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Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants

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ABSTRACT

The Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants (SRP-LR) provides guidance to Nuclear Regulatory Commission staff reviewers in the Office of Nuclear Reactor Regulation. These reviewers perform safety reviews of applications to renew nuclear power plant licenses in accordance with Title 10 of the Code of Federal Regulations Part 54. The principal purposes of the SRP-LR are to ensure the quality and uniformity of staff reviews and to present a well-defined base from which to evaluate applicant programs and activities for the period of extended operation. The SRP-LR is also intended to make information about regulatory matters widely available, to enhance communication with interested members of the public and the nuclear power industry, and to improve public and industry understanding of the staff review process. The safety review is based primarily on the information provided by the applicant in a license renewal application. Each of the individual SRP-LR sections addresses (1) who performs the review, (2) the matters that are reviewed, (3) the basis for review, (4) the way the review is accomplished, and (5) the conclusions that are sought.

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ABBREVIATIONS

AFW	auxiliary feedwater
AMP	aging management program
AMR	aging management review
ANL	Argonne National Laboratory
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATWS	anticipated transients without scram
B&W	Babcock & Wilcox
BTP	branch technical position
BWR	boiling water reactor
BWRVIP	Boiling Water Reactor Vessel and Internals Project
CASS	cast austenitic stainless steel
CDF	core damage frequency
CE	Combustion Engineering
CFR	Code of Federal Regulations
CLB	current licensing basis
CRD	control rod drive
CUF	cumulative usage factor
DBA	design basis accident
DBE	design basis event
DG	Draft Regulatory Guide
DOR	Division of Operating Reactors
DRIP	Division of Regulatory Improvement Programs
ECCS	emergency core cooling system
ECT	eddy current testing
EDG	emergency diesel generator
EFPY	effective full power year
EPRI	Electric Power Research Institute
EPU	extended power uprate
FAC	flow-accelerated corrosion
FR	Federal Register
FSAR	Final Safety Analysis Report
GALL	Generic Aging Lessons Learned
GE	General Electric
GL	generic letter
GSI	generic safety issue
HAZ	heat-affected zone
HELB	high-energy line break
HPCI	high-pressure coolant injection
HVAC	heating, ventilation, and air conditioning

ABBREVIATIONS (continued)

I&C	instrumentation and control
IASCC	irradiation assisted stress corrosion cracking
IEEE	Institute of Electrical and Electronics Engineers
IGA	intergranular attack
IGSCC	intergranular stress corrosion cracking
IN	information notice
INPO	Institute of Nuclear Power Operations
IPA	integrated plant assessment
IPE	individual plant examination
IPEEE	individual plant examination of external events
IR	insulation resistance
ISI	inservice inspection
ITG	Issues Task Group
LCD	liquid crystal display
LED	light-emitting diode
LER	licensee event report
LOCA	loss of coolant accident
LRA	license renewal application
LTOP	low-temperature overpressure protection
MIC	microbiologically-influenced corrosion
MEAP	**m**aterial/**e**nvironment/**a**ging effect/**p**rogram as summarized on AMR line-items
MRV	minimum required value
NDE	nondestructive examination
NDT	nil-ductility temperature
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association
NPS	nominal pipe size
NRC	Nuclear Regulatory Commission
NRR	NRC Office of Nuclear Reactor Regulation
NSAC	Nuclear Safety Analysis Center
NSR	non-safety related
NSSS	nuclear steam supply system
ODSCC	outside diameter stress corrosion cracking
OM	operation and maintenance
P&ID	piping and instrument diagrams
PLL	predicted lower limit
PRA	probabilistic risk analysis
PT	penetrant testing
P-T	pressure-temperature
PTS	pressurized thermal shock
PWR	pressurized water reactor
PWSCC	primary water stress corrosion cracking
QA	quality assurance

ABBREVIATIONS (continued)

RCIC	reactor core isolation cooling
RCPB	reactor coolant pressure boundary
RCS	reactor coolant system
RG	Regulatory Guide
RLEP	License Renewal & Environmental Impacts Program
RPV	reactor pressure vessel
RT	reference temperature
SBO	station blackout
SCC	stress corrosion cracking
SER	safety evaluation report
SG	steam generator
S/G	standards and guides
SOC	statements of consideration
SOER	significant operating experience report
SR	safety related
SRM	staff requirements memorandum
SRP	standard review plan
SRP-LR	standard review plan for license renewal
SS	stainless steel
SSC	systems, structures, and components
SSE	safe shutdown earthquake
TLAA	time-limited aging analysis
UFSAR	updated final safety analysis report
USI	unresolved safety issue
UT	ultrasonic testing
UV	ultraviolet
WSLR	within scope of license renewal

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INTRODUCTION

The Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants (SRP-LR) provides guidance to Nuclear Regulatory Commission (NRC) staff reviewers in the Office of Nuclear Reactor Regulation (NRR). These reviewers perform safety reviews of applications to renew nuclear power plant licenses in accordance with Title 10 of the *Code of Federal Regulations* (CFR) Part 54. The principal purposes of the SRP-LR are to ensure the quality and uniformity of staff reviews and to present a well-defined base from which to evaluate applicant programs and activities for the period of extended operation. The SRP-LR is also intended to make information about regulatory matters widely available, to enhance communication with interested members of the public and the nuclear power industry, and to improve their understanding of the staff review process.

The safety review is based primarily on the information provided by the applicant in a license renewal application. The NRC regulation in 10 CFR 54.4 defines what is within the scope of the license renewal rule. The NRC regulation in 10 CFR 54.21 requires that each license renewal application shall include an integrated plant assessment (IPA), current licensing basis (CLB) changes during review of the application by NRC, an evaluation of time-limited aging analyses (TLAAs), and a final safety analysis report (FSAR) supplement.

In addition to the technical information required by 10 CFR 54.21, a license renewal application must contain general information (10 CFR 54.19), necessary technical specification changes (10 CFR 54.22), and environmental information (10 CFR 54.23). The application must be sufficiently detailed to permit the reviewers to determine (1) whether there is reasonable assurance that the activities authorized by the renewed license will continue to be conducted in accordance with the CLB and (2) whether any changes made to the plant's CLB to comply with 10 CFR Part 54 are in accord with the Atomic Energy Act of 1954 and NRC regulations.

Before submitting a license renewal application, an applicant should have analyzed the plant to ensure that actions have been or will be taken to (1) manage the effects of aging during the period of extended operation (this determination should be based on the functionality of structures and components that are within the scope of license renewal and that require an aging management review), and (2) evaluate TLAAs. The license renewal application is the principal document in which the applicant provides the information needed to understand the basis upon which this assurance can be made.

10 CFR 54.21 specifies, in general terms, the technical information to be supplied in the license renewal application. Regulatory Guide 1.188, "Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses," endorses the Nuclear Energy Institute (NEI) guidance in NEI 95-10, "Industry Guidelines for Implementing the Requirements of 10 CFR Part 54 — The License Renewal Rule." NEI 95-10 provides guidance on the format and content of a license renewal application. The SRP-LR sections are keyed to and are numbered according to the section numbers RG 1.188.

During the review of the initial license renewal applications, NRC staff and the applicants have found that most of the programs to manage aging that are credited for license renewal are existing programs. In a staff paper (SECY 99-148), "Credit for Existing Programs for License Renewal," dated June 3, 1999, the staff described options and provided a recommendation for crediting existing programs to improve the efficiency of the license renewal process. In a staff requirements memorandum (SRM) dated August 27, 1999, the NRC approved the staff recommendation and directed the staff to focus the review guidance in the SRP-LR on areas where existing programs should be augmented for license renewal. Under the terms of the SRM, the SRP-LR would reference a “Generic Aging Lessons Learned” (GALL) report, which evaluates existing programs generically, to document (1) the conditions under which existing programs are considered adequate to manage identified aging effects without change and (2) the conditions under which existing programs should be augmented for this purpose.

The GALL Report (NUREG-1801) should be treated as an approved topical report. The NRC reviewers should not repeat their review of a matter described in the GALL Report, but should find an application acceptable with respect to such a matter when the application references the GALL Report and the evaluation of the matter in the GALL Report applies to the plant. However, reviewers should ensure that the material presented in the GALL Report is applicable to the specific plant involved and that the applicants have identified specific programs as described and evaluated in the GALL Report if they rely on the report for license renewal.

The SRP-LR is divided into four major chapters: (1) Administrative Information; (2) Scoping and Screening Methodology for Identifying Structures and Components Subject to Aging Management Review, and Implementation Results; (3) Aging Management Review Results; and (4) Time-Limited Aging Analyses. The appendixes to the SRP-LR list branch technical positions. The SRP-LR addresses various site conditions and plant designs and provides complete procedures for all of the areas of review pertinent to each of the SRP-LR sections. For any specific application, NRC reviewers may select and emphasize particular aspects of each SRP-LR section, as appropriate for the application. In some cases, the major portion of the review of a plant program or activity may be done on a generic basis (with the owners’ group of that plant type) rather than in the context of reviews of particular applications from utilities. In other cases, a plant program or activity may be sufficiently similar to that of a previous plant that a complete review of the program or activity is not needed. For these and similar reasons, reviewers need not carry out in detail all of the review steps listed in each SRP-LR section in the review of every application.

The individual SRP-LR sections address (1) who performs the review, (2) the matters that are reviewed, (3) the basis for review, (4) the way the review is accomplished, and (5) the conclusions that are sought. One of the objectives of the SRP-LR is to assign review responsibilities to the appropriate NRR branches. Each SRP-LR section identifies the branch that has the primary review responsibility for that section. In some review areas, the primary branch may require support; the branches that are assigned these secondary review responsibilities are also identified for each SRP-LR section.

Each SRP-LR section is organized into the following six subsections, generally consistent with NUREG-0800 “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants,” (3rd Edition, July 1981 with individual sections subsequently revised as needed).

1. Areas of Review

This subsection describes the scope of review, that is, what is being reviewed by the branch that has primary review responsibility. It contains a description of the systems, structures, components, analyses, data, or other information that are reviewed as part of the license renewal application. It also contains a discussion of the information needed or the review expected from other branches to permit the primary review branch to complete its review.

2. Acceptance Criteria

This subsection contains a statement of the purpose of the review, an identification of applicable NRC requirements, and the technical basis for determining the acceptability of programs and activities within the area of review of the SRP-LR section. The technical bases consist of specific criteria, such as NRC regulatory guides, codes and standards, and branch technical positions.

Consistent with the approach described in NUREG-0800, the technical bases for some sections of the SRP-LR can be provided in branch technical positions or appendixes as they are developed and can be included in the SRP-LR.

3. Review Procedures

This subsection discusses the way the review is accomplished. It is generally a step-by-step procedure that the reviewer follows to provide reasonable verification that the applicable acceptance criteria have been met.

4. Evaluation Findings

This subsection presents the type of conclusion that is sought for the particular review area (e.g., the reviewers' determination as to whether the applicant has adequately identified the aging effects and the aging management programs credited with managing the aging effects). For each section, a conclusion of this type is included in the safety evaluation report (SER), in which the reviewers publish the results of their review. The SER also contains a description of the review, including which aspects of the review were selected or emphasized; which matters were modified by the applicant, required additional information, will be resolved in the future, or remain unresolved; where the applicant's program deviates from the criteria provided in the SRP-LR; and the bases for any deviations from the SRP-LR or exemptions from the regulations.

5. Implementation

This subsection discusses the NRC staff's plans for using the SRP-LR section.

6. References

This subsection lists the references used in the review process.

The SRP-LR incorporates the staff experience in the review of the initial license renewal applications. It may be considered a part of a continuing regulatory framework development activity that documents current methods of review and provides a basis for orderly modifications of the review process in the future. The SRP-LR will be revised and updated periodically, as needed, to incorporate experience gained during future reviews, to clarify the content or correct errors, to reflect changes in relevant regulations, and to incorporate modifications approved by the NRR Director. A revision number and publication date are printed in a lower corner of each page of each SRP-LR section. Because individual sections will be revised as needed, the revision numbers and dates may not be the same for all sections. The table of contents indicates the revision numbers of the most current sections.

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CHAPTER 1

ADMINISTRATIVE INFORMATION

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1.1 DOCKETING OF TIMELY AND SUFFICIENT RENEWAL APPLICATION

Review Responsibilities

Primary - Program responsible for license renewal projects
Secondary - Branches responsible for technical review, as appropriate

1.1.1 Areas of Review

This section addresses (1) the review of the acceptability of a license renewal application for docketing in accordance with 10 CFR 2.101 and the requirements of 10 CFR Part 54, and (2) whether a license renewal application is timely and sufficient, which allows the provisions of 10 CFR 2.109(b) to apply. Application of this regulation, which was written to comply with the Administrative Procedures Act, means that the current license will not expire until the NRC makes a final determination on the license renewal application.

The review described in this section is not a detailed, in-depth review of the technical aspects of the application. The docketing and subsequent finding of a timely and sufficient renewal application does not preclude the NRC reviewers from requesting additional information as the review proceeds, nor does it predict the NRC's final determination regarding the approval or denial of the renewal application. A plant's current license will not expire upon the passing of the license's expiration date if the renewal application was found to be timely and sufficient. During this time, and until the renewal application has been finally determined by the NRC, the licensee must continue to perform its activities in accordance with the facility's current licensing basis (CLB), including all applicable license conditions, orders, rules, and regulations.

In determining whether an application is acceptable for docketing, the following areas of the license renewal application are reviewed.

1.1.1.1 Docketing and Sufficiency of Application

The license renewal application is reviewed for acceptability for docketing as a sufficient application in accordance with 10 CFR 2.101, 10 CFR Part 51, and 10 CFR Part 54.

1.1.1.2 Timeliness of Application

The timeliness of a license renewal application is reviewed in accordance with 10 CFR 2.109(b).

1.1.2 Acceptance Criteria

1.1.2.1 Docketing/Sufficiency of Application

The NRC staff determines acceptance for docketing and sufficiency on the basis of the required contents of an application, established in 10 CFR 2.101, 10 CFR 51.53(c), 54.17, 54.19, 54.21, 54.22, 54.23 and 54.4. A license renewal application is sufficient if it contains the reports, analyses, and other documents required in such an application.

1.1.2.2 Timeliness of Application

In accordance with 10 CFR 2.109(b), a license renewal application is timely if it is submitted at least 5 years before the expiration of the current operating license (unless an exemption is granted) and it is determined to be sufficient.

1.1.3 Review Procedures

A licensee may choose to submit plant-specific reports addressing portions of the license renewal rule requirements for NRC review and approval prior to submitting a renewal application. An applicant may incorporate (by reference) these reports or other information contained in previous applications for licenses or license amendments, statements, or correspondence filed with the NRC, provided that the references are clear and specific. However, the final determination of the docketing of a sufficient renewal application is made only after a formal license renewal application has been submitted to the NRC.

For each area of review, NRC staff should implement the following review procedures.

1.1.3.1 Docketing and Sufficiency of Application

Upon receipt of a tendered application for license renewal, the reviewer should determine whether the applicant has made a reasonable effort to provide the required administrative, technical, and environmental information.[1] The reviewer should use the review checklist provided in Table 1.1-1 to determine whether the application is reasonably complete and conforms to the requirements outlined in 10 CFR Part 54.

Items I.1 through I.10 in the checklist address administrative information: for the purpose of this review, the reviewer should check the “Yes” column if the required information is included in the application. Item II in the checklist addresses timeliness of the application.

Items II.1 through II.3, III, and IV in the checklist address technical information, the FSAR supplement, and technical specification changes, respectively. Chapters 2, 3, and 4 of the SRP-LR provide information regarding the technical review. Although the purpose of the docketing and sufficiency review is not to determine the technical adequacy of the application, the reviewer should determine whether the applicant has provided reasonably complete information in the application to address the renewal rule requirements. The reviewer may request assistance from appropriate technical review branches to determine whether the application provides sufficient information to address the items in the checklist so that the staff can begin their technical review. The reviewer should check the “Yes” column for a checklist item if the applicant has provided reasonably complete information in the application to address the checklist item.

Item V of the checklist addresses environmental information. The environmental review staff should review the supplement to the environmental report prepared by the applicant in accordance with the guidelines in NUREG-1555, “Standard Review Plans for Environmental Reviews for Nuclear Power Plants,” Supplement 1, “Operating License Renewal” (Ref. 2). The

[1] NRC Regulatory Guide 1.188, “Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses” (Ref. 1), provides guidance on the format and content of a renewal application.

reviewer should check the “Yes” column if it is determined that the renewal application contains environmental information consistent with the requirements of 10 CFR Part 51.

The application should address each item in the checklist in order to be considered reasonably complete and sufficient. If the reviewer determines that an item in the checklist is not applicable, the reviewer should include a brief statement that the item is not applicable and provide the basis for the statement.

If information in the application for a checklist item is either not provided or not reasonably complete and no justification is provided, the reviewer should check the “No” column for that checklist item. By checking the “No” column for any checklist item, except Item VI as discussed in Subsection 1.1.3.2, the reviewer indicates that the application is not acceptable for docketing as a sufficient renewal application unless the applicant modifies the application to provide the missing or incomplete information.

If the reviewer determines that the application is not acceptable for docketing as a sufficient application, the letter to the applicant should clearly state that (1) the application is not sufficient and is not acceptable for docketing, and (2) the current license will expire at its expiration date. The letter should also include a description of the deficiencies found in the application and offer an opportunity for the applicant to modify its application to provide the missing or incomplete information. The reviewer should review the modified application, if submitted, to determine whether it is acceptable for docketing as a sufficient application.

If the reviewer is able to answer “Yes” to the applicable items in the checklist, the application is acceptable for docketing as a sufficient renewal application. The applicant should be notified by letter that the application is accepted for docketing. Normally, the letter should be issued within 30 days of receipt of a renewal application. A notice of acceptance for docketing of the application and notice of opportunity for a hearing regarding renewal of the license will be published in the *Federal Register*.

If the application is acceptable for docketing as a sufficient application, the staff should begin its technical review. For license renewal applications, the NRC intends to maintain the docket number of the current operating license for administrative convenience.

1.1.3.2 Timeliness of Application

Upon receipt of a tendered application for license renewal, the reviewer performs a docketing and sufficiency review, as discussed in Subsection 1.1.3.1.

If the sufficient application is submitted at least 5 years before the expiration of the current operating license, the reviewer checks the “Yes” column for Item VI in the checklist. If an applicant has to modify its application, as discussed in Subsection 1.1.3.1, before the staff can find the application acceptable for docketing as a sufficient application, the modified application should be submitted at least 5 years before the expiration of the current operating license unless an exemption is granted.

If the reviewer checks the “No” column in Item VI in the checklist, indicating that a sufficient renewal application has not been submitted at least 5 years before the expiration of the current operating license, the letter to the applicant should clearly state that (1) the application is not timely, (2) the provisions in 10 CFR 2.109(b) have not been satisfied, and (3) the current license will expire on the expiration date. However, if the application is otherwise determined to be acceptable for docketing, the technical review can begin.

1.1.4 Evaluation Findings

The reviewer determines whether sufficient and adequate information has been provided to satisfy the provisions outlined here. Depending on the results of this review, one of the following conclusions is included in the staff's letter to the applicant:

- On the basis of its review, as discussed above, the staff has determined that the applicant has submitted sufficient information that is acceptable for docketing, in accordance with 10 CFR 54.19, 54.21, 54.22, 54.23, 54.4 and 51.53(c). However, the staff's determination does not preclude the request for additional information as the review proceeds.

- On the basis of its review, as discussed above, the staff has determined that the application is *not acceptable* for docketing as a timely and sufficient renewal application.

1.1.5 Implementation

Except in cases in which the applicant proposes an acceptable alternative method for complying with specified portions of NRC regulations, the method described herein will be used by NRC staff members in their evaluation of conformance with NRC regulations.

1.1.6 References

1. NRC Regulatory Guide 1.188, "Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses," U.S. Nuclear Regulatory Commission, January 2005.

2. NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants," Supplement 1, "Operating License Renewal," U.S. Nuclear Regulatory Commission, October 1999.

Table 1.1-1. Acceptance Review Checklist for Docketing of Timely and Sufficient Renewal Application

				Yes	No
I.	**General Information**				
1.	Application identifies specific unit(s) applying for license renewal			☐	☐
2.	Filing of renewal application 10 CFR 54.17(a) is in accordance with:				
	A.	10 CFR Part 2, Subpart A; 10 CFR 2.101		☐	☐
	B.	10 CFR 50.4			
		a.	Application is addressed to the Document Control Desk as specified in 10 CFR 50.4(a)	☐	☐
		b.	Signed original application and 13 copies are provided to the Document Control Desk. One copy is provided to the appropriate Regional office [10 CFR 50.4(b)(3)]	☐	☐
		c.	Form of the application meets the requirements of 10 CFR 50.4(c)	☐	☐
	C.	10 CFR 50.30			
		a.	Application is filed in accordance with 10 CFR 50.4 [10 CFR 50.30(a)(1)]	☐	☐
		b.	Application is submitted under oath or affirmation [10 CFR 50.30(b)]	☐	☐
3.	Applicant is eligible to apply for a license and is not a foreign-owned or foreign-controlled entity [10 CFR 54.17(b)]			☐	☐
4.	Application is not submitted earlier than 20 years before expiration of current license [10 CFR 54.17(c)]			☐	☐
5.	Application states whether it contains applications for other kinds of licenses [10 CFR 54.17(d)]			☐	☐
6.	Information incorporated by reference in the application is contained in other documents previously filed with the Commission, and the references are clear and specific [10 CFR 54.17(e)]			☐	☐
7.	Restricted data or other defense information, if any, is separated from unclassified information in accordance with 10 CFR 50.33(j) [10 CFR 54.17(f)]			☐	☐
8.	If the application contains restricted data, written agreement on the control of accessibility to such information is provided [10 CFR 54.17(g)]			☐	☐

Table 1.1-1. Acceptance Review Checklist for Docketing of Timely and Sufficient Renewal Application (continued)

			Yes	No
9.	Information specified in 10 CFR 50.33(a) through (e), (h), and (i) is provided or referenced [10 CFR 54.19(a)]:			
	A.	Name of applicant	☐	☐
	B.	Address of applicant	☐	☐
	C.	Business description	☐	☐
	D.	Citizenship and ownership details	☐	☐
	E.	License information	☐	☐
	F.	Construction or alteration dates	☐	☐
	G.	Regulatory agencies and local publications	☐	☐
10.	Conforming changes, as needed, to the standard indemnity agreement have been submitted (10 CFR 140.92, Appendix B) to account for the proposed change in the expiration date [10 CFR 54.19(b)]		☐	☐

II. Technical Information

			Yes	No
1.	An integrated plant assessment [10 CFR 54.21(a)] is provided, and consists of:			
	A.	For those SSCs within the scope of license renewal [10 CFR 54.4], identification and listing of those structures and components that are subject to an aging management review (AMR) in accordance with 10 CFR 54.21(a)(1)(i) and (ii)		
		a. Description of the boundary of the system or structure considered (if applicant initially scoped at the system or structure level). Within this boundary, identification of structures and components subject to an AMR. For commodity groups, description of basis for the grouping	☐	☐
		b. Lists of structures and components subject to an AMR	☐	☐
	B.	Description and justification of methods used to identify structures and components subject to an AMR [10 CFR 54.21(a)(2)]	☐	☐

Table 1.1-1. Acceptance Review Checklist for Docketing of Timely and Sufficient Renewal Application (continued)

Item	Yes	No
C. Demonstration that the effects of aging will be adequately managed for each structure and component identified, so that their intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation [10 CFR 54.21(a)(3)]		
a. Description of the intended function(s) of the structures and components	☐	☐
b. Identification of applicable aging effects based on materials, environment, operating experience, etc.	☐	☐
c. Identification and description of aging management programs	☐	☐
d. Demonstration of aging management provided	☐	☐
2. An evaluation of time-limited aging analyses (TLAAs) is provided, and consists of:		
A. Listing of plant-specific TLAAs in accordance with the six criteria specified in 10 CFR 54.3 [10 CFR 54.21(c)(1)]	☐	☐
B. An evaluation of each identified TLAA using one of the three approaches specified in 10 CFR 54.21(c)(1)(i) to (iii)	☐	☐
3. All plant-specific exemptions granted pursuant to 10 CFR 50.12 and in effect that are based on a TLAA are listed, and evaluations justifying the continuation of these exemptions for the period of extended operation are provided [10 CFR 54.21(c)(2)]	☐	☐
A. Listing of plant-specific exemptions that are based on TLAAs as defined in 10 CFR 54.3 [10 CFR 54.21(c)(2)]	☐	☐
B. An evaluation of each identified exemption justifying the continuation of these exemptions for the period of extended operation [10 CFR 54.21(c)(2)]	☐	☐
III. An FSAR supplement [10 CFR 54.21(d)] is provided and contains the following information:		
1. Summary description of the aging management programs and activities for managing the effects of aging	☐	☐
2. Summary description of the evaluation of TLAAs	☐	☐

Table 1.1-1. Acceptance Review Checklist for Docketing of Timely and Sufficient Renewal Application (continued)

		Yes	No
IV.	**Technical Specification Changes**		
	Any technical specification changes necessary to manage the aging effects during the period of extended operation and their justifications are included in the application [10 CFR 54.22]	☐	☐
V.	**Environmental Information**		
	Application includes a supplement to the environmental report that is in accordance with the requirements of Subpart A of 10 CFR Part 51 [10 CFR 54.23]	☐	☐
VI.	**Timeliness Provision**		
	The application is sufficient and submitted at least 5 years before expiration of current license [10 CFR 2.109(b)]. If not, application can be accepted for docketing, but the timely renewal provision in 10 CFR 2.109(b) does not apply	☐	☐

CHAPTER 2

SCOPING AND SCREENING METHODOLOGY FOR IDENTIFYING STRUCTURES AND COMPONENTS SUBJECT TO AGING MANAGEMENT REVIEW AND IMPLEMENTATION RESULTS

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2.1 SCOPING AND SCREENING METHODOLOGY

Review Responsibilities

Primary - Branch responsible for quality assurance
Secondary - Branches responsible for systems, as appropriate

2.1.1 Areas of Review

This section addresses the scoping and screening methodology for license renewal. As required by 10 CFR 54.21(a)(2), the applicant, in its integrated plant assessment (IPA), is to describe and justify methods used to identify systems, structures, and components (SSCs) subject to an aging management review (AMR). The SSCs subject to AMR are those that perform an intended function, as described on 10 CFR 54.4 and meet two criteria:

1. They perform such functions without moving parts or without a change in configuration or properties, as set forth in 10 CFR 54.21(a)(1)(i), (denoted as "passive" components and structures in this SRP), and

2. They are not subject to replacement based on a qualified life or specified time period, as set forth in 10 CFR 54.21(a)(1)(ii), (denoted as "long-lived" structures and components).

The identification of the SSCs within the scope of license renewal is called "scoping." For those SSCs within the scope of license renewal, the identification of "passive," "long-lived" structures and components that are subject to an AMR is called "screening."

To verify that the applicant has properly implemented its methodology, the staff reviews the implementation results separately, following the guidance in Sections 2.2 through 2.5.

The following areas relating to the applicant's scoping and screening methodology are reviewed.

2.1.1.1 Scoping

The methodology used by the applicant to implement the scoping requirements of 10 CFR 54.4, "Scope," is reviewed.

2.1.1.2 Screening

The methodology used by the applicant to implement the "screening" requirements of 10 CFR 54.21(a)(1) is reviewed.

2.1.2 Acceptance Criteria

The acceptance criteria for the areas of review are based on the following regulations:

- 10 CFR 54.4(a) as it relates to the identification of plant SSCs within the scope of the rule;

- 10 CFR 54.4(b) as it relates to the identification of the intended functions of plant SSCs determined to be within the scope of the rule; and
- 10 CFR 54.21(a)(1) and (a)(2) as they relate to the methods utilized by the applicant to identify plant structures and components subject to an AMR.

Specific criteria necessary to determine whether the applicant has met the relevant requirements of 10 CFR 54.4(a), 54.4(b), 54.21(a)(1), and 54.21(a)(2) are as follows.

2.1.2.1 Scoping

The scoping methodology used by the applicant should be consistent with the process described in Section 3.0, “Identify the SSCs Within the Scope of License Renewal and Their Intended Functions,” of NEI 95-10, “Industry Guideline for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule,” (Ref. 1), or the justification provided by the applicant for any exceptions should provide a reasonable basis for the exception.

2.1.2.2 Screening

The screening methodology used by the applicant should be consistent with the process described in Section 4.1, “Identification of Structures and Components Subject to an Aging Management Review and Intended Functions,” of NEI 95-10, (Ref. 1) as referenced by Regulatory Guide 1.188.

2.1.3 Review Procedures

Preparation for the review of the scoping and screening methodology employed by the applicant should include the following:

- Review of the NRC’s safety evaluation report (SER) that was issued along with the operating license for the facility. This review is conducted for the purpose of familiarization with the principal design criteria for the facility and its current licensing basis (CLB), as defined in 10 CFR 54.3(a).

- Review of Chapters 1 through 12 of the Updated Final Safety Analysis Report (UFSAR) and the facility’s technical specifications for the purposes of familiarization with the facility design and the nomenclature that is applied to SSCs within the facility (including the bases for such nomenclature). During this review, the SSCs should be identified that are relied upon to remain functional during and after design basis events (DBEs), as defined in 10 CFR 50.49(b)(1)(ii), for which the facility was designed, to ensure that the functions described in 10 CFR 54.4(a)(1) are successfully accomplished. This review should also yield information regarding seismic Category I SSCs as defined in Regulatory Guide 1.29, “Seismic Design Classification” (Ref. 2). For a newer plant, this information is typically contained in Section 3.2.1, “Seismic Classification,” of the UFSAR consistent with the Standard Review Plan (NUREG-0800) (Ref. 3).

- Review of Chapter 15 (or equivalent) of the UFSAR to identify the anticipated operational occurrences and postulated accidents that are explicitly evaluated in the accident analyses for the facility. During this review, the SSCs that are relied upon to remain functional during and following design basis events (as defined in 10 CFR 50.49(b)(1)) to ensure the functions described in 10 CFR 54.4(a)(1) should be identified.

- The set of design basis events as defined in the rule is not limited to Chapter 15 (or equivalent) of the UFSAR. Examples of design basis events that may not be described in this chapter include external events, such as floods, storms, earthquakes, tornadoes, or hurricanes, and internal events, such as a high-energy-line break. Information regarding design basis events as defined in 10 CFR

50.49(b)(1) may be found in any chapter of the facility UFSAR, the Commission's regulations, NRC orders, exemptions, or license conditions within the CLB. These sources should also be reviewed to identify systems, structures, and components that are relied upon to remain functional during and following design basis events (as defined in 10 CFR 50.49(b)(1)) to ensure the functions described in 10 CFR 54.4(a)(1).

- Review of the facility's Probabilistic Risk Analysis (PRA) Summary Report that was prepared by the licensee in response to Generic Letter (GL) 88-20, "Individual Plant Examination for Severe Accident Vulnerabilities - 10 CFR 50.54(f)," dated November 23, 1988 (Ref. 4). This review should yield additional information regarding the impact of the Individual Plant Examination (IPE) on the CLB for the facility. While the LR Rule is "deterministic," the NRC in the statements of consideration (SOC) accompanying the Rule also states: "In license renewal, probabilistic methods may be most useful, on a plant-specific basis, in helping to assess the relative importance of structures and components that are subject to an aging management review by helping to draw attention to specific vulnerabilities (e.g., results of an IPE or IPEEE)" (60 FR 22468). For example, the reviewer should focus on IPE information pertaining to plant changes or modifications that are initiated by the licensee in accordance with the requirements of 10 CFR 50.59 or 10 CFR 50.90.

- Review of the results of the facility's Individual Plant Examination of External Events (IPEEE) study conducted as a follow-up to the IPE performed as a result of GL 88-20 to identify any changes or modifications made to the facility in accordance with the requirements of 10 CFR 50.59 or 10 CFR 50.90.

- Review of the applicant's docketed correspondence related to the following regulations:

  (a) 10 CFR 50.48, "Fire Protection,"

  (b) 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants,"

  (c) 10 CFR 50.61, "Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events," [applicable to pressurized water reactor (PWR) plants].

  (d) 10 CFR 50.62, "Requirements for Reduction of Risk from Anticipated Transients without Scram Events for Light-Water-Cooled Nuclear Power Plants," and

  (e) 10 CFR 50.63, "Loss of All Alternating Current Power," (applicable to PWR plants).

Other staff members are reviewing the applicant's scoping and screening results separately following the guidance in Sections 2.2 through 2.5. The reviewer should keep these other staff members informed of findings that may affect their review of the applicant's scoping and screening results. The reviewer should coordinate this sharing of information through the license renewal project manager.

2.1.3.1 Scoping

Once the information delineated above has been gathered, the reviewer reviews the applicant's methodology to determine whether its depth and breadth are sufficiently comprehensive to identify the SSCs within the scope of license renewal, and the structures and components requiring an AMR. Because "[t]he CLB represents the evolving set of requirements and commitments for a specific plant that are modified as necessary over the life of a plant to ensure continuation of an adequate level of safety" (60 FR 22465, May 8, 1995), the regulations, orders, license conditions, exemptions, and technical specifications defining functional requirements for facility SSCs that make up an applicant's CLB should be considered as the initial input into the scoping process. 10 CFR 50.49 defines DBEs as conditions of normal operation, including anticipated operational occurrences, DBAs, external events, and natural phenomena for which the plant must be designed to ensure (1) the integrity of the reactor pressure boundary, (2) the capability to shut down the reactor and maintain it in safe shutdown condition, or (3) the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to those referred to in 10 CFR 50.34(a)(1), 50.67(b)(2), or 100.11, as applicable. Therefore, to determine the safety-related (SR) SSCs that are within the scope of the rule under 10 CFR 54.4 (a)(1), the applicant must identify those SSCs that are relied upon to remain functional during and following these DBEs, consistent with the CLB of the facility. Most licensees have developed lists or database that identify systems, structures, and components relied on for compliance with other regulations in a manner consistent with the CLB of their facilities. Consistent with the licensing process and regulatory criteria used to develop such lists or databases, licensees should build upon these information sources to satisfy 10 CFR Part 54 requirements.

With respect to technical specifications, the NRC states (60 FR 22467):

> *The Commission believes that there is sufficient experience with its policy on technical specifications to apply that policy generically in revising the license renewal rule consistent with the Commission's desire to credit existing regulatory programs. Therefore, the Commission concludes that the technical specification limiting conditions for operation scoping category is unwarranted and has deleted the requirement that identifies systems, structures, and components with operability requirements in technical specifications as being within the scope of the license renewal review.*

Therefore, the applicant need not consider its technical specifications and applicable limiting conditions of operation when scoping for license renewal. This is not to say that the events and functions addressed within the applicant's technical specifications can be excluded in determining the SSCs within the scope of license renewal solely on the basis of such an event's inclusion in the technical specifications. Rather, those SSCs governed by an applicant's technical specifications that are relied upon to remain functional during a DBE, as identified within the applicant's UFSAR, applicable NRC regulations, license conditions, NRC orders, and exemptions, need to be included within the scope of license renewal.

