho National Laboratories, *Evidence of Aging Effects on Certain Safety-Related Components*, NUREG/CR-6442, 1996.

We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Contributors to this report were R.K. Wild, Team Leader; Kevin Nietmann, Senior Technical Advisor; Vicki Foster, Audit Manager; Timothy Wilson, Senior Management Analyst; Larry Weglicki, Senior Auditor; Jenny Cheung, Auditor; and Tariq Noaman, Management Analyst.


AGENCY FORMAL COMMENTS



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

September 27, 2013

MEMORANDUM TO: Stephen D. Dingbaum
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Office of the Inspector General

FROM: Michael R. Johnson 
Deputy Executive Director for Reactor
and Preparedness Programs
Office of the Executive Director of Operations

SUBJECT: FORMAL COMMENTS ON OFFICE OF THE INSPECTOR
GENERAL DRAFT REPORT ON THE NUCLEAR REGULATORY
COMMISSION'S OVERSIGHT OF ACTIVE COMPONENT AGING

This memorandum responds to Ms. Vicki Foster's September 13, 2013, e-mail transmitting the Office of the Inspector General's (OIG) revised draft report, "Audit of the U.S. Nuclear Regulatory Commission's Oversight of Active Component Aging." Based on a thorough review of the draft audit report and extensive interaction between the OIG and U.S. Nuclear Regulatory Commission (NRC) staff, the NRC disagrees with the major premise of this audit, which is that the NRC oversight of active component aging is not being effectively dealt with under existing oversight programs. Nearly all of the active component aging data contained within the Office of Nuclear Reactor Regulation (NRR) Operating Experience Branch (IOEB) Aging Study was derived from inspection findings in which NRC inspectors effectively documented active component aging issues and cited associated violations of the regulations.

The staff also does not agree that its activities for managing active component aging are not focused or coordinated. While we agree that there is no one section of the regulations or oversight programs that specifically deals with active component aging, and while there is always room for improvement, active component aging issues are effectively addressed through various aspects of the regulations and oversight programs. For example, the staff relies on Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," (Criteria III, V, XI, and XVI), technical specifications, and the Maintenance Rule, all of which deal with component degradation and age-related performance issues.

Licensee performance is assessed against these regulations under the Reactor Oversight Process (ROP), which allows inspectors and NRC managers to ensure regulatory compliance. The NRC deals with issues identified under the ROP in a performance-based and risk-informed manner. Furthermore, the NRC has ample regulations that require licensees to report performance issues that may be caused by active component aging. These include the

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reporting requirements of 10 CFR 50.72, "Immediate Notification Requirements for Operating Nuclear Power Plants," and 10 CFR 50.73, "Licensee Event Report System."

When this information is combined with ROP inspection results and industry component failure databases—all of which are routinely assessed by the staff—they provide ample visibility for the staff to collect and evaluate age-related data for active components. The staff does not believe that additional programs that involve monitoring, collecting, and trending of active component aging are necessary to identify adverse trends or to take appropriate regulatory action.

The staff also disagrees that it needs to perform a thorough and systematic evaluation to determine the need for a specific NRC program to oversee the management of active component aging activities. The ROP performs this task by providing a framework for ensuring that both active and passive aging issues with the potential to impact safety are addressed in a timely manner. The NRC has processes in place to systematically evaluate the results of the ROP, along with other data sources, and these processes provide adequate assurance that the NRC will identify safety-significant, age-related failures of active components.

Furthermore, the staff believes that no additional mechanisms are needed to monitor, collect, and trend age-related data on active component aging. The staff already collects or has access to operating experience data gathered from reportable events, international events, industry failure data, and inspection findings that are routinely screened for significance and trending and analysis. The creation of additional mechanisms to perform these tasks is not necessary.

Other staff comments on the OIG audit are as follows:

- There are valid reasons why inspectors cite different requirements to document findings involving age-related issues. These may include variability in the identified performance deficiencies, event causes, and plant licensing bases. Reasons for the variability in citing different requirements were not explored in the report.
- The staff is actively considering recommendations identified in the IOEB study for improving inspector awareness of aging issues and clarifying inspection procedure guidance as part of the ongoing ROP Enhancement Project.
- The IOEB study represented a new approach for performing analysis of ROP data. While the program has experience with the communication and implementation of recommendations for specific technical issues, the structure for implementing the kind of broad recommendations that were presented in this study, and which require coordination across multiple offices, is being refined as the recommendations are being implemented, presenting learning opportunities and challenges for their completion.

