

A.1 AGING MANAGEMENT REVIEW - GENERIC (BRANCH TECHNICAL POSITION RLSB-1)

A.1.1 Background

Pursuant to 10 CFR 54.21(a)(3), a license renewal applicant is required to demonstrate that the effects of aging on structures and components subject to an aging management review will be adequately managed so that their intended functions will be maintained consistent with the current licensing basis (CLB) for the period of extended operation. The purpose of this branch technical position is to address the aging management demonstration that has not been addressed specifically in Chapters 3 and 4 of this standard review plan.

The license renewal process is not intended to demonstrate absolute assurance that structures and components will not fail, but rather that there is reasonable assurance that they will perform such that the intended functions are maintained consistent with the CLB during the period of extended operation.

Aging management programs are generally of four types: prevention, mitigation, condition monitoring, and performance monitoring. Prevention programs preclude the effects of aging from occurring, for example, coating programs to prevent external corrosion of a tank. Mitigation programs attempt to slow the effects of aging, for example, water chemistry programs to mitigate internal corrosion of piping. Condition monitoring programs inspect and examine for the presence and extent of aging effects, for example, visual inspection of concrete structures for cracking and ultrasonic measurement of pipe wall for erosion-corrosion induced wall thinning. Performance monitoring programs test the ability of a structure or component to perform its intended function(s), for example, heat balances on heat exchangers for the heat transfer intended function of the tubes. In many instances, more than one type of aging management programs are implemented to ensure that aging effects are managed. For example, in managing internal corrosion of piping, a mitigation program (water chemistry) may be used to minimize susceptibility to corrosion. However, it may also be necessary to have a condition monitoring program (ultrasonic inspection) to verify that corrosion is indeed insignificant.

A.1.2 Branch Technical Position

A.1.2.1 Applicable Aging Effects

1. The determination of applicable aging effects is based on the degradations that have actually occurred and those that potentially could cause structure and component degradation. The materials, environment, stresses, service conditions, operating experience, and other relevant information should be considered in identifying applicable aging effects. The effects of aging on the structure and component intended function(s) should also be considered.
2. Relevant aging information may be contained in, but not limited to, the following documents: plant-specific maintenance and inspection records; plant-specific site deviation or issue reports; plant-specific NRC and Institute of Nuclear Power Operations (INPO) inspection reports; plant-specific licensee self-assessment reports; plant-specific and other licensee event reports (LERs); NRC, INPO, and vendor generic communications; generic safety issues/unresolved safety issues (GSIs/USIs); NUREG reports; and Electric Power Research Institute (EPRI) reports.

3. If operating experience or other information indicates that a certain aging effect may be potentially applicable and an applicant determines that it is not applicable to its plant, the basis for this determination should be provided.
4. An aging effect should be identified as applicable for license renewal even if there is a preventative or mitigation program associated with that aging effect. For example, water chemistry, a coating, or use of cathodic protection could prevent or mitigate corrosion, but corrosion should be identified as applicable for license renewal and the aging management review should consider the adequacy of the water chemistry, coating, or cathodic protection.
5. Specific identification of aging mechanisms is not a requirement; however, it is an option to identify specific aging mechanisms and the associated aging effects in the integrated plant assessment (IPA).
6. The applicable aging effects to be considered for license renewal include those that could result from normal plant operation, including plant/system operating transients and plant shutdown. Aging effects from abnormal events need not be postulated specifically for license renewal. However, if an abnormal event has occurred at a particular plant, its contribution to the aging effects on structures and components for license renewal should be considered for that plant. For example, if a resin intrusion has occurred in the reactor coolant system at a particular plant, the contribution of this resin intrusion event to aging should be considered for that plant.

Design basis events (DBEs) are abnormal events and they include: design basis pipe break, loss of coolant accident (LOCA), and safe shutdown earthquake (SSE). Potential degradations resulting from DBEs are addressed, as appropriate, as part of the plant's CLB. There are other abnormal events which should be considered on a case-by-case basis. For example, abuse due to human activity is an abnormal event and aging effects from such abuse need not be postulated for license renewal. When a safety significant piece of equipment is accidentally damaged by a licensee, the licensee is required to take immediate corrective action under existing procedures, that is, Appendix B to 10 CFR Part 50, to ensure functionality of the equipment. The equipment degradation is not due to aging and corrective action is not necessary solely for the period of extended operation. However, for example, leakage from bolted connections should not be considered as abnormal events. Although bolted connections are not supposed to leak, experience shows that leaks do occur and the leakage could cause corrosion. Thus, the aging effects from leakage of bolting connections should be evaluated for license renewal.

In addition, an aging effect observed as a result of an abnormal event does not necessarily preclude that aging effect from occurring during normal operation for the period of extended operation. For example, a certain pressurized water reactor observed clad cracking in its pressurizer and attributed that to an abnormal dry out of the pressurizer. Although dry out of a pressurizer is an abnormal event, the potential for clad cracking in the pressurizer during normal operation should still be evaluated for license renewal. This is because the pressurizer is subject to extensive thermal fluctuations and water level changes during plant operation which may result in clad cracking given sufficient operating time. The abnormal dry out of the pressurizer at that certain plant may have merely accelerated the rate of the aging effect.