For licensee commitments, such as licensee responses to NRC Bulletins, GLs, or enforcement actions, and those documented in staff safety evaluations or licensee event reports, and which make up the remainder of an applicant's CLB, many of the associated SSCs need not be considered under license renewal. Generic communications, safety evaluations, and other similar documents found on the docket are not regulatory requirements, and commitments made by a licensee to address any associated safety concerns are not typically considered to be design requirements. However, any generic communication, safety evaluation, or licensee commitment that specifically identifies or describes a function associated with a system, structure, or component necessary to fulfill the requirement of a particular regulation, order, license condition, and/or exemption may need to be considered when scoping for license renewal. For example, NRC Bulletin 88-11, "Pressurizer Surge Line Thermal Stratification," states:

The licensing basis according to 10 CFR 50.55a for all PWRs requires that the licensee meet the American Society of Mechanical Engineers Boiler and Pressure Vessel Code Sections III and XI and to reconcile the pipe stresses and fatigue evaluation when any significant differences are observed between measured data and the analytical results for the hypothesized conditions. Staff evaluation indicates that the thermal stratification phenomenon could occur in all PWR surge lines and may invalidate the analyses supporting the integrity of the surge line. The staff's concerns include unexpected bending and thermal striping (rapid oscillation of the thermal boundary interface along the piping inside surface) as they affect the overall integrity of the surge line for its design life (e.g., the increase of fatigue).

Therefore, this bulletin specifically describes conditions that may affect compliance with the requirements associated with 10 CFR 50.55a and functions specifically related to this regulation that must be considered in the scoping process for license renewal.

An applicant may take an approach in scoping and screening that combines similar components from various systems. For example, containment isolation valves from various systems may be identified as a single system for purposes of license renewal.

Staff from branches responsible for systems may be requested to assist in reviewing the plant design basis and intended function(s), as necessary.

The reviewer should verify that the applicant's scoping methods document the actual information sources used (for example, those identified in Table 2.1-1).

Table 2.1-2 contains specific staff guidance on certain subjects of scoping.

2.1.3.1.1 Safety-Related

The applicant's methodology is reviewed to ensure that the SR SSCs are identified to satisfactorily accomplish any of the intended functions identified in 10 CFR 54.4(a)(1). The reviewer must ascertain how, and to what extent, the applicant incorporated the information in the CLB for the facility in its methodology. Specifically, the reviewer should review the application, as well as all other relevant sources of information outlined above, to identify the set of plant-specific conditions of normal operation, DBAs, external events, and natural phenomena for which the plant must be designed to ensure the following functions:

- The integrity of the reactor coolant pressure boundary;
- The capability to shut down the reactor and maintain it in a safe shutdown condition; or
- The capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the guidelines in 10 CFR 50.34(a)(1), 50.67(b)(2), or 100.11, as applicable.

2.1.3.1.2 Nonsafety-Related

The applicant's methodology is reviewed to ensure that nonsafety-related (NSR) SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1) are identified as being within the scope of license renewal.

The scoping criterion under 10 CFR 54.4(a)(2), in general, is intended to identify those NSR SSCs that support SR functions. More specifically, this scoping criterion requires an applicant to identify all NSR SSCs whose failure could prevent satisfactory accomplishment of the applicable functions of the SSCs identified under 10 CFR 54.4(a)(1). Section III.c(iii) of the SOC (60 FR 22467) clarifies the NRC's intent for this requirement in the following statement:

> *The inclusion of nonsafety-related systems, structures, and components whose failure could prevent other systems, structures, and components from accomplishing a safety function is intended to provide protection against safety function failure in cases where the safety-related structure or component is not itself impaired by age-related degradation but is vulnerable to failure from the failure of another structure or component that may be so impaired.*

In addition, Section III.c(iii) of the SOC provides the following guidance to assist an applicant in determining the extent to which failures must be considered when applying this scoping criterion:

> *Consideration of hypothetical failures that could result from system interdependencies that are not part of the current licensing bases and that have not been previously experienced is not required. [...] However, for some license renewal applicants, the Commission cannot exclude the possibility that hypothetical failures that <u>are part of the CLB</u> may require consideration of second-, third-, or fourth-level support systems.*

Therefore, to satisfy the scoping criterion under 10 CFR 54.4(a)(2), the applicant must identify those NSR SSCs (including certain second-, third-, or fourth-level support systems) whose failures are considered in the CLB and could prevent the satisfactory accomplishment of an SR function identified under 10 CFR 54.4(a)(1). In order to identify such systems, the applicant should consider those failures identified in (1) the documentation that makes up its CLB, (2) plant-specific operating experience, and (3) industry-wide operating experience that is specifically applicable to its facility. The applicant need not consider hypothetical failures that are not part of the CLB, have not been previously experienced, or are not applicable to its facility.

In part, 10 CFR 54.4(a)(2) requires that the applicant consider all NSR SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), 10 CFR 54.4(a)(1)(ii), or 10 CFR 54.4(a)(1)(iii) to be within the scope of license renewal. By letters dated December 3, 2001, and March 15, 2002, the NRC issued a staff position to NEI which provided staff guidance for determining what SSCs meet the 10 CFR 54.4(a)(2) criterion. The December 3, 2001 letter, "License Renewal Issue: Scoping of Seismic II/I Piping Systems," provided specific examples of operating experience which identified pipe failure events [summarized in Information Notice (IN) 2001-09, "Main Feedwater System Degradation in Safety-Related ASME Code Class 2 Piping Inside the Containment of a Pressurized Water Reactor"] and the approaches the NRC considers acceptable to determine which piping systems should be included in scope based on the 10 CFR 54.4(a)(2) criterion. The March 15, 2002 letter, "License Renewal Issue: Guidance on the Identification and Treatment of Structures, Systems, and Components Which Meet 10 CFR 54.4(a)(2)," further described the staff's recommendations for the evaluation of non-piping SSCs to determine which additional NSR SSCs are within scope. The position states that the applicants should not consider hypothetical failures, but rather should base their evaluation on the plant's CLB, engineering judgment and analyses, and relevant operating experience. The paper further describes operating experience as all documented plant-specific and industry-wide experience that can be used to determine the plausibility of a failure. Documentation would include NRC generic communications and event reports, plant-specific condition reports, industry reports such as significant operating experience reports (SOERs), and engineering evaluations.

For example, the safety classification of a pipe at certain locations, such as valves, may change throughout its length in the plant. In these instances, the applicant should identify the SR portion of the pipe as being within the scope of license renewal under 10 CFR 54.4(a)(1). However, the entire pipe run, including associated piping anchors, may have been analyzed as part of the CLB to establish that it could withstand DBE loads. If this is the case, a failure in the pipe run or in the associated piping anchors could render the SR portion of the piping unable to perform its intended function under CLB design conditions. Therefore, the reviewer must verify that the applicant's methodology would include (1) the remaining NSR piping up to its anchors and (2) the associated piping anchors as being within the scope of license renewal under 10 CFR 54.4(a)(2).

In order to comply, in part, with the requirements of 10 CFR 54.4(a)(2), all applicants must include in scope all NSR piping attached directly to SR piping (within scope) up to a defined anchor point consistent with the plant CLB. This anchor point may be served by a true anchor (a device or structure which ensures forces and moments are restrained in three (3) orthogonal directions) or an equivalent anchor, such as a large piece of plant equipment (e.g., a heat exchanger,) determined by an evaluation of the plant-specific piping design (i.e., design documentation, such as piping stress analysis for the facility).

Applicants should be able to define an equivalent anchor consistent with their CLB (e.g., described in the UFSAR or other CLB documentation), which is being credited for the 10 CFR 54.4(a)(2) evaluation, and be able to describe the structures and components that are part of the NSR piping segment boundary up to and including the anchor point or equivalent anchor point within scope of the rule.

There may be isolated cases where an equivalent anchor point for a particular piping segment is not clearly described within the existing CLB information. In those instances the applicant may use a combination of restraints or supports such that the NSR piping and associated structures and components attached to SR piping is included in scope up to a boundary point which encompasses at least two (2) supports in each of three (3) orthogonal directions.

It is important to note that the scoping criterion under 10 CFR 54.4(a)(2) specifically applies to those functions "identified in paragraphs (a)(1)(i), (ii), and (iii)" of 10 CFR 54.4 and does not apply to functions identified in 10 CFR 54.4(a)(3), as discussed below.

2.1.3.1.3 "Regulated Events"

The applicant's methodology is reviewed to ensure that SSCs relied on in safety analyses or plant evaluations to perform functions that demonstrate compliance with the requirements of the fire protection, environmental qualification, pressurized thermal shock (PTS), anticipated transients without scram (ATWS), and station blackout (SBO) regulations are identified. The reviewer should review the applicant's docketed correspondence associated with compliance of the facility with these regulations.

The scoping criteria in 10 CFR 54.4(a)(3) require an applicant to consider *"[a]ll structures, systems, and components relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the [specified] Commission regulations. . ."* In addition, Section III.c(iii) (60 FR 22467) of the SOC states that the NRC intended to limit the potential for unnecessary expansion of the review for SSCs that meet the scoping criteria under 10 CFR 54.4(a)(3) and provides additional guidance that qualifies what is meant by "*those SSCs relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission regulations*" in the following statement:

> *[T]he Commission intends that this [referring to 10 CFR 54.4(a)(3)] scoping category include all SSC whose function is relied upon to demonstrate compliance*

with these Commission[ ] regulations. An applicant for license renewal should rely on the plant's current licensing bases, actual plant-specific experience, industry-wide operating experience, as appropriate, and existing engineering evaluations to determine those SSC that are the initial focus of license renewal review.

Therefore, all SSCs that are relied upon in the plant's CLB (as defined in 10 CFR 54.3), plant-specific experience, industry-wide experience (as appropriate), and safety analyses or plant evaluations to perform a function that demonstrates compliance with NRC regulations identified under 10 CFR 54.4(a)(3), are required to be included within the scope of the rule. For example, if an NSR diesel generator is required for safe shutdown under the fire protection plan, the diesel generator and all SSCs specifically relied upon for that generator to comply with NRC regulations shall be included within the scope of license renewal under 10 CFR 54.4(a)(3). Such SSCs may include, but should not be limited to, the cooling water system or systems relied upon for operability, the diesel support pedestal, and any applicable power supply cable specifically relied upon for safe shutdown in the event of a fire.

In addition, the last sentence of the second paragraph in Section III.c(iii) of the SOC provides the following guidance for limiting the application of the scoping criterion under 10 CFR 54.4(a)(3) as it applies to the use of hypothetical failures:

Consideration of hypothetical failures that could result from system interdependencies, that are not part of the current licensing bases and that have not been previously experienced is not required. (60 FR 22467)

The SOC does not provide any additional guidance relating to the use of hypothetical failures or the need to consider second-, third-, or fourth-level support systems for scoping under 10 CFR 54.4(a)(3). Therefore, in the absence of any guidance, an applicant need not consider hypothetical failures or second-, third-, or fourth-level support systems in determining the SSCs within the scope of the rule under 10 CFR 54.4(a)(3). For example, if an NSR diesel generator is relied upon only to remain functional to demonstrate compliance with the NRC SBO regulation, the applicant need not consider the following SSCs: (1) an alternate/backup cooling water system, (2) non-seismically-qualified building walls, or (3) an overhead segment of non-seismically-qualified piping (in a Seismic II/I configuration). This guidance is not intended to exclude any support system (whether identified by an applicant's CLB, or as indicated from actual plant-specific experience, industry wide experience [as applicable], safety analyses, or plant evaluations) that is specifically relied upon for compliance with, the applicable NRC regulation. For example, if analysis of an NSR diesel generator (relied upon to demonstrate compliance with an applicable NRC regulation) specifically relies upon a second cooling system to cool the diesel generator jacket water cooling system for the generator to be operable, then both cooling systems must be included within the scope of the rule under 10 CFR 54.4(a)(3).

The applicant is required to identify the SSCs whose functions are relied upon to demonstrate compliance with the regulations identified in 10 CFR 54.4(a)(3) (that is, whose functions were credited in the analysis or evaluation). Mere mention of an SSC in the analysis or evaluation does not necessarily constitute support of an intended function as required by the regulation.

For environmental qualification, the reviewer verifies that the applicant has indicated that the environmental qualification equipment is that equipment already identified by the licensee under 10 CFR 50.49(b), that is, equipment relied upon in safety analyses or plant evaluations to demonstrate compliance with NRC regulations for environmental qualification (10 CFR 50.49).

The PTS regulation is applicable only to PWRs. If the renewal application is for a PWR and the applicant relies on a Regulatory Guide 1.154 (Ref. 5) analysis to satisfy 10 CFR 50.61, as described in the plant's CLB, the reviewer verifies that the applicant's methodology would include SSCs relied on in that analysis.

For SBO, the reviewer verifies that the applicant's methodology would include those SSCs relied upon during the "coping duration" and "recovery" phase of an SBO event. In addition, because 10 CFR 50.63(c)(1)(ii) and its associated guidance in Regulatory Guide 1.155 include procedures to recover from an SBO that include offsite and onsite power, the plant system portion of the offsite power system that is used to connect the plant to the offsite power source should also be included within the scope of the rule.

2.1.3.2 Screening

Once the SSCs within the scope of license renewal have been identified, the next step is determining which structures and components are subject to an AMR (i.e., "screening") (Ref. 1).

2.1.3.2.1 "Passive"

The reviewer reviews the applicant's methodology to ensure that "passive" structures and components are identified as those that perform their intended functions without moving parts or a change in configuration or properties in accordance with 10 CFR 54.21(a)(1)(i). The description of "passive" may also be interpreted to include structures and components that do not display "a change in state." 10 CFR 54.21(a)(1)(i) provides specific examples of structures and components that do or do not meet the criterion. The reviewer verifies that the applicant's screening methodology includes consideration of the intended functions of structures and components consistent with the plant's CLB, as typified in Tables 2.1-4(a) and (b), respectively (Ref. 1).

The license renewal rule focuses on "passive" structures and components because structures and components that have passive functions generally do not have performance and condition characteristics that are as readily observable as those that perform active functions. "Passive" structures and components, for the purpose of the license renewal rule, are those that perform an intended function, as described in 10 CFR 54.4, without moving parts or without a change in configuration or properties (Ref. 2). The description of "passive" may also be interpreted to include structures and components that do not display "a change of state."

Table 2.1-5 provides a list of typical structures and components identifying whether they meet 10 CFR 54.21(a)(1)(i).

10 CFR 54.21(a)(1)(i) explicitly excludes instrumentation, such as pressure transmitters, pressure indicators, and water level indicators, from an AMR. The applicant does not have to identify pressure-retaining boundaries of this instrumentation because 10 CFR 54.21(a)(1)(i) excludes this instrumentation without exception, unlike pumps and valves. Further, instrumentation is sensitive equipment and degradation of its pressure retaining boundary would be readily determinable by surveillance and testing. If an applicant determines that certain structures and components listed in Table 2.1-5 as meeting 10 CFR 54.21(a)(1)(i) do not meet that requirement for its plant, the reviewer reviews the applicant's basis for that determination.

2.1.3.2.2 "Long-Lived"

The applicant's methodology is reviewed to ensure that "long-lived" structures and components are identified as those that are not subject to periodic replacement based on a qualified life or specified time period. Passive structures and components that are not replaced on the basis of a qualified life or specified time period require an AMR.

Replacement programs may be based on vendor recommendations, plant experience, or any means that establishes a specific replacement frequency under a controlled program. Section f(i)(b) of the SOC provides the following guidance for identifying "long-lived" structures and components:

> *In sum, a structure or component that is not replaced either (i) on a specified interval based upon the qualified life of the structure or component or (ii) periodically in accordance with a specified time period is deemed by § 54.21(a)(1)(ii) of this rule to be "long-lived," and therefore subject to the § 54.21(a)(3)aging management review [60 FR 22478].*

A qualified life does not necessarily have to be based on calendar time. A qualified life based on run time or cycles are examples of qualified life references that are not based on calendar time (Ref. 3).

Structures and components that are replaced on the basis of performance or condition are not generically excluded from an AMR. Rather, performance or condition monitoring may be evaluated later in the IPA as programs to ensure functionality during the period of extended operation. On this topic, Section f(i)(b) of the SOC provides the following guidance:

> *It is important to note, however, that the Commission has decided not to generically exclude passive structures and components that are replaced based on performance or condition from an aging management review. Absent the specific nature of the performance or condition replacement criteria and the fact that the Commission has determined that the components with "passive" functions are not as readily monitorable as components with active functions, such generic exclusion is not appropriate. However, the Commission does not intend to preclude a license renewal applicant from providing site-specific justification in a license renewal application that a replacement program on the basis of performance or condition for a passive structure or component provides reasonable assurance that the intended function of the passive structure or component will be maintained in the period of extended operation. [60 FR 22478]*

2.1.4 Evaluation Findings

When the review of the information in the license renewal application is complete, and the reviewer has determined that it is satisfactory and in accordance with the acceptance criteria in Subsection 2.1.2, a statement of the following type should be included in the staff's safety evaluation report:

> On the basis of its review, as discussed above, the staff concludes that there is reasonable assurance that the applicant's methodology for identifying the systems, structures, and components within the scope of license renewal and the structures and components requiring an aging management review is consistent with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1).

2.1.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of NRC regulations, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

2.1.6 References

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

2. Regulatory Guide 1.29, Rev. 2, “Seismic Design Classification,” September 1978.

3. NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants,” July 1981.

4. Generic Letter (GL) 88-20, “Individual Plant Examination for Severe Accident Vulnerabilities-10 CFR 50.54(f),” dated November 23, 1988.

5. Regulatory Guide 1.154, “Format and Content of Plant-Specific Pressurized Thermal Shock Safety Analysis Reports for Pressurized Water Reactors,” January 1987.

6. Deleted.

7. NUREG-1723, “Safety Evaluation Report Related to the License Renewal of Oconee Nuclear Stations, Units 1, 2, and 3,” March 2000.

8. Letter to Douglas J. Walters, Nuclear Energy Institute, from Christopher I. Grimes, NRC, dated August 5, 1999.

9. Summary of December 8, 1999, Meeting with the Nuclear Energy Institute (NEI) on License Renewal Issue (LR) 98-12, “Consumables,” Project No. 690, January 21, 2000.

10. Letter to William R. McCollum, Jr., Duke Energy Corporation, from Christopher I. Grimes, NRC, dated October 8,1999.

11. NEI 95-10, Rev. 0, “Industry Guideline for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule,” Nuclear Energy Institute, March 1, 1996.

12. Letter to Alan Nelson, Nuclear Energy Institute, and David Lochbaum, Union of Concerned Scientists, from Christopher I. Grimes, NRC, “License Renewal Issue: Scoping of Seismic II/I Piping Systems,” dated December 3, 2001.

13. Letter to Alan Nelson, Nuclear Energy Institute, and David Lochbaum, Union of Concerned Scientists, from Christopher I. Grimes, NRC, “License Renewal Issue: Guidance on the Identification and Treatment of Structures, Systems, and Components Which Meet 10 CFR 54.4(a)(2),” dated March 15, 2002.

14. Letter to Alan Nelson, Nuclear Energy Institute, and David Lochbaum, Union of Concerned Scientists, from Christopher I. Grimes, NRC, “Staff Guidance on Scoping of Equipment Relied on to Meet the Requirements of the Station Blackout (SBO) Rule (10 CFR 50.63) for License Renewal (10 CFR 54.4(a)(3)),” dated April 1, 2002.

Table 2.1-1 Sample Listing of Potential Information Sources

Verified databases (databases that are subject to administrative controls to assure and maintain the integrity of the stored data or information)
Master equipment lists (including NSSS vendor listings)
Q-lists
Updated Final Safety Analysis Reports
Piping and instrument diagrams
NRC Orders, Exemptions, or License Conditions for the facility
Design-basis documents
General arrangement or structural outline drawings
Probabilistic risk assessment summary report
Maintenance rule compliance documentation
Design-basis event evaluations (including plant-specific 10 CFR 50.59 evaluation procedures)
Emergency operating procedures
Docketed correspondence
System interaction commitments
Technical specifications
Environmental qualification program documents
Regulatory compliance reports (including Safety Evaluation Reports)
Severe Accident Management Guidelines

Table 2.1-2. Specific Staff Guidance on Scoping

Issue	Guidance
Commodity groups	The applicant may also group like structures and components into commodity groups. Examples of commodity groups are pipe supports and cable trays. The basis for grouping structures and components can be determined by such characteristics as similar function, similar design, similar materials of construction, similar aging management practices, or similar environments. If the applicant uses commodity groups, the reviewer verifies that the applicant has described the basis for the groups.
Complex assemblies	Some structures and components, when combined, are considered a complex assembly (for example, diesel generator starting air skids or heating, ventilating, and air conditioning refrigerant units). For purposes of performing an AMR, it is important to clearly establish the boundaries of review. An applicant should establish the boundaries for such assemblies by identifying each structure and component that makes up the complex assembly and determining whether or not each structure and component is subject to an AMR (Ref. 1). NEI 95-10, Revision 0, Appendix C, Example 5 (Ref. 11), illustrates how the evaluation boundary for a control room chiller complex assembly might be determined. The control room chillers were purchased as skid mounted equipment. These chillers are part of the control room chilled water system. There are two (2) control room chillers. Each is a 100% capacity refrigeration unit. The functions of the control room chillers are: to provide a reliable source of chilled water at a maximum temperature of 44°F, to provide a pressure boundary for the control room chilled water system, to provide a pressure boundary for the service water system, and to provide a pressure boundary for the refrigerant. All of these functions are considered intended functions. Typically, control room chillers are considered as one functional unit; however, for purposes of evaluating the effects of aging, it is necessary to consider the individual components. Therefore, the boundary of each control room chiller is established as follows: 1. At the inlet and outlet flanges of the service water system connections on the control room chiller condenser. Connected piping is part of the service water system. 2. At the inlet and outlet flanges of the control room chilled water system piping connections on the control room chiller evaporator. Connected piping is part of the control room chilled water system. 3. For electrical power supplies, the boundary is the output terminals on the circuit breakers supplying power to the skid. This includes the cables from the circuit breaker to the skid and applies for 480 VAC and 120 VAC. 4. The interface for instrument air supplies is at the instrument air tubing connection to the pressure control regulators, temperature controllers and transmitters, and solenoid valves located on the skid. The tubing from the instrument air header to the device on the skid is part of the instrument air system. 5. The interface with the annunciator system is at the external connection of the contacts of the device on the skid (limit switch, pressure switch, level switch, etc.) that indicates the alarm condition. The cables are part of the annunciator system. Based on the boundary established, the following components would be subject to an aging management review: condenser, evaporator, economizer, chiller refrigerant piping, refrigerant expansion orifice, foundations and bolting, electrical cabinets, cables, conduit, trays and supports, valves

Table 2.1-2 Specific Staff Guidance on Scoping (continued)

Issue	Guidance
Hypothetical failures	For 10 CFR 54.4(a)(2), an applicant should consider those failures identified in (1) the documentation that makes up its CLB, (2) plant-specific operating experience, and (3) industry-wide operating experience that is specifically applicable to its facility. The applicant need not consider hypothetical failures that are not part of CLB and that have not been previously experienced. For example, an applicant should consider including (1) the portion of a fire protection system identified in the UFSAR that supplies water to the refueling floor that is relied upon in a DBA analysis as an alternate source of cooling water that can be used to mitigate the consequences from the loss of spent fuel pool cooling, (2) a nonsafety-related, non-seismically-qualified building whose intended function as described in the plant's CLB is to protect a tank that is relied upon as an alternate source of cooling water needed to mitigate the consequences of a DBE, and (3) a segment of nonsafety-related piping identified as a Seismic II/I component in the applicant's CLB (Ref. 8).
Cascading	For 10 CFR 54.4(a)(3), an applicant need not consider hypothetical failures or second-, third, or fourth-level support systems. For example, if a nonsafety-related diesel generator is only relied upon to remain functional to demonstrate compliance with the NRC's SBO regulations, an applicant may not need to consider (1) an alternate/backup cooling water system, (2) the diesel generator non-seismically-qualified building walls, or (3) an overhead segment of non-seismically-qualified piping (in a Seismic II/I configuration). An applicant may not exclude any support system (identified by its CLB, actual plant-specific experience, industry-wide experience, as applicable, or existing engineering evaluations) that is specifically relied upon for compliance with, or operation within, applicable NRC regulation. For example, if the analysis of a nonsafety-related diesel generator (relied upon to demonstrate compliance with an applicable NRC regulation) specifically relies upon a second cooling system to cool the diesel generator jacket water cooling system for the diesel to be operable, then both cooling systems must be included within the scope of the rule (Ref. 8).

Table 2.1-3 Specific Staff Guidance on Screening

Issue	Guidance
Consumables	Consumables may be divided into the following four categories for the purpose of license renewal: (a) packing, gaskets, component seals, and O-rings; (b) structural sealants; (c) oil, grease, and component filters; and (d) system filters, fire extinguishers, fire hoses, and air packs. The consumables in both categories (a) and (b) are considered as subcomponents and are not explicitly called out in the scoping and screening procedures. Rather, they are implicitly included at the component level (e.g., if a valve is identified as being in scope, a seal in that valve would also be in scope as a subcomponent of that valve). For category (a), the applicant would generally be able to exclude these subcomponents using a clear basis, such as the example of ASME Section III not being relied on for pressure boundary. For category (b), these subcomponents may perform functions without moving parts or a change in configuration, and they are not typically replaced. The applicant's structural AMP should address these items with respect to an AMR program on a plant-specific basis. The consumables in category (c) are usually short-lived and periodically replaced, and can normally be excluded from an AMR on that basis. Likewise, the consumables that fall within category (d) are typically replaced based on performance or condition monitoring that identifies whether these components are at the end of their qualified lives and may be excluded, on a plant-specific basis, from AMR under 10 CFR 54.21(a)(1)(ii). The applicant should identify the standards that are relied on for the replacement as part of the methodology description (for example, NFPA standards for fire protection equipment) (Ref. 9).
Heat exchanger intended functions	Both the pressure boundary and heat transfer functions for heat exchangers should be considered because heat transfer may be a primary safety function of these components. There may be a unique aging effect associated with different materials in the heat exchanger parts that are associated with the heat transfer function and not the pressure boundary function. Normally the programs that effectively manage aging effects of the pressure boundary function can, in conjunction with the procedures for monitoring heat exchanger performance, effectively manage aging effects applicable to the heat transfer function (Ref. 10).
Multiple functions	Structures and components may have multiple functions. The intended functions as delineated in 10 CFR 54.4(b) are to be reviewed for license renewal. For example, a flow orifice that is credited in a plant's accident analysis to limit flow would have two intended functions. One intended function is pressure boundary. The other intended function is to limit flow. The reviewer verifies that the applicant has considered multiple functions in identifying structure and component intended functions.

Table 2.1-4(a) Typical "Passive" Structure Intended Functions

Structures	
Intended Function	**Description**
Direct Flow	Provide spray shield or curbs for directing flow (e.g., safety injection flow to containment sump)
Expansion/Separation	Provide for thermal expansion and/or seismic separation
Fire Barrier	Provide rated fire barrier to confine or retard a fire from spreading to or from adjacent areas of the plant
Flood Barrier	Provide flood protection barrier (internal and external flooding event)
Gaseous Release Path	Provide path for release of filtered and unfiltered gaseous discharge
Heat Sink	Provide heat sink during station blackout or design-basis accidents
HELB Shielding	Provide shielding against high-energy line breaks (HELB)
Missile Barrier	Provide missile barrier (internally or externally generated)
Pipe Whip Restraint	Provide pipe whip restraint
Pressure Relief	Provide over-pressure protection
Shelter, Protection	Provide shelter/protection to safety-related components
Shielding	Provide shielding against radiation
Shutdown Cooling Water	Provide source of cooling water for plant shutdown
Structural Pressure Barrier	Provide pressure boundary or essentially leaktight barrier to protect public health and safety in the event of any postulated design-basis events.

Table 2.1-4(b) Typical "Passive" Component Intended Functions

Components	
Intended Function	**Description**
Absorb Neutrons	Absorb neutrons
Electrical Continuity	Provide electrical connections to specified sections of an electrical circuit to deliver voltage, current or signals
Insulate (electrical)	Insulate and support an electrical conductor
Filter	Provide filtration
Heat Transfer	Provide heat transfer
Leakage Boundary (Spatial)	Nonsafety-related component that maintains mechanical and structural integrity to prevent spatial interactions that could cause failure of safety-related SSCs
Pressure Boundary	Provide pressure-retaining boundary so that sufficient flow at adequate pressure is delivered, or provide fission product barrier for containment pressure boundary, or provide containment isolation for fission product retention
Spray	Convert fluid into spray
Structural Integrity (Attached)	Nonsafety-related component that maintains mechanical and structural integrity to provide structural support to attached safety-related piping and components
Structural Support	Provide structural and/or functional support to safety-related and/or nonsafety-related components
Throttle	Provide flow restriction

Table 2.1-5 Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment

Item	Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)
1	Structures	Category I Structures	Yes
2	Structures	Primary Containment Structure	Yes
3	Structures	Intake Structures	Yes
4	Structures	Intake Canal	Yes
5	Structures	Other Non-Category I Structures Within the Scope of License Renewal	Yes
6	Structures	Equipment Supports and Foundations	Yes
7	Structures	Structural Bellows	Yes
8	Structures	Controlled Leakage Doors	Yes
9	Structures	Penetration Seals	Yes
10	Structures	Compressible Joints and Seals	Yes
11	Structures	Fuel Pool and Sump Liners	Yes
12	Structures	Concrete Curbs	Yes
13	Structures	Offgas Stack and Flue	Yes
14	Structures	Fire Barriers	Yes
15	Structures	Pipe Whip Restraints and Jet Impingement Shields	Yes
16	Structures	Electrical and Instrumentation and Control Penetration Assemblies	Yes
17	Structures	Instrumentation Racks, Frames, Panels, and Enclosures	Yes
18	Structures	Electrical Panels, Racks, Cabinets, and Other Enclosures	Yes
19	Structures	Cable Trays and Supports	Yes
20	Structures	Conduit	Yes
21	Structures	TubeTrack®	Yes
22	Structures	Reactor Vessel Internals	Yes
23	Structures	ASME Class 1 Hangers and Supports	Yes
24	Structures	Non-ASME Class 1 Hangers and Supports	Yes
25	Structures	Snubbers	No
26	Reactor Coolant Pressure Boundary Components (Note: the components of the RCPB are defined by each plant's CLB and site specific documentation	ASME Class 1 Piping	Yes
27	Reactor Coolant Pressure Boundary Components	Reactor Vessel	Yes

Table 2.1-5 Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment

Item	Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)
28	Reactor Coolant Pressure Boundary Components	Reactor Coolant Pumps	Yes (Casing)
29	Reactor Coolant Pressure Boundary Components	Control Rod Drives	No
30	Reactor Coolant Pressure Boundary Components	Control Rod Drive Housing	Yes
31	Reactor Coolant Pressure Boundary Components	Steam Generators	Yes
32	Reactor Coolant Pressure Boundary Components	Pressurizers	Yes
33	Non-Class I Piping Components	Underground Piping	Yes
34	Non-Class I Piping Components	Piping in Low Temperature Demineralized Water Service	Yes
35	Non-Class I Piping Components	Piping in High Temperature Single Phase Service	Yes
36	Non-Class I Piping Components	Piping in Multiple Phase Service	Yes
37	Non-Class I Piping Components	Service Water Piping	Yes
38	Non-Class I Piping Components	Low Temperature Gas Transport Piping	Yes
39	Non-Class I Piping Components	Stainless Steel Tubing	Yes
40	Non-Class I Piping Components	Instrument Tubing	Yes
41	Non-Class I Piping Components	Expansion Joints	Yes
42	Non-Class I Piping Components	Ductwork	Yes
43	Non-Class I Piping Components	Sprinklers Heads	Yes
44	Non-Class I Piping Components	Miscellaneous Appurtenances (Includes fittings, couplings, reducers, elbows, thermowells, flanges, fasteners, welded attachments, etc.)	Yes
45	Pumps	ECCS Pumps	Yes (Casing)
46	Pumps	Service Water and Fire Pumps	Yes (Casing)
47	Pumps	Lube Oil and Closed Cooling Water Pumps	Yes (Casing)
48	Pumps	Condensate Pumps	Yes (Casing)

Table 2.1-5 Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment

Item	Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)
49	Pumps	Borated Water Pumps	Yes (Casing)
50	Pumps	Emergency Service Water Pumps	Yes (Casing)
51	Pumps	Submersible Pumps	Yes (Casing)
52	Turbines	Turbine Pump Drives (excluding pumps)	Yes (Casing)
53	Turbines	Gas Turbines	Yes (Casing)
54	Turbines	Controls (Actuator and Overspeed Trip)	No
55	Engines	Fire Pump Diesel Engines	No
56	Emergency Diesel Generators	Emergency Diesel Generators	No
57	Heat Exchangers	Condensers	Yes
58	Heat Exchangers	HVAC Coolers (including housings)	Yes
59	Heat Exchangers	Primary Water System Heat Exchangers	Yes
60	Heat Exchangers	Treated Water System Heat Exchangers	Yes
61	Heat Exchangers	Closed Cooling Water System Heat Exchangers	Yes
62	Heat Exchangers	Lubricating Oil System Heat Exchangers	Yes
63	Heat Exchangers	Raw Water System Heat Exchangers	Yes
64	Heat Exchangers	Containment Atmospheric System Heat Exchangers	Yes
65	Miscellaneous Process Components	Gland Seal Blower	No
66	Miscellaneous Process Components	Recombiners	The applicant shall identify the intended function and apply the IPA process to determine if the grouping is active or passive.
67	Miscellaneous Process Components	Flexible Connectors	Yes
68	Miscellaneous Process Components	Strainers	Yes
69	Miscellaneous Process Components	Rupture Disks	Yes
70	Miscellaneous Process Components	Steam Traps	Yes
71	Miscellaneous Process Components	Restricting Orifices	Yes
72	Miscellaneous Process Components	Air Compressor	No

Table 2.1-5 Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment

Item	Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)
73	Electrical and I&C	Alarm Unit (e.g., fire detection devices)	No
74	Electrical and I&C	Analyzers (e.g., gas analyzers, conductivity analyzers)	No
75	Electrical and I&C	Annunciators (e.g., lights, buzzers, alarms)	No
76	Electrical and I&C	Batteries	No
77	Electrical and I&C	Cables and Connections, Bus, electrical portions of Electrical and I&C Penetration Assemblies, Includes fuse holders outside of cabinets of active electrical SCs (e.g., electrical penetration assembly cables and connections, connectors, electrical splices, fuse holders, terminal blocks, power cables, control cables, instrument cables, insulated cables, communication cables, uninsulated ground conductors, transmission conductors, isolated-phase bus, nonsegregated-phase bus, segregated-phase bus, switchyard bus)	Yes
78	Electrical and I&C	Chargers, Converters, Inverters (e.g., converters-voltage/current, converters-voltage/pneumatic, battery chargers/inverters, motor-generator sets)	No
79	Electrical and I&C	Circuit Breakers (e.g., air circuit breakers, molded case circuit breakers, oil-filled circuit breakers)	No
80	Electrical and I&C	Communication Equipment (e.g., telephones, video or audio recording or playback equipment, intercoms, computer terminals, electronic messaging, radios, transmission line traps and other power-line carrier equipment)	No
81	Electrical and I&C	Electric Heaters	No Yes for a Pressure Boundary if applicable
82	Electrical and I&C	Heat Tracing	No
83	Electrical and I&C	Electrical Controls and Panel Internal Component Assemblies (may include internal devices such as, but not limited to, switches, breakers, indicating lights, etc.) (e.g., main control board, HVAC control board)	No

Table 2.1-5 Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment

Item	Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)
84	Electrical and I&C	Elements, RTDs, Sensors, Thermocouples, Transducers (e.g., conductivity elements, flow elements, temperature sensors, radiation sensors, watt transducers, thermocouples, RTDs, vibration probes, amp transducers, frequency transducers, power factor transducers, speed transducers, var. transducers, vibration transducers, voltage transducers)	No Yes for a Pressure Boundary if applicable
85	Electrical and I&C	Fuses	No
86	Electrical and I&C	Generators, Motors (e.g., emergency diesel generators, ECCS and emergency service water pump motors, small motors, motor-generator sets, steam turbine generators, combustion turbine generators, fan motors, pump motors, valve motors, air compressor motors)	No
87	Electrical and I&C	High-voltage Insulators (e.g., porcelain switchyard insulators, transmission line insulators)	Yes
88	Electrical and I&C	Surge Arresters (e.g., switchyard surge arresters, lightning arresters, surge suppressers, surge capacitors, protective capacitors)	No
89	Electrical and I&C	Indicators (e.g., differential pressure indicators, pressure indicators, flow indicators, level indicators, speed indicators, temperature indicators, analog indicators, digital indicators, LED bar graph indicators, LCD indicators)	No
90	Electrical and I&C	Isolators (e.g., transformer isolators, optical isolators, isolation relays, isolating transfer diodes)	No
91	Electrical and I&C	Light Bulbs (e.g., indicating lights, emergency lighting, incandescent light bulbs, fluorescent light bulbs)	No
92	Electrical and I&C	Loop Controllers (e.g., differential pressure indicating controllers, flow indicating controllers, temperature controllers, controllers, speed controllers, programmable logic controller, single loop digital controller, process controllers, manual loader, selector station, hand/auto station, auto/manual station)	No

Table 2.1-5 Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment

Item	Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)
93	Electrical and I&C	Meters (e.g., ammeters, volt meters, frequency meters, var meters, watt meters, power factor meters, watt-hour meters)	No
94	Electrical and I&C	Power Supplies	No
95	Electrical and I&C	Radiation Monitors (e.g., area radiation monitors, process radiation monitors)	No
96	Electrical and I&C	Recorders (e.g., chart recorders, digital recorders, events recorders)	No
97	Electrical and I&C	Regulators (e.g., voltage regulators)	No
98	Electrical and I&C	Relays(e.g., protective relays, control/logic relays, auxiliary relays)	No
99	Electrical and I&C	Signal Conditioners	No
100	Electrical and I&C	Solenoid Operators	No
101	Electrical and I&C	Solid-State Devices (e.g., transistors, circuit boards, computers)	No
102	Electrical and I&C	Switches (e.g., differential pressure indicating switches, differential pressure switches, pressure indicator switches, pressure switches, flow switches, conductivity switches, level indicating switches, temperature indicating switches, temperature switches, moisture switches, position switches, vibration switches, level switches, control switches, automatic transfer switches, manual transfer switches, manual disconnect switches, current switches, limit switches, knife switches)	No
103	Electrical and I&C	Switchgear, Load Centers, Motor Control Centers, Distribution Panel Internal Component Assemblies (may include internal devices such as, but not limited to, switches, breakers, indicating lights, etc.) (e.g., 4.16 kV switchgear, 480V load centers, 480V motor control centers, 250 VDC motor control centers, 6.9 kV switchgear units, 240/125V power distribution panels)	No
104	Electrical and I&C	Transformers (e.g., instrument transformers, load center transformers, small distribution transformers, large power transformers, isolation transformers, coupling capacitor voltage transformers)	No

Table 2.1-5 Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment

Item	Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)
105	Electrical and I&C	Transmitters (e.g., differential pressure transmitters, pressure transmitters, flow transmitters, level transmitters, radiation transmitters, static pressure transmitters)	No
106	Valves	Hydraulic Operated Valves	Yes (Bodies)
107	Valves	Explosive Valves	Yes (Bodies)
108	Valves	Manual Valves	Yes (Bodies)
109	Valves	Small Valves	Yes (Bodies)
110	Valves	Motor-Operated Valves	Yes (Bodies)
111	Valves	Air-Operated Valves	Yes (Bodies)
112	Valves	Main Steam Isolation Valves	Yes (Bodies)
113	Valves	Small Relief Valves	Yes (Bodies)
114	Valves	Check Valves	Yes (Bodies)
115	Valves	Safety Relief Valves	Yes (Bodies)
116	Valves	Dampers, louvers, and gravity dampers	Yes (Housings)
117	Tanks	Air Accumulators	Yes
118	Tanks	Discharge Accumulators (Dampers)	Yes
119	Tanks	Boron Acid Storage Tanks	Yes
120	Tanks	Above Ground Oil Tanks	Yes
121	Tanks	Underground Oil Tanks	Yes
122	Tanks	Demineralized Water Tanks	Yes
123	Tanks	Neutron Shield Tank	Yes
124	Fans	Ventilation Fans (includes intake fans, exhaust fans, and purge fans)	Yes (Housings)
125	Fans	Other Fans	Yes (Housings)
126	Miscellaneous	Emergency Lighting	No
127	Miscellaneous	Hose Stations	Yes

2.2 PLANT-LEVEL SCOPING RESULTS

Review Responsibilities

Primary - Plant Systems Branch
Secondary - Branches responsible for systems and structures

2.2.1 Areas of Review

This section addresses the plant-level scoping results for license renewal. 10 CFR 54.21(a)(1) requires the applicant to identify and list structures and components subject to an aging management review (AMR). These are “passive,” “long-lived” structures and components that are within the scope of license renewal. In addition, 10 CFR 54.21(a)(2) requires the applicant to describe and justify the methods used to identify these structures and components. The staff reviews the applicant’s methodology separately following the guidance in Section 2.1.