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- The NRC staff points to the overall capability of the ROP (including the structure of the Significance Determination Process) and current reporting requirements as substantive evidence that there is adequate assurance that it is addressing active component aging issues impacting safety.

cc: Chairman Macfarlane
Commissioner Svinicki
Commissioner Apostolakis
Commissioner Magwood
Commissioner Ostendorff
SECY

OIG ANALYSIS OF AGENCY FORMAL COMMENTS

On July 22, 2013, OIG issued the discussion draft of this report to the Executive Director for Operations. OIG met with NRC management and staff on August 20, 2013, at an exit conference and on August 26, 2013, at a staff meeting to discuss the draft report content. At these meetings, the agency provided informal comments, which OIG subsequently incorporated into the draft report as appropriate. On September 27, 2013, NRC provided formal comments to the draft report that indicated their disagreement with the audit report contents. OIG's analysis of those comments is as follows:

OIG maintains that NRC needs to improve the unfocused and uncoordinated approach management officials use for oversight of licensees' management of active component aging. The comments that the agency provided reflect an overall misunderstanding and misinterpretation of the report content.

OIG has assigned a reference number to each of the agency's comments to aid the following point-by-point analysis:

Agency Comment 1:

"NRC disagrees with the major premise of this audit, which is that the NRC oversight of active component aging is not being effectively dealt with under existing oversight programs."

OIG Response to Agency Comment 1:

The agency misunderstands and has misinterpreted the audit's major premise. The major premise of this report is not that oversight of active component aging is not being effectively dealt with under existing oversight programs. The message is that OIG could not determine the extent to which NRC provides effective oversight due to a lack of agency analysis that tests its assumptions regarding active component aging. OIG concluded that this has occurred because NRC has not conducted a systematic evaluation of program needs for overseeing licensees' aging management for active components since the establishment of ROP in 2000, and does not have mechanisms for continual monitoring and trending of age-related data for active components. Consequently, NRC cannot be fully assured that it is effectively overseeing licensees' management of aging active components.

Agency Comment 2:

“Nearly all of the active component aging data contained within the Office of Nuclear Reactor Regulation (NRR) Operating Experience Branch (IOEB) Aging Study was derived from inspection findings in which NRC inspectors effectively documented active component aging issues and cited associated violations of the regulations.”

OIG Response to Agency Comment 2:

NRC's statement that nearly all of the active component aging data contained within the Office of Nuclear Reactor Regulation *IOEB Component Aging Study 2007-2011 — Insights from Inspection Findings and Reportable Events*, July 24, 2012 (*IOEB Study*) was derived from inspection findings in which NRC inspectors effectively documented active component aging issues and cited associated violations of the regulations is not correct.

OIG analysis of the inspection and event reports from which the *IOEB Study* data was derived indicates that about one quarter of the failures identified in the report were not derived from inspection reports. Rather, these failures were provided by licensees to NRC in licensee event reports. Moreover, almost all of the regulatory non-compliances are non-cited violations. The agency's claim that almost all of the 105 events were cited violations derived from inspection activity is inaccurate. In fact, more than half of the events in the report did not result in violations of any kind.

Prior OIG analysis¹⁰ indicates that for every safety-related component failure that occurs and is reported, there are several that occur but do not meet the level of reportability using 10 CFR Part 50.72, *Immediate Notification Requirements for Operating Nuclear Power Plants* and 10 CFR 50.73, *Licensee Event Report System* reporting criteria, indicating that there may be many more safety-related components that have degraded or failed due to aging that have not been reported to NRC.

¹⁰ *Audit of NRC's Implementation of 10 CFR Part 21, Reporting of Defects and Noncompliance*, OIG-11-A-08, March 23, 2011.

Agency Comment 3:

“The staff also does not agree that its activities for managing active component aging are not focused or coordinated. While we agree that there is no one section of the regulations or oversight programs that specifically deals with active component aging, and while there is always room for improvement, active component aging issues are effectively addressed through various aspects of the regulations and oversight programs. For example, the staff relies on Title 10 of the Code of Federal Regulations (10 CFR) Part 50, “Domestic Licensing of Production and Utilization Facilities,” Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants,” (Criteria III, V, XI, and XVI), technical specifications, and the Maintenance Rule, all of which deal with component degradation and age related performance issues.”