A.1.2.2 Aging Management for License Renewal

1. An acceptable aging management program should consist of the 10 elements described in Table A.1-1, as appropriate (Ref. 1). These program elements/attributes are discussed further in Position A.1.2.3 below.
2. All programs and activities that are credited for managing a certain aging effect for a specific structure or component should be described. These aging management programs/activities may be evaluated together for the 10 elements described in Table A.1-1, as appropriate.
3. The risk significance of a structure or component could be considered in evaluating the robustness of an aging management program. Probabilistic arguments may be used to assist in developing an approach for aging management adequacy. However, use of probabilistic arguments alone is not an acceptable basis for concluding that, for those structures and components subject to an aging management review, the effects of aging will be adequately managed in the period of extended operation. Thus, risk significance may be considered in developing the details of an aging management program for the structure or component for license renewal, but may not be used to conclude that no aging management program is necessary for license renewal.

A.1.2.3 Aging Management Program Elements

A.1.2.3.1 Scope of Program

1. The specific program necessary for license renewal should be identified. The scope of the program should include the specific structures and components that the program is credited for managing aging of.

A.1.2.3.2 Preventive Actions

1. For prevention and mitigation programs, the activities for prevention and mitigation should be described. These actions should mitigate or prevent aging degradation.
2. For condition or performance monitoring programs, they do not rely on preventive actions and thus, this information need not be provided. However, in many instances, more than one type of aging management programs should be implemented to ensure that aging effects are managed.

A.1.2.3.3 Parameters Monitored or Inspected

1. The parameters to be monitored or inspected should be identified. These parameters should be linked to the degradation of the particular structure and component intended function(s).
2. For a condition monitoring program, the parameter monitored or inspected should detect the presence and extent of aging effects. Some examples are measurements of wall thicknesses and detection and sizing of cracks.
3. For a performance monitoring program, a link should be established between the degradation of the particular structure and component intended functions and the parameter(s) being monitored. An example where a performance monitoring program could

link the degradation of passive component intended function(s) with the performance being monitored is heat balances on heat exchangers to ensure the heat transfer intended function of the tubes. Fouling of the heat exchanger tubes affects the heat transfer intended function and could be monitored by periodic heat balances. While this example only deals with one intended function of the tubes, which is heat transfer, additional programs may be necessary to manage other intended function(s) of the tubes, such as pressure boundary.

A performance monitoring program may not assure the structure and component intended function(s) without linking the degradation of passive intended functions with the performance being monitored. For example, a periodic diesel generator test alone would not provide assurance that the diesel will start and run properly under all applicable design conditions. While the test verifies that the diesel will perform if all the support systems function, it provides little information related to the material condition of the support components and their ability to withstand design basis event loads. Thus, a design basis event, such as a seismic event, could cause the diesel supports, such as the diesel embedment plate anchors or the fuel oil tank, to fail if the effects of aging on these components are not managed during the period of extended operation.

4. For prevention and mitigation programs, the parameters monitored should be the specific parameters being controlled to achieve prevention or mitigation of aging effects. An example is the coolant oxygen level which is being controlled in a water chemistry program to mitigate pipe cracking.

A.1.2.3.4 Detection of Aging Effects

1. Detection of aging effects should occur before there is a loss of the structure and component intended function(s). The parameters to be monitored or inspected should be appropriate to ensure that the structure and component intended function(s) will be adequately maintained for license renewal under all CLB design conditions.
2. Nuclear power plants are licensed based on redundancy, diversity, and defense-in-depth principles. A degraded or failed component reduces the reliability of the system, challenges safety systems, and contributes to plant risk. Thus, the effects of aging on a structure or component should be managed to ensure its availability to perform its intended function(s) as designed when called upon. In this way, all system level intended function(s), including redundancy, diversity, and defense-in-depth consistent with the plant's CLB, would be maintained for license renewal. A program based solely on detecting structure and component failure should not be considered as an effective aging management program for license renewal.

A.1.2.3.5 Monitoring and Trending

1. Monitoring and trending activities should be described and they should provide predictability of the extent of degradation and timely corrective or mitigative actions. Monitoring, inspection, technique, frequency, and sample size should be appropriate for timely detection of aging effects. Plant-specific and/or industry-wide operating experience may be considered in evaluating the appropriateness of the technique and frequency.
2. Sampling may be used to inspect a group of structures and components. There should be a basis for selecting the inspection population and sample size. The population should be selected based on similarity of materials of construction, fabrication, procurement, design,

installation, operating environments, and aging effects. The sample size should be selected based on consideration of the specific aging effect, location, existing technical information, system and structure design, materials of construction, service environment, previous failure history, etc. The samples should be biased towards locations most susceptible to the specific aging effect of concern. Provisions should also be included on expanding the sample size when degradation is detected in the initial sample.