The applicant should provide a list of all the plant systems and structures, identifying those that are within the scope of license renewal. If the list exists elsewhere, such as in the Updated Final Safety Analysis Report (UFSAR), it is acceptable to merely identify the reference. The license renewal rule does not require the identification of all plant systems and structures within the scope of license renewal. However, providing such a list may make the review more efficient. On the basis of the Design Basis Events (DBEs) considered in the plant’s current licensing basis (CLB), and other CLB information relating to nonsafety-related systems and structures and certain regulated events, the applicant would identify those plant-level systems and structures within the scope of license renewal, as defined in 10 CFR 54.4(a). This is “scoping” of the plant-level systems and structures for license renewal. To verify that the applicant has properly implemented its methodology, the staff focuses its review on the implementation results to confirm that there is no omission of plant-level systems and structures within the scope of license renewal.

Examples of plant systems are the reactor coolant, containment spray, standby gas treatment (BWR), emergency core cooling, open and closed cycle cooling water, compressed air, chemical and volume control (PWR), standby liquid control (BWR), main steam, feedwater, condensate, steam generator blowdown (PWR), and auxiliary feedwater systems (PWR).

Examples of plant structures are the primary containment, secondary containment (BWR), control room, auxiliary building, fuel storage building, radwaste building, and ultimate heat sink cooling tower.

Examples of components are the reactor vessel, reactor vessel internals, steam generator (PWR), and light and heavy load-handling cranes. Some applicants may have categorized such components as plant “systems” for their convenience.

After plant-level scoping, the applicant should identify the portions of the system or structure that perform an intended function, as defined in 10 CFR 54.4(b). Then the applicant should identify those structures and components that are “passive” and “long-lived” in accordance with 10 CFR 54.21(a)(1)(i) and (ii). These “passive,” “long-lived” structures and components are those that are subject to an AMR. The staff reviews these results separately following the guidance in Sections 2.3 through 2.5.

The applicant has the flexibility to determine the set of systems and structures it considers as within the scope of license renewal, provided that this set includes the systems and structures that the NRC has determined are within the scope of license renewal. Therefore, the reviewer need not review all systems and structures that the applicant has identified to be within the scope of license renewal because the applicant has the option to include more systems and components than those defined to be within the scope of license renewal by 10 CFR 54.4.

The following areas relating to the methodology implementation results for the plant-level systems and structures are reviewed.

2.2.1.1 Systems and Structures Within the Scope of License Renewal

The reviewer verifies the applicant's identification of plant-level systems and structures that are within the scope of license renewal.

2.2.2 Acceptance Criteria

The acceptance criteria for the area of review define methods for determining whether the applicant has identified the systems and structures within the scope of license renewal in accordance with NRC regulations in 10 CFR 54.4. For the applicant's implementation of its methodology to be acceptable, the staff should have reasonable assurance that there has been no omission of plant-level systems and structures within the scope of license renewal.

2.2.2.1 Systems and Structures Within the Scope of License Renewal

Systems and structures are within the scope of license renewal as delineated in 10 CFR 54.4(a) if they are

- Safety-related systems and structures that are relied upon to remain functional during and following DBEs [as defined in 10 CFR 50.49(b)(1)] to ensure the following functions:
  - The integrity of the reactor coolant pressure boundary,
  - The capability to shut down the reactor and maintain it in a safe shutdown condition, or
  - The capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the guidelines in 10 CFR 50.34(a)(1), 50.67(b)(2), or 100.11, as applicable.
- Nonsafety-related systems and structures whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1) above.
- Systems and structures relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with NRC regulations for fire protection (10 CFR 50.48), environmental qualification (10 CFR 50.49), PTS (10 CFR 50.61), ATWS (10 CFR 50.62), and SBO (10 CFR 50.63).

2.2.3 Review Procedures

The reviewer verifies the applicant's scoping and screening results. If the reviewer requests additional information from the applicant regarding why a certain system or structure was not identified by the applicant as being within the scope of license renewal for the applicant's plant, the reviewer should provide a focused question, clearly explaining what information is needed, explaining why it is needed, and how it will allow the staff to make its safety finding. In addition, other staff members review the applicant's scoping and screening methodology separately following the guidance in Section 2.1. The reviewer should keep these other staff members informed of findings that may affect their review of the applicant's methodology. The reviewer should coordinate this sharing of information through the license renewal project manager.

For the area of review, the following review procedures are to be followed.

2.2.3.1 Systems and Structures Within the Scope of License Renewal

The reviewer determines whether the applicant has properly identified the plant-level systems and structures within the scope of license renewal by reviewing selected systems and structures that the applicant did not identify as being within the scope of license renewal to verify that they do not have any intended functions.

The reviewer should use the plant UFSAR, orders, applicable regulations, exemptions, and license conditions to determine the design basis for the structures, systems, and components (SSCs) (if components are identified as "systems" by the applicant). The design basis determines the intended function(s) of an SSC. Such functions determine whether the SSC is within the scope of license renewal under 10 CFR 54.4.

This section addresses scoping at a system or structure level. Thus, if any portion of a system or structure performs an intended function as defined in 10 CFR 54.4(b), the system or structure is within the scope of license renewal. The review of the individual portions of systems and structures that are within the scope of license renewal are addressed separately in Sections 2.3 through 2.5.

The applicant should submit a list of all plant-level systems and structures, identifying those that are within the scope of license renewal. The reviewer should sample selected systems and structures that the applicant did not identify as within the scope of license renewal to determine if they perform any intended functions. The following are examples:

- The applicant does not identify the radiation monitoring system as being within the scope of license renewal. The reviewer may review the UFSAR to verify that this particular system does not perform any intended functions at the applicant's plant.

- The applicant does not identify the polar crane as being within the scope of license renewal. The reviewer may review the UFSAR to verify that this particular structure is not "Seismic II over I," denoting a structure that is not seismic Category I interacting with a Seismic Category I structure as described in Position C.2 of Regulatory Guide 1.29, "Seismic Design Classification" (Ref. 1).

- The applicant does not identify the fire protection pump house as within the scope of license renewal. The reviewer may review the plant's commitments to the fire protection regulation (10 CFR 50.48) to verify that this particular structure does not perform any intended functions at the plant.

- The applicant uses the "spaces" approach for scoping electrical equipment and elects to include all electrical equipment on site to be within the scope of license renewal except for the 525 kV switchyard and the 230 kV transmission lines. The reviewer may review the UFSAR and commitments to the SBO regulation (10 CFR 50.63) to verify that the 525 kV switchyard and the 230 kV transmission lines do not perform any intended functions at the applicant's plant.

Table 2.2-1 contains additional examples based on lessons learned from the review of the initial license renewal applications, including a discussion of the plant-specific determination of whether a system or structure is within the scope of license renewal.

The applicant may choose to group similar components and structures together in commodity groups for separate analyses. If only a portion of a system or structure has an intended function and is addressed separately in a specific commodity group, it is acceptable for an applicant to identify that system or structure as not being within the scope of license renewal. However, for completeness, the applicant should include some reference indicating that the portion of the system or structure with an intended function that is evaluated with the commodity group.

Section 2.1 contains additional guidance on the following:

- Commodity groups
- Complex assemblies
- Hypothetical failure
- Cascading

If the reviewer has reviewed systems and structures in sufficient detail and does not identify any omissions of systems and structures from those within the scope of license renewal, the staff would have reasonable assurance that the applicant has identified the systems and structures within the scope of license renewal.

- If the reviewer determines that the applicant has satisfied the criteria described in this review section, the staff would have reasonable assurance that the applicant has identified the systems and structures within the scope of license renewal.

2.2.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of the SRP-LR, then the staff's evaluation supports conclusions of the following type, to be included in the safety evaluation report:

> On the basis of its review, as discussed above, the staff concludes that there is reasonable assurance that the applicant has appropriately identified the systems and structures within the scope of license renewal in accordance with 10 CFR 54.4.

2.2.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specific portions of NRC regulations, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

2.2.6 References

1. Regulatory Guide 1.29, Rev. 2, "Seismic Design Classifications," September 1978.

Table 2.2-1. Examples of System and Structure Scoping and Basis for Disposition

Example	Disposition
Recirculation cooling water system	One function of the recirculation cooling water system is to remove decay heat from the stored fuel in the spent fuel pool via the spent fuel pool cooling system. However, the spent fuel pool cooling system at the subject facility is not safety-related, and, following a seismic event, the safety-related spent fuel pool structure and spent fuel pool makeup water supplies ensure the adequate removal of decay heat to prevent potential offsite exposures comparable to those described in 10 CFR Part 100. Therefore, the recirculation cooling water system is not within the scope of license renewal based on the spent fuel decay heat removal function.
SBO diesel generator building	The plant's UFSAR indicates that certain structural components of the SBO diesel generator building for the plant are designed to preclude seismic failure and subsequent impact of the structure on the adjacent safety-related emergency diesel generator building. In addition, the UFSAR indicates that certain equipment attached to the roof of the building has been anchored to resist tornado wind loads. Thus, the SBO diesel generator building is within the scope of license renewal.

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2.3 SCOPING AND SCREENING RESULTS: MECHANICAL SYSTEMS

Review Responsibilities

Primary - Branches responsible for systems
Secondary - None

2.3.1 Areas of Review

This section addresses the mechanical systems scoping and screening results for license renewal. Typical mechanical systems consist of the following:

- Reactor coolant system (such as reactor vessel and internals, components forming part of coolant pressure boundary, coolant piping system and connected lines, and steam generators).

- Engineered safety features (such as containment spray and isolation systems, standby gas treatment system, emergency core cooling system, and fan cooler system).

- Auxiliary systems (such as new and spent fuel storage, spent fuel cooling and cleanup systems, suppression pool cleanup system, load handling system, open and closed cycle cooling water systems, ultimate heat sink, compressed air system, chemical and volume control system, standby liquid control system, coolant storage/refueling water systems, ventilation systems, diesel generator system, and fire protection system).

- Steam and power conversion system (such as turbines, main and extraction steam, feedwater, condensate, steam generator blowdown, and auxiliary feedwater).

10 CFR 54.21(a)(1) requires an applicant to identify and list structures and components subject to an aging management review (AMR). These are “passive,” “long-lived” structures and components that are within the scope of license renewal (WSLR). In addition, 10 CFR 54.21(a)(2) requires an applicant to describe and justify the methods used to identify these structures and components. The staff reviews the applicant’s methodology separately following the guidance in Section 2.1. To verify that the applicant has properly implemented its methodology, the staff focuses its review on the implementation results. Such a focus allows the staff to confirm that there is no omission of mechanical system components that are subject to an AMR by the applicant. If the review identifies no omission, the staff has the basis to find that there is reasonable assurance that the applicant has identified the mechanical system components that are subject to an AMR.

An applicant should list all plant-level systems and structures. On the basis of the Design Basis Events (DBEs) considered in the plant’s current licensing basis (CLB) and other CLB information relating to nonsafety-related systems and structures and certain regulated events, the applicant should identify those plant-level systems and structures WSLR, as defined in 10 CFR 54.4(a). This is “scoping” of the plant-level systems and structures for license renewal. The staff reviews the applicant’s plant-level “scoping” results separately following the guidance in Section 2.2.

For a mechanical system that is within the scope of license renewal, the applicant should identify the portions of the system that perform an intended function, as defined in 10 CFR 54.4(b). The applicant may identify these particular portions of the system in marked-up piping and instrument diagrams (P&IDs) or other media. This is “scoping” of mechanical components in a system to identify those that are WSLR for a system.

For these identified mechanical components that are WSLR, the applicant must identify those that are “passive” and “long-lived” as required by 10 CFR 54.21(a)(1)(i) and (ii). These “passive,” “long-lived” mechanical components are those that are subject to an AMR. This is “screening” of mechanical components in a system to identify those that are “passive” and “long-lived.”

The applicant has the flexibility to determine the set of structures and components for which an AMR is performed, provided that this set includes the structures and components for which the NRC has determined that an AMR is required. This is based on the Statements of Consideration (SOC) for the license renewal rule (60 FR 22478). Therefore, the reviewer need not review all components that the applicant has identified as subject to an AMR because the applicant has the option to include more components than those required to be subject to an AMR pursuant to 10 CFR 54.21(a)(1).

2.3.2 Acceptance Criteria

The acceptance criteria for the areas of review define methods for determining whether the applicant has met the requirements of NRC regulations in 10 CFR 54.21(a)(1). For the applicant’s implementation of its methodology to be acceptable, the staff should have reasonable assurance that there has been no omission of mechanical system components that are subject to an AMR.

2.3.2.1 Components Within the Scope of License Renewal

Mechanical components are WSLR as delineated in 10 CFR 54.4(a) if they are

- Safety-related structures, systems, or components (SSCs) that are relied upon to remain functional during and following DBEs [as defined in 10 CFR 50.49(b)(1)] to ensure the following functions:
  - The integrity of the reactor coolant pressure boundary;
  - The capability to shut down the reactor and maintain it in a safe shutdown condition; or
  - The capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the guidelines in 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2), or 10 CFR 100.11, as applicable.
- All nonsafety-related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii), or (iii).
- All SSCs relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with NRC regulations for fire protection (10 CFR 50.48), environmental qualification (10 CFR 50.49), PTS (10 CFR 50.61), ATWS (10 CFR 50.62), and SBO (10 CFR 50.63).

2.3.2.2 Components Subject to an Aging Management Review

Mechanical components are subject to an AMR if they are WSLR and perform an intended function as defined in 10 CFR 54.4(b) without moving parts or a change in configuration or properties (“passive”), and are not subject to replacement based on a qualified life or specified time period (“long-lived”) [10 CFR 54.21(a)(1)(i) and (ii)].

2.3.3 Review Procedures

The reviewer verifies the applicant's scoping and screening results. If the reviewer requests additional information from the applicant regarding why a certain component was not identified by the applicant as being WSLR or subject to an AMR for the applicant's plant, the reviewer should provide a focused question that clearly explains what information is needed, why the information is needed, and how the information will allow the staff to make its safety finding. In addition, other staff members review the applicant's scoping and screening methodology separately following the guidance in Section 2.1. The reviewer should keep these other staff members informed of findings that may affect their review of the applicant's methodology. The reviewer should coordinate this sharing of information through the license renewal project manager.

For each area of review, the following review procedures are to be followed.

2.3.3.1 Components Within the Scope of License Renewal

In this step, the staff determines whether the applicant has properly identified the components that are WSLR. The Rule requires applicants to identify components that are subject to an AMR, but not components that are WSLR. Whereas in the past LRAs have included a table of components that are WSLR, that information need not be submitted with future LRAs. Although that information will be available at plant sites for inspection, the reviewer should determine through sampling of P&IDs, and review of UFSAR and other plant documents, what portion of the components are within scope. The reviewer should check to see if any components exist that the staff believes are within scope but are not identified by the applicant as being subject to an AMR (and request that the applicant provide justification for omitting those components that are "passive" and "long lived").

The reviewer should use the UFSAR, orders, applicable regulations, exemptions, and license conditions to determine the design basis for the SSCs. The design basis specifies the intended function(s) of the system(s). That intended function is used to determine the components within that system that are relied upon for the system to perform its intended functions.

The reviewer should focus the review on those components that are not identified as being WSLR, especially the license renewal boundary points and major flow paths. The reviewer should verify that the components do not have intended functions. Portions of the system identified as being WSLR by the applicant do not have to be reviewed because the applicant has the option to include more components within the scope than the rule requires.

Further, the reviewer should select system functions described in the UFSAR that are required by 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the rule.

For example, if a reviewer verifies that a portion of a system does not perform an intended function, is not identified as being subject to an AMR by the applicant, and is isolated from the portion of the system that is identified as being subject to an AMR by a boundary valve, the reviewer should verify that the boundary valve is subject to an AMR, or that the valve is not necessary for the within-scope portion of the system to perform its intended function. Likewise, the reviewer should identify, to the extend practical, the system functions of the piping runs and components that are identified as not being WSLR to ensure they do not have intended functions that meet the requirements of 10 CFR 54.4.

Section 2.1 contains additional guidance on the following:

- Commodity groups

- Complex assemblies
- Hypothetical failure
- Cascading

If the reviewer has reviewed components in sufficient detail and does not identify any omissions of components WSLR, the reviewer would have reasonable assurance that the applicant has identified the components WSLR for the mechanical systems.

Table 2.3-1 provides examples of mechanical components scoping lessons learned from the review of the initial license renewal applications and the basis for their disposition.

2.3.3.2 Components Subject to an Aging Management Review

In this step, the reviewer determines whether the applicant has properly identified the components subject to an AMR from among those which are WSLR (i.e., those identified in Subsection 2.3.3.1). The reviewer should review selected components that the applicant has identified as WSLR but as not subject to an AMR. The reviewer should verify that the applicant has not omitted from an AMR components that perform intended functions without moving parts or without a change in configuration or properties and that are not subject to replacement on the basis of a qualified life or specified time period.

Starting with the boundary verified in Subsection 2.3.3.1, the reviewer should sample components that are WSLR for that system, but were not identified by the applicant as subject to an AMR. Only components that are “passive” and “long-lived” are subject to an AMR. Table 2.1-5 is provided for the reviewer to assist in identifying whether certain components are “passive.” The applicant should justify omitting a component from an AMR that is WSLR at their facility and is listed as “passive” on Table 2.1-5. Although Table 2.1-5 is extensive, it may not be all inclusive. Thus, the reviewer should use other available information sources, such as prior application reviews, to determine whether a component may be subject to an AMR.

For example, an applicant has marked a boundary of a certain system that is WSLR. The marked-up diagram shows that there are pipes, valves, and air compressors within this boundary. The applicant has identified piping and valve bodies as subject to an AMR. Because Table 2.1-5 indicates that air compressors are not subject to an AMR, the reviewer should find the applicant’s determination acceptable.

Section 2.1 contains additional guidance on screening the following:

- Consumables
- Heat exchanger intended functions
- Multiple functions

If the reviewer does not identify any omissions of components from those that are subject to an AMR, the staff would then have reasonable assurance that the applicant has identified the components subject to an AMR for the mechanical systems.

Table 2.3-2 provides examples of mechanical components screening developed from lessons learned during the review of the initial license renewal applications and bases for their disposition.

If the applicant determines that a component is subject to an AMR, the applicant should also identify the component’s intended function, as defined in 10 CFR 54.4. Such functions must be maintained by any necessary AMRs. Table 2.3-3 provides examples of mechanical component intended functions.

2.3.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of the SRP-LR, then the staff's evaluation supports conclusions of the following type, to be included in the safety evaluation report:

> On the basis of its review, as discussed above, the staff concludes that there is reasonable assurance that the applicant has appropriately identified the mechanical system components within the scope of license renewal, as required by 10 CFR 54.4, and that the applicant has adequately identified the system components subject to an aging management review in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specific portions of NRC regulations, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

2.3.6 References

None.

Table 2.3-1. Examples of Mechanical Components Scoping and Basis for Disposition

Example	Disposition
Piping segment that provides structural support	The safety-related/nonsafety-related boundary along a pipe run may occur at a valve location. The nonsafety-related piping segment between this valve and the next seismic anchor provides structural support in a seismic event. This piping segment is WSLR.
Containment heating and ventilation system ductwork downstream of the fusible links providing cooling to the steam generator compartment and reactor vessel annulus	This nonsafety-related ductwork provides cooling to support the applicant's environmental qualification program. However, the failure of the cavity cooling system ductwork will not prevent the satisfactory completion of any critical safety function during and following a design basis event. Thus, this ductwork is not WSLR.
Standpipe installed inside the fuel oil storage tank	The standpipe as described in the applicant's CLB ensures that there is sufficient fuel oil reserve for the emergency diesel generator to operate for the number of days specified in the plant technical specifications following DBEs. Therefore, this standpipe is WSLR.
Insulation on boron injection tank	The temperature is high enough that insulation is not necessary to prevent boron precipitation. The plant technical specifications require periodic verification of the tank temperature. Thus, the insulation is not relied on to ensure the function of the emergency system and is not WSLR.
Pressurizer spray head	The spray head is not credited for the mitigation of any accidents addressed in the UFSAR accident analyses for many plants. The function of the pressurizer spray is to reduce reactor coolant system pressure during normal operating conditions. However, some plants rely on this component for pressure control to achieve cold shutdown during certain fire events. Failure of the spray head should be evaluated in terms of any possible damage to surrounding safety grade components, in addition to the need for spray. Therefore, this component should be evaluated on a plant-specific basis.

Table 2.3-2. Examples of Mechanical Components Screening and Basis for Disposition

Example	Disposition
Diesel engine jacket water heat exchanger, and portions of the diesel fuel oil system and starting air system supplied by a vendor on a diesel generator skid	These are “passive,” “long-lived” components having intended functions. They are subject to an AMR for license renewal even though the diesel generator is considered “active.”
Fuel assemblies	The fuel assemblies are replaced at regular intervals based on the fuel cycle of the plant. They are not subject to an AMR.
Valve internals (such as disk and seat)	10 CFR 54.21(a)(1)(i) excludes valves, other than the valve body, from AMR. The statements of consideration of the license renewal rule provide the basis for excluding structures and components that perform their intended functions with moving parts or with a change in configuration or properties. Although the valve body is subject to an AMR, valve internals are not.

Table 2.3-3. Examples of Mechanical Component Intended Functions

Component	Intended Function[a]
Piping	Pressure boundary
Valve body	Pressure boundary
Pump casing	Pressure boundary
Orifice	Pressure boundary flow restriction
Heat exchanger	Pressure boundary heat transfer
Reactor vessel internals	Structural support of fuel assemblies, control rods, and incore instrumentation, to maintain core configuration and flow distribution

[a] The component intended functions are those that support the system intended functions. For example, a heat exchanger in the spent fuel cooling system has a pressure boundary intended function, but may not have a heat transfer function. Similarly, not all orifices have flow restriction as an intended function.

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2.4 SCOPING AND SCREENING RESULTS: STRUCTURES

Review Responsibilities

Primary - Mechanical and Civil Engineering Branch
Secondary - None

2.4.1 Areas of Review

This section addresses the scoping and screening results of structures and structural components for license renewal. Typical structures include the following:

- The primary containment structure;

- Building structures (such as the intake structure, diesel generator building, auxiliary building, and turbine building);

- Component supports (such as cable trays, pipe hangers, elastomer vibration isolators, equipment frames and stanchions, and HVAC ducting supports);

- Nonsafety-related structures whose failure could prevent safety-related structures, systems, and components (SSCs) from performing their intended functions (that is, seismic Category II over I structures).

Typical structural components include the following: liner plates, walls, floors, roofs, foundations, doors, beams, columns, and frames.

10 CFR 54.21(a)(1) requires an applicant to identify and list structures and components subject to an aging management review (AMR). These are “passive,” “long-lived” structures and components that are within the scope of license renewal (WSLR). In addition, 10 CFR 54.21(a)(2) requires an applicant to describe and justify the methods used to identify these structures and components. The staff reviews the applicant’s methodology separately following the guidance in Section 2.1. To verify that the applicant has properly implemented its methodology, the staff focuses its review on the implementation results. Such a focus allows the staff to confirm that there is no omission of structures that are subject to an AMR by the applicant. If the review identifies no omission, the staff has the basis to find that there is reasonable assurance that the applicant has identified the structural components that are subject to an AMR.

An applicant should list all plant-level systems and structures. On the basis of the Design Basis Events (DBEs) considered in the plant’s current licensing basis (CLB) and other CLB information relating to nonsafety-related systems and structures and certain regulated events, the applicant should identify those plant-level systems and structures WSLR, as defined in 10 CFR 54.4(a). This is “scoping” of the plant-level systems and structures for license renewal. The staff reviews the applicant’s plant-level “scoping” results separately following the guidance in Section 2.2.

For structures that are WSLR, an applicant must identify the structural components that are “passive” and “long-lived” in accordance with 10 CFR 54.21(a)(1)(i) and (ii). These “passive,” “long-lived” structural components are those that are subject to an AMR (“screening”). The applicant’s methodology implementation results for identifying structural components subject to an AMR is the area of review.

The applicant has the flexibility to determine the set of structures and components for which an AMR is performed, provided that this set includes the structures and components for which the

NRC has determined that an AMR is required. This flexibility is described in the statements of consideration for the License Renewal Rule (60 FR 22478). Therefore, the reviewer should not focus the review on structural components that the applicant has already identified as subject to an AMR because it is an applicant's option to include more structural components than those subject to an AMR, pursuant to 10 CFR 54.21(a)(1). Rather, the reviewer should focus on those structural components that are not included by the applicant as subject to an AMR to ensure that they do not perform an intended function as defined in 10 CFR 54.4(b) or are not "passive" and "long-lived."

2.4.2 Acceptance Criteria

The acceptance criteria for the areas of review define methods for determining whether the applicant has met the requirements of NRC regulations in 10 CFR 54.21(a)(1). For the applicant's implementation of its methodology to be acceptable, the staff should have reasonable assurance that there has been no omission of structural components that are subject to an AMR.

2.4.2.1 Structural Components Subject to an Aging Management Review

Structural components are WSLR as delineated in 10 CFR 54.4(a) if they are

- Safety-related SSCs that are relied upon to remain functional during and following DBEs [as defined in 10 CFR 50.49(b)(1)] to ensure the following functions:
  - The integrity of the reactor coolant pressure boundary;
  - The capability to shut down the reactor and maintain it in a safe shutdown condition; or
  - The capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the guidelines in 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2), or 10 CFR 100.11, as applicable.
- All nonsafety-related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii), or (iii).
- All SSCs relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with NRC regulations for fire protection (10 CFR 50.48), environmental qualification (10 CFR 50.49), PTS (10 CFR 50.61), ATWS (10 CFR 50.62), and SBO (10 CFR 50.63).

Structural components are subject to an AMR if they are WSLR and perform an intended function as defined in 10 CFR 54.4(b) without moving parts or a change in configuration or properties ("passive"), and are not subject to replacement based on a qualified life or specified time period ("long-lived") [10 CFR 54.21(a)(1)(i) and (ii)].

2.4.3 Review Procedures

The reviewer verifies the applicant's scoping and screening results. If the reviewer requests additional information from the applicant regarding why a certain structure was not identified by the applicant as being WSLR or subject to an AMR for the applicant's plant, the reviewer should provide a focused question that clearly explains what information is needed, why the information is needed, and how the information will allow the staff to make its safety finding. In addition, other staff members review the applicant's scoping and screening methodology separately following the guidance in Section 2.1. The reviewer should keep these other staff members informed of findings that may affect their review of the applicant's methodology. The reviewer should coordinate this sharing of information through the license renewal project manager.

For each area of review, the following review procedures are to be followed:

2.4.3.1 Structural Components Within the Scope of License Renewal

In this step, the staff determines which structures and structural components are WSLR. The Rule requires applicants to identify structures that are subject to an AMR, but not structures that are WSLR. Whereas, in the past, LRAs have included a table of structures that are WSLR, that information need not be submitted with future LRAs. Although that information will be available at plant sites for inspection, the reviewer should determine through sampling of P&IDs, and review of the UFSAR and other plant documents, what portion of the components are within scope. The reviewer should check to see if any structures exist that the staff believes are within scope but are not identified by the applicant as being subject to an AMR (and request that the applicant provide justification for omitting those structures that are "passive" and "long lived").

2.4.3.2 Structural Components Subject to an Aging Management Review

In general, structural components are "passive" and "long lived." Thus, they are subject to an AMR if they are WSLR. For each of the plant-level structures WSLR, an applicant should identify those structural components that have intended functions. For example, the applicant may identify that its auxiliary building is WSLR. For this auxiliary building, the applicant may identify the structural components of beams, concrete walls, blowout panels, etc., that are subject to an AMR. The applicant should justify omitting a component from an AMR that is WSLR at its facility and is listed as "passive" on Table 2.1-5. Although Table 2.1-5 is extensive, it may not be all inclusive. Thus, the reviewer should use other available information, such as prior application reviews, to determine whether a component may be subject to an AMR.

As set forth below, the reviewer should focus on individual structures not subject to an AMR, one at a time, to confirm that the structural components that have intended functions have been identified by the applicant. In a few instances, only portions of a particular building are WSLR. For example, a portion of a particular turbine building provides shelter for some safety-related equipment, which is an intended function, and the remainder of this particular building does not have any intended functions. In this case, the reviewer should verify that the applicant has identified the relevant particular portion of the turbine building as being WSLR and subject to an AMR.

The reviewer should use the UFSAR, orders, applicable regulations, exemptions, and license conditions to determine the design basis for the SSCs. The design basis specifies the intended function(s) of the system(s). That intended function is used to determine the components within that system that are relied upon for the system to perform its intended functions.

The reviewer should focus the review on those structural components that have not been identified as being WSLR. For example, for a building WSLR, if an applicant did not identify the building roof as subject to an AMR, the reviewer should verify that the roof has no intended functions, such as a "Seismic II over I" concern in accordance with the plant's CLB. The reviewer need not verify all structural components that have been identified as subject to an AMR by the applicant because the applicant has the option to include more structural components than the rule requires to be subject to an AMR.

Further, the reviewer should select functions described in the UFSAR to verify that structural components having intended functions were not omitted from the scope of the review. For example, if the UFSAR indicates that a dike within the fire pump house prevents a fuel oil fire from spreading to the electrically driven fire pump, the reviewer should verify that this dike has been identified as being WSLR. Similarly, if a non-safety-related structure or component is included in the plant's CLB as a part of the safe shutdown path resulting from the resolution of the unresolved safety issue, USI A-46, the reviewer should verify that the structure or component has been included WSLR.

The applicant should also identify the intended functions of structural components. Table 2.1-4 provides typical “passive” structural component intended functions.

The staff has developed additional scoping/screening guidance. For example, some structural components may be grouped together as a commodity, such as pipe hangers, and some structural components are considered consumable materials, such as sealants. Additional guidance on these and others are contained in Section 2.1 for the following:

- Commodity groups
- Hypothetical failure
- Cascading
- Consumables
- Multiple functions

If the reviewer does not identify any omissions of components from those that are subject to an AMR, the staff would have reasonable assurance that the applicant has identified the components subject to an AMR for the structural systems.

Table 2.4-1 provides examples of structural components scoping/screening lessons learned from the review of initial license renewal applications and the basis for disposition.

If the applicant determines that a structural component may be subject to an AMR, the applicant should also identify the component’s intended functions, as defined in 10 CFR 54.4. Such functions must be maintained by any necessary AMPs.

If the reviewer determines that the applicant has satisfied the criteria described in this review section, the staff would have reasonable assurance that the applicant has identified the components that are WSLR and subject to an AMR.

2.4.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of the SRP-LR, then the staff’s evaluation supports conclusions of the following type, to be included in the safety evaluation report:

> On the basis of its review, as discussed above, the staff concludes that there is reasonable assurance that the applicant has appropriately identified the structural components subject to an aging management review in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.4.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specific portions of NRC regulations, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

2.4.6 References

1. NUREG-1211, "Regulatory Analysis for Resolution of Unresolved Safety Issue A-46, `Seismic Qualification of Equipment in Operating Plants,'" U.S. Nuclear Regulatory Commission, February 1987.