OIG Response to Agency Comment 3:

OIG did not conclude that regulations were unfocused and uncoordinated or that active component aging issues are not effectively addressed through various aspects of the regulations and oversight programs. Rather, OIG concluded that NRC's approach for oversight of licensees' management of active component aging is not focused or coordinated because NRC's approach includes staff-initiated projects, using inspections that are not aging-related, and agency senior managers who are not aware of these uncoordinated activities.

Furthermore, NRC asserted that active component aging issues are effectively addressed through various aspects of the regulations and oversight programs. For the sake of clarity, OIG did not indicate anywhere in the report that the use of the regulations was ineffective. OIG even stated in the report that inspectors have used those regulations to support a basis for age-related inspection findings. However, with regard to effectiveness, OIG stated in the report that it could not determine the extent to which NRC provides effective oversight due to a lack of agency analysis that tests its assumptions regarding active component aging.

Agency Comment 4:

“Licensee performance is assessed against these regulations under the Reactor Oversight Process (ROP), which allows inspectors and NRC managers to ensure regulatory compliance. The NRC deals with issues identified under the ROP in a performance based and risk informed manner. Furthermore, the NRC has ample regulations that require licensees to report performance issues that may be caused by active component aging. These include the reporting requirements of 10 CFR 50.72, “Immediate Notification Requirements for Operating Nuclear Power Plants,” and 10 CFR 50.73, “Licensee Event Report System.”

OIG Response to Agency Comment 4:

The agency states that NRC has ample regulations that require licensees to report performance issues that may be caused by active component aging. However, OIG did not conclude that regulations or reporting methods were inadequate. OIG did note that NRC was not in a position to determine whether or not oversight of active aging components was effective because NRC had not collected and evaluated the requisite data to determine the need for further action regarding active component aging. In such a scenario, it would be inappropriate for OIG, NRC, or anybody else to conclude one way or the other whether the regulations or reporting methods were adequate.

Agency Comment 5:

“When this information is combined with ROP inspection results and industry component failure databases—all of which are routinely assessed by the staff—they provide ample visibility for the staff to collect and evaluate age related data for active components. The staff does not believe that additional programs that involve monitoring, collecting, and trending of active component aging are necessary to identify adverse trends or to take appropriate regulatory action.”

OIG Response to Agency Comment 5:

NRC states that the staff does not believe that additional programs that involve monitoring, collecting, and trending of active component aging are necessary to identify adverse trends or to take appropriate regulatory action. OIG recognizes that NRC collects a great deal of industry operating experience. However, the agency does not collect or evaluate it for aging active component degradation or failures. Given the evidence reviewed in this audit, OIG concluded that NRC should establish a factual basis for its belief that no additional programs for the monitoring, collecting, and trending of active component aging data are necessary.

Agency Comment 6:

“The staff also disagrees that it needs to perform a thorough and systematic evaluation to determine the need for a specific NRC program to oversee the management of active component aging activities. The ROP performs this task by providing a framework for ensuring that both active and passive aging issues with the potential to impact safety are addressed in a timely manner. The NRC has processes in place to systematically evaluate the results of the ROP, along with other data sources, and these processes provide adequate assurance that the NRC will identify safety-significant, age-related failures of active components.”

OIG Response to Agency Comment 6:

As noted in the report, the agency is not in a position to determine the effectiveness of active aging oversight because they have not done the necessary evaluation to conclude whether or not an active component aging oversight program is needed. OIG asked for, and the agency did not provide, evidence that it already performs a systematic evaluation that proves specifically how ROP and the other processes adequately address active component aging.

Furthermore, for ROP and the other processes that NRC asserts adequately address active component aging, the agency does not evaluate program results to determine if active component aging degradation and failures are acceptable or not. A recent example—whereby inspectors found numerous active component age-related issues during additional inspections in response to failures at the Fort Calhoun Nuclear Power Plant after notable performance deficiencies occurred—suggests the need to evaluate all of those regulations and processes that NRC claims have been effective in the oversight of active component aging.

Agency Comment 7:

“Furthermore, the staff believes that no additional mechanisms are needed to monitor, collect, and trend age-related data on active component aging. The staff already collects or has access to operating experience data gathered from reportable events, international events, industry failure data, and inspection findings that are routinely screened for significance and trending and analysis. The creation of additional mechanisms to perform these tasks is not necessary.”