A.1.2.3.6 Acceptance Criteria

1. The acceptance criteria of the program and its basis should be described. The acceptance criteria, against which the need for corrective actions will be evaluated, should ensure that the structure and component intended function(s) are maintained under all CLB design conditions during the period of extended operation. The program should include a methodology for analyzing the results against applicable acceptance criteria.

For example, carbon steel pipe wall thinning may occur under certain conditions due to erosion-corrosion. An aging management program for erosion-corrosion may consist of periodically measuring the pipe wall thickness and comparing that to a specific minimum wall acceptance criterion. Corrective action is taken, such as piping replacement, prior to reaching this acceptance criterion. This piping may be designed for thermal, pressure, deadweight, seismic, and other loads, and this acceptance criterion must be appropriate to ensure that the thinned piping would be able to carry these CLB design loads. This acceptance criterion should provide for timely corrective action before loss of intended function under these CLB design loads.

2. Acceptance criteria could be numerical values. Or, it could be a discussion of the process for calculating the specific numerical values of the acceptance criteria to ensure that the structure and component intended function(s) will be maintained under all CLB design conditions. If references are available, this information may be referenced.
3. It is not necessary to justify any acceptance criteria taken directly from the design basis information that is included in the FSAR because that is a part of the CLB. Also, it is not necessary to discuss CLB design loads if the acceptance criteria do not permit degradation because a structure and component without degradation should continue to function as originally designed.

A.1.2.3.7 Corrective Actions

1. Actions to be taken when the acceptance criteria are not met should be described. Corrective actions, including root cause determination and prevention of recurrence, should be timely.
2. If corrective actions permit analysis without repair or replacement, the analysis should ensure that the structure and component intended function(s) will be maintained consistent with the CLB.

A.1.2.3.8 Confirmation Process

1. The confirmation process should be described. The confirmation process should ensure that preventive actions are adequate and that appropriate corrective actions have been completed and are effective.

2. For prevention and mitigation programs, the effectiveness of these programs should be periodically verified. For example, in managing internal corrosion of piping, a mitigation program (water chemistry) may be used to minimize susceptibility to corrosion. However, it may also be necessary to have a condition monitoring program (ultrasonic inspection) to verify that corrosion is indeed insignificant.
3. When corrective actions are necessary, there should be follow up activities to confirm that the corrective actions are completed, root cause determination is performed, and recurrence is prevented.

A.1.2.3.9 Administrative Controls

1. The administrative controls of the program should be described. The administrative controls should provide a formal review and approval process.
2. Any aging management programs to be relied on for license renewal should have regulatory and administrative controls. That is the basis for 10 CFR 54.21(d) to require that the FSAR supplement includes a summary description of the programs and activities for managing the effects of aging for license renewal. Thus, any informal programs relied on to manage aging for license renewal need to be administratively controlled and included in the FSAR supplement.

A.1.2.3.10 Operating experience

1. Operating experience with existing programs should be discussed. The operating experience of aging management programs, including past corrective actions resulting in program enhancements or additional programs, should be reviewed. A past failure would not necessarily invalidate an aging management program because the feedback from operating experience should have resulted in appropriate program enhancements or new programs. This information can show where an existing program has succeeded and where it has failed, if any, in intercepting aging degradation in a timely manner. This information should provide objective evidence to support that the effects of aging will be adequately managed so that the structure and component intended function(s) will be maintained during the period of extended operation.
2. An applicant may have to commit to providing operating experience in the future for new programs to confirm their effectiveness.

A.1.3 References

1. NEI 95-10, Revision 1, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule," Nuclear Energy Institute, January 2000.

Table A.1-1. Elements of an Aging Management Program for License Renewal

Element	Description
1. Scope of program	Scope of program should include the specific structures and components subject to an aging management review for license renewal.
2. Preventive actions	Preventive actions should mitigate or prevent aging degradation.
3. Parameters monitored or inspected	Parameters monitored or inspected should be linked to the degradation of the particular structure and component intended function(s).
4. Detection of aging effects	Detection of aging effects should occur before there is a loss of the structure and component intended function(s).
5. Monitoring and trending	Monitoring and trending should provide predictability of the extent of degradation and timely corrective or mitigative actions. The monitoring, inspection, testing frequency, and sample size should be appropriate for timely detection of aging effects.
6. Acceptance criteria	Acceptance criteria, against which the need for corrective action will be evaluated, should ensure that the structure and component intended function(s) are maintained under all CLB design conditions during the period of extended operation.
7. Corrective actions	Corrective actions, including root cause determination and prevention of recurrence, should be timely.
8. Confirmation process	Confirmation process should ensure that preventive actions are adequate and that appropriate corrective actions have been completed and are effective.
9. Administrative controls	Administrative controls should provide a formal review and approval process.
10. Operating experience	Operating experience of the aging management program, including past corrective actions resulting in program enhancements or additional programs, should provide objective evidence to support that the effects of aging will be adequately managed so that the structure and component intended function(s) will be maintained during the period of extended operation.