2. NUREG-0933, "A Prioritization of Generic Safety Issues," U.S. Nuclear Regulatory Commission, June 2004.

Table 2.4-1. Examples of Structural Components Scoping/Screening and Basis for Disposition

Example	Disposition
Roof of turbine building	An applicant indicates that degradation or loss of its turbine building roof will not result in the loss of any intended functions. The turbine building contains safety-related SSCs in the basement, which would remain sheltered and protected by several reinforced concrete floors if the turbine building roof were to degrade. Because this roof does not perform an intended function, it is not WSLR.
Post-tensioned containment tendon gallery	The intended function of the post-tensioning system is to impose compressive forces on the concrete containment structure to resist the internal pressure resulting from a DBA with no loss of structural integrity. Although the tendon gallery is not relied on to maintain containment integrity during DBEs, operating experience indicates that water infiltration and high humidity in the tendon gallery can contribute to a significant aging effect on the vertical tendon anchorages that could potentially result in loss of the ability of the post-tensioning system to perform its intended function. However, containment inspections provide reasonable assurance that the tendon anchorages, including those in the gallery, will continue to perform their intended functions. Because the tendon gallery itself does not perform an intended function, it is not WSLR.
Water-stops	Ground water leakage into the auxiliary building could occur as a result of degradation to the water-stops. This leakage may cause flooding of equipment WSLR. (The plant's UFSAR discusses the effects of flooding.) The water-stops perform their functions without moving parts or a change in configuration, and they are not typically replaced. Thus, the water-stops are subject to an AMR. However, they need not be called out explicitly in the scoping/screening results if they are included as parts of structural components that are subject to an AMR.

2.5 SCOPING AND SCREENING RESULTS: ELECTRICAL AND INSTRUMENTATION AND CONTROLS SYSTEMS

Review Responsibilities

Primary - Branch responsible for electrical and instrumentation and controls engineering
Secondary - None

2.5.1 Areas of Review

This review plan section addresses the electrical and instrumentation and controls (I&C) scoping and screening results for license renewal. Typical electrical and I&C components that are subject to an aging management review (AMR) for license renewal include electrical cables and connections.

10 CFR 54.21(a)(1) requires an applicant to identify and list structures and components subject to an AMR. These are "passive," "long-lived" structures and components that are within the scope of license renewal (WSLR). In addition, 10 CFR 54.21(a)(2) requires an applicant to describe and justify the methods used to identify these structures and components. The staff reviews the applicant's methodology separately following the guidance in Section 2.1. To verify that the applicant has properly implemented its methodology, the staff focuses its review on the implementation results. Such a focus allows the staff to confirm that there is no omission of electrical and I&C components that are subject to an AMR by the applicant. If the review identifies no omission, the staff has the basis to find that there is reasonable assurance that the applicant has identified the electrical and I&C components that are subject to an AMR.

An applicant should list all plant-level systems and structures. On the basis of the DBEs considered in the plant's CLB and other CLB information relating to nonsafety-related systems and structures and certain regulated events, the applicant would identify those plant-level systems and structures that are WSLR, as defined in 10 CFR 54.4(a). This is "scoping" of the plant-level systems and structures for license renewal. The staff reviews the applicant's plant-level "scoping" results separately following the guidance in Section 2.2.

For an electrical and I&C system that is WSLR, an applicant may not identify the specific electrical and I&C components that are subject to an AMR. For example, an applicant may not "tag" each specific length of cable that is "passive" and "long-lived," and performs an intended function as defined in 10 CFR 54.4(b). Instead, an applicant may use the so-called "plant spaces" approach (Ref. 1), which is explained below. The "plant spaces" approach provides efficiencies in the AMR of electrical equipment located within the same plant space environment.

Under the "plant spaces" approach, an applicant would identify all "passive," "long-lived" electrical equipment within a specified plant space as subject to an AMR, regardless of whether these components perform any intended functions. For example, an applicant could identify all "passive," "long-lived" electrical equipment located within the turbine building ("plant space") to be subject to an AMR for license renewal. In the subsequent AMR, the applicant would evaluate the environment of the turbine building to determine the appropriate aging management activities for this equipment. The applicant has options to further refine this encompassing scope on an as-needed basis. For this example, if the applicant identified elevated temperatures in a particular area within the turbine building, the applicant may elect to further refine the scope in this particular area by: (1) identifying electrical equipment that is not subject to an AMR and; (2) excluding this equipment from the AMR. In this case, the excluded electrical equipment would be reported in the application as not being subject to an AMR.

10 CFR 54.21(a)(1)(i) provides many examples of electrical and I&C components that are not considered to be "passive" and are not subject to an AMR for license renewal. Therefore, the

applicant is expected to identify only a few electrical and I&C components, such as electrical penetrations, cables, and connections, that are “passive” and subject to an AMR. However, the TLAA evaluation requirements in 10 CFR 54.21(c) apply to environmental qualification of electrical equipment, which is not limited to “passive” components.

An applicant has the flexibility to determine the set of electrical and I&C components for which an AMR is performed, provided that this set includes the electrical and I&C components for which the NRC has determined an AMR is required. This is based on the statements of consideration for the License Renewal Rule (60 FR 22478). Therefore, the reviewer need not review all components that the applicant has identified as subject to an AMR because the applicant has the option to include more components than those required by 10 CFR 54.21(a)(1).

2.5.2 Acceptance Criteria

The acceptance criteria for the areas of review define methods for determining whether the applicant has met the requirements of NRC regulations in 10 CFR 54.21(a)(1). For the applicant’s implementation of its methodology to be acceptable, the staff should have reasonable assurance that there has been no omission of electrical and I&C system components that are subject to an AMR.

2.5.2.1 Components Within the Scope of License Renewal

Electrical and I&C components are WSLR as delineated in 10 CFR 54.4(a) if they are

- Safety-related SSCs that are relied upon to remain functional during and following DBEs (as defined in 10 CFR 50.49(b)(1)) to ensure the following functions:
  - The integrity of the reactor coolant pressure boundary;
  - The capability to shut down the reactor and maintain it in a safe shutdown condition; or
  - The capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the guidelines in 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2) or 10 CFR 100.11, as applicable.
- All nonsafety-related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii) or (iii).
- All SSCs relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with NRC regulations for fire protection (10 CFR 50.48), environmental qualification (10 CFR 50.49), PTS (10 CFR 50.61), ATWS (10 CFR 50.62), and SBO (10 CFR 50.63).

2.5.2.1.1 Components Within the Scope of SBO (10 CFR 50.63)

Both the offsite and onsite power systems are relied upon to meet the requirements of the SBO Rule. This includes the following:

- The onsite power system meeting the requirements under 10 CFR 54.4(a)(1) (safety-related systems)

- Equipment that is required to cope with an SBO (e.g., alternate ac power sources) meeting the requirements under 10 CFR 54.4(a)(3)

- The plant system portion of the offsite power system that is used to connect the plant to the offsite power source meeting the requirements under 10 CFR 54.4(a)(3). This path typically includes the switchyard circuit breakers that connect to the offsite system power transformers (startup transformers), the transformers themselves, the intervening overhead or underground circuits between circuit breaker and transformer and transformer and onsite electrical distribution system, and the associated control circuits and structures.

2.5.2.2 Components Subject to an Aging Management Review

Electrical and I&C components are subject to an AMR if they are WSLR and perform an intended function as defined in 10 CFR 54.4(b) without moving parts or without a change in configuration or properties ("passive"), and are not subject to replacement based on a qualified life or specified time period ("long-lived") [10 CFR 54.21(a)(1)(i) and (ii)].

2.5.3 Review Procedures

The reviewer verifies the applicant's scoping and screening results. If the reviewer requests additional information from the applicant regarding why a certain component was not identified by the applicant as being WSLR or subject to an AMR for the applicant's plant, the reviewer should provide a focused question that clearly explains what information is needed, why the information is needed, and how the information will allow the staff to make its safety finding. In addition, other staff members review the applicant's scoping and screening methodology separately following the guidance in Section 2.1. The reviewer should keep these other staff members informed of findings that may affect their review of the applicant's methodology. The reviewer should coordinate this sharing of information through the license renewal project manager.

The reviewer should verify that an applicant has identified in the license renewal application the electrical and I&C components that are subject to an AMR for its plant. The review procedures are presented below and assume that the applicant has performed "scoping" and "screening" of electrical and I&C system components in that sequence. However, the applicant may elect to perform "screening" before "scoping," which is acceptable because regardless of the sequence, the end result should encompass the electrical and I&C components that are subject to an AMR.

The scope of 10 CFR 50.49 electric equipment to be included within 10 CFR 54.4(a)(3) is that "long-lived" (qualified life of 40 years or greater) equipment already identified by licensees under 10 CFR 50.49(b), which specifies certain electric equipment important to safety. Licensees may rely upon their listing of environmental qualification equipment, as required by 10 CFR 50.49(d), for purposes of satisfying 10 CFR 54.4(a)(3) with respect to equipment within the scope of 10 CFR 50.49 (60 FR 22466). However, the License Renewal Rule has a requirement (10 CFR 54.21(c)) on the evaluation of TLAAs, including environmental qualification (10 CFR 50.49). Environmental qualification equipment is not limited to "passive" equipment. The applicant may identify environmental qualification equipment separately for TLAA evaluation and not include such equipment as subject to an AMR under 10 CFR 54.21(a)(1). The environmental qualification equipment identified for TLAA evaluation would include the "passive" environmental qualification equipment subject to an AMR. The TLAA evaluation would ensure that the environmental qualification equipment would be functional for the period of extended operation. The staff reviews the applicant's environmental qualification TLAA evaluation separately following the guidance in Section 4.4.

For each area of review, the following review procedures are to be followed.

2.5.3.1 Components Within the Scope of License Renewal

In this step, the staff determines whether the applicant has properly identified the components that are WSLR. The Rule requires applicants to identify components that are subject to an AMR, but not components that are WSLR. Whereas, in the past, LRAs have included a table of components that are WSLR, generally that information need not be submitted with future LRAs. Although that information will be available at plant sites for inspection, the reviewer must determine through sampling of one line diagrams, and review of UFSAR and other plant documents, what portion of the components are WSLR. The reviewer must check to see if any components exist that the staff believes are within the scope but are not identified by the applicant as being subject to AMR (any request that the applicant provide justification for omitting those components that are “passive” and “long lived”).

The reviewer should use the UFSAR, orders, applicable regulations, exemptions, and license conditions to determine the design basis for the SSCs. The design basis specifies the intended function(s) of the system(s). That intended function is used to determine the components within that system that are required for the system to perform its intended functions.

The applicant may use the “plant spaces” approach in scoping electrical and I&C components for license renewal. In the “plant spaces” approach, an applicant may indicate that all electrical and I&C components located within a particular plant area (“plant space”), such as the containment and auxiliary building, are WSLR. The applicant may also indicate that all electrical and I&C components located within another plant area (“plant space”), such as the warehouse, are not WSLR. Table 2.5-1 contains examples of this “plant spaces” approach and the corresponding review procedures.

The applicant would use the “plant spaces” approach for the subsequent AMR of the electrical and I&C components. The applicant would evaluate the environment of the “plant spaces” to determine the appropriate aging management activities for equipment located there. The applicant has the option to further refine this encompassing scope on an as-needed basis. For example, if the applicant identified elevated temperatures in a particular area within a building (“plant space”), the applicant may elect to identify only those “passive,” “long-lived” electrical and I&C components that perform an intended function in this particular area as subject to an AMR. This approach of limiting the “plant spaces” is consistent with the “plant spaces” approach. In this case, the reviewer verifies that the applicant has specifically identified the electrical and I&C components that may be WSLR in these limited “plant spaces.” The reviewer should verify that the electrical and I&C components that the applicant has elected to further exclude do not indeed have any intended functions as defined in 10 CFR 54.4(b).

Section 2.1 contains additional guidance on scoping the following:

- Commodity groups
- Complex assemblies
- Scoping events
- Hypothetical failure
- Cascading

If the reviewer does not identify any omissions of components from those that are WSLR, the staff would have reasonable assurance that the applicant has identified the components WSLR for the electrical and I&C systems.

2.5.3.2 Component Subject to an Aging Management Review

In this step, the reviewer determines whether the applicant has properly identified the components subject to an AMR from among those which are WSLR (i.e., those identified in Subsection 2.5.3.1). The reviewer should review selected components that the applicant has identified as being WSLR to verify that the applicant has identified these components as being subject to an AMR if they perform intended functions without moving parts or without a change in configuration or properties and are not subject to replacement on the basis of a qualified life or specified time period. The description of “passive” may also be interpreted to include structures and components that do not display “a change in state.”

Only components that are “passive” and “long-lived” are subject to an AMR. Table 2.1-5 lists many typical components and structures, and their associated intended functions, and identifies whether they are “passive.” The reviewer should use Table 2.1-5 in identifying whether certain components are “passive.” The reviewer should verify that electrical and I&C components identified as “passive” in Table 2.1-5 have been included by the applicant as being subject to an AMR. Although Table 2.1-5 is extensive, it may not be all inclusive. Thus, the reviewer should use other available information sources, such as prior application reviews, to determine whether a component may be subject to an AMR.

Section 2.1 contains additional guidance on screening the following:

- Consumables
- Multiple intended functions

If the reviewer does not identify any omissions of components from those that are subject to an AMR, the staff would have reasonable assurance that the applicant has identified the components subject to an AMR for the electrical and I&C systems.

2.5.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of the SRP-LR, then the staff’s evaluation supports conclusions of the following type, to be included in the safety evaluation report:

> On the basis of its review, as discussed above, the staff concludes that there is reasonable assurance that the applicant has appropriately identified the electrical and instrumentation and controls system components subject to an aging management review in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.5.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specific portions of NRC regulations, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

2.5.6 References

1. SAND96-0344, “Aging Management Guideline for Commercial Nuclear Power Plants-Electrical Cable and Terminations,” Sandia National Laboratories, September 1996, page 6-11.

Table 2.5-1. Examples of "Plant Spaces" Approach for Electrical and I&C Scoping and Corresponding Review Procedures

Example	Review Procedures
An applicant indicates that all electrical and I&C components on site are WSLR.	This is acceptable, and a staff review is not necessary because all electrical and I&C components are included without exception and would include those required by the rule.
An applicant indicates that all electrical and I&C components located in seven specific buildings (containment, auxiliary building, turbine building, etc.) are WSLR.	The reviewer should review electrical systems and components in areas outside of these seven buildings ("plant spaces"). The reviewer should verify that the applicant has included any direct-buried cables in trenches between these building as WSLR if they perform an intended function. The reviewer should also select buildings other than the seven indicated (for example, the radwaste facility) to verify that they do not contain any electrical and I&C components that perform any intended functions.
An applicant indicates that all electrical and I&C components located on site, except for the 525 kV switchyard, 230 kV transmission lines, radwaste facility, and 44 kV substation, are WSLR.	The reviewer should select the specifically excluded "plant spaces" (that is, the 525 kV switchyard, 230 kV transmission lines, radwaste facility, and 44 kV substation) to verify that they do not contain any electrical and I&C components that perform any intended functions.

CHAPTER 3

AGING MANAGEMENT REVIEW

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3.0 INTRODUCTION TO STAFF REVIEW OF AGING MANAGEMENT

The NRC project manager (PM) responsible for the safety review of the license renewal application (LRA) is responsible for assigning to appropriate NRC Office of Nuclear Reactor Regulation (NRR) divisions the review or audit of aging management reviews (AMRs) or aging management programs (AMPs) identified in the applicant's LRA. The PM should document to which organization each AMR or AMP is assigned. The assigned AMRs and AMPs should be reviewed per the criteria described in Sections 3.1 through 3.6 of this standard review plan (SRP-LR, NUREG-1800) for review of license renewal applications, as directed by the scope of each of these sections.

The NRC divisions that are usually assigned responsibility for the review of AMRs and AMPs are the Division of Engineering (DE), Division of System Safety Analysis (DSSA), and the Division of Regulatory Improvement Program (DRIP) License Renewal and Environmental Impacts Program (RLEP). Typically, the PM will assign DRIP/RLEP to review the AMRs and AMPs that the LRA identifies as being consistent with the GALL Report or NRC-approved precedents. As common exceptions to this assignment, the PM will assign to DE those AMRs and AMPs that address issues identified as emerging technical issues. Usually, AMRs and AMPs that are not in one of the aforementioned categories are assigned to DE.

Review of the AMPs requires assessment of ten program elements as defined in this SRP-LR. The NRC divisions assigned the AMP should review the ten program elements to verify their technical adequacy. For three of the ten program elements (corrective actions, confirmation process, and administrative controls) the NRC division responsible for quality assurance should verify that the applicant has documented a commitment in the FSAR Supplement to expand the scope of its 10 CFR Part 50, Appendix B program to address the associated program elements for each AMP. If the applicant chooses alternate means of addressing these three program elements (e.g., use of a process other than the applicant's 10 CFR Part 50, Appendix B program), the NRC divisions assigned to review the AMP should request that the Division responsible for quality assurance review the applicant's proposal on a case-by-case basis.

3.0.1 Background on the Types of Reviews

10 CFR 54.21(a)(3) requires that the LRA must demonstrate, for systems, structures, and components (SSCs) identified in the scope of license renewal and subject to an AMR pursuant to 10 CRF 54.21(a)(1), that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the current licensing basis (CLB) for the period of extended operation. This AMR consists of identifying the material, environment, aging effects, and the AMP(s) credited for managing the aging effects.

Sections 3.1 through 3.6 of this SRP-LR describe how the AMRs and AMPs are reviewed. One method that the applicant may use to conduct its AMRs is to satisfy the NUREG-1801 (GALL Report) recommendations. The applicant may choose to use methodology other than that in the GALL Report to demonstrate compliance with 10 CFR 54.21(a)(3).

As stated in the GALL Report:

> The GALL Report is a technical basis document to the SRP-LR, which provides the staff with guidance in reviewing a license renewal application. The GALL Report should be treated in the same manner as an approved topical report that is generically applicable. An applicant may reference the GALL Report in a license renewal application to

demonstrate that the programs at the applicant's facility correspond to those reviewed and approved in the GALL Report and that no further staff review is required, as described in the next paragraph. If the material presented in the GALL Report is applicable to the applicant's facility, the staff should find the applicant's reference to the GALL Report acceptable. In making this determination, the staff should consider whether the applicant has identified specific programs described and evaluated in the GALL Report. The staff, however, should not conduct a re-review of the substance of the matters described in the GALL Report. Rather, the staff should ensure that the applicant verifies that the approvals set forth in the GALL Report for generic programs apply to the applicant's programs. The focus of the staff review should be on augmented programs for license renewal. The staff should also review information that is not addressed in the GALL Report or is otherwise different from that in the GALL Report.

If an applicant takes credit for a program in the GALL Report, it is incumbent on the applicant to ensure that the plant program contains all the elements of the referenced GALL Report program. In addition, the conditions at the plant must be bounded by the conditions for which the GALL Report program was evaluated. The above verifications must be documented on-site in an auditable form. The applicant should include a certification in the license renewal application that the verifications have been completed and are documented on-site in an auditable form.

The GALL Report contains one acceptable way to manage aging effects for license renewal. An applicant may propose alternatives for staff review in its plant-specific license renewal application. Use of the GALL Report is not required, but its use should facilitate both preparation of a license renewal application by an applicant and timely, uniform review by the NRC staff.

In addition, the GALL Report does not address scoping of structures and components for license renewal. Scoping is plant-specific, and the results depend on the plant design and current licensing basis. The inclusion of a certain structure or component in the GALL Report does not mean that this particular structure or component is within the scope of license renewal for all plants. Conversely, the omission of a certain structure or component in the GALL Report does not mean that this particular structure or component is not within the scope of license renewal for any plants.

The GALL Report contains an evaluation of a large number of structures and components that may be in the scope of a typical LRA. The evaluation results documented in the GALL Report indicate that many existing, typical generic aging management programs are adequate to manage aging effects for particular structures or components for license renewal without change. The GALL Report also contains recommendations on specific areas for which generic existing programs should be augmented (require further evaluation) for license renewal and documents the technical basis for each such determination. In addition, the GALL Report identifies certain SSCs that may or may not be subject to particular aging effects, and for which industry groups are developing generic aging management programs or investigating whether aging management is warranted. To the extent the ultimate generic resolution of such an issue will need NRC review and approval for plant-specific implementation, as indicated in a plant-specific FSAR supplement, and reflected in the SER associated with a particular LR application, an amendment pursuant to 10 CFR 50.90 will be necessary.

In this SRP-LR, Subsection 3.X.2 (where X denotes number 1-6) presents the acceptance criteria describing methods to determine whether the applicant has met the requirements of NRC's regulations in 10 CFR 54.21. Subsection 3.X.3 presents the review procedures to be followed. Some rows (line-items) in the AMR tables (in Chapters II through VIII of the GALL Report, Vol. II) establish the need to perform "further evaluations." The acceptance criteria for satisfying these "further evaluations" are found in Subsections 3.X.2.2. The related review procedures are provided in Subsections 3.X.3.2.

In Regulatory Guide 1.188, "Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses," the NRC has endorsed an acceptable methodology for applicants to structure license renewal applications. Using the guidance described in the aforementioned Regulatory Guide, the applicant documents in the LRA whether its AMR line-item is consistent or not consistent with the GALL Report.

A portion of the AMR includes the assessment of the AMPs in the GALL Report. The applicant may choose to use an AMP that is consistent with the GALL Report AMP, or may choose a plant-specific AMP.

If a GALL Report AMP is selected to manage aging, the applicant may take one or more exceptions to specific GALL Report AMP program elements. However, any deviation or exception to the GALL Report AMP should be described and justified. Exceptions are portions of the GALL Report AMP that the applicant does not intend to implement.

In some cases, an applicant may choose an existing plant program that does not currently meet all the program elements defined in the GALL Report AMP. If this is the situation, the applicant may make a commitment to augment the existing program to satisfy the GALL Report AMP element prior to the period of extended operation. This commitment is an AMP enhancement.

Enhancements are revisions or additions to existing aging management programs that the applicant commits to implement prior to the period of extended operation. Enhancements include, but are not limited to, those activities needed to ensure consistency with the GALL Report recommendations. Enhancements may expand, but not reduce, the scope of an AMP.

An audit and review is conducted at the applicant's facility to evaluate those AMRs or AMPs that the applicant claims to be consistent with the GALL Report. An audit also includes technical assessments of exceptions or enhancements to the GALL Report AMP program elements. Reviews are performed to address those AMRs or AMPs related to emergent issues, stated to be not consistent with the GALL Report, or based on an NRC-approved precedent (e.g., AMRs and AMPs addressed in an NRC SER of a previous LRA). As a result of the criteria established in 10 CFR Part 54, and the guidance provided in SRP-LR, GALL Report, Regulatory Guide 1.188, and the applicant's exceptions and/or enhancements to a GALL Report AMP, the following types of AMRs and AMPs should be audited or reviewed by the NRC staff.

AMRs

- AMR results consistent with the GALL Report
- AMR results for which further evaluation is recommended by the GALL Report
- AMR results not consistent with or not addressed in the GALL Report

AMPs

- Consistent with GALL Report AMPs

- Plant-specific AMPs

FSAR Supplement

- Each LRA AMP will provide an FSAR Supplement which defines changes to the FSAR that will be made as a condition of a renewed license. This FSAR Supplement defines the aging management programs the applicant is crediting to satisfy 10 CFR 54.21(a)(3).
- The FSAR Supplement should also contain a commitment to implement the LRA AMP enhancement prior to the period of extended operation.

3.0.2 Applications with approved Extended Power Uprates

Extended power uprates (EPU) are licensing actions that some licensees have recently requested the NRC staff to approve. This can affect aging management. In a NRC staff letter to the Advisory Committee on Reactor Safeguards, dated October 26, 2004, (ADAMS Accession ML042790085), the NRC Executive Director for Operation states that, "All license renewal applications with an approved EPU will be required to perform an operating experience review and its impact on [aging] management programs for structures, and components before entering the period of extended operation." One way for an applicant with an approved EPU to satisfy this criterion is to document its commitment to perform an operating experience review and its impact on aging management programs for systems, structures, and components (SSCs) before entering the period of extended operation as part of its license renewal application. Such licensee commitments should be documented in the NRC staff's SER written in support of issuing a renewed license. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date. EPU impact on SSCs should be part of the license renewal review. If necessary, the PM will assign a responsible group to address EPU.

3.1 AGING MANAGEMENT OF REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM

Review Responsibilities

Primary - Branch assigned responsibility by PM as described in SRP-LR Section 3.0 of this SRP-LR.

3.1.1 Areas of Review

This section addresses the aging management review (AMR) and the associated aging management program (AMP) of the reactor vessel, internals, and reactor coolant system. For a recent vintage plant, the information related to the reactor vessel, internals, and reactor coolant system is contained in Chapter 5, "Reactor Coolant System and Connected Systems," of the plant's final safety analysis report (FSAR), consistent with the Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (NUREG-0800). For older plants, the location of applicable information is plant-specific because an older plant's FSAR may have predated NUREG-0800.

The reactor vessel, internals, and reactor coolant system includes the reactor vessel and internals. For Boiling Water Reactors (BWRs), this system also includes the reactor coolant recirculation system and portions of other systems connected to the pressure vessel extending to the first isolation valve outside of containment or to the first anchor point. These connected systems include residual heat removal, low-pressure core spray, high-pressure core spray, low-pressure coolant injection, high-pressure coolant injection, reactor core isolation cooling, isolation condenser, reactor coolant cleanup, feedwater, and main steam. For Pressurized Water Reactors (PWRs), the reactor coolant system includes the primary coolant loop, the pressurizer and pressurizer relief tank, and the steam generators. The connected systems for PWRs include the residual heat removal or low pressure injection system, core flood spray or safety injection tank, chemical and volume control system or high pressure injection system, and sampling system.

The responsible review organization is to review the following license renewal application (LRA) AMR and AMP items assigned to it, per SRP-LR Section 3.0:

<u>AMRs</u>

- AMR results consistent with the GALL Report
- AMR results for which further evaluation is recommended by the GALL Report
- AMR results not consistent with or not addressed in the GALL Report

<u>AMPs</u>

- Consistent with GALL Report AMPs
- Plant-specific AMPs

<u>FSAR Supplement</u>

- The responsible review organization is to review the FSAR Supplement associated with each assigned AMP.

3.1.2 Acceptance Criteria

The acceptance criteria for the areas of review describe methods for determining whether the applicant has met the requirements of the NRC's regulations in 10 CFR 54.21.

3.1.2.1 AMR Results Consistent with the GALL Report

The AMR and the AMPs applicable to the reactor vessel, internals, and reactor coolant system are described and evaluated in Chapter IV of NUREG-1801 (GALL Report).

The applicant's LRA should provide sufficient information so that the reviewer is able to confirm that the specific LRA AMR line-item and the associated LRA (licensee) AMP are consistent with the cited GALL Report AMR line-item. The reviewer should then confirm that the LRA AMR line-item is consistent with the GALL Report AMR line-item to which it is compared.

For AMPs, if the applicant identifies an exception to any of the program elements of the cited GALL Report AMP, the LRA AMP should include a basis demonstrating how the criteria of 10 CFR 54.21(a)(3) would still be met. The reviewer should then confirm that the LRA AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the LRA AMP, the reviewer identifies a difference from the GALL Report AMP that should have been identified as an exception to the GALL Report AMP, this difference should be reviewed and properly dispositioned. The reviewer should document the disposition of all LRA-defined exceptions and staff-identified differences.

The LRA should identify any enhancements that are needed to permit an existing licensee AMP to be declared consistent with the GALL Report AMP to which the licensee AMP is compared. The reviewer is to confirm both that the enhancement, when implemented, would allow the existing licensee AMP to be consistent with the GALL Report AMP and also that the applicant has a commitment in the FSAR Supplement to implement the enhancement prior to the period of extended operation. The reviewer should document the disposition of all enhancements.

3.1.2.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

The basic acceptance criteria defined in Subsection 3.1.2.1 apply to all of the AMRs and AMPs reviewed as part of this section. In addition, if the GALL Report AMR line-item to which the LRA AMR line-item is compared identifies that further evaluation is recommended, then additional criteria apply as identified by the GALL Report for each of the following aging effect/aging mechanism combinations.

3.1.2.2.1 Cumulative Fatigue Damage

Fatigue is a time-limited aging analysis (TLAA) as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). This TLAA is addressed separately in Section 4.3, "Metal Fatigue Analysis," of this SRP-LR.

3.1.2.2.2 Loss of Material due to General, Pitting, and Crevice Corrosion

1. Loss of material due to general, pitting, and crevice corrosion could occur in the steel PWR steam generator shell assembly exposed to secondary feedwater and steam. Loss of material due to general, pitting, and crevice corrosion could also occur for the steel top head enclosure (without cladding) top head nozzles [vent, top head spray or reactor core isolation

cooling (RCIC), and spare] exposed to reactor coolant. The existing program relies on control of reactor water chemistry to mitigate corrosion. However, control of water chemistry does not preclude loss of material due to pitting and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

2. Loss of material due to pitting and crevice corrosion could occur in stainless steel BWR isolation condenser components exposed to reactor coolant. Loss of material due to general, pitting, and crevice corrosion could occur in steel BWR isolation condenser components. The existing program relies on control of reactor water chemistry to mitigate corrosion. However, control of water chemistry does not preclude loss of material due to pitting and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

3. Loss of material due to pitting and crevice corrosion could occur for stainless steel, nickel alloy, and steel with stainless steel or nickel alloy cladding flanges, nozzles, penetrations, pressure housings, safe ends, and vessel shells, heads and welds exposed to reactor coolant. The existing program relies on control of reactor water chemistry to mitigate corrosion. However, control of water chemistry does not preclude loss of material due to pitting and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

4. Loss of material due to general, pitting, and crevice corrosion could occur in the steel PWR steam generator upper and lower shell and transition cone exposed to secondary feedwater and steam. The existing program relies on control of chemistry to mitigate corrosion and In-service Inspection (ISI) to detect loss of material. The extent and schedule of the existing steam generator inspections are designed to ensure that flaws cannot attain a depth sufficient to threaten the integrity of the welds. However, according to NRC Information Notice (IN) 90-04, the program may not be sufficient to detect pitting and crevice corrosion, if general and pitting corrosion of the shell is known to exist. The GALL Report recommends augmented inspection to manage this aging effect. Furthermore, the GALL Report clarifies that this issue is limited to Westinghouse Model 44 and 51 Steam Generators where a high stress region exists at the shell to transition cone weld. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.1.2.2.3 Loss of Fracture Toughness due to Neutron Irradiation Embrittlement

1. Neutron irradiation embrittlement is a TLAA to be evaluated for the period of extended operation for all ferritic materials that have a neutron fluence greater than 10^{17} n/cm2 (E >1 MeV) at the end of the license renewal term. Certain aspects of neutron irradiation embrittlement are TLAAs as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). This TLAA is addressed separately in Section 4.2, "Reactor Vessel Neutron Embrittlement Analysis," of this SRP-LR.

2. Loss of fracture toughness due to neutron irradiation embrittlement could occur in BWR and PWR reactor vessel beltline shell, nozzle, and welds exposed to reactor coolant and neutron flux. A reactor vessel materials surveillance program monitors neutron irradiation embrittlement of the reactor vessel. Reactor vessel surveillance program is plant-specific, depending on matters such as the composition of limiting materials, availability of surveillance capsules, and projected fluence levels. In accordance with 10 CFR Part 50, Appendix H, an applicant is required to submit its proposed withdrawal schedule for approval prior to implementation. Untested capsules placed in storage must be maintained for future insertion. Thus, further staff evaluation is required for license renewal. Specific recommendations for an acceptable AMP are provided in Chapter XI, Section M31 of the GALL Report.

3.1.2.2.4 Cracking due to Stress Corrosion Cracking (SCC) and Intergranular Stress Corrosion Cracking (IGSCC)

1. Cracking due to SCC and IGSCC could occur in the stainless steel and nickel alloy BWR top head enclosure vessel flange leak detection lines. The GALL Report recommends that a plant-specific AMP be evaluated because existing programs may not be capable of mitigating or detecting cracking due to SCC and IGSCC. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

2. Cracking due to SCC and IGSCC could occur in stainless steel BWR isolation condenser components exposed to reactor coolant. The existing program relies on control of reactor water chemistry to mitigate SCC and on ASME Section XI ISI. However, the existing program should be augmented to detect cracking due to SCC and IGSCC. The GALL Report recommends an augmented program to include temperature and radioactivity monitoring of the shell-side water, and eddy current testing of tubes to ensure that the component's intended function will be maintained during the period of extended operation. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.1.2.2.5 Crack Growth due to Cyclic Loading

Crack growth due to cyclic loading could occur in reactor vessel shell forgings clad with stainless steel using a high-heat-input welding process. Growth of intergranular separations (underclad cracks) in the heat affected zone under austenitic stainless steel cladding is a TLAA to be evaluated for the period of extended operation for all the SA 508-Cl 2 forgings where the cladding was deposited with a high heat input welding process. The methodology for evaluating the underclad flaw should be consistent with the current well-established flaw evaluation procedure and criterion in the ASME Section XI Code. See the SRP-LR, Section 4.7, "Other Plant-Specific Time-Limited Aging Analysis," for generic guidance for meeting the requirements of 10 CFR 54.21(c).

3.1.2.2.6 Loss of Fracture Toughness due to Neutron Irradiation Embrittlement and Void Swelling

Loss of fracture toughness due to neutron irradiation embrittlement and void swelling could occur in stainless steel and nickel alloy reactor vessel internals components exposed to reactor coolant and neutron flux. The GALL Report recommends no further aging management review if the applicant provides a commitment in the FSAR Supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.

3.1.2.2.7 Cracking due to Stress Corrosion Cracking

1. Cracking due to SCC could occur in the PWR stainless steel reactor vessel flange leak detection lines and bottom-mounted instrument guide tubes exposed to reactor coolant. The GALL Report recommends further evaluation to ensure that these aging effects are adequately managed. The GALL Report recommends that a plant specific AMP be evaluated to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

2. Cracking due to SCC could occur in Class 1 PWR cast austenitic stainless steel (CASS) reactor coolant system piping, piping components, and piping elements exposed to reactor coolant. The existing program relies on control of water chemistry to mitigate SCC; however SCC could occur for CASS components that do not meet the NUREG-0313 guidelines with regard to ferrite and carbon content. The GALL Report recommends further evaluation of a plant specific program for these components to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.1.2.2.8 Cracking due to Cyclic Loading

1. Cracking due to cyclic loading could occur in the stainless steel BWR jet pump sensing lines. The GALL Report recommends that a plant specific AMP be evaluated to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

2. Cracking due to cyclic loading could occur in steel and stainless steel BWR isolation condenser components exposed to reactor coolant. The existing program relies on ASME Section XI ISI. However, the existing program should be augmented to detect cracking due to cyclic loading. The GALL Report recommends an augmented program to include temperature and radioactivity monitoring of the shell-side water, and eddy current testing of tubes to ensure that the component's intended function will be maintained during the period of extended operation. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.1.2.2.9 Loss of Preload due to Stress Relaxation

Loss of preload due to stress relaxation could occur in stainless steel and nickel alloy PWR reactor vessel internals screws, bolts, tie rods, and hold-down springs exposed to reactor coolant. The GALL Report recommends no further aging management review if the applicant provides a commitment in the FSAR Supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.

3.1.2.2.10 Loss of Material due to Erosion

Loss of material due to erosion could occur in steel steam generator feedwater impingement plates and supports exposed to secondary feedwater. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.1.2.2.11 Cracking due to Flow-Induced Vibration

Cracking due to flow-induced vibration could occur for the BWR stainless steel steam dryers exposed to reactor coolant. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.1.2.2.12 Cracking due to Stress Corrosion Cracking and Irradiation-Assisted Stress Corrosion Cracking (IASCC)

Cracking due to SCC and IASCC could occur in PWR stainless steel reactor internals exposed to reactor coolant. The existing program relies on control of water chemistry to mitigate these effects. The GALL Report recommends no further aging management review if the applicant provides a commitment in the FSAR Supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.

3.1.2.2.13 Cracking due to Primary Water Stress Corrosion Cracking (PWSCC)

Cracking due to PWSCC could occur in PWR components made of nickel alloy and steel with nickel alloy cladding, including reactor coolant pressure boundary components and penetrations inside the RCS such as pressurizer heater sheathes and sleeves, nozzles, and other internal components. With the exception of reactor vessel upper head nozzles and penetrations, the GALL Report recommends ASME Section XI ISI (for Class 1 components) and control of water chemistry. For nickel alloy components, no further aging management review is necessary if the applicant complies with applicable NRC Orders and provides a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.

3.1.2.2.14 Wall Thinning due to Flow-Accelerated Corrosion

Wall thinning due to flow-accelerated corrosion could occur in steel feedwater inlet rings and supports. The GALL Report references NRC IN 91-19, "Steam Generator Feedwater Distribution Piping Damage," for evidence of flow accelerated corrosion in steam generators and recommends that a plant-specific AMP be evaluated because existing programs may not be capable of mitigating or detecting wall thinning due to flow-accelerated corrosion. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.1.2.2.15 Changes in Dimensions due to Void Swelling

Changes in dimensions due to void swelling could occur in stainless steel and nickel alloy PWR reactor internal components exposed to reactor coolant. The GALL Report recommends no further aging management review if the applicant provides a commitment in the FSAR Supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.

3.1.2.2.16 Cracking due to Stress Corrosion Cracking and Primary Water Stress Corrosion Cracking

1. Cracking due to SCC could occur on the primary coolant side of PWR steel steam generator upper and lower heads, tubesheets, and tube-to-tube sheet welds made or clad with stainless steel. Cracking due to PWSCC could occur on the primary coolant side of PWR steel steam generator upper and lower heads, tubesheets, and tube-to-tube sheet welds made or clad with nickel alloy. The GALL Report recommends ASME Section XI ISI and control of water chemistry to manage this aging and recommends no further aging management review for PWSCC of nickel alloy if the applicant complies with applicable NRC Orders and provides a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.

2. Cracking due to SCC could occur on stainless steel pressurizer spray heads. Cracking due to PWSCC could occur on nickel-alloy pressurizer spray heads. The existing program relies on control of water chemistry to mitigate this aging effect. The GALL Report recommends one-time inspection to confirm that cracking is not occurring. For nickel alloy welded spray heads, the GALL Report recommends no further aging management review if the applicant complies with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.

3.1.2.2.17 Cracking due to Stress Corrosion Cracking, Primary Water Stress Corrosion Cracking, and Irradiation-Assisted Stress Corrosion Cracking

Cracking due to stress corrosion cracking (SCC), primary water stress corrosion cracking (PWSCC), and irradiation assisted stress corrosion cracking (IASCC) could occur in PWR stainless steel and nickel alloy reactor vessel internals components. The existing program relies on control of water chemistry to mitigate these effects. However, the existing program should be augmented to manage these aging effects for reactor vessel internals components. The GALL Report recommends no further aging management review if the applicant provides a commitment in the FSAR Supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.

3.1.2.2.18 Quality Assurance for Aging Management of Nonsafety-Related Components

Acceptance criteria are described in Branch Technical Position IQMB-1 (Appendix A.2 of this SRP-LR).

3.1.2.3 AMR Results Not Consistent with or Not Addressed in GALL Report

Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.1.2.4 FSAR Supplement

The summary description of the programs and activities for managing the effects of aging for the period of extended operation in the FSAR Supplement should be sufficiently comprehensive such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the bases for determining that aging effects will be managed during the period of extended operation. The description should also contain any future aging management activities, including enhancements and commitments, to be completed before the period of extended operation. Examples of the type of information to be included are provided in Table 3.1-2 of this SRP-LR.

3.1.3 Review Procedures

For each area of review, the following review procedures are to be followed.

3.1.3.1 AMR Results Consistent with the GALL Report

The applicant may reference the GALL Report in its LRA, as appropriate, and demonstrate that the AMRs and AMPs at its facility are consistent with those reviewed and approved in the GALL Report. The reviewer should not conduct a re-review of the substance of the matters described in the GALL Report. If the applicant has provided the information necessary to adopt the finding of program acceptability as described and evaluated in the GALL Report, the reviewer should find acceptable the applicant's reference to the GALL Report in its LRA. In making this determination, the reviewer confirms that the applicant has provided a brief description of the system, components, materials, and environment. The reviewer also confirms that the applicant has stated that the applicable aging effects and industry and plant-specific operating experience have been reviewed by the applicant and are evaluated in the GALL Report.

Furthermore, the reviewer should confirm that the applicant has addressed operating experience identified after the issuance of the GALL Report. Performance of this review requires the reviewer to confirm that the applicant has identified those aging effects for the reactor vessel, internals, and reactor coolant system components that are contained in the GALL Report as applicable to its plant.

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL Report. If the applicant commits to an enhancement to make its LRA AMP consistent with a GALL Report AMP, then the reviewer is to confirm that this enhancement, when implemented, will make the LRA AMP consistent with the GALL Report AMP. If the applicant identifies, in the LRA AMP, an exception to any of the program elements of the GALL Report AMP with which the applicant is claiming to be consistent, the reviewer is to confirm that the LRA AMP with the exception will satisfy the criteria of 10 CFR 54.21(a)(3). If the reviewer identifies a difference, not identified by the LRA, between the LRA AMP and the GALL Report AMP, with which the LRA claims to be consistent, the reviewer should confirm that the LRA AMP with this difference satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions or differences. The AMPs evaluated in GALL Report pertinent to the reactor vessel, internals, and reactor coolant system are summarized in Table 3.1-1 of this SRP-LR. In this table, the ID column provides a row identifier useful in matching the information presented in the corresponding table in the GALL Report, Vol. 1. The Related Item column identifies the item number in the GALL Report, Vol. 2, Chapters II through VIII, presenting detailed information summarized by this row.

3.1.3.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

The basic review procedures defined in Subsection 3.1.3.1 apply to all of the AMRs and AMPs provided in this section. In addition, if the GALL Report AMR line-item to which the LRA AMR line-item is compared identifies that “further evaluation is recommended,” then additional criteria apply as identified by the GALL Report for each of the following aging effect/aging mechanism combinations.

3.1.3.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The staff reviews the evaluation of this TLAA separately following the guidance in Section 4.3 of this SRP-LR.

3.1.3.2.2 Loss of Material due to General, Pitting, and Crevice Corrosion

1. The GALL Report recommends an augmented program for the management of loss of material due to general, pitting, and crevice corrosion for steel PWR steam generator shell assembly exposed to secondary feedwater and steam. The existing program relies on control of chemistry to mitigate corrosion and ISI to detect loss of material. The extent and schedule of the existing steam generator inspections are designed to ensure that flaws cannot attain a depth sufficient to threaten the integrity of the welds. However, according to NRC IN 90-04, the program may not be sufficient to detect pitting and crevice corrosion, if general and pitting corrosion of the shell is known to exist. The GALL Report recommends augmented inspection to manage this aging effect. Furthermore, the GALL Report clarifies that this issue is limited to Westinghouse Model 44 and 51 Steam Generators where a high stress region exists at the shell to transition cone weld. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR). Loss of material due to general, pitting, and crevice corrosion could also occur for the steel top head enclosure (without cladding) top head nozzles (vent, top head spray or RCIC, and spare) exposed to reactor coolant. The existing program relies on control of reactor water chemistry to mitigate corrosion. However, control of water chemistry does not preclude loss of material due to pitting and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the chemistry control program should be verified to ensure that corrosion is

not occurring. The reviewer verifies on a case-by-case basis that the applicant has proposed a program that will manage loss of material due to general, pitting and crevice corrosion by providing enhanced inspection and supplemental methods to detect loss of material and ensure that the component intended function will be maintained during the period of extended operation.

2. The GALL Report recommends an augmented program for the management of loss of material due to pitting and crevice corrosion for stainless steel BWR isolation condenser components exposed to reactor coolant. The GALL Report also recommends an augmented program for the management of loss of material due to general, pitting, and crevice corrosion for steel BWR isolation condenser components. The existing program relies on control of reactor water chemistry to mitigate corrosion. However, control of water chemistry does not preclude loss of material due to pitting and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring. The reviewer verifies on a case-by-case basis that the applicant has proposed an augmented program that will manage loss of material due to general, pitting, and crevice corrosion and ensure that the component intended function will be maintained during the period of extended operation.

3. The GALL Report recommends further evaluation of programs to manage the loss of material due to pitting and crevice corrosion for stainless steel, nickel alloy, and steel with stainless steel or nickel alloy cladding flanges, nozzles, penetrations, pressure housings, safe ends, and vessel shells, heads and welds exposed to reactor coolant to verify the effectiveness of the chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to determine whether corrosion is not occurring or the corrosion is progressing very slowly so that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques. Follow-up actions are to be based on the inspection results.

4. The GALL Report recommends further evaluation of programs to manage the loss of material due to general, pitting, and crevice corrosion for steel PWR steam generator upper and lower shell and transition cone exposed to secondary feedwater and steam. The existing program relies on control of reactor water chemistry to mitigate corrosion and on ISI for detection. Based on NRC IN 90-04, if general, pitting, and crevice corrosion of the shell exists, the existing program requirements may not be sufficient to detect loss of material due to these effects, and additional inspection procedures may be necessary. The reviewer verifies on a case-by-case basis that the applicant has proposed an augmented program that will manage loss of material due to general, pitting, and crevice corrosion and ensure that the component intended function will be maintained during the period of extended operation.

3.1.3.2.3 Loss of Fracture Toughness due to Neutron Irradiation Embrittlement

1. Neutron irradiation embrittlement is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The staff reviews the evaluation of this TLAA following the guidance in Section 4.2 of this SRP-LR.

2. The GALL Report recommends further evaluation of the reactor vessel materials surveillance program for the period of extended operation. Neutron embrittlement of the reactor vessel is monitored by a reactor vessel materials surveillance program. Reactor vessel surveillance program is plant specific, depending on matters such as the composition of limiting materials, availability of surveillance capsules, and projected fluence levels. In accordance with 10 CFR Part 50, Appendix H, an applicant must submit its proposed withdrawal schedule for approval prior to implementation. Untested capsules placed in storage must be maintained for future insertion. Thus, further staff evaluation is required for license renewal. The reviewer verifies on a case-by-case basis that the applicant has proposed an adequate reactor vessel materials surveillance program for the period of extended operation. Specific recommendations for an acceptable AMP are provided in Chapter XI, Section M31 of the GALL Report.

3.1.3.2.4 Cracking due to Stress Corrosion Cracking and Intergranular Stress Corrosion Cracking

1. The GALL Report recommends that a plant-specific AMP be evaluated to manage cracking due to SCC and IGSCC in stainless steel and nickel alloy BWR top head enclosure vessel flange leak detection lines. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

2. The GALL Report recommends an augmented program to include temperature and radioactivity monitoring of the shell-side water, and eddy current testing of tubes for the management of cracking due to SCC and IGSCC of the stainless steel BWR isolation condenser components. The existing program relies on control of reactor water chemistry to mitigate SCC and IGSCC and on ASME Section XI ISI to detect leakage. However, the existing program should be augmented to detect cracking due to SCC and IGSCC. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.1.3.2.5 Crack Growth due to Cyclic Loading

The GALL Report recommends further evaluation of programs to manage crack growth due to cyclic loading in reactor vessel shell forgings clad with stainless steel using a high-heat-input welding process. Growth of intergranular separations (underclad cracks) in the heat affected zone under austenitic stainless steel cladding is a TLAA to be evaluated for the period of extended operation for all the SA 508-Cl 2 forgings where the cladding was deposited with a high heat input welding process. The methodology for evaluating the underclad flaw should be consistent with the current well-established flaw evaluation procedure and criterion in the ASME Section XI Code. The SRP-LR, Section 4.7, "Other Plant-Specific Time-Limited Aging Analysis," provides generic guidance for meeting the requirements of 10 CFR 54.21(c). The staff reviews the evaluation of this TLAA separately following the guidance in Section 4.7 of this SRP-LR.

3.1.3.2.6 Loss of Fracture Toughness due to Neutron Irradiation Embrittlement and Void Swelling

The GALL Report recommends no further evaluation of programs to manage loss of fracture toughness due to neutron irradiation embrittlement and void swelling in stainless steel and nickel alloy reactor vessel internals if the applicant provides a commitment in the FSAR Supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval. The reviewer reviews the application to confirm the FSAR Supplement contains the appropriate commitment to ensure that an adequate program will be in place for the management of these aging effects. If the FSAR Supplement does not contain the appropriate commitment, the staff reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.1.3.2.7 Cracking due to Stress Corrosion Cracking

1. The GALL Report recommends that a plant-specific AMP be evaluated to manage cracking due to SCC in stainless steel PWR reactor vessel flange leak detection lines and bottom-mounted instrument guide tubes exposed to reactor coolant. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

2. The GALL Report recommends that a plant-specific AMP be evaluated to manage cracking due to SCC in Class 1 CASS PWR reactor coolant system piping, piping components, and piping elements exposed to reactor coolant that do not meet the carbon and ferrite content guidelines of NUREG-0313. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.1.3.2.8 Cracking due to Cyclic Loading

1. The GALL Report recommends that a plant specific AMP be evaluated for the management of cracking due to cyclic loading in stainless steel BWR jet pump sensing lines. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

2. The GALL Report recommends an augmented program for the management of cracking due to cyclic loading in steel and stainless steel BWR isolation condenser components. The existing program relies on ASME Section XI ISI for detection. However, the inspection requirements should be augmented to detect cracking due to cyclic loading. An augmented program to include temperature and radioactivity monitoring of the shell-side water and eddy current testing of tubes is recommended to ensure that the component's intended function will be maintained during the period of extended operation. The reviewer verifies on a case-by-case basis that the applicant has proposed an augmented program that will detect cracking and ensure that the component intended function will be maintained during the period of extended operation.

3.1.3.2.9 Loss of Preload due to Stress Relaxation

The GALL Report recommends further evaluation of programs to manage loss of preload due to stress relaxation that could occur in stainless steel and nickel alloy reactor vessel internals screws, bolts, tie rods, and hold-down springs exposed to reactor coolant. The GALL Report recommends no further aging management review if the applicant provides a commitment in the FSAR Supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval. The reviewer reviews the application to confirm the FSAR Supplement contains the appropriate commitment to ensure that an adequate program will be in place for the management of these aging effects. If the FSAR Supplement does not contain the appropriate commitment, the staff reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of this aging effect.

3.1.3.2.10 Loss of Material due to Erosion

The GALL Report recommends further evaluation of a plant-specific AMP for the management of loss of material due to erosion of steel steam generator feedwater impingement plates and supports exposed to secondary feedwater. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.1.3.2.11 Cracking due to Flow-Induced Vibration

The GALL Report recommends further evaluation of a plant-specific AMP for the management of cracking due to flow-induced vibration of BWR stainless steel steam dryers. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.1.3.2.12 Cracking due to Stress Corrosion Cracking and Irradiation-Assisted Stress Corrosion Cracking

The GALL Report recommends further evaluation of programs to manage cracking due to SCC and IASCC in stainless steel reactor internal components exposed to reactor coolant. The GALL Report recommends no further aging management review if the applicant provides a commitment in the FSAR Supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.

The reviewer reviews the application to confirm the FSAR Supplement contains the appropriate commitment to ensure that an adequate program will be in place for the management of these aging effects. If the FSAR Supplement does not contain the appropriate commitment, the staff reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.1.3.2.13 Cracking due to Primary Water Stress Corrosion Cracking

For cracking due to PWSCC of PWR components (with the exception of reactor vessel upper head nozzles and penetrations) made of nickel alloy or having nickel alloy cladding, the GALL Report recommends no further aging management review if the applicant complies with applicable NRC Orders and provides a commitment in the FSAR Supplement to implement applicable (1) Bulletins and Generic Letters associated with nickel alloys and (2) staff-accepted industry guidelines.

The reviewer reviews the application to confirm the FSAR Supplement contains the appropriate commitment to ensure that an adequate program will be in place for the management of PWSCC. If the FSAR Supplement does not contain the appropriate commitment, the staff reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of PWSCC.

3.1.3.2.14 Wall Thinning due to Flow-accelerated Corrosion

The GALL Report recommends that a plant-specific AMP be evaluated to manage loss of material due to wall thinning in the feedwater inlet ring and supports. Reference NRC IN 91-19, "Steam Generator Feedwater Distribution Piping Damage," for evidence of flow accelerated corrosion in steam generators. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.1.3.2.15 Changes in Dimensions due to Void Swelling

For changes in dimensions due to void swelling in stainless steel and nickel alloy reactor internal components, the GALL Report recommends no further aging management review if the applicant provides a commitment in the FSAR Supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.

The reviewer reviews the application to confirm the FSAR Supplement contains the appropriate commitment to ensure that an adequate program will be in place for the management of this aging effect. If the FSAR Supplement does not contain the appropriate commitment, the staff reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of this aging effect.

3.1.3.2.16 Cracking due to Stress Corrosion Cracking and Primary Water Stress Corrosion Cracking

1. The GALL Report recommends ASME Section XI ISI and control of water chemistry to manage SCC and PWSCC on the primary coolant side of PWR steel steam generator upper and lower heads, tubesheets, and tube-to-tube sheet welds made or clad with stainless steel or nickel alloy. For cracking due to PWSCC of nickel-alloy-clad components, the GALL Report recommends no further aging management review if the applicant complies with applicable NRC Orders and provides a commitment in the FSAR Supplement to implement applicable (1) Bulletins, and Generic Letters associated with nickel alloys and

(2) staff-accepted industry guidelines.

The reviewer reviews the application to confirm the FSAR Supplement contains the appropriate commitment to ensure that an adequate program will be in place for the management of PWSCC. If the FSAR Supplement does not contain the appropriate commitment, the staff reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of SCC and PWSCC.

2. The GALL Report recommends control of water chemistry and a one-time inspection to manage cracking due to SCC of stainless steel pressurizer spray heads and PWSCC of nickel alloy pressurizer spray heads. It recommends no further aging management review if the applicant complies with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.

   The reviewer reviews the application to confirm the FSAR Supplement contains the appropriate commitment to ensure that an adequate program will be in place for the management of PWSCC. If the FSAR Supplement does not contain the appropriate commitment, the staff reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of PWSCC. The reviewer verifies that the proposed one-time inspection will be performed using techniques similar to ASME Code and ASTM standards including visual, ultrasonic, and surface techniques to ensure that the component's intended function will be maintained during the period of extended operation.

3.1.3.2.17 Cracking due to Stress Corrosion Cracking, Primary Water Stress Corrosion Cracking, and Irradiation-Assisted Stress Corrosion Cracking

The GALL Report recommends further evaluation of programs to manage cracking due to SCC, PWSCC, and IASCC in stainless steel and nickel alloy reactor vessel internals. The existing program relies on control of water chemistry to mitigate these effects. However, the existing program should be augmented to manage these aging effects for reactor vessel internals components. The GALL Report recommends no further aging management review if the applicant provides a commitment in the FSAR Supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.

The reviewer reviews the application to confirm the FSAR Supplement contains the appropriate commitment to ensure that an adequate program will be in place for the management of these aging effects. If the FSAR Supplement does not contain the appropriate commitment, the staff reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.1.3.2.18 Quality Assurance for Aging Management of Nonsafety-Related Components

The applicant's AMPs for license renewal should contain the elements of corrective actions, the confirmation process, and administrative controls. Safety-related components are covered by 10

CFR Part 50, Appendix B, which is adequate to address these program elements. However, Appendix B does not apply to nonsafety-related components that are subject to an aging management review for license renewal. Nevertheless, the applicant has the option to expand the scope of its 10 CFR Part 50, Appendix B program to include these components and address the associated program elements. If the applicant chooses this option, the reviewer verifies that the applicant has documented such a commitment in the FSAR Supplement. If the applicant chooses alternative means, the branch responsible for quality assurance should be requested to review the applicant's proposal on a case-by-case basis.

3.1.3.3 AMR Results Not Consistent with or Not Addressed in the GALL Report

The reviewer should confirm that the applicant, in its LRA, has identified applicable aging effects, listed the appropriate combination of materials and environments, and AMPs that will adequately manage the aging effects. The AMP credited by the applicant could be an AMP that is described and evaluated in the GALL Report or a plant-specific program. Review procedures are described in Branch Technical Position RSLB-1 (Appendix A.1 of this SRP-LR).

3.1.3.4 FSAR Supplement

The reviewer confirms that the applicant has provided information equivalent to that in Table 3.1-2 in the FSAR Supplement for aging management of the reactor vessel, internals, and reactor coolant system for license renewal. The reviewer also confirms that the applicant has provided information equivalent to that in Table 3.1-2 in the FSAR Supplement for Subsection 3.1.3.3, "AMR Results Not Consistent with or Not Addressed in the GALL Report."

The staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR Supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license conditions until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR Supplement without prior NRC approval, provided that the applicant evaluates each such change and finds it acceptable pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR supplement before the license is renewed, no condition will be necessary.

As noted in Table 3.1-2, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should confirm that the applicant has identified and committed in the license renewal application to any future aging management activities, including enhancements and commitments to be completed before entering the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.1.4 Evaluation Findings

If the reviewer determines then an evaluation finding similar to the following text should be included in the staff's safety evaluation report:

> On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated that the aging effects associated with the reactor vessel, internals, and reactor coolant system components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable FSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of the reactor vessel, internals and reactor coolant system, as required by 10 CFR 54.21(d).

3.1.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

3.1.6 References

1. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, July 1981.

2. NUREG-1801, "Generic Aging Lessons Learned (GALL)," U.S. Nuclear Regulatory Commission, Revision 1, September 2005.

3. NEI 97-06, "Steam Generator Program Guidelines," Nuclear Energy Institute, December 1997.

4. NRC Information Notice 90-04, "Cracking of the Upper Shell-to-Transition Cone Girth Welds in Steam Generators," U.S. Nuclear Regulatory Commission, January 26, 1990.

5. NUREG-0313, Rev. 2, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping," U.S. Nuclear Regulatory Commission, January 1988.

6. EPRI TR-107569-V1R5, "PWR Steam Generator Examination Guidelines, Rev. 5," Electric Power Research Institute, September 1997.

7. NRC Regulatory Guide 1.83, "Inservice Inspection of Pressurized Water Reactor Steam Generator Tubes," U.S. Nuclear Regulatory Commission, June 1974.

8. NRC Regulatory Guide 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes (for Comment)," U.S. Nuclear Regulatory Commission, May 1976.

9. NRC Generic Letter 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking," U.S. Nuclear Regulatory Commission, August 3, 1995.

10. NRC Information Notice 90-10, "Primary Water Stress Corrosion Cracking (PWSCC) of Inconel 600," U.S. Nuclear Regulatory Commission, February 23, 1990.

11. NRC Information Notice 90-30, "Ultrasonic Inspection Techniques for Dissimilar Metal Welds," U.S. Nuclear Regulatory Commission, May 1, 1990.

12. NRC Generic Letter 89-08, "Erosion/Corrosion-Induced Pipe Wall Thinning," May 2, 1989.

13. NSAC-202L-R2, "Recommendations for an Effective Flow-accelerated Corrosion Program," Electric Power Research Institute, April 1999.

14. NRC Information Notice 96-11, "Ingress of Demineralizer Resins Increase Potential for Stress Corrosion Cracking of Control Rod Drive Mechanism Penetrations," February 14, 1996.

15. NRC Generic Letter 97-06, "Degradation of Steam Generator Internals," U.S. Nuclear Regulatory Commission, December 30, 1997.

16. BWRVIP-29 (EPRI TR-103515), *BWR Water Chemistry Guidelines-Revision 3, Normal and Hydrogen Water Chemistry*, Electric Power Research Institute, Palo Alto, CA, February 1994.

17. EPRI NP-5769, *Degradation and Failure of Bolting in Nuclear Power Plants*, Volumes 1 and 2, Electric Power Research Institute, Palo Alto, CA, April 1988.

18. EPRI TR-105714, *PWR primary Water Chemistry Guidelines-Revision 3*, Electric Power Research Institute, Palo Alto, CA, Nov. 1995.

19. NRC Generic Letter 88-01, *NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping*, January 25, 1988.

20. NRC Generic Letter 97-01, *Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Closure Head Penetrations*, April 1, 1997.

21. NRC Information Notice 97-46, *Unisolable Crack in High-Pressure Injection Piping*, July 9, 1997.

22. NRC Regulatory Guide 1.99, Rev. 2, *Radiation Embrittlement of Reactor Vessel Materials,* May 1988.

23. NUREG-0619, *BWR Feedwater Nozzle and Control Rod Drive Return Line Nozzle Cracking*, U.S. Nuclear Regulatory Commission, November 1980.

24. NUREG-1339, *Resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants*, Richard E. Johnson, U.S. Nuclear Regulatory Commission, June 1990.

25. EPRI TR-104213, *Bolted Joint Maintenance & Application Guide,* Electric Power Research Institute, Palo Alto, CA, December 1995.

26. NEI letter dated Dec. 11, 1998, Dave Modeen to Gus Lainas, "Responses to NRC Requests for Additional Information (RAIs) on GL 97-01."

27. EPRI TR-102134, *PWR Secondary Water Chemistry Guideline-Revision 3*, Electric Power Research Institute, Palo Alto, CA, May 1993.

28. NRC Information Notice 91-19, *Steam Generator Feedwater Distribution Piping Damage*, March 12, 1991.

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
1	BWR	Steel pressure vessel support skirt and attachment welds	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (See subsection 3.1.2.2.1)	R-70
2	BWR	Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy reactor vessel components: flanges; nozzles; penetrations; safe ends; thermal sleeves; vessel shells, heads and welds	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Yes, TLAA (See subsection 3.1.2.2.1)	R-04
3	BWR	Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy reactor coolant pressure boundary piping, piping components, and piping elements exposed to reactor coolant	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Yes, TLAA (See subsection 3.1.2.2.1)	R-220
4	BWR	Steel pump and valve closure bolting	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) check Code limits for allowable cycles (less than 7000 cycles) of thermal stress range	Yes, TLAA (See subsection 3.1.2.2.1)	R-28
5	BWR/ PWR	Stainless steel and nickel alloy reactor vessel internals components	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (See subsection 3.1.2.2.1)	R-53
6	PWR	Nickel Alloy tubes and sleeves in a reactor coolant and secondary feedwater/steam environment	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (See subsection 3.1.2.2.1)	R-46

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
7	PWR	Steel and stainless steel reactor coolant pressure boundary closure bolting, head closure studs, support skirts and attachment welds, pressurizer relief tank components, steam generator components, piping and components external surfaces and bolting	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (See subsection 3.1.2.2.1)	R-13 R-18 R-33 R-73
8	PWR	Steel; stainless steel; and nickel-alloy reactor coolant pressure boundary piping, piping components, piping elements; flanges; nozzles and safe ends; pressurizer vessel shell heads and welds; heater sheaths and sleeves; penetrations; and thermal sleeves	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Yes, TLAA (See subsection 3.1.2.2.1)	R-223
9	PWR	Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy reactor vessel components: flanges; nozzles; penetrations; pressure housings; safe ends; thermal sleeves; vessel shells, heads and welds	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Yes, TLAA (See subsection 3.1.2.2.1)	R-219
10	PWR	Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy steam generator components (flanges; penetrations; nozzles; safe ends, lower heads and welds)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Yes, TLAA (See subsection 3.1.2.2.1)	R-221 R-222
11	BWR	Steel top head enclosure (without cladding) top head nozzles (vent, top head spray or RCIC, and spare) exposed to reactor coolant	Loss of material due to general, pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.1.2.2.2.1)	R-59

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
12	PWR	Steel steam generator shell assembly exposed to secondary feedwater and steam	Loss of material due to general, pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.1.2.2.2.1)	R-224
13	BWR	Steel and stainless steel isolation condenser components exposed to reactor coolant	Loss of material due to general (steel only), pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.1.2.2.2.2)	R-16
14	BWR	Stainless steel, nickel-alloy, and steel with nickel-alloy or stainless steel cladding reactor vessel flanges, nozzles, penetrations, safe ends, vessel shells, heads and welds	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.1.2.2.2.3)	RP-25
15	BWR	Stainless steel; steel with nickel-alloy or stainless steel cladding; and nickel-alloy reactor coolant pressure boundary components exposed to reactor coolant	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.1.2.2.2.3)	RP-27
16	PWR	Steel steam generator upper and lower shell and transition cone exposed to secondary feedwater and steam	Loss of material due to general, pitting and crevice corrosion	Inservice Inspection (IWB, IWC, and IWD), and Water Chemistry and, for Westinghouse Model 44 and 51 S/G, if general and pitting corrosion of the shell is known to exist, additional inspection procedures are to be developed.	Yes, detection of aging effects is to be evaluated (See subsection 3.1.2.2.2.4)	R-34

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
17	BWR/ PWR	Steel (with or without stainless steel cladding) reactor vessel beltline shell, nozzles, and welds	Loss of fracture toughness due to neutron irradiation embrittlement	TLAA, evaluated in accordance with Appendix G of 10 CFR Part 50 and RG 1.99. The applicant may choose to demonstrate that the materials of the nozzles are not controlling for the TLAA evaluations.	Yes, TLAA (See subsection 3.1.2.2.3.1)	R-62 R-67 R-81 R-84
18	BWR/ PWR	Steel (with or without stainless steel cladding) reactor vessel beltline shell, nozzles, and welds; safety injection nozzles	Loss of fracture toughness due to neutron irradiation embrittlement	Reactor Vessel Surveillance	Yes, plant specific (See subsection 3.1.2.2.3.2)	R-63 R-82 R-86
19	BWR	Stainless steel and nickel alloy top head enclosure vessel flange leak detection line	Cracking due to stress corrosion cracking and intergranular stress corrosion cracking	A plant-specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.1.2.2.4.1)	R-61
20	BWR	Stainless steel isolation condenser components exposed to reactor coolant	Cracking due to stress corrosion cracking and intergranular stress corrosion cracking	Inservice Inspection (IWB, IWC, and IWD), Water Chemistry, and plant-specific verification program	Yes, detection of aging effects is to be evaluated (See subsection 3.1.2.2.4.2)	R-15
21	PWR	Reactor vessel shell fabricated of SA508-Cl 2 forgings clad with stainless steel using a high-heat-input welding process	Crack growth due to cyclic loading	TLAA	Yes, TLAA (See subsection 3.1.2.2.5)	R-85

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
22	PWR	Stainless steel and nickel alloy reactor vessel internals components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement, void swelling	FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	No, but licensee commitment to be confirmed (See subsection 3.1.2.2.6)	R-122 R-127 R-128 R-132 R-135 R-141 R-157 R-161 R-164 R-169 R-178 R-188 R-196 R-205 R-212 R-216
23	PWR	Stainless steel reactor vessel closure head flange leak detection line and bottom-mounted instrument guide tubes	Cracking due to stress corrosion cracking	A plant-specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.1.2.2.7.1)	R-74 RP-13
24	PWR	Class 1 cast austenitic stainless steel piping, piping components, and piping elements exposed to reactor coolant	Cracking due to stress corrosion cracking	Water Chemistry and, for CASS components that do not meet the NUREG-0313 guidelines, a plant specific aging management program	Yes, plant specific (See subsection 3.1.2.2.7.2)	R-05
25	BWR	Stainless steel jet pump sensing line	Cracking due to cyclic loading	A plant-specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.1.2.2.8.1)	R-102
26	BWR	Steel and stainless steel isolation condenser components exposed to reactor coolant	Cracking due to cyclic loading	Inservice Inspection (IWB, IWC, and IWD) and plant-specific verification program	Yes, detection of aging effects is to be evaluated (See subsection 3.1.2.2.8.2)	R-225

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
27	PWR	Stainless steel and nickel alloy reactor vessel internals screws, bolts, tie rods, and hold-down springs	Loss of preload due to stress relaxation	FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	No, but licensee commitment to be confirmed (See subsection 3.1.2.2.9)	R-108 R-114 R-129 R-136 R-137 R-154 R-165 R-184 R-192 R-197 R-201 R-207 R-213
28	PWR	Steel steam generator feedwater impingement plate and support exposed to secondary feedwater	Loss of material due to erosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.1.2.2.10)	R-39
29	BWR	Stainless steel steam dryers exposed to reactor coolant	Cracking due to flow-induced vibration	A plant-specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.1.2.2.11)	RP-18

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
30	PWR	Stainless steel reactor vessel internals components (e.g., Upper internals assembly, RCCA guide tube assemblies, Baffle/former assembly, Lower internal assembly, shroud assemblies, Plenum cover and plenum cylinder, Upper grid assembly, Control rod guide tube (CRGT) assembly, Core support shield assembly, Core barrel assembly, Lower grid assembly, Flow distributor assembly, Thermal shield, Instrumentation support structures)	Cracking due to stress corrosion cracking, irradiation-assisted stress corrosion cracking	Water Chemistry and FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	No, but licensee commitment needs to be confirmed (See subsection 3.1.2.2.12)	R-106 R-109 R-116 R-120 R-123 R-125 R-138 R-143 R-146 R-149 R-155 R-159 R-166 R-172 R-173 R-175 R-176 R-180 R-181 R-185 R-193 R-202 R-209 R-214

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
31	PWR	Nickel alloy and steel with nickel-alloy cladding piping, piping component, piping elements, penetrations, nozzles, safe ends, and welds (other than reactor vessel head); pressurizer heater sheaths, sleeves, diaphragm plate, manways and flanges; core support pads/core guide lugs	Cracking due to primary water stress corrosion cracking	Inservice Inspection (IWB, IWC, and IWD) and Water Chemistry and for nickel alloy, comply with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	No, but licensee commitment needs to be confirmed (See subsection 3.1.2.2.13)	R-01 R-06 R-88 R-89 RP-22 RP-31
32	PWR	Steel steam generator feedwater inlet ring and supports	Wall thinning due to flow-accelerated corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.1.2.2.14)	R-51

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
33	PWR	Stainless steel and nickel alloy reactor vessel internals components	Changes in dimensions due to void swelling	FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	No, but licensee commitment to be confirmed (See subsection 3.1.2.2.15)	R-107 R-110 R-113 R-117 R-119 R-121 R-124 R-126 R-131 R-134 R-139 R-144 R-147 R-151 R-158 R-160 R-163 R-168 R-174 R-177 R-182 R-187 R-195 R-199 R-204 R-211 R-215

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report						
ID	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Related Item**
34	PWR	Stainless steel and nickel alloy reactor control rod drive head penetration pressure housings	Cracking due to stress corrosion cracking and primary water stress corrosion cracking	Inservice Inspection (IWB, IWC, and IWD) and Water Chemistry and for nickel alloy, comply with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	No, but licensee commitment needs to be confirmed (See subsection 3.1.2.2.16.1)	R-76
35	PWR	Steel with stainless steel or nickel alloy cladding primary side components; steam generator upper and lower heads, tubesheets and tube-to-tube sheet welds	Cracking due to stress corrosion cracking and primary water stress corrosion cracking	Inservice Inspection (IWB, IWC, and IWD) and Water Chemistry and for nickel alloy, comply with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	No, but licensee commitment needs to be confirmed (See subsection 3.1.2.2.16.1)	R-35
36	PWR	Nickel alloy, stainless steel pressurizer spray head	Cracking due to stress corrosion cracking and primary water stress corrosion cracking	Water Chemistry and One-Time Inspection and, for nickel alloy welded spray heads, comply with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	No, unless licensee commitment needs to be confirmed (See subsection 3.1.2.2.16.2)	R-24

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
37	PWR	Stainless steel and nickel alloy reactor vessel internals components (e.g., Upper internals assembly, RCCA guide tube assemblies, Lower internal assembly, CEA shroud assemblies, Core shroud assembly, Core support shield assembly, Core barrel assembly, Lower grid assembly, Flow distributor assembly)	Cracking due to stress corrosion cracking, primary water stress corrosion cracking, irradiation-assisted stress corrosion cracking	Water Chemistry and FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	No, but licensee commitment needs to be confirmed (See subsection 3.1.2.2.17)	R-112 R-118 R-130 R-133 R-150 R-162 R-167 R-186 R-194 R-203 R-210
38	BWR	Steel (with or without stainless steel cladding) control rod drive return line nozzles exposed to reactor coolant	Cracking due to cyclic loading	BWR CR Drive Return Line Nozzle	No	R-66
39	BWR	Steel (with or without stainless steel cladding) feedwater nozzles exposed to reactor coolant	Cracking due to cyclic loading	BWR Feedwater Nozzle	No	R-65
40	BWR	Stainless steel and nickel alloy penetrations for control rod drive stub tubes instrumentation, jet pump instrument, standby liquid control, flux monitor, and drain line exposed to reactor coolant	Cracking due to stress corrosion cracking, Intergranular stress corrosion cracking, cyclic loading	BWR Penetrations and Water Chemistry	No	R-69
41	BWR	Stainless steel and nickel alloy piping, piping components, and piping elements greater than or equal to 4 NPS; nozzle safe ends and associated welds	Cracking due to stress corrosion cracking and intergranular stress corrosion cracking	BWR Stress Corrosion Cracking and Water Chemistry	No	R-20 R-21 R-68
42	BWR	Stainless steel and nickel alloy vessel shell attachment welds exposed to reactor coolant	Cracking due to stress corrosion cracking and intergranular stress corrosion cracking	BWR Vessel ID Attachment Welds and Water Chemistry	No	R-64

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
43	BWR	Stainless steel fuel supports and control rod drive assemblies control rod drive housing exposed to reactor coolant	Cracking due to stress corrosion cracking and intergranular stress corrosion cracking	BWR Vessel Internals and Water Chemistry	No	R-104
44	BWR	Stainless steel and nickel alloy core shroud, core plate, core plate bolts, support structure, top guide, core spray lines, spargers, jet pump assemblies, control rod drive housing, nuclear instrumentation guide tubes	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	BWR Vessel Internals and Water Chemistry	No	R-92 R-93 R-96 R-97 R-98 R-99 R-100 R-105
45	BWR	Steel piping, piping components, and piping elements exposed to reactor coolant	Wall thinning due to flow-accelerated corrosion	Flow-Accelerated Corrosion	No	R-23
46	BWR	Nickel alloy core shroud and core plate access hole cover (mechanical covers)	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	Inservice Inspection (IWB, IWC, and IWD), and Water Chemistry	No	R-95
47	BWR	Stainless steel and nickel-alloy reactor vessel internals exposed to reactor coolant	Loss of material due to pitting and crevice corrosion	Inservice Inspection (IWB, IWC, and IWD), and Water Chemistry	No	RP-26
48	BWR	Steel and stainless steel Class 1 piping, fittings and branch connections < NPS 4 exposed to reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking (for stainless steel only), and thermal and mechanical loading	Inservice Inspection (IWB, IWC, and IWD), Water chemistry, and One-Time Inspection of ASME Code Class 1 Small-bore Piping	No	R-03

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
49	BWR	Nickel alloy core shroud and core plate access hole cover (welded covers)	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	Inservice Inspection (IWB, IWC, and IWD), Water Chemistry, and, for BWRs with a crevice in the access hole covers, augmented inspection using UT or other demonstrated acceptable inspection of the access hole cover welds	No	R-94
50	BWR	High-strength low alloy steel top head closure studs and nuts exposed to air with reactor coolant leakage	Cracking due to stress corrosion cracking and intergranular stress corrosion cracking	Reactor Head Closure Studs	No	R-60
51	BWR	Cast austenitic stainless steel jet pump assembly castings; orificed fuel support	Loss of fracture toughness due to thermal aging and neutron irradiation embrittlement	Thermal Aging and Neutron Irradiation Embrittlement of CASS	No	R-101 R-103
52	BWR/ PWR	Steel and stainless steel reactor coolant pressure boundary (RCPB) pump and valve closure bolting, manway and holding bolting, flange bolting, and closure bolting in high-pressure and high-temperature systems	Cracking due to stress corrosion cracking, loss of material due to wear, loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	No	R-10 R-11 R-12 R-26 R-27 R-29 R-32 R-78 R-79 R-80
53	BWR/ PWR	Steel piping, piping components, and piping elements exposed to closed cycle cooling water	Loss of material due to general, pitting and crevice corrosion	Closed-Cycle Cooling Water System	No	RP-10

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
54	BWR/ PWR	Copper alloy piping, piping components, and piping elements exposed to closed cycle cooling water	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	RP-11
55	BWR/ PWR	Cast austenitic stainless steel Class 1 pump casings, and valve bodies and bonnets exposed to reactor coolant >250°C (>482°F)	Loss of fracture toughness due to thermal aging embrittlement	Inservice inspection (IWB, IWC, and IWD). Thermal aging susceptibility screening is not necessary, inservice inspection requirements are sufficient for managing these aging effects. ASME Code Case N-481 also provides an alternative for pump casings.	No	R-08
56	BWR/ PWR	Copper alloy >15% Zn piping, piping components, and piping elements exposed to closed cycle cooling water	Loss of material due to selective leaching	Selective Leaching of Materials	No	RP-12
57	BWR/ PWR	Cast austenitic stainless steel Class 1 piping, piping component, and piping elements and control rod drive pressure housings exposed to reactor coolant >250°C (>482°F)	Loss of fracture toughness due to thermal aging embrittlement	Thermal Aging Embrittlement of CASS	No	R-52 R-77
58	PWR	Steel reactor coolant pressure boundary external surfaces exposed to air with borated water leakage	Loss of material due to Boric acid corrosion	Boric Acid Corrosion	No	R-17
59	PWR	Steel steam generator steam nozzle and safe end, feedwater nozzle and safe end, AFW nozzles and safe ends exposed to secondary feedwater/steam	Wall thinning due to flow-accelerated corrosion	Flow-Accelerated Corrosion	No	R-37 R-38
60	PWR	Stainless steel flux thimble tubes (with or without chrome plating)	Loss of material due to Wear	Flux Thimble Tube Inspection	No	R-145

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
61	PWR	Stainless steel, steel pressurizer integral support exposed to air with metal temperature up to 288°C (550°F)	Cracking due to cyclic loading	Inservice Inspection (IWB, IWC, and IWD)	No	R-19
62	PWR	Stainless steel, steel with stainless steel cladding reactor coolant system cold leg, hot leg, surge line, and spray line piping and fittings exposed to reactor coolant	Cracking due to cyclic loading	Inservice Inspection (IWB, IWC, and IWD)	No	R-56
63	PWR	Steel reactor vessel flange, stainless steel and nickel alloy reactor vessel internals exposed to reactor coolant (e.g., upper and lower internals assembly, CEA shroud assembly, core support barrel, upper grid assembly, core support shield assembly, lower grid assembly)	Loss of material due to Wear	Inservice Inspection (IWB, IWC, and IWD)	No	R-87 R-115 R-142 R-148 R-152 R-156 R-170 R-179 R-190 R-208
64	PWR	Stainless steel and steel with stainless steel or nickel alloy cladding pressurizer components	Cracking due to stress corrosion cracking, primary water stress corrosion cracking	Inservice Inspection (IWB, IWC, and IWD) and Water Chemistry	No	R-25
65	PWR	Nickel alloy reactor vessel upper head and control rod drive penetration nozzles, instrument tubes, head vent pipe (top head), and welds	Cracking due to primary water stress corrosion cracking	Inservice Inspection (IWB, IWC, and IWD) and Water Chemistry and Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors	No	R-75 R-90

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report						
ID	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Related Item**
66	PWR	Steel steam generator secondary manways and handholds (cover only) exposed to air with leaking secondary-side water and/or steam	Loss of material due to erosion	Inservice Inspection (IWB, IWC, and IWD) for Class 2 components	No	R-31
67	PWR	Steel with stainless steel or nickel alloy cladding; or stainless steel pressurizer components exposed to reactor coolant	Cracking due to cyclic loading	Inservice Inspection (IWB, IWC, and IWD), and Water Chemistry	No	R-58
68	PWR	Stainless steel, steel with stainless steel cladding Class 1 piping, fittings, pump casings, valve bodies, nozzles, safe ends, manways, flanges, CRD housing; pressurizer heater sheaths, sleeves, diaphragm plate; pressurizer relief tank components, reactor coolant system cold leg, hot leg, surge line, and spray line piping and fittings	Cracking due to stress corrosion cracking	Inservice Inspection (IWB, IWC, and IWD), and Water Chemistry	No	R-07 R-09 R-14 R-30 R-217
69	PWR	Stainless steel, nickel alloy safety injection nozzles, safe ends, and associated welds and buttering exposed to reactor coolant	Cracking due to stress corrosion cracking, primary water stress corrosion cracking	Inservice Inspection (IWB, IWC, and IWD), and Water Chemistry	No	R-83
70	PWR	Stainless steel; steel with stainless steel cladding Class 1 piping, fittings and branch connections < NPS 4 exposed to reactor coolant	Cracking due to stress corrosion cracking, thermal and mechanical loading	Inservice Inspection (IWB, IWC, and IWD), Water chemistry, and One-Time Inspection of ASME Code Class 1 Small-bore Piping	No	R-02
71	PWR	High-strength low alloy steel closure head stud assembly exposed to air with reactor coolant leakage	Cracking due to stress corrosion cracking; loss of material due to wear	Reactor Head Closure Studs	No	R-71 R-72

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
72	PWR	Nickel alloy steam generator tubes and sleeves exposed to secondary feedwater/ steam	Cracking due to OD stress corrosion cracking and intergranular attack, loss of material due to fretting and wear	Steam Generator Tube Integrity and Water Chemistry	No	R-47 R-48 R-49
73	PWR	Nickel alloy steam generator tubes, repair sleeves, and tube plugs exposed to reactor coolant	Cracking due to primary water stress corrosion cracking	Steam Generator Tube Integrity and Water Chemistry	No	R-40 R-44
74	PWR	Chrome plated steel, stainless steel, nickel alloy steam generator anti-vibration bars exposed to secondary feedwater/ steam	Cracking due to stress corrosion cracking, loss of material due to crevice corrosion and fretting	Steam Generator Tube Integrity and Water Chemistry	No	RP-14 RP-15
75	PWR	Nickel alloy once-through steam generator tubes exposed to secondary feedwater/ steam	Denting due to corrosion of carbon steel tube support plate	Steam Generator Tube Integrity and Water Chemistry	No	R-226
76	PWR	Steel steam generator tube support plate, tube bundle wrapper exposed to secondary feedwater/steam	Loss of material due to erosion, general, pitting, and crevice corrosion, ligament cracking due to corrosion	Steam Generator Tube Integrity and Water Chemistry	No	R-42 RP-16
77	PWR	Nickel alloy steam generator tubes and sleeves exposed to phosphate chemistry in secondary feedwater/ steam	Loss of material due to wastage and pitting corrosion	Steam Generator Tube Integrity and Water Chemistry	No	R-50
78	PWR	Steel steam generator tube support lattice bars exposed to secondary feedwater/ steam	Wall thinning due to flow-accelerated corrosion	Steam Generator Tube Integrity and Water Chemistry	No	R-41

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
79	PWR	Nickel alloy steam generator tubes exposed to secondary feedwater/ steam	Denting due to corrosion of steel tube support plate	Steam Generator Tube Integrity; Water Chemistry and, for plants that could experience denting at the upper support plates, evaluate potential for rapidly propagating cracks and then develop and take corrective actions consistent with Bulletin 88-02.	No	R-43
80	PWR	Cast austenitic stainless steel reactor vessel internals (e.g., upper internals assembly, lower internal assembly, CEA shroud assemblies, control rod guide tube assembly, core support shield assembly, lower grid assembly)	Loss of fracture toughness due to thermal aging and neutron irradiation embrittlement	Thermal Aging and Neutron Irradiation Embrittlement of CASS	No	R-111 R-140 R-153 R-171 R-183 R-191 R-206
81	PWR	Nickel alloy or nickel-alloy clad steam generator divider plate exposed to reactor coolant	Cracking due to primary water stress corrosion cracking	Water Chemistry	No	RP-21
82	PWR	Stainless steel steam generator primary side divider plate exposed to reactor coolant	Cracking due to stress corrosion cracking	Water Chemistry	No	RP-17
83	PWR	Stainless steel; steel with nickel-alloy or stainless steel cladding; and nickel-alloy reactor vessel internals and reactor coolant pressure boundary components exposed to reactor coolant	Loss of material due to pitting and crevice corrosion	Water Chemistry	No	RP-23 RP-24 RP-28

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
84	PWR	Nickel alloy steam generator components such as, secondary side nozzles (vent, drain, and instrumentation) exposed to secondary feedwater/ steam	Cracking due to stress corrosion cracking	Water Chemistry and One-Time Inspection or Inservice Inspection (IWB, IWC, and IWD).	No	R-36
85	BWR/ PWR	Nickel alloy piping, piping components, and piping elements exposed to air – indoor uncontrolled (external)	None	None	NA - No AEM or AMP	RP-03
86	BWR/ PWR	Stainless steel piping, piping components, and piping elements exposed to air – indoor uncontrolled (External); air with borated water leakage; concrete; gas	None	None	NA - No AEM or AMP	RP-04 RP-05 RP-06 RP-07
87	BWR/ PWR	Steel piping, piping components, and piping elements in concrete	None	None	NA - No AEM or AMP	RP-01

Table 3.1-2 FSAR Supplement for Aging Management of Reactor Vessel, Internals, and Reactor Coolant System		
Program	**Description of Program**	**Implementation Schedule***
ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	The program consists of periodic volumetric, surface, and/or visual examination of components and their supports for assessment, signs of degradation, and corrective actions. This program is in accordance with ASME Section XI, 1995 edition through the 1996 addenda.	Existing program
Bolting Integrity	This program relies on recommendations for a comprehensive bolting integrity program, as delineated in NUREG-1339, and industry recommendations, as delineated in the Electric Power Research Institute (EPRI) NP-5769, with the exceptions noted in NUREG-1339 for safety-related bolting. The program relies on industry recommendations for a comprehensive bolting maintenance, as delineated in the EPRI TR-104213 for pressure retaining bolting and structural bolting. The program generally includes periodic inspection of closure bolting for indication of loss of preload, cracking, and loss of material due to corrosion, rust, etc. The program also includes preventive measures to preclude or minimize loss of preload and cracking. Other aging management programs, such as XI.M1, “ASME Section XI Inservice Inspection (ISI) Subsections IWB, IWC, and IWD” and XI.S3, “ASME Section XI Subsection IWF” also manage inspection of safety-related bolting and supplement this bolting integrity program. This program covers bolting within the scope of license renewal, including:1) safety-related bolting, 2) bolting for nuclear steam supply system (NSSS) component supports, 3) bolting for other pressure retaining components, including non-safety-related bolting, and 4) structural bolting. (actual measured yield strength $\geq$ 150 ksi).	Existing program
Boric Acid Corrosion	The program consists of (1) visual inspection of external surfaces that are potentially exposed to borated water leakage, (2) timely discovery of leak path and removal of the boric acid residues, (3) assessment of the damage, and (4) follow-up inspection for adequacy. This program is implemented in response to GL 88-05 and recent operating experience.	Existing program

Table 3.1-2 FSAR Supplement for Aging Management of Reactor Vessel, Internals, and Reactor Coolant System		
Program	**Description of Program**	**Implementation Schedule***
BWR Control Rod Drive Return Line Nozzle	The program monitors the effects of cracking on the intended function of the component by detection and sizing of cracks by ISI in accordance with the NUREG-0619 and alternative recommendation of GE NE-523-A71-0594. NUREG-0619 specifies UT of the entire nozzle and penetration testing (PT) of varying portions of the blend radius and bore. GE NE-523-A71-0594 specifies UT of specific regions of the blend radius and bore. UT techniques and personnel qualification are according to the guidelines of GE NE-523-A71-0594.	Program should be implemented before the period of extended operation.
BWR Feedwater Nozzle	This program includes (a) enhancing inservice inspection (ISI) specified in the American Society of Mechanical Engineers (ASME) Code, Section XI, with the recommendation of General Electric (GE) NE-523-A71-0594 to perform periodic ultrasonic testing inspection of critical regions of the BWR feedwater nozzle.	Existing program
BWR Penetrations	The program includes (a) inspection and flaw evaluation in conformance with the guidelines of staff-approved boiling water reactor vessel and internals project (BWRVIP)-49 and BWRVIP-27 documents and (b) monitoring and control of reactor coolant water chemistry in accordance with the guidelines of BWRVIP-29 (EPRI TR-103515) to ensure the long-term integrity and safe operation of boiling water reactor (BWR) vessel internal components.	Existing program
BWR Stress Corrosion Cracking	The program to manage intergranular stress corrosion cracking (IGSCC) in boiling water reactor (BWR) coolant pressure boundary piping made of stainless steel (SS) is delineated in NUREG-0313, Rev. 2, and Nuclear Regulatory Commission (NRC) Generic Letter (GL) 88-01 and its Supplement 1. The program includes (a) preventive measures to mitigate IGSCC and (b) inspections to monitor IGSCC and its effects.	Existing program
BWR Vessel ID Attachment Welds	The program includes (a) inspection and flaw evaluation in conformance with the guidelines of staff-approved boiling water reactor vessel and internals project (BWRVIP) -48 and (b) monitoring and control of reactor coolant water chemistry in accordance with the guidelines of BWRVIP-29 (EPRI TR-103515).	Existing program

Table 3.1-2 FSAR Supplement for Aging Management of Reactor Vessel, Internals, and Reactor Coolant System		
Program	**Description of Program**	**Implementation Schedule***
BWR Vessel Internals	The program includes (a) inspection and flaw evaluation in conformance with the guidelines of applicable and staff-approved boiling water reactor vessel and internals project (BWRVIP) documents and (b) monitoring and control of reactor coolant water chemistry in accordance with the guidelines of BWRVIP-29 (EPRI TR-103515) to ensure the long-term integrity and safe operation of boiling water reactor (BWR) vessel internal components.	Existing program
Closed-Cycle Cooling Water System	The program relies on preventive measures to minimize corrosion and SCC by maintaining inhibitors and by performing non-chemistry monitoring consisting of inspection and nondestructive evaluations based on the guidelines of EPRI-TR-107396 for closed–cycle cooling water systems.	
Flow-Accelerated Corrosion	The program consists of the following: (1) conduct appropriate analysis and baseline inspection, (2) determine extent of thinning and replace/repair components, and (3) perform follow up inspections to confirm or quantify and take longer-term corrective actions. This program is in response to NRC GL 89-08.	Existing program
Flux Thimble Tube Inspection	This inspection program is used to monitor for thinning of the flux thimble tube walls, which provide a path for the incore neutron flux monitoring system detectors and which form part of the reactor coolant pressure boundary. This program implements the recommendations of NRC Bulletin 88 09, "Thimble Tube Thinning in Westinghouse Reactors." The program includes: (1) specific augmented inspections using eddy current testing or other applicant-justified and NRC-accepted inspection techniques for detecting wear in flux detector thimble tubes, (2) bases for establishing a base-line monitoring frequency for the augmented examinations of the flux detector thimble tubes based on the applicant's response to NRC Bulletin 88-09 and bases for amending the monitoring frequency based on actual plant-specific thimble tube wear rate results, (3) specific flaw evaluation acceptance criteria to be used if loss of material by wear is detected in the flux detector thimble tubes and (4) specific corrective actions to be taken if the acceptance criteria for detected indications are exceeded.	Existing Program

Table 3.1-2 FSAR Supplement for Aging Management of Reactor Vessel, Internals, and Reactor Coolant System		
Program	**Description of Program**	**Implementation Schedule***
Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors	This program is established to ensure that augmented inservice inspections (ISI) of all nickel-alloy vessel head penetration (VHP) nozzles welded to the upper reactor vessel (RV) head of a PWR-designed light-water reactor will continue to be performed as mandated by the interim requirements in Order EA-03-009, "Issuance of Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors," as amended by the First Revision of the Order, or by any subsequent NRC requirements that may be established to supersede the requirements of Order EA-03-009. The program is focused on managing the effects of cracking due to PWSCC of the nickel-alloy used in the fabrication of the upper VHP nozzles at PWR-designed nuclear facilities. The scope of this AMP is limited to upper VHP nozzles, including control rod drive mechanism (CRDM) nozzles, control element drive mechanism (CEDM) nozzles, thermocouples (TC) nozzles, in-core instrumentation (ICI) nozzles, and vent line nozzles; associated J-groove welds; and the adjoining upper RV closure head. The program includes: (1) a primary water stress corrosion cracking susceptibility assessment to rank the upper VHP nozzles according to the ranking criteria in the First Revised Order EA-03-009 for "Low," "Moderate," "High," and "Replaced" ranking categories, (2) specific augmented inspection techniques and monitoring frequencies for performing augmented inspections of the upper VHP nozzles and upper reactor vessel heads, as defined in the First Revised Order EA-03-009 and based on the susceptible ranking category for the VHP nozzles, (3) specific flaw evaluation acceptance criteria to be used if cracking or loss of material is detected in the VHP nozzles or upper reactor vessel heads, and (4) specific corrective actions to be taken if the acceptance criteria for detected indications are exceeded.	Existing program
One-Time Inspection	This program verifies the effectiveness of other aging management programs by determining if the aging effect is not occurring or the aging effect is progressing slowly so that the intended function will be maintained during the period of extended operation.	Inspection should be completed before the period of extended operation.

Table 3.1-2 FSAR Supplement for Aging Management of Reactor Vessel, Internals, and Reactor Coolant System		
Program	**Description of Program**	**Implementation Schedule***
One-time Inspection of ASME Code Class 1 Small Bore-Piping	This program is a one-time volumetric inspection of a sample of ASME Code Class 1 piping less than NPS 4. The program includes measures to verify that degradation is not occurring, thereby either confirming that there is no need to manage aging-related degradation or validating the effectiveness of any existing program for the period of extended operation. The one-time inspection program for ASME Code Class 1 small-bore piping includes locations that are susceptible to cracking. This program is applicable only to plants that have not experienced cracking of ASME Code Class 1 small-bore piping resulting from stress corrosion or thermal fatigue. Should evidence of significant aging be revealed by a one-time inspection or previous operating experience, periodic inspection will be proposed, as managed by a plant-specific program.	The inspection should be completed before the period of extended operation
Plant-specific AMP	The description should contain information associated with the basis for determining that aging effects will be managed during the period of extended operation.	Program should be implemented before the period of extended operation.
Reactor Head Closure Studs	This program includes inservice inspection ISI. For boiling water reactors (BWRs), this program also includes additional preventive actions and inspection techniques.	Existing program
Reactor Vessel Surveillance	This program, extending the scope of 10 CFR Part 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements" provides sufficient material data and dosimetry to monitor irradiation embrittlement at the end of the period of extended operation, and to determine the need for operating restrictions on the inlet temperature, neutron spectrum, and neutron flux. If surveillance capsules are not withdrawn during the period of extended operation, operating restrictions are to be established to ensure that the plant is operated under the conditions to which the surveillance capsules were exposed. All capsules in the reactor vessel that are removed and tested must meet the test procedures and reporting requirements of ASTM E 185-82 to the extent practicable for the configuration of the specimens in the capsule. Any changes to the capsule withdrawal schedule, including spare capsules, must be approved by the NRC prior to implementation. Untested capsules placed in storage must be maintained for future insertion.	The surveillance capsule withdrawal schedule should be revised before the period of extended operation.

Table 3.1-2 FSAR Supplement for Aging Management of Reactor Vessel, Internals, and Reactor Coolant System		
Program	**Description of Program**	**Implementation Schedule***
Selective Leaching of Materials	The program includes a hardness measurement of selected components that may be susceptible to selective leaching to determine whether loss of materials is occurring and whether the process will affect the ability of the components to perform their intended function for the period of extended operation. For systems subjected to environments where water is not treated (i.e., the open-cycle cooling water system and the ultimate heat sinks), the program also follows the guidance in NRC GL 89-13.	Program should be implemented before the period of extended operation.
Steam Generator Tube Integrity	This program consists of SG inspection scope, frequency, acceptance criteria for the plugging and repair of flawed tubes in accordance with the plant technical specifications and includes commitments to NEI 97-06.	Existing program
Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)	The program consists of (1) determination of the susceptibility of cast austenitic stainless steel components to thermal aging embrittlement, (2) accounting for the synergistic effects of thermal aging and neutron irradiation, and (3) implementing a supplemental examination program, as necessary.	Program should be implemented before the period of extended operation.
Thermal Aging of Cast Austenitic Stainless Steel (CASS)	This program includes (a) determination of the susceptibility of cast austenitic stainless steel components to thermal aging embrittlement and (b) for potentially susceptible components aging management is accomplished through either enhanced volumetric examination or plant- or component-specific flaw tolerance evaluation.	Existing program
Water Chemistry	To mitigate aging effects on component surfaces that are exposed to water as process fluid, chemistry programs are used to control water chemistry for impurities (e.g., chloride, fluoride, and sulfate) that accelerate corrosion. This program relies on monitoring and control of water chemistry to keep peak levels of various contaminants below the system-specific limits based on EPRI guidelines.	Existing program

* An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

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3.2 AGING MANAGEMENT OF ENGINEERED SAFETY FEATURES

Review Responsibilities

Primary- Branch assigned responsibility by PM as described in SRP-LR Section 3.0 of this SRP-LR.

3.2.1 Areas of Review

This section addresses the aging management review (AMR) and the associated aging management program (AMP) of the engineered safety features. For a recent vintage plant, the information related to the engineered safety features is contained in Chapter 6, "Engineered Safety Features," of the plant's FSAR, consistent with the "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG-0800). The engineered safety features contained in this review plan section are generally consistent with those contained in NUREG-0800 except for the refueling water, control room habitability, and residual heat removal systems. For older plants, the location of applicable information is plant-specific because an older plant's Final Safety analysis Report (FSAR) may have predated NUREG-0800.

The engineered safety features consist of containment spray, standby gas treatment [Boiling Water Reactors (BWRs)], containment isolation components, and emergency core cooling systems.

The responsible review organization is to review the following license renewal application (LRA) AMR and AMP items assigned to it, per SRP-LR Section 3.0:

AMRs

- AMR results consistent with the GALL Report
- AMR results for which further evaluation is recommended by the GALL Report
- AMRs results not consistent with or not addressed in the GALL Report

AMPs

- Consistent with GALL Report AMPs
- Plant-specific AMPs

FSAR Supplement

- The responsible review organization is to review the FSAR Supplement associated with each assigned AMP.

3.2.2 Acceptance Criteria

The acceptance criteria for the areas of review describe methods for determining whether the applicant has met the requirements of the NRC's regulations in 10 CFR 54.21.

3.2.2.1 AMR Results Consistent with the GALL Report

The AMR and the AMPs applicable to the engineered safety features are described and evaluated in Chapter V of NUREG-1801 (GALL Report).

The applicant's LRA should provide sufficient information so that the NRC reviewer is able to confirm that the specific LRA AMR line-item and the associated LRA AMP are consistent with the cited GALL Report AMR line-item. The reviewer should then confirm that the LRA AMR line-item is consistent with the GALL Report AMR line-item to which it is compared.

For AMPs, if the applicant identifies an exception to any of the program elements of the cited GALL Report AMP, the LRA AMP should include a basis demonstrating how the criteria of 10 CFR 54.21(a)(3) would still be met. The NRC reviewer should then confirm that the LRA AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the LRA AMP, the reviewer identifies a difference from the GALL Report AMP that should have been identified as an exception to the GALL Report AMP, this difference should be reviewed and properly dispositioned. The reviewer should document the disposition of all LRA-defined exceptions and staff-identified differences.

The LRA should identify any enhancements that are needed to permit an existing AMP to be declared consistent with the GALL Report AMP to which the LRA AMP is compared. The reviewer is to confirm both that the enhancement, when implemented, would allow the existing plant AMP to be consistent with the GALL Report AMP and also that the applicant has a commitment in the FSAR Supplement to implement the enhancement prior to the period of extended operation. The reviewer should review and document the disposition of all enhancements.

3.2.2.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

The basic acceptance criteria defined in Subsection 3.2.2.1 apply to all of the AMRs and AMPs reviewed as part of this section. In addition, if the GALL Report AMR line-item to which the LRA AMR line-item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL Report for each of the following aging effect/aging mechanism combinations.

3.2.2.2.1 Cumulative Fatigue Damage

Fatigue is a time-limited aging analysis (TLAA) as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). This TLAA is addressed separately in Section 4.3, "Metal Fatigue Analysis" of this SRP-LR.

3.2.2.2.2 Loss of Material due to Cladding

Loss of material due to cladding breach could occur for PWR steel pump casings with stainless steel cladding exposed to treated borated water. The GALL Report references NRC Information Notice 94-63, Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks, and recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.2.2.2.3 Loss of Material due to Pitting and Crevice Corrosion

1. Loss of material due to pitting and crevice corrosion could occur for internal surfaces of stainless steel containment isolation piping, piping components, and piping elements exposed to treated water. The existing AMP relies on monitoring and control of water chemistry to mitigate degradation. However, control of water chemistry does not preclude

loss of material due to pitting and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

2. Loss of material from pitting and crevice corrosion could occur for stainless steel piping, piping components, and piping elements exposed to soil. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of this SRP-LR).

3. Loss of material from pitting and crevice corrosion could occur for BWR stainless steel and aluminum piping, piping components, and piping elements exposed to treated water. The existing AMP relies on monitoring and control of water chemistry for BWRs to mitigate degradation. However, control of water chemistry does not preclude loss of material due to pitting and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the water chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

4. Loss of material from pitting and crevice corrosion could occur for stainless steel and copper alloy piping, piping components, and piping elements exposed to lubricating oil. The existing program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation to verify the effectiveness of the lubricating oil program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

5. Loss of material from pitting and crevice corrosion could occur for of partially encased stainless steel tanks exposed to raw water due to cracking of the perimeter seal from weathering. The GALL Report recommends further evaluation to ensure that the aging effect is adequately managed. The GALL Report recommends that a plant-specific AMP be evaluated because moisture and water can egress under the tank if the perimeter seal is degraded. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of this SRP-LR).

6. Loss of material from pitting and crevice corrosion could occur for stainless steel piping, piping components, piping elements, and tanks exposed to internal condensation. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of this SRP-LR).

3.2.2.2.4 Reduction of Heat Transfer due to Fouling

1. Reduction of heat transfer due to fouling could occur for steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil. The existing AMP relies on monitoring and control of lube oil chemistry to mitigate reduction of heat transfer due to fouling. However, control of lube oil chemistry may not always have been adequate to preclude fouling. Therefore, the effectiveness of lube oil chemistry control should be verified to ensure that fouling is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of lube oil chemistry control. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

2. Reduction of heat transfer due to fouling could occur for stainless steel heat exchanger tubes exposed to treated water. The existing program relies on control of water chemistry to manage reduction of heat transfer due to fouling. However, control of water chemistry may have been inadequate. Therefore, the GALL report recommends that the effectiveness of the chemistry control program should be verified to ensure that reduction of heat transfer due to fouling is not occurring. A one-time inspection is an acceptable method to ensure that reduction of heat transfer is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.2.2.2.5 Hardening and Loss of Strength due to Elastomer Degradation

Hardening and loss of strength due to elastomer degradation could occur in elastomer seals and components associated with the BWR Standby Gas Treatment System ductwork and filters exposed to air-indoor uncontrolled. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of this SRP-LR).

3.2.2.2.6 Loss of Material due to Erosion

Loss of material due to erosion could occur in the stainless steel high pressure safety injection (HPSI) pump miniflow recirculation orifice exposed to treated borated water. The GALL Report recommends a plant-specific AMP be evaluated for erosion of the orifice due to extended use of the centrifugal HPSI pump for normal charging. The GALL Report references Licensee Event Report (LER) 50-275/94-023 for evidence of erosion. Further evaluation is recommended to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of this SRP-LR).

3.2.2.2.7 Loss of Material due to General Corrosion and Fouling

Loss of material due to general corrosion and fouling can occur for steel drywell and suppression chamber spray system nozzle and flow orifice internal surfaces exposed to air - indoor uncontrolled. This could result in plugging of the spray nozzles and flow orifices. This aging mechanism and effect will apply since the spray nozzles and flow orifices are occasionally wetted, even though the majority of the time this system is on standby. The wetting and drying of these components can accelerate corrosion and fouling. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of this SRP-LR).

3.2.2.2.8 Loss of material due to General, Pitting, and Crevice Corrosion

1. Loss of material due to general, pitting and crevice corrosion could occur for BWR steel piping, piping components, and piping elements exposed to treated water. The existing AMP relies on monitoring and control of water chemistry) for BWRs to mitigate degradation. However, control of water chemistry does not preclude loss of material due to general, pitting, and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the water chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component’s intended function will be maintained during the period of extended operation.

2. Loss of material due to general, pitting and crevice corrosion could occur for the internal surfaces of steel containment isolation piping, piping components, and piping elements exposed to treated water. The existing AMP relies on monitoring and control of water chemistry to mitigate degradation. However, control of water chemistry does not preclude loss of material due to general, pitting, and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component’s intended function will be maintained during the period of extended operation.

3. Loss of material due to general, pitting and crevice corrosion could occur for steel piping, piping components, and piping elements exposed to lubricating oil. The existing program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation to verify the effectiveness of the lubricating oil program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component’s intended function will be maintained during the period of extended operation.

3.2.2.2.9 Loss of material due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion (MIC)

Loss of material due to general, pitting, crevice, and MIC could occur for steel (with or without coating or wrapping) piping, piping components, and piping elements buried in soil. The buried piping and tanks inspection program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general, pitting, and crevice corrosion and MIC. The effectiveness of the buried piping and tanks inspection program should be verified to evaluate an applicant's inspection frequency and operating experience with buried components, ensuring that loss of material is not occurring.

3.2.2.2.10 Quality Assurance for Aging Management of Nonsafety-Related Components

Acceptance criteria are described in Branch Technical Position IQMB-1 (Appendix A.2 of this SRP-LR.)

3.2.2.3 AMR Results Not Consistent with or Not Addressed in GALL Report

Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of this SRP-LR).

3.2.2.4 FSAR Supplement

The summary description of the programs and activities for managing the effects of aging for the period of extended operation in the FSAR Supplement should be sufficiently comprehensive such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the bases for determining that aging effects will be managed during the period of extended operation. The description should also contain any future aging management activities, including enhancements and commitments, to be completed before the period of extended operation. Examples of the type of information to be included are provided in Table 3.2-2 of this SRP-LR.

3.2.3 Review Procedures

For each area of review, the following review procedures are to be followed:

3.2.3.1 AMR Results Consistent with the GALL Report

The applicant may reference the GALL Report in its LRA, as appropriate, and demonstrate that the AMRs and AMPs at its facility are consistent with those reviewed and approved in the GALL Report. The reviewer should not conduct a re-review of the substance of the matters described in the GALL Report. If the applicant has provided the information necessary to adopt the finding of program acceptability as described and evaluated in the GALL Report, the reviewer should find acceptable the applicant’s reference to the GALL Report in its LRA. In making this determination, the reviewer confirms that the applicant has provided a brief description of the system, components, materials, and environment. The reviewer also confirms that the applicant has stated that the applicable aging effects and industry and plant-specific operating experience have been reviewed by the applicant and are evaluated in the GALL Report.

Furthermore, the reviewer should confirm that the applicant has addressed operating experience identified after the issuance of the GALL Report. Performance of this review requires the reviewer to confirm that the applicant has identified those aging effects for the engineered safety features system components that are contained in the GALL Report as applicable to its plant.

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL Report. If the applicant commits to an enhancement to make its LRA AMP consistent with a GALL Report AMP, then the reviewer is to confirm that this enhancement, when implemented, will make the LRA AMP consistent with the GALL Report AMP. If the applicant identifies, in the LRA AMP, an exception to any of the program elements of the GALL Report AMP with which the applicant is claiming to be consistent, the reviewer is to confirm that the LRA AMP with the exception will satisfy the criteria of 10 CFR 54.21(a)(3). If the reviewer identifies a difference, not identified by the LRA, between the LRA AMP and the GALL Report AMP, with which the LRA claims to be consistent, the reviewer should confirm that the LRA AMP with this difference satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions or differences. The AMPs evaluated in the GALL Report pertinent to the engineered safety features components are summarized in Table 3.2-1 of this SRP-LR. In this table, the ID column provides a row identifier useful in matching the information presented in the corresponding table in the GALL Report, Vol. 1. The Related Item column identifies the item number in the GALL Report, Vol. 2, Chapters II through VIII, presenting detailed information summarized by this row.

3.2.3.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

The basic review procedures defined in Subsection 3.2.3.1 apply to all of the AMRs and AMPs provided in this section. In addition, if the GALL Report AMR line-item to which the LRA AMR line-item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL Report for each of the following aging effect/aging mechanism combinations.

3.2.3.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The staff reviews the evaluation of this TLAA separately, following the guidance in Section 4.3 of this SRP-LR.

3.2.3.2.2 Loss of Material due to Cladding Breach

The GALL Report recommends further evaluation of programs to manage loss of material due to cladding breach for PWR steel charging pump casings with stainless steel cladding. The GALL Report references NRC Information Notice 94-63, Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks, and recommends further evaluation of a plant-specific program to ensure that the aging effect is adequately managed. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of general corrosion of these components.

3.2.3.2.3 Loss of Material due to Pitting and Crevice Corrosion

1. The GALL Report recommends further evaluation of programs to manage the loss of material due to pitting and crevice corrosion for the internal surfaces of stainless steel containment isolation piping, piping components, and piping elements exposed to treated water to verify the effectiveness of the chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to determine whether corrosion is not occurring or the corrosion is progressing very slowly so that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The inspection techniques may include visual, ultrasonic, and surface examination techniques. Follow-up actions are to be based on the inspection results.

2. The GALL Report recommends further evaluation of programs to manage the loss of material due to pitting and crevice corrosion for stainless steel components exposed to soil, raw water, or internal condensation. The GALL Report specifically recommends that the program address the bottom of partially encased stainless steel tanks because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of Loss of material due to pitting and crevice corrosion of these components.

3. The GALL Report recommends further evaluation of programs to manage the loss of material due to pitting and crevice corrosion for stainless steel and aluminum piping, piping components, and piping elements exposed to treated water to verify the effectiveness of the chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to determine whether corrosion is not occurring or the corrosion is progressing very slowly so that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques. Follow-up actions are to be based on the inspection results.

4. The GALL Report recommends further evaluation of programs to manage the loss of material due to pitting and crevice corrosion of stainless steel and copper alloy piping, piping components, and piping elements exposed to lubricating oil. The existing program relies on monitoring and control of lubricating oil contamination to maintain contaminants within acceptable limits. The effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to determine whether corrosion is not occurring or the corrosion is progressing very slowly so that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques. Follow-up actions are to be based on the inspection results.

3.2.3.2.4 Reduction of Heat Transfer due to Fouling

1. The GALL Report recommends further evaluation of programs to manage reduction of heat transfer due to fouling for steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil to verify the effectiveness of lube oil chemistry control. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to determine whether fouling is not occurring or is progressing very slowly so that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components at susceptible locations to ensure that fouling is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques. Follow-up actions are to be based on the inspection results.

2. The GALL report recommends further evaluation of programs to verify the effectiveness of control of water chemistry to manage reduction of heat transfer due to fouling for stainless steel heat exchanger tubes exposed to treated water on either side.

   The reviewer reviews the applicant's proposed program to ensure that fouling is not occurring and that the component's intended function will be maintained during the period of extended operation. If the applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques. Follow-up actions are to be based on the inspection results.

3.2.3.2.5 Hardening and Loss of Strength due to Elastomer Degradation

The GALL Report recommends further evaluation of programs to manage changes in properties due to degradation of elastomer seals and components associated with BWR standby gas treatment system ductwork and filters. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place to manage changes in properties due to degradation of elastomer seals and components in the standby gas treatment system.

3.2.3.2.6 Loss of Material due to Erosion

The GALL Report recommends further evaluation of programs to manage loss of material due to erosion of the stainless steel high pressure safety injection pump miniflow orifice. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place to manage this aging effect.

3.2.3.2.7 Loss of Material due to General Corrosion and Fouling

The GALL Report recommends further evaluation of programs to manage loss of material due to general corrosion and fouling for steel drywell and suppression chamber spray system spray nozzles and orifices exposed to air - indoor uncontrolled. This is necessary to prevent the plugging of spray nozzles and spargers of the BWR drywell and suppression chamber spray system. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of loss of material due to general corrosion and fouling of these components.

3.2.3.2.8 Loss of Material due to General, Pitting, and Crevice Corrosion

1. The GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion for BWR steel piping, piping components, and piping elements exposed to treated water to verify the effectiveness of the chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to determine whether corrosion is not occurring or the corrosion is progressing very slowly so that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques. Follow-up actions are to be based on the inspection results.

2. The GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion for the internal surfaces of steel containment isolation piping, piping components, and piping elements exposed to treated water to verify the effectiveness of the chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to determine whether corrosion is not occurring or the corrosion is progressing very slowly so that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques. Follow-up actions are to be based on the inspection results.

3. The GALL Report recommends further evaluation of programs to manage the loss of material due to general, pitting, and crevice corrosion of steel piping, piping components,

and piping elements exposed to lubricating oil. The existing program relies on monitoring and control of lubricating oil contamination to maintain contaminants within acceptable limits. The effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

The reviewer reviews the applicant's proposed program to determine whether corrosion is not occurring or the corrosion is progressing very slowly so that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques. Follow-up actions are to be based on the inspection results.

3.2.3.2.9 Loss of Material due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion

The GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, crevice, and MIC of the external surfaces of buried steel (with or without coating or wrapping) piping, piping components, and piping elements to verify the effectiveness of the buried piping and tanks inspection program. The buried piping and tanks inspection program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general, pitting, and crevice corrosion and MIC. The effectiveness of the buried piping and tanks inspection program should be verified to evaluate an applicant's inspection frequency and operating experience with buried components, ensuring that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.2.3.2.10 Quality Assurance for Aging Management of Nonsafety-Related Components

The applicant's AMPs for license renewal should contain the elements of corrective actions, the confirmation process, and administrative controls. Safety-related components are covered by 10 CFR Part 50, Appendix B, which is adequate to address these program elements. However, Appendix B does not apply to nonsafety-related components that are subject to an aging management review for license renewal. Nevertheless, the applicant has the option to expand the scope of its 10 CFR Part 50, Appendix B program to include these components and address the associated program elements. If the applicant chooses this option, the reviewer verifies that the applicant has documented such a commitment in the FSAR Supplement. If the applicant chooses alternative means, the branch responsible for quality assurance should be requested to review the applicant's proposal on a case-by-case basis.

3.2.3.3 AMR Results Not Consistent with or Not Addressed in the GALL Report

The reviewer should confirm that the applicant, in its LRA, has identified applicable aging effects, listed the appropriate combination of materials and environments, and AMPs that will adequately manage the aging effects. The AMP credited by the applicant could be an AMP that is described and evaluated in the GALL Report or a plant-specific program. Review procedures are described in Branch Technical Position RSLB-1 (Appendix A.1 of this SRP-LR).

3.2.3.4 FSAR Supplement

The reviewer confirms that the applicant has provided information equivalent to that in Table 3.2-2 in the FSAR Supplement for aging management of the engineered safety features for license renewal. The reviewer also confirms that the applicant has provided information equivalent to that in Table 3.2-2 in the FSAR Supplement for Section 3.2.3.3, "AMR Results Not Consistent with or Not Addressed in the GALL Report."

The staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR Supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR Supplement without prior NRC approval, provided that the applicant evaluates each such change and finds it acceptable pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR supplement before the license is renewed, no condition will be necessary.

As noted in Table 3.2-2, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should confirm that the applicant has identified and committed in the LRA to any future aging management activities, including enhancements and commitments, to be completed before entering the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.2.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of this section, then an evaluation finding similar to the following text should be included in the staff's safety evaluation report:

> On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated that the aging effects associated with the engineered safety features systems components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).
>
> The staff also reviewed the applicable FSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of the engineered safety features systems, as required by 10 CFR 54.21(d).

3.2.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

3.2.6 References

1. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, July 1981.

2. NUREG-1801, "Generic Aging Lessons Learned (GALL)," U.S. Nuclear Regulatory Commission, Revision 1, September 2005.

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
1	BWR/ PWR	Steel and stainless steel piping, piping components, and piping elements in emergency core cooling system	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (See subsection 3.2.2.2.1)	E-10 E-13
2	PWR	Steel with stainless steel cladding pump casing exposed to treated borated water	Loss of material due to cladding breach	A plant-specific aging management program is to be evaluated. Reference NRC Information Notice 94-63, “Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks"	Yes, verify that plant-specific program addresses cladding breach (See subsection 3.2.2.2.2)	EP-49
3	BWR/ PWR	Stainless steel containment isolation piping and components internal surfaces exposed to treated water	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.2.2.2.3.1)	E-33
4	BWR/ PWR	Stainless steel piping, piping components, and piping elements exposed to soil	Loss of material due to pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant-specific (See subsection 3.2.2.2.3.2)	EP-31
5	BWR	Stainless steel and aluminum piping, piping components, and piping elements exposed to treated water	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.2.2.2.3.3)	EP-26 EP-32

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
6	BWR/ PWR	Stainless steel and copper alloy piping, piping components, and piping elements exposed to lubricating oil	Loss of material due to pitting and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.2.2.2.3.4)	EP-45 EP-51
7	BWR/ PWR	Partially encased stainless steel tanks with breached moisture barrier exposed to raw water	Loss of material due to pitting and crevice corrosion	A plant-specific aging management program is to be evaluated for pitting and crevice corrosion of tank bottoms because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering.	Yes, plant-specific (See subsection 3.2.2.2.3.5)	E-01
8	BWR/ PWR	Stainless steel piping, piping components, piping elements, and tank internal surfaces exposed to condensation (internal)	Loss of material due to pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant-specific (See subsection 3.2.2.2.3.6)	E-14 EP-53
9	BWR/ PWR	Steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil	Reduction of heat transfer due to fouling	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.2.2.2.4.1)	EP-40 EP-47 EP-50
10	BWR/ PWR	Stainless steel heat exchanger tubes exposed to treated water	Reduction of heat transfer due to fouling	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.2.2.2.4.2)	EP-34

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL Report						
ID	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Related Item**
11	BWR	Elastomer seals and components in standby gas treatment system exposed to air - indoor uncontrolled	Hardening and loss of strength due to elastomer degradation	A plant-specific aging management program is to be evaluated.	Yes, plant-specific (See subsection 3.2.2.2.5)	E-06
12	PWR	Stainless steel high-pressure safety injection (charging) pump miniflow orifice exposed to treated borated water	Loss of material due to erosion	A plant-specific aging management program is to be evaluated for erosion of the orifice due to extended use of the centrifugal HPSI pump for normal charging.	Yes, plant-specific (See subsection 3.2.2.2.6)	E-24
13	BWR	Steel drywell and suppression chamber spray system nozzle and flow orifice internal surfaces exposed to air - indoor uncontrolled (internal)	Loss of material due to general corrosion and fouling	A plant-specific aging management program is to be evaluated.	Yes, plant-specific (See subsection 3.2.2.2.7)	E-04
14	BWR	Steel piping, piping components, and piping elements exposed to treated water	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.2.2.2.8.1)	E-08
15	BWR/ PWR	Steel containment isolation piping, piping components, and piping elements internal surfaces exposed to treated water	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.2.2.2.8.2)	E-31
16	BWR/ PWR	Steel piping, piping components, and piping elements exposed to lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.2.2.2.8.3)	EP-46

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
17	BWR/ PWR	Steel (with or without coating or wrapping) piping, piping components, and piping elements buried in soil	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	No Yes, detection of aging effects and operating experience are to be further evaluated (See subsection 3.2.2.2.9)	E-42
18	BWR	Stainless steel piping, piping components, and piping elements exposed to treated water >60°C (>140°F)	Cracking due to stress corrosion cracking and intergranular stress corrosion cracking	BWR Stress Corrosion Cracking and Water Chemistry	No	E-37
19	BWR	Steel piping, piping components, and piping elements exposed to steam or treated water	Wall thinning due to flow-accelerated corrosion	Flow-Accelerated Corrosion	No	E-07 E-09
20	BWR	Cast austenitic stainless steel piping, piping components, and piping elements exposed to treated water (borated or unborated) >250°C (>482°F)	Loss of fracture toughness due to thermal aging embrittlement	Thermal Aging Embrittlement of CASS	No	E-11
21	BWR/ PWR	High-strength steel closure bolting exposed to air with steam or water leakage	Cracking due to cyclic loading, stress corrosion cracking	Bolting Integrity	No	E-03

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
22	BWR/ PWR	Steel closure bolting exposed to air with steam or water leakage	Loss of material due to general corrosion	Bolting Integrity	No	E-02
23	BWR/ PWR	Steel bolting and closure bolting exposed to air – outdoor (external), or air – indoor uncontrolled (external)	Loss of material due to general, pitting, and crevice corrosion	Bolting Integrity	No	EP-1 EP-25
24	BWR/ PWR	Steel closure bolting exposed to air – indoor uncontrolled (external)	Loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	No	EP-24
25	BWR/ PWR	Stainless steel piping, piping components, and piping elements exposed to closed cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	Closed-Cycle Cooling Water System	No	EP-44
26	BWR/ PWR	Steel piping, piping components, and piping elements exposed to closed cycle cooling water	Loss of material due to general, pitting, and crevice corrosion	Closed-Cycle Cooling Water System	No	EP-48
27	BWR/ PWR	Steel heat exchanger components exposed to closed cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	E-17

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL Report						
ID	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Related Item**
28	BWR/ PWR	Stainless steel piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water	Loss of material due to pitting and crevice corrosion	Closed-Cycle Cooling Water System	No	E-19 EP-33
29	BWR/ PWR	Copper alloy piping, piping components, piping elements, and heat exchanger components exposed to closed cycle cooling water	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	EP-13 EP-36
30	BWR/ PWR	Stainless steel and copper alloy heat exchanger tubes exposed to closed cycle cooling water	Reduction of heat transfer due to fouling	Closed-Cycle Cooling Water System	No	EP-35 EP-39
31	BWR/ PWR	External surfaces of steel components including ducting, piping, ducting closure bolting, and containment isolation piping external surfaces exposed to air - indoor uncontrolled (external); condensation (external) and air - outdoor (external)	Loss of material due to general corrosion	External Surfaces Monitoring	No	E-26 E-30 E-35 E-40 E-44 E-45 E-46
32	BWR/ PWR	Steel piping and ducting components and internal surfaces exposed to air – indoor uncontrolled (Internal)	Loss of material due to general corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	E-25 E-29

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL Report						
ID	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Related Item**
33	BWR/ PWR	Steel encapsulation components exposed to air-indoor uncontrolled (internal)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	EP-42
34	BWR/ PWR	Steel piping, piping components, and piping elements exposed to condensation (internal)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	E-27
35	BWR/ PWR	Steel containment isolation piping and components internal surfaces exposed to raw water	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, and fouling	Open-Cycle Cooling Water System	No	E-22
36	BWR/ PWR	Steel heat exchanger components exposed to raw water	Loss of material due to general, pitting, crevice, galvanic, and microbiologically-influenced corrosion, and fouling	Open-Cycle Cooling Water System	No	E-18
37	BWR/ PWR	Stainless steel piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Open-Cycle Cooling Water System	No	EP-55

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL Report						
ID	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Related Item**
38	BWR/ PWR	Stainless steel containment isolation piping and components internal surfaces exposed to raw water	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion, and fouling	Open-Cycle Cooling Water System	No	E-34
39	BWR/ PWR	Stainless steel heat exchanger components exposed to raw water	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion, and fouling	Open-Cycle Cooling Water System	No	E-20
40	BWR/ PWR	Steel and stainless steel heat exchanger tubes (serviced by open-cycle cooling water) exposed to raw water	Reduction of heat transfer due to fouling	Open-Cycle Cooling Water System	No	E-21 E-23
41	BWR/ PWR	Copper alloy >15% Zn piping, piping components, piping elements, and heat exchanger components exposed to closed cycle cooling water	Loss of material due to selective leaching	Selective Leaching of Materials	No	EP-27 EP-37
42	BWR/ PWR	Gray cast iron piping, piping components, piping elements exposed to closed-cycle cooling water	Loss of material due to selective leaching	Selective Leaching of Materials	No	EP-52

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
43	BWR/ PWR	Gray cast iron piping, piping components, and piping elements exposed to soil	Loss of material due to selective leaching	Selective Leaching of Materials	No	EP-54
44	BWR/ PWR	Gray cast iron motor cooler exposed to treated water	Loss of material due to selective leaching	Selective Leaching of Materials	No	E-43
45	PWR	Aluminum, copper alloy >15% Zn, and steel external surfaces, bolting, and piping, piping components, and piping elements exposed to air with borated water leakage	Loss of material due to Boric acid corrosion	Boric Acid Corrosion	No	E-28 E-41 EP-2 EP-38
46	PWR	Steel encapsulation components exposed to air with borated water leakage (internal)	Loss of material due to general, pitting, crevice and boric acid corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	EP-43
47	PWR	Cast austenitic stainless steel piping, piping components, and piping elements exposed to treated borated water >250°C (>482°F)	Loss of fracture toughness due to thermal aging embrittlement	Thermal Aging Embrittlement of CASS	No	E-47

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL Report						
ID	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Related Item**
48	PWR	Stainless steel or stainless-steel-clad steel piping, piping components, piping elements, and tanks (including safety injection tanks/accumulators) exposed to treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Water Chemistry	No	E-12 E-38
49	PWR	Stainless steel piping, piping components, piping elements, and tanks exposed to treated borated water	Loss of material due to pitting and crevice corrosion	Water Chemistry	No	EP-41
50	BWR/ PWR	Aluminum piping, piping components, and piping elements exposed to air- indoor uncontrolled (internal/external)	None	None	NA - No AEM or AMP	EP-3
51	BWR/ PWR	Galvanized steel ducting exposed to air – indoor controlled (external)	None	None	NA - No AEM or AMP	EP-14
52	BWR/ PWR	Glass piping elements exposed to air – indoor uncontrolled (external), lubricating oil, raw water, treated water, or treated borated water	None	None	NA - No AEM or AMP	EP-15 EP-16 EP-28 EP-29 EP-30

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
53	BWR/ PWR	Stainless steel, copper alloy, and nickel alloy piping, piping components, and piping elements exposed to air – indoor uncontrolled (external)	None	None	NA - No AEM or AMP	EP-10 EP-17 EP-18
54	BWR/ PWR	Steel piping, piping components, and piping elements exposed to air – indoor controlled (external)	None	None	NA - No AEM or AMP	EP-4
55	BWR/ PWR	Steel and stainless steel piping, piping components, and piping elements in concrete	None	None	NA - No AEM or AMP	EP-5 EP-20
56	BWR/ PWR	Steel, stainless steel, and copper alloy piping, piping components, and piping elements exposed to gas	None	None	NA - No AEM or AMP	EP-7 EP-9 EP-22
57	PWR	Stainless steel and copper alloy <15% Zn piping, piping components, and piping elements exposed to air with borated water leakage	None	None	NA - No AEM or AMP	EP-12 EP-19

Table 3.2-2 FSAR Supplement for Aging Management of Engineered Safety Features

Program	Description of Program	Implementation Schedule*
Bolting Integrity	This program relies on recommendations for a comprehensive bolting integrity program, as delineated in NUREG-1339, and industry recommendations, as delineated in the Electric Power Research Institute (EPRI) NP-5769, with the exceptions noted in NUREG-1339 for safety-related bolting. The program relies on industry recommendations for a comprehensive bolting maintenance, as delineated in the EPRI TR-104213 for pressure retaining bolting and structural bolting. The program generally includes periodic inspection of closure bolting for indication of loss of preload, cracking, and loss of material due to corrosion, rust, etc. The program also includes preventive measures to preclude or minimize loss of preload and cracking. Other aging management programs, such as XI.M1, “ASME Section XI Inservice Inspection (ISI) Subsections IWB, IWC, and IWD” and XI.S3, “ASME Section XI Subsection IWF” also manage inspection of safety-related bolting and supplement this bolting integrity program. This program covers bolting within the scope of license renewal, including:1) safety-related bolting, 2) bolting for nuclear steam supply system (NSSS) component supports, 3) bolting for other pressure retaining components, including non-safety-related bolting, and 4) structural bolting. (actual measured yield strength $\geq$ 150 ksi).	Existing program
Boric Acid Corrosion	The program consists of (1) visual inspection of external surfaces that are potentially exposed to borated water leakage, (2) timely discovery of leak path and removal of the boric acid residues, (3) assessment of the damage, and (4) follow up inspection for adequacy. This program is implemented in response to GL 88-05 and recent operating experience.	Existing program
Buried Piping And Tanks Inspection	The program includes (1) preventive measures to mitigate corrosion, and (2) periodic inspection to manage the effects of corrosion on the pressure-retaining capacity of buried steel piping and tanks. Preventive measures are in accordance with standard industry practice for maintaining external coatings and wrappings and cathodic protection. As an alternative, buried piping and tanks are inspected visually for any evidence of damage when they are excavated during maintenance and when a pipe is dug up and inspected for any reason with a frequency that is based on operating experience.	Program should be implemented before the period of extended operation.

Table 3.2-2 FSAR Supplement for Aging Management of Engineered Safety Features

Program	Description of Program	Implementation Schedule*
Buried Piping And Tanks Surveillance	The program includes preventive measures to mitigate corrosion by protecting the external surface of buried piping and components, e.g., coating, wrapping, and a cathodic protection system. The program also includes surveillance and monitoring of the coating conductance versus time or current. This program is based on standard industry practices as described in NACE-RP-0285-95 and RP-0169-96.	Existing program
BWR Stress Corrosion Cracking	The program to manage intergranular stress corrosion cracking (IGSCC) in boiling water reactor coolant pressure boundary piping made of stainless steel (SS) is delineated, in part, in NUREG-0313, Rev. 2, and Nuclear Regulatory Commission (NRC) Generic Letter (GL) 88-01 and its Supplement 1. The program includes (a) preventive measures to mitigate IGSCC and (b) inspections to monitor IGSCC and its effects	Existing Program
Closed-Cycle Cooling Water System	The program relies on preventive measures to minimize corrosion and SCC by maintaining inhibitors and by performing non-chemistry monitoring consisting of inspection and nondestructive evaluations based on the guidelines of EPRI-TR-107396 for closed–cycle cooling water systems.	Existing program
External Surfaces Monitoring Program	This program is based on system inspections and walkdowns. This program consists of periodic visual inspections of components such as piping, piping components, ducting, and other equipment within the scope of license renewal and subject to aging management review in order to manage aging effects. The program manages aging effects through visual inspection of external surfaces for evidence of material loss and leakage. Loss of material due to boric acid corrosion is managed by the Boric Acid Corrosion Program. Surfaces that are inaccessible during plant operations are inspected during refueling outages. Surfaces that are inaccessible during both plant operations and refueling outages are inspected at frequencies to provide reasonable assurance that effect of aging will be managed such that applicable components will perform their intended function during the period of extended operation.	Existing program
Flow-Accelerated Corrosion (FAC)	The program consists of (1) conduct appropriate analysis and baseline inspection, (2) determine extent of thinning, and replace/repair components, and (3) perform follow-up inspections to confirm or quantify and take longer-term corrective actions. The program relies on implementation of EPRI guidelines of NSAC-202L-R2.	Existing program

Table 3.2-2 FSAR Supplement for Aging Management of Engineered Safety Features

Program	Description of Program	Implementation Schedule*
Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	The program visually inspects internal surfaces of steel piping, piping elements, ducting, and components in an internal environment (indoor uncontrolled air, condensation, and steam) that are not included in other aging management programs, for loss of material. Inspections are performed when the internal surfaces are accessible during the performance of periodic surveillance tests, during preventive maintenance activities or during scheduled outages. The program includes visual inspection to assure that existing environment conditions are not causing material degradation that could result in a loss of system intended functions.	Existing program
Lubricating Oil Analysis	This program ensures the oil environment in the mechanical systems is maintained to the required quality. The program maintains oil systems free of contaminants (primarily water and particulates) thereby preserving an environment that is not conducive to loss of material, cracking, or reduction of heat transfer. Lubricating oil testing activities include sampling and analysis of lubricating oil for detrimental contaminants. The presence of water or particulates may also be indicative of inleakage and corrosion product buildup.	Existing program
One-Time Inspection	This program verifies the effectiveness of other aging management program by determining if the aging effect is not occurring or the aging effect is progressing slowly so that the intended function will be maintained during the period of extended operation.	The inspection should be completed before the period of extended operation
Open-Cycle Cooling Water System	The program includes (a) surveillance and control of biofouling, (b) tests to verify heat transfer, (c) routine inspection and maintenance program, (d) system walk down inspection, and (e) review of maintenance, operating, and training practices and procedures. The program provides assurance that the open-cycle cooling water system is in compliance with General Design Criteria and Quality Assurance to ensure that the open-cycle cooling water (or service water) system can be managed for an extended period of operation. This program is in response to NRC GL 89-13.	Existing program
Plant-specific AMP	The program should contain information associated with the bases for determining that aging effects will be managed during the period of extended operation.	Program should be implemented before the period of extended operation

Table 3.2-2 FSAR Supplement for Aging Management of Engineered Safety Features

Program	Description of Program	Implementation Schedule*
Selective Leaching of Materials	The program includes a hardness measurement of selected components that may be susceptible to selective leaching to determine whether loss of materials is occurring and whether the process will affect the ability of the components to perform their intended function for the period of extended operation. For systems subjected to environments where water is not treated (i.e., the open-cycle cooling water system and the ultimate heat sinks), the program also follows the guidance in NRC GL 89-13.	Program should be implemented before the period of extended operation.
Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	The program consists of the determination of the susceptibility of CASS piping, piping components, and piping elements in PWR ECCS systems including interfacing pipe lines to the chemical and volume control system and to the spent fuel pool; and in BWR ECCS systems including interfacing pipe lines to the suppression chamber and to the drywell and suppression chamber spray system in regard to thermal aging embrittlement based on the casting method, molybdenum content, and ferrite percentage. For potentially susceptible piping, aging management is accomplished either through enhanced volumetric examination or component-specific flaw tolerance evaluation.	Existing program
Water Chemistry	To mitigate aging effects on component surfaces that are exposed to water as a process fluid, chemistry programs are used to control water impurities (e.g., chloride, fluoride, sulfate) that accelerate corrosion. This program relies on monitoring and control of water chemistry to keep peak levels of various contaminants below the system-specific limits.	Existing program

* An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.3 AGING MANAGEMENT OF AUXILIARY SYSTEMS

Review Responsibilities

Primary- Branch assigned responsibility by PM as described in SRP-LR Section 3.0 of this SRP-LR.

3.3.1 Areas of Review

This section addresses the aging management review (AMR)and the associated aging management program (AMP) of the auxiliary systems for license renewal. For a recent vintage plant, the information related to the auxiliary systems contained in Chapter 9, "Auxiliary Systems," of the plant's FSAR consistent with the "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG-0800). The auxiliary systems contained in this review plan section are generally consistent with those contained in NUREG-0800 except for refueling water, chilled water, heat removal, condenser circulating water, and condensate storage system. For older plants, the location of applicable information is plant-specific because an older plant's FSAR may have predated NUREG-0800.

Typical auxiliary systems that are subject to an AMR for license renewal are new fuel storage, spent fuel storage, spent fuel pool cooling and cleanup (BWR/PWR), suppression pool cleanup (BWR), overhead heavy load and light load (related to refueling) handling, open-cycle cooling water, closed-cycle cooling water, ultimate heat sink, compressed air, chemical and volume control (PWR), standby liquid control (BWR), reactor water cleanup (BWR), shutdown cooling (older BWR), control room area ventilation, auxiliary and radwaste area ventilation, primary containment heating and ventilation, diesel generator building ventilation, fire protection, diesel fuel oil, and emergency diesel generator. This review plan section also includes structures and components in non-safety related systems that are not connected to safety related SSCs but have a spatial relationship such that their failure could adversely impact the performance of a safety related SSC intended function. Examples of such non-safety related systems may be plant drains, liquid waste processing, potable/sanitary water, water treatment, process sampling, and cooling water systems.

Aging management is reviewed, following the guidance in this SRP-LR Section 3.1, for portions of the chemical and volume control system for PWRs, and for standby liquid control, reactor water cleanup, and shutdown cooling systems extending up to the first isolation valve outside of containment for BWRs (the shutdown cooling systems for older BWRs). The following systems have portions that are classified as Group B quality standard: open-cycle cooling water (service water system), closed-cycle cooling water, compressed air, standby liquid control, shutdown cooling system (older BWR), control room area ventilation and auxiliary and radwaste area ventilation. Aging management for these portions is reviewed following the guidance in Section 3.3. The aging management program for the cooling towers is reviewed following the guidance in Section 3.5 for "Group 6" structures.

The responsible review organization is to review the following license renewal application (LRA) AMR and AMP items assigned to it, per SRP-LR Section 3.0:

<u>AMRs</u>

- AMR results consistent with the GALL Report
- AMR results for which further evaluation is recommended by the GALL Report
- AMR results not consistent with or not addressed in the GALL Report

AMPs

- Consistent with GALL Report AMPs
- Plant-specific AMPs

FSAR Supplement

- The responsible review organization is to review the FSAR Supplement associated with each assigned AMP.

3.3.2 Acceptance Criteria

The acceptance criteria for the areas of review describe methods for determining whether the applicant has met the requirements of the NRC's regulations in 10 CFR 54.21.

3.3.2.1 AMR Results Consistent with the GALL Report

The AMR and the AMPs applicable to the auxiliary system features are described and evaluated in Chapter VII of NUREG-1801 (GALL Report).

The applicant's LRA should provide sufficient information so that the NRC reviewer is able to confirm that the specific LRA AMR line-item and the associated LRA AMP are consistent with the cited GALL Report AMR line-item. The reviewer should then confirm that the LRA AMR line-item is consistent with the GALL Report AMR line-item to which it is compared.

For AMPs, if the applicant identifies an exception to any of the program elements of the cited GALL Report AMP, the LRA AMP should include a basis demonstrating how the criteria of 10 CFR 54.21(a)(3) would still be met. The NRC reviewer should then confirm that the LRA AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the LRA AMP, the reviewer identifies a difference from the GALL Report AMP that should have been identified as an exception to the GALL Report AMP, this difference should be reviewed and properly dispositioned. The reviewer should document the disposition of all LRA-defined exceptions and staff-identified differences.

The LRA should identify any enhancements that are needed to permit an existing LRA AMP to be declared consistent with the GALL Report AMP to which the LRA AMP is compared. The reviewer is to confirm both that the enhancement, when implemented, would allow the existing LRA AMP to be consistent with the GALL Report AMP and also that the applicant has a commitment in the FSAR Supplement to implement the enhancement prior to the period of extended operation. The reviewer should document the disposition of all enhancements.

3.3.2.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

The basic acceptance criteria, defined in Subsection 3.3.2.1, apply to all of the AMRs and AMPs reviewed as part of this section. In addition, if the GALL Report AMR line-item to which the LRA AMR line-item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL Report for each of the following aging effect/aging mechanism combinations.

3.3.2.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). This TLAA is addressed separately in Section 4.3, "Metal Fatigue Analysis" or Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses" of this SRP-LR.

3.3.2.2.2 Reduction of Heat Transfer due to Fouling

Reduction of heat transfer due to fouling could occur for stainless steel heat exchanger tubes exposed to treated water. The existing program relies on control of water chemistry to manage reduction of heat transfer due to fouling. However, control of water chemistry may have been inadequate. Therefore, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure that reduction of heat transfer due to fouling is not occurring. A one-time inspection is an acceptable method to ensure that reduction of heat transfer is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.3.2.2.3 Cracking due to Stress Corrosion Cracking (SCC)

1. Cracking due to SCC could occur in the stainless steel piping, piping components, and piping elements of the BWR Standby Liquid Control system that are exposed to sodium pentaborate solution greater than 60°C (>140°F). The existing aging management program relies on monitoring and control of water chemistry to manage the aging effects of cracking due to SCC. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause SCC. Therefore, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure that SCC is not occurring. A one-time inspection of select components at susceptible locations is an acceptable method to ensure that SCC is not occurring and that the component's intended function will be maintained during the period of extended operation.

2. Cracking due to SCC could occur in stainless steel and stainless clad steel heat exchanger components exposed to treated water greater than 60°C (>140°F). The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

3. Cracking due to SCC could occur in stainless steel diesel engine exhaust piping, piping components, and piping elements exposed to diesel exhaust. The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

3.3.2.2.4 Cracking due to Stress Corrosion Cracking and Cyclic Loading

1. Cracking due to SCC and cyclic loading could occur in stainless steel PWR non-regenerative heat exchanger components exposed to treated borated water greater than 60°C (>140°F) in the chemical and volume control system. The existing aging management program on monitoring and control of primary water chemistry in PWRs to manage the aging effects of cracking due to SCC. However, control of water chemistry does not preclude cracking due to SCC and cyclic loading. Therefore, the effectiveness of the water chemistry

control program should be verified to ensure that cracking is not occurring. The GALL Report recommends that a plant-specific aging management program be evaluated to verify the absence of cracking due to SCC and cyclic loading to ensure that these aging effects are managed adequately. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.

2. Cracking due to SCC and cyclic loading could occur in stainless steel PWR regenerative heat exchanger components exposed to treated borated water greater than 60°C (>140°F). The existing aging management program relies on monitoring and control of primary water chemistry in PWRs to manage the aging effects of cracking due to SCC. However, control of water chemistry does not preclude cracking due to SCC and cyclic loading. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that cracking is not occurring. The GALL Report recommends that a plant-specific aging management program be evaluated to verify the absence of cracking due to SCC and cyclic loading to ensure that these aging effects are managed adequately. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

3. Cracking due to SCC and cyclic loading could occur for the stainless steel pump casing for the PWR high-pressure pumps in the chemical and volume control system. The existing aging management program relies on monitoring and control of primary water chemistry in PWRs to manage the aging effects of cracking due to SCC. However, control of water chemistry does not preclude cracking due to SCC and cyclic loading. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that cracking is not occurring. The GALL Report recommends that a plant-specific aging management program be evaluated to verify the absence of cracking due to SCC and cyclic loading to ensure that these aging effects are managed adequately. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

3.3.2.2.5 Hardening and Loss of Strength due to Elastomer Degradation

1. Hardening and loss of strength due to elastomer degradation could occur in elastomer seals and components of heating and ventilation systems exposed to air – indoor uncontrolled (internal/external. The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

2. Hardening loss of strength due to elastomer degradation could occur in elastomer linings of the filters, valves, and ion exchangers in spent fuel pool cooling and cleanup systems (BWR and PWR) exposed to treated water or to treated borated water. The GALL Report recommends that a plant-specific aging management program be evaluated to determine and assesses the qualified life of the linings in the environment to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

3.3.2.2.6 Reduction of Neutron-Absorbing Capacity and Loss of Material due to General Corrosion

Reduction of neutron-absorbing capacity and loss of material due to general corrosion could occur in the neutron-absorbing sheets of BWR and PWR spent fuel storage racks exposed to treated water or to treated borated water. The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.3.2.2.7 Loss of Material due to General, Pitting, and Crevice Corrosion

1. Loss of material due to general, pitting, and crevice corrosion could occur in steel piping, piping components, and piping elements, including the tubing, valves, and tanks in the reactor coolant pump oil collection system, exposed to lubricating oil (as part of the fire protection system). The existing aging management program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lubricating oil program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

   In addition, corrosion may occur at locations in the reactor coolant pump oil collection tank where water from wash downs may accumulate. Therefore, the effectiveness of the program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion, to include determining the thickness of the lower portion of the tank. A one-time inspection is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

2. Loss of material due to general, pitting, and crevice corrosion could occur in steel piping, piping components, and piping elements in the BWR reactor water cleanup and shutdown cooling systems exposed to treated water. The existing aging management program relies on monitoring and control of reactor water chemistry to manage the aging effects of loss of material from general, pitting and crevice corrosion. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause general, pitting, or crevice corrosion. Therefore, the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage loss of material from general, pitting, and crevice corrosion to verify the effectiveness of the water chemistry program. A one-time inspection of select components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3. Loss of material due to general (steel only) pitting and crevice corrosion could occur for steel and stainless steel diesel exhaust piping, piping components, and piping elements exposed to diesel exhaust. The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

3.3.2.2.8 Loss of Material due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion (MIC)

Loss of material due to general, pitting, crevice corrosion, and microbiologically-influenced corrosion (MIC) could occur for steel (with or without coating or wrapping) piping, piping components, and piping elements buried in soil. The buried piping and tanks inspection program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general, pitting, and crevice corrosion and MIC. The effectiveness of the buried piping and tanks inspection program should be verified to evaluate an applicant's inspection frequency and operating experience with buried components, ensuring that loss of material is not occurring.

3.3.2.2.9 Loss of Material due to General, Pitting, Crevice, Microbiologically-Influenced Corrosion and Fouling

1. Loss of material due to general, pitting, crevice, MIC, and fouling could occur for steel piping, piping components, piping elements, and tanks exposed to fuel oil. The existing aging management program relies on the fuel oil chemistry program for monitoring and control of fuel oil contamination to manage loss of material due to corrosion or fouling. Corrosion or fouling may occur at locations where contaminants accumulate. The effectiveness of the fuel oil chemistry control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, crevice, MIC, and fouling to verify the effectiveness of the fuel oil chemistry program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

2. Loss of material due to general, pitting, crevice, MIC, and fouling could occur for steel heat exchanger components exposed to lubricating oil. The existing aging management program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lube oil program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.3.2.2.10 Loss of Material due to Pitting and Crevice Corrosion

1. Loss of material due to pitting and crevice corrosion could occur in BWR and PWR steel piping with elastomer lining or stainless steel cladding that are exposed to treated water and treated borated water if the cladding or lining is degraded. The existing aging management program relies on monitoring and control of reactor water chemistry to manage the aging effects of loss of material from pitting and crevice corrosion. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause pitting, or crevice corrosion. Therefore, the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage loss of material from pitting and crevice corrosion to verify the effectiveness of the water chemistry program. A one-time inspection of select

components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

2. Loss of material due to pitting and crevice corrosion could occur for stainless steel and aluminum piping, piping components, piping elements, and for stainless steel and steel with stainless steel cladding heat exchanger components exposed to treated water. The existing aging management program relies on monitoring and control of reactor water chemistry to manage the aging effects of loss of material from pitting and crevice corrosion. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause pitting, or crevice corrosion. Therefore, the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage loss of material from pitting and crevice corrosion to verify the effectiveness of the water chemistry program. A one-time inspection of select components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3. Loss of material due to pitting and crevice corrosion could occur for copper alloy HVAC piping, piping components, and piping elements exposed to condensation (external). The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

4. Loss of material due to pitting and crevice corrosion could occur for copper alloy piping, piping components, and piping elements exposed to lubricating oil. The existing aging management program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lubricating oil program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

5. Loss of material due to pitting and crevice corrosion could occur for HVAC aluminum piping, piping components, and piping elements and stainless steel ducting and components exposed to condensation. The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

6. Loss of material due to pitting and crevice corrosion could occur for copper alloy fire protection system piping, piping components, and piping elements exposed to internal condensation. The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

7. Loss of material due to pitting and crevice corrosion could occur for stainless steel piping, piping components, and piping elements exposed to soil. The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

8. Loss of material due to pitting and crevice corrosion could occur for stainless steel piping, piping components, and piping elements of the BWR Standby Liquid Control System that are exposed to sodium pentaborate solution. The existing aging management program relies on monitoring and control of water chemistry to manage the aging effects of loss of material due to pitting and crevice corrosion. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause loss of material due to pitting and crevice corrosion. Therefore, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure this aging is not occurring. A one-time inspection of select components at susceptible locations is an acceptable method to ensure that loss of material due to pitting and crevice corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.3.2.2.11 Loss of Material due to Pitting, Crevice, and Galvanic Corrosion

Loss of material due to pitting, crevice, and galvanic corrosion could occur for copper alloy piping, piping components, and piping elements exposed to treated water. Therefore, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure this aging is not occurring. A one-time inspection of select components at susceptible locations is an acceptable method to ensure that loss of material due to pitting and crevice corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.3.2.2.12 Loss of Material due to Pitting, Crevice, and Microbiologically-Influenced Corrosion

1. Loss of material due to pitting, crevice, and MIC could occur in stainless steel, aluminum, and copper alloy piping, piping components, and piping elements exposed to fuel oil. The existing aging management program relies on the fuel oil chemistry program for monitoring and control of fuel oil contamination to manage loss of material due to corrosion. However, corrosion may occur at locations where contaminants accumulate and the effectiveness of fuel oil chemistry control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the fuel oil chemistry control program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

2. Loss of material due to pitting, crevice, and MIC could occur in stainless steel piping, piping components, and piping elements exposed to lubricating oil. The existing program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of

programs to manage corrosion to verify the effectiveness of the lubricating oil program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.3.2.2.13 Loss of Material due to Wear

Loss of material due to wear could occur in the elastomer seals and components exposed to air indoor uncontrolled (internal or external). The GALL Report recommends further evaluation to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

3.3.2.2.14 Loss of Material due to Cladding Breach

Loss of material due to cladding breach could occur for PWR steel charging pump casings with stainless steel cladding exposed to treated borated water. The GALL Report references NRC Information Notice 94-63, Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks, and recommends further evaluation of a plant-specific aging management program to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.3.2.2.15 Quality Assurance for Aging Management of Nonsafety-Related Components

Acceptance criteria are described in Branch Technical Position IQMB-1 (Appendix A.2, of this SRP-LR.)

3.3.2.3 AMR Results Not Consistent with or Not Addressed in GALL Report

Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

3.3.2.4 FSAR Supplement

The summary description of the programs and activities for managing the effects of aging for the period of extended operation in the FSAR Supplement should be sufficiently comprehensive such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the bases for determining that aging effects will be managed during the period of extended operation. The description should also contain any future aging management activities, including enhancements and commitments, to be completed before the period of extended operation. Examples of the type of information required are provided in Table 3.3-2 of this SRP-LR

3.3.3 Review Procedures

For each area of review, the following review procedures are to be followed:

3.3.3.1 AMR Results Consistent with the GALL Report

The applicant may reference the GALL Report in its LRA, as appropriate, and demonstrate that the AMRs and AMPs at its facility are consistent with those reviewed and approved in the GALL Report. The reviewer should not conduct a re-review of the substance of the matters described in the GALL Report. If the applicant has provided the information necessary to adopt the finding of program acceptability as described and evaluated in the GALL Report, the reviewer should find acceptable the applicant's reference to the GALL Report in its LRA. In making this determination, the reviewer confirms that the applicant has provided a brief description of the system, components, materials, and environment. The reviewer also confirms that the applicant has stated that the applicable aging effects and industry and plant-specific operating experience have been reviewed by the applicant and are evaluated in the GALL Report.

Furthermore, the reviewer should confirm that the applicant has addressed operating experience identified after the issuance of the GALL Report. Performance of this review requires the reviewer to confirm that the applicant has identified those aging effects for the auxiliary system components that are contained in the GALL Report as applicable to its plant.

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL Report. If the applicant commits to an enhancement to make its LRA AMP consistent with a GALL Report AMP, then the reviewer is to confirm that this enhancement, when implemented, will make the LRA AMP consistent with the GALL Report AMP. If the applicant identifies, in the LRA AMP, an exception to any of the program elements of the GALL Report AMP with which the applicant is claiming to be consistent, the reviewer is to confirm that the LRA AMP with the exception will satisfy the criteria of 10 CFR 54.21(a)(3). If the reviewer identifies a difference, not identified by the LRA, between the LRA AMP and the GALL Report AMP with which the LRA claims to be consistent, the reviewer should confirm that the LRA AMP with this difference satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions or differences. The AMPs evaluated in GALL Report pertinent to the auxiliary systems components are summarized in Table 3.3-1 of this SRP-LR. In this table, the ID column provides a row identifier useful in matching the information presented in the corresponding table in the GALL Report, Vol. 1. The Related Item column identifies the item number in the GALL Report, Vol. 2, Chapters II through VIII, presenting detailed information summarized by this row.

3.3.3.2 AMR Results Report for Which Further Evaluation is Recommended by the GALL Report

The basic review procedures defined in Subsection 3.3.3.1 apply to all of the AMRs and AMPs provided in this section. In addition, if the GALL Report AMR line-item to which the LRA AMR line-item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL Report for each of the following aging effect/aging mechanism combinations.

3.3.3.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.3 of this SRP-LR.

3.3.3.2.2 Reduction of Heat Transfer due to Fouling

The GALL Report recommends further evaluation of programs to verify the effectiveness of control of water chemistry to manage reduction of heat transfer due to fouling for stainless steel heat exchanger tubes exposed to treated water on either side.

The reviewer reviews the applicant's proposed program to ensure that fouling not occurring and that the component's intended function will be maintained during the period of extended operation. If the applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques.

3.3.3.2.3 Cracking due to Stress Corrosion Cracking

1. The GALL Report recommends further evaluation of programs to manage cracking due to SCC of the stainless steel piping, piping components, and piping elements of the BWR Standby Liquid Control system that are exposed to sodium pentaborate solution greater than 60°C (>140°F). The water chemistry program relies on monitoring and control of reactor water chemistry to manage the effects of cracking from SCC. The effectiveness of the water chemistry control program should be reviewed to verify that cracking is not occurring and that the component's intended function would be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. If the applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques.

2. The GALL Report recommends further evaluation of programs to manage the cracking due to SCC of stainless steel and stainless steel clad heat exchanger components exposed to treated water greater than 60°C (>140°F). The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3. The GALL Report recommends further evaluation of programs to manage cracking due to SCC of stainless steel diesel engine exhaust piping, piping components, and piping elements exposed to diesel exhaust. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.3.3.2.4 Cracking due to Stress Corrosion Cracking and Cyclic Loading

1. The GALL Report also recommends further evaluation of programs to manage cracking due to SCC and cyclic loading in the stainless steel non-regenerative heat exchangers in the chemical and volume control system (PWR) exposed to treated borated water greater than 60°C (>140°F). The water chemistry program relies on monitoring and control of water chemistry to manage the aging effects of cracking due to SCC and cyclic loading. The GALL Report recommends the effectiveness of the chemistry control program be verified to ensure that cracking is not occurring. The absence of cracking due to SCC and cyclic loading is to be verified. An acceptable verification program is to include temperature and radioactivity

monitoring of the shell side water, and eddy current testing of tubes. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

2. The GALL Report recommends further evaluation of programs to manage cracking due to SCC and cyclic loading in the stainless steel PWR regenerative heat exchanger components exposed to treated borated water greater than 60°C (>140°F). The water chemistry program relies on monitoring and control of water chemistry to manage the aging effects of cracking due to SCC and cyclic loading. The GALL Report recommends the effectiveness of the chemistry control program be verified to ensure that cracking is not occurring. The absence of cracking due to SCC and cyclic loading is to be verified. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3. The GALL Report recommends further evaluation of programs to manage cracking due to cyclic loading for the stainless steel pump casing of high-pressure pumps in the PWR chemical and volume control system. The GALL Report recommends further evaluation to ensure that these aging effects are adequately managed. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.3.3.2.5 Hardening and Cracking or Loss of Strength due to Elastomer Degradation

1. The GALL Report recommends further evaluation of programs to manage the Hardening and loss of strength due to elastomer degradation could occur in elastomer seals and components of heating and ventilation systems exposed to air – indoor uncontrolled (internal/external. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

2. The GALL Report also recommends further evaluation of programs to manage the hardening and cracking due to elastomer degradation of valves in spent fuel pool cooling and cleanup system (BWR and PWR). The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.3.3.2.6 Reduction of Neutron-Absorbing Capacity and Loss of Material due to General Corrosion

The GALL Report recommends further evaluation of programs to manage reduction of neutron-absorbing capacity and loss of material due to general corrosion of the neutron-absorbing sheets in BWR and PWR spent fuel storage racks. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.3.3.2.7 Loss of Material due to General, Pitting, and Crevice Corrosion

1. The GALL Report recommends further evaluation of programs to manage the loss of material due to general, pitting, and crevice corrosion of steel piping, piping components, and piping elements exposed to lubricating oil, including the tanks, valve bodies, and tubing in the reactor coolant pump oil collection system (as part of the fire protection system). The

existing program relies on monitoring and control of lubricating oil contamination to maintain contaminants within acceptable limits. The effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects. If the applicant proposes a one-time visual inspection of the bottom portion of the interior of the tank, the inspection would be performed to ensure that corrosion is not occurring. If corrosion is identified, a volumetric examination would then be conducted on any problematic areas. The results of examinations will be used as a leading indicator of other susceptible components. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface examination techniques.

2. The GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion of steel piping, piping component, and piping elements exposed to treated water in the BWR reactor water cleanup and shutdown cooling systems The GALL Report recommends further evaluations to verify the effectiveness of the water chemistry program. The water chemistry program relies on monitoring and control of reactor water chemistry to manage the aging effects of loss of material from general, pitting and crevice corrosion (Ref. 3). However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause general, pitting and crevice corrosion. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that corrosion is not occurring and that the component's intended function would be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. If the applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques.

3. The GALL Report recommends further evaluation of programs to manage loss of material due to pitting and crevice corrosion in stainless steel diesel exhaust piping, piping components, and piping elements exposed to diesel exhaust. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.3.3.2.8 Loss of Material due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion

The GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion and MIC of steel (with or without coating or wrapping) piping, piping components, and piping elements buried in soil. The buried piping and tanks inspection program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general, pitting, and crevice corrosion and MIC. The effectiveness of the buried piping and tanks inspection program should be verified to evaluate an applicant's inspection frequency and operating experience with buried components, ensuring that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.3.3.2.9 Loss of Material due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion and Fouling)

1. The GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion and MIC and to fouling of steel piping, piping components, piping elements, and tanks exposed to fuel oil. The fuel oil chemistry program relies on monitoring and control of fuel oil contamination to manage loss of material due to corrosion or fouling. Corrosion or fouling may occur at locations where contaminants accumulate. The effectiveness of the fuel oil program should be verified to ensure that corrosion/fouling is not occurring and that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to ensure that corrosion/fouling is not occurring and that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components and susceptible locations to ensure that corrosion/fouling is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques.

2. The GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion and MIC and to fouling of steel heat exchanger components exposed to lubricating oil. The existing program relies on monitoring and control of lubricating oil contamination to maintain contaminants within acceptable limits. The effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to determine whether corrosion is not occurring or the corrosion is progressing very slowly so that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The inspection techniques may include visual, ultrasonic, and surface examination techniques. Follow-up actions are to be based on the inspection results.

3.3.3.2.10 Loss of Material due to Pitting and Crevice Corrosion

1. The GALL Report recommends further evaluation of programs to manage loss of material due to pitting and crevice corrosion of the steel piping, piping components and piping elements with degraded elastomer lining or stainless steel cladding that are exposed to treated water or treated borated water to verify the effectiveness of the water chemistry program. The water chemistry program relies on monitoring and control of reactor water chemistry to manage the aging effects of loss of material from pitting and crevice corrosion (Ref. 3, 4). However, high concentrations of impurities at crevices and locations of stagnant

flow conditions could cause pitting and crevice corrosion. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that corrosion is not occurring and that the component's intended function would be maintained during the period of extended operation.

The reviewer reviews the applicant's proposed program to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. If the applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques.

2. The GALL Report recommends further evaluation of programs to manage the loss of material due to pitting and crevice corrosion of stainless steel and aluminum piping, piping components, piping elements exposed to treated water and for stainless steel and steel with stainless steel cladding heat exchanger components exposed to treated water. The water chemistry program relies on monitoring and control of reactor water chemistry to manage the aging effects of loss of material from pitting and crevice corrosion (Ref. 3, 4). However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause pitting and crevice corrosion. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that corrosion is not occurring and that the component's intended function would be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. If the applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques.

3. The GALL Report recommends further evaluation of programs to manage the loss of material due to pitting and crevice corrosion for copper alloy HVAC piping, piping components, and piping elements exposed to condensation (external). The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

4. The GALL Report recommends further evaluation of programs to manage the loss of material due to pitting and crevice corrosion of copper alloy piping, piping components, and piping elements exposed to lubricating oil. The existing program relies on monitoring and control of lubricating oil contamination to maintain contaminants within acceptable limits. The effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to determine whether corrosion is not occurring or the corrosion is progressing very slowly so that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The inspection techniques may include visual, ultrasonic, and surface examination techniques. Follow-up actions are to be based on the inspection results.

5. The GALL Report recommends further evaluation of programs to manage the loss of material due to pitting and crevice corrosion of HVAC system aluminum piping, piping components, and piping elements and stainless steel ducting and components exposed to condensation. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

6. The GALL Report recommends further evaluation of programs to manage the loss of material due to pitting and crevice corrosion of copper alloy fire protection system piping, piping components, and piping elements exposed to internal condensation. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of this aging effect.

7. The GALL Report recommends further evaluation of programs to manage the loss of material due to pitting and crevice corrosion of stainless steel piping, piping components, and piping elements exposed to soil. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

8. The GALL Report recommends further evaluation of programs to manage the loss of material due to pitting and crevice corrosion of stainless steel piping, piping components, and piping elements of the BWR Standby Liquid Control system that are exposed to sodium pentaborate solution to verify the effectiveness of the water chemistry program. The water chemistry program relies on monitoring and control of reactor water chemistry to manage the aging effects of loss of material from pitting and crevice corrosion. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause pitting and crevice corrosion. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that corrosion is not occurring and that the components' intended function would be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. If the applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.3.3.2.11 Loss of Material due to Pitting, Crevice, and Galvanic Corrosion

The GALL Report recommends further evaluation of programs to manage the loss of material due to pitting, crevice, and galvanic corrosion of copper alloy piping, piping components, and piping elements that are exposed to treated water. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.3.3.2.12 Loss of Material due to Pitting, Crevice, and Microbiologically-Influenced Corrosion

1. The GALL Report recommends further evaluation of programs to manage loss of material due to pitting, crevice, and MIC of stainless steel, aluminum, and copper alloy piping, piping components, and piping elements exposed to fuel oil. The fuel oil chemistry program relies on monitoring and control of fuel oil contamination to manage loss of material due to corrosion. Corrosion may occur at locations where contaminants accumulate. The effectiveness of fuel oil chemistry control should be verified to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components and susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques.

2. The GALL Report recommends further evaluation of programs to manage loss of material due to pitting, crevice, and MIC of stainless steel piping, piping components, and piping elements exposed to lubricating oil. The existing program relies on monitoring and control of lubricating oil contamination to maintain contaminants within acceptable limits. The effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components and susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques.

3.3.3.2.13 Loss of Material due to Wear

The GALL Report recommends further evaluation of programs to manage the loss of material due to wear of the elastomer seals and components of the ventilation systems. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.3.3.2.14 Loss of Material due to Cladding Breach

The GALL Report recommends further evaluation of programs to manage loss of material due to cladding breach for PWR steel charging pump casings with stainless steel cladding. The GALL Report references NRC Information Notice 94-63, Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks and recommends further evaluation on a plant-specific basis to ensure that the aging effect is adequately managed. The reviewer reviews the applicant's proposed programs on a case-by-case basis to ensure that an adequate program will be in place for the management of general corrosion of these components.

3.3.3.2.15 Quality Assurance for Aging Management of Nonsafety-Related Components

The applicant's aging management programs for license renewal should contain the elements of corrective actions, the confirmation process, and administrative controls. Safety-related components are covered by 10 CFR Part 50, Appendix B, which is adequate to address these program elements. However, Appendix B does not apply to nonsafety-related components that are subject to an AMR for license renewal. Nevertheless, the applicant has the option to expand the scope of its 10 CFR Part 50, Appendix B program to include these components and address the associated program elements. If the applicant chooses this option, the reviewer verifies that the applicant has documented such a commitment in the FSAR Supplement. If the applicant chooses alternative means, the branch responsible for quality assurance should be requested to review the applicant's proposal on a case-by-case basis.

3.3.3.3 AMR Results Not Consistent with or Not Addressed in GALL Report

The reviewer should confirm that the applicant, in its LRA, has identified applicable aging effects, listed the appropriate combination of materials and environments, and AMPs that will adequately manage the aging effects. The AMP credited by the applicant could be an AMP that is described and evaluated in the GALL Report or a plant-specific program. Review procedures are described in Branch Technical Position RSLB-1 (Appendix A.1 of this SRP-LR).

3.3.3.4 FSAR Supplement

The reviewer confirms that the applicant has provided information equivalent to that in Table 3.3-2 in the FSAR Supplement for aging management of the auxiliary systems for license renewal. The reviewer also confirms that the applicant has provided information equivalent to that in Table 3.3-2 in the FSAR Supplement for Subsection 3.3.3.3, "AMR Results Not Consistent with or Not Addressed in the GALL Report."

The staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR Supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR Supplement without prior NRC approval, provided that the applicant evaluates each such change and finds it acceptable pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR supplement before the license is renewed, no condition will be necessary.

As noted in Table 3.3-2, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should confirm that the applicant has identified and committed in the LRA to any future aging management activities, including enhancements and commitments, to be completed before entering the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.3.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of this section, then an evaluation finding similar to the following text should be included in the staff's safety evaluation report:

> On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated that the aging effects associated with the auxiliary systems components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).
>
> The staff also reviewed the applicable FSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of the auxiliary systems, as required by 10 CFR 54.21(d).

3.3.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

3.3.6 References

1. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, July 1981.

2. NUREG-1801, "Generic Aging Lessons Learned (GALL)," U.S. Nuclear Regulatory Commission, Revision 1, September 2005.

3. ASME Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, The ASME Boiler and Pressure Vessel Code, 1989 or later edition as approved in 10 CFR 50.55a, The American Society of Mechanical Engineers, New York, NY.

4. ASTM D95-83, Standard Test Method for Water in Petroleum Products and Bituminous Materials by Distillation, American Society for Testing and Materials, West Conshohocken, PA, 1983.

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report						
ID	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Related Item**
1	BWR/ PWR	Steel cranes - structural girders exposed to air – indoor uncontrolled (external)	Cumulative fatigue damage	TLAA to be evaluated for structural girders of cranes. See the Standard Review Plan, Section 4.7 for generic guidance for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA (See subsection 3.3.2.2.1)	A-06
2	BWR/ PWR	Steel and stainless steel piping, piping components, piping elements, and heat exchanger components exposed to air – indoor uncontrolled, treated borated water or treated water	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (See subsection 3.3.2.2.1)	A-34 A-57 A-62 A-100
3	BWR/ PWR	Stainless steel heat exchanger tubes exposed to treated water	Reduction of heat transfer due to fouling	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See section 3.3.2.2.2)	AP-62
4	BWR	Stainless steel piping, piping components, and piping elements exposed to sodium pentaborate solution >60°C (>140°F)	Cracking due to stress corrosion cracking	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.3.1)	A-59
5	BWR/ PWR	Stainless steel and stainless clad steel heat exchanger components exposed to treated water >60°C (>140°F)	Cracking due to stress corrosion cracking	A plant specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.3.2.2.3.2)	A-71 A-85
6	BWR/ PWR	Stainless steel diesel engine exhaust piping, piping components, and piping elements exposed to diesel exhaust	Cracking due to stress corrosion cracking	A plant specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.3.2.2.3.3)	AP-33

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
7	PWR	Stainless steel non-regenerative heat exchanger components exposed to treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking and cyclic loading	Water Chemistry and a plant-specific verification program. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.	Yes, plant specific (See subsection 3.3.2.2.4.1)	A-69
8	PWR	Stainless steel regenerative heat exchanger components exposed to treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking and cyclic loading	Water Chemistry and a plant-specific verification program. The AMP is to be augmented by verifying the absence of cracking due to stress corrosion cracking and cyclic loading. A plant specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.3.2.2.4.2)	A-84
9	PWR	Stainless steel high-pressure pump casing in PWR chemical and volume control system	Cracking due to stress corrosion cracking and cyclic loading	Water Chemistry and a plant-specific verification program. The AMP is to be augmented by verifying the absence of cracking due to stress corrosion cracking and cyclic loading. A plant specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.3.2.2.4.3)	A-76
10	BWR/ PWR	High-strength steel closure bolting exposed to air with steam or water leakage.	Cracking due to stress corrosion cracking, cyclic loading	Bolting Integrity The AMP is to be augmented by appropriate inspection to detect cracking if the bolts are not otherwise replaced during maintenance.	Yes, if the bolts are not replaced during maintenance (see Subsection 3.3.2.2.4.4)	A-104

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
11	BWR/ PWR	Elastomer seals and components exposed to air – indoor uncontrolled (internal/external)	Hardening and loss of strength due to elastomer degradation	A plant specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.3.2.2.5.1)	A-17
12	BWR/ PWR	Elastomer lining exposed to treated water or treated borated water	Hardening and loss of strength due to elastomer degradation	A plant-specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.3.2.2.5.2)	A-15 A-16
13	BWR/ PWR	Boral, boron steel spent fuel storage racks neutron-absorbing sheets exposed to treated water or treated borated water	Reduction of neutron-absorbing capacity and loss of material due to general corrosion	A plant specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.3.2.2.6)	A-88 A-89
14	BWR/ PWR	Steel piping, piping component, and piping elements exposed to lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.7.1)	AP-30
15	BWR/ PWR	Steel reactor coolant pump oil collection system piping, tubing, and valve bodies exposed to lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.7.1)	A-83
16	BWR/ PWR	Steel reactor coolant pump oil collection system tank exposed to lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection to evaluate the thickness of the lower portion of the tank	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.7.1)	A-82
17	BWR	Steel piping, piping components, and piping elements exposed to treated water	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.7.2)	A-35

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
18	BWR/ PWR	Stainless steel and steel diesel engine exhaust piping, piping components, and piping elements exposed to diesel exhaust	Loss of material/ general (steel only), pitting and crevice corrosion	A plant specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.3.2.2.7.3)	A-27
19	BWR/ PWR	Steel (with or without coating or wrapping) piping, piping components, and piping elements exposed to soil	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	No Yes, detection of aging effects and operating experience are to be further evaluated (See subsection 3.3.2.2.8)	A-01
20	BWR/ PWR	Steel piping, piping components, piping elements, and tanks exposed to fuel oil	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion, and fouling	Fuel Oil Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.9.1)	A-30
21	BWR/ PWR	Steel heat exchanger components exposed to lubricating oil	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion, and fouling	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.9.2)	AP-39
22	BWR/ PWR	Steel with elastomer lining or stainless steel cladding piping, piping components, and piping elements exposed to treated water and treated borated water	Loss of material due to pitting and crevice corrosion (only for steel after lining/cladding degradation)	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.10.1)	A-39 A-40

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
23	BWR	Stainless steel and steel with stainless steel cladding heat exchanger components exposed to treated water	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.10.2)	A-70
24	BWR/ PWR	Stainless steel and aluminum piping, piping components, and piping elements exposed to treated water	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.10.2)	A-58 AP-38
25	BWR/ PWR	Copper alloy HVAC piping, piping components, piping elements exposed to condensation (external)	Loss of material due to pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.3.2.2.10.3)	A-46
26	BWR/ PWR	Copper alloy piping, piping components, and piping elements exposed to lubricating oil	Loss of material due to pitting and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.10.4)	AP-47
27	BWR/ PWR	Stainless steel HVAC ducting and aluminum HVAC piping, piping components and piping elements exposed to condensation	Loss of material due to pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.3.2.2.10.5)	A-09 AP-74
28	BWR/ PWR	Copper alloy fire protection piping, piping components, and piping elements exposed to condensation (internal)	Loss of material due to pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.3.2.2.10.6)	AP-78
29	BWR/ PWR	Stainless steel piping, piping components, and piping elements exposed to soil	Loss of material due to pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.3.2.2.10.7)	AP-56

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
30	BWR	Stainless steel piping, piping components, and piping elements exposed to sodium pentaborate solution	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.10.8)	AP-73
31	BWR	Copper alloy piping, piping components, and piping elements exposed to treated water	Loss of material due to pitting, crevice, and galvanic corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.11)	AP-64
32	BWR/ PWR	Stainless steel, aluminum and copper alloy piping, piping components, and piping elements exposed to fuel oil	Loss of material due to pitting, crevice, and microbiologically influenced corrosion	Fuel Oil Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.12.1)	AP-35 AP-44 AP-54
33	BWR/ PWR	Stainless steel piping, piping components, and piping elements exposed to lubricating oil	Loss of material due to pitting, crevice, and microbiologically influenced corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.12.2)	AP-59
34	BWR/ PWR	Elastomer seals and components exposed to air – indoor uncontrolled (internal or external)	Loss of material due to Wear	A plant specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.3.2.2.13)	A-18 A-73

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report						
ID	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Related Item**
35	PWR	Steel with stainless steel cladding pump casing exposed to treated borated water	Loss of material due to cladding breach	A plant-specific aging management program is to be evaluated. Reference NRC Information Notice 94-63, "Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks."	Yes, verify plant-specific program addresses cladding breach (See subsection 3.3.2.2.14)	AP-85
36	BWR	Boraflex spent fuel storage racks neutron-absorbing sheets exposed to treated water	Reduction of neutron-absorbing capacity due to boraflex degradation	Boraflex Monitoring	No	A-87
37	BWR	Stainless steel piping, piping components, and piping elements exposed to treated water >60°C (>140°F)	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	BWR Reactor Water Cleanup System	No	A-60
38	BWR	Stainless steel piping, piping components, and piping elements exposed to treated water >60°C (>140°F)	Cracking due to stress corrosion cracking	BWR Stress Corrosion Cracking and Water Chemistry	No	A-61
39	BWR	Stainless steel BWR spent fuel storage racks exposed to treated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Water Chemistry	No	A-96
40	BWR/ PWR	Steel tanks in diesel fuel oil system exposed to air - outdoor (external)	Loss of material due to general, pitting, and crevice corrosion	Aboveground Steel Tanks	No	A-95
41	BWR/ PWR	High-strength steel closure bolting exposed to air with steam or water leakage	Cracking due to cyclic loading, stress corrosion cracking	Bolting Integrity	No	A-04
42	BWR/ PWR	Steel closure bolting exposed to air with steam or water leakage	Loss of material due to general corrosion	Bolting Integrity	No	A-03

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
43	BWR/ PWR	Steel bolting and closure bolting exposed to air – indoor uncontrolled (external) or air – outdoor (External)	Loss of material due to general, pitting, and crevice corrosion	Bolting Integrity	No	AP-27 AP-28
44	BWR/ PWR	Steel compressed air system closure bolting exposed to condensation	Loss of material due to general, pitting, and crevice corrosion	Bolting Integrity	No	A-103
45	BWR/ PWR	Steel closure bolting exposed to air – indoor uncontrolled (external)	Loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	No	AP-26
46	BWR/ PWR	Stainless steel and stainless clad steel piping, piping components, piping elements, and heat exchanger components exposed to closed cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	Closed-Cycle Cooling Water System	No	A-68 AP-60
47	BWR/ PWR	Steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to closed cycle cooling water	Loss of material due to general, pitting, and crevice corrosion	Closed-Cycle Cooling Water System	No	A-25
48	BWR/ PWR	Steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to closed cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	A-63
49	BWR/ PWR	Stainless steel; steel with stainless steel cladding heat exchanger components exposed to closed cycle cooling water	Loss of material due to microbiologically influenced corrosion	Closed-Cycle Cooling Water System	No	A-67
50	BWR/ PWR	Stainless steel piping, piping components, and piping elements exposed to closed cycle cooling water	Loss of material due to pitting and crevice corrosion	Closed-Cycle Cooling Water System	No	A-52

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
51	BWR/ PWR	Copper alloy piping, piping components, piping elements, and heat exchanger components exposed to closed cycle cooling water	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	AP-12 AP-34
52	BWR/ PWR	Steel, stainless steel, and copper alloy heat exchanger tubes exposed to closed cycle cooling water	Reduction of heat transfer due to fouling	Closed-Cycle Cooling Water System	No	AP-63 AP-77 AP-80
53	BWR/ PWR	Steel compressed air system piping, piping components, and piping elements exposed to condensation (internal)	Loss of material due to general and pitting corrosion	Compressed Air Monitoring	No	A-26
54	BWR/ PWR	Stainless steel compressed air system piping, piping components, and piping elements exposed to internal condensation	Loss of material due to pitting and crevice corrosion	Compressed Air Monitoring	No	AP-81
55	BWR/ PWR	Steel ducting closure bolting exposed to air – indoor uncontrolled (external)	Loss of material due to general corrosion	External Surfaces Monitoring	No	A-105
56	BWR/ PWR	Steel HVAC ducting and components external surfaces exposed to air – indoor uncontrolled (external)	Loss of material due to general corrosion	External Surfaces Monitoring	No	A-10
57	BWR/ PWR	Steel piping and components external surfaces exposed to air – indoor uncontrolled (External)	Loss of material due to general corrosion	External Surfaces Monitoring	No	A-80

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
58	BWR/ PWR	Steel external surfaces exposed to air – indoor uncontrolled (external), air - outdoor (external), and condensation (external)	Loss of material due to general corrosion	External Surfaces Monitoring	No	A-77 A-78 A-81
59	BWR/ PWR	Steel heat exchanger components exposed to air – indoor uncontrolled (external) or air -outdoor (external)	Loss of material due to general, pitting, and crevice corrosion	External Surfaces Monitoring	No	AP-40 AP-41
60	BWR/ PWR	Steel piping, piping components, and piping elements exposed to air - outdoor (external)	Loss of material due to general, pitting, and crevice corrosion	External Surfaces Monitoring	No	A-24
61	BWR/ PWR	Elastomer fire barrier penetration seals exposed to air – outdoor or air - indoor uncontrolled	Increased hardness, shrinkage and loss of strength due to weathering	Fire Protection	No	A-19 A-20
62	BWR/ PWR	Aluminum piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting and crevice corrosion	Fire Protection	No	AP-83
63	BWR/ PWR	Steel fire rated doors exposed to air – outdoor or air - indoor