OIG Response to Agency Comment 7:

The staff believes that no additional mechanisms are needed to monitor, collect, and trend age-related data on active component aging because the staff already collects or has access to operating experience data. In fact, OIG found that the staff does collect data, but the data is not analyzed to identify or trend active component degradation/failures. Furthermore, OIG notes that existing operating experience data gathered from reportable events, international events, industry failure data, and inspection findings are routinely screened for significance and trending and analysis but not for active component degradation and failure due to aging. NRC does not collect active aging data using “active component aging” as a specific, discrete subcategory, although the infrastructure is in place to do so. According to an industry organization representative’s presentation during the 2013 NRC Regulatory Information Conference, the system NRC uses to obtain age-related data could be programmed to include aging as a cause code field that can be selected for age-related data collection purposes. Furthermore,

an NRR senior manager said that he would communicate with an industry contact to obtain NRC access to additional operating experience data.

OIG determined that NRC has not developed or incorporated within policy and guidance the mechanisms for continually monitoring, collecting, and trending age-related data for active components. These mechanisms could be the existing infrastructure for collecting and evaluating operating experience data or new mechanisms at NRC's discretion.

OIG made changes to this report to clarify that NRC has not systematically and continually collected or evaluated active component age-related data using existing mechanisms.

Agency Comment 8:

"There are valid reasons why inspectors cite different requirements to document findings involving age-related issues. These may include variability in the identified performance deficiencies, event causes, and plant licensing bases. Reasons for the variability in citing different requirements were not explored in the report."

OIG Response to Agency Comment 8:

OIG *described* how inspectors cite licensees against regulations to address aging active component failures and did not challenge the use of multiple regulations to cite licensees. OIG did not state that the reasons why inspectors cite different requirements to document findings involving age-related issues was invalid or question the variability in citing different requirements. OIG *does* call into question, however, the variability in use of any of the regulatory or inspection tools that is due to unfamiliarity or lack of inspector experience as described in this report with regard to a lack of understanding of the Maintenance Rule for purposes of inspecting for active component aging phenomena. That such variability exists for these reasons and that NRC managers are unaware of this variability is a central message of the OIG report.

Agency Comment 9:

"The staff is actively considering recommendations identified in the *IOEB Study* for improving inspector awareness of aging issues and clarifying inspection procedure guidance as part of the ongoing ROP Enhancement Project."

OIG Response to Agency Comment 9:

The *IOEB Study* was completed in July 2012 and was presented to NRR management in November 2012. In March 2013, NRC staff provided OIG with

conflicting information regarding inclusion of the aging study as part of the ROP Enhancement Project, which was documented in the audit report. OIG continues to note that NRC is actively considering the *IOEB Study* recommendations; however, the agency has not been clear as to what, exactly, comprises that consideration.

Agency Comment 10:

“The IOEB study represented a new approach for performing analysis of ROP data. While the program has experience with the communication and implementation of recommendations for specific technical issues, the structure for implementing the kind of broad recommendations that were presented in this study, and which require coordination across multiple offices, is being refined as the recommendations are being implemented, presenting learning opportunities and challenges for their completion.”

OIG Response to Agency Comment 10:

The agency states that it is in the process of implementing the *IOEB Study* recommendations. However, OIG notes that this comment is inconsistent with Agency Comment 9 above that states the *IOEB Study* is being considered as part of the ROP Enhancement Project. Based on these formal comments, it is not clear whether the agency is considering or implementing the recommendations. The agency has been rather opaque in its responses to OIG auditor inquiries as to what recommendations, specifically, are under consideration or being implemented.

Agency Comment 11:

“The NRC staff points to the overall capability of the ROP (including the structure of the Significance Determination Process) and current reporting requirements as substantive evidence that there is adequate assurance that it is addressing active component aging issues impacting safety.”

OIG Response to Agency Comment 11:

The agency did not provide substantive evidence of adequate assurance that it is addressing active component aging issues impacting safety. In fact, the agency provided no evidence and believes that active component issues are addressed through ROP. OIG could not therefore determine the extent to which NRC provides effective oversight due to a lack of agency analysis that tests its assumptions regarding active component aging.

Furthermore, OIG did not state that there was inadequate assurance that ROP and current reporting requirements were addressing active component aging

issues impacting safety. OIG noted that a systematic evaluation of program needs for overseeing licensees' aging management for active components has not been conducted since the establishment of ROP in 2000. Additionally, NRC does not trend active component aging degradation and failures that could provide evidence of adequate assurance that it is addressing active component aging issues impacting safety. Consequently, NRC cannot be fully assured that it is effectively overseeing licensees' management of aging active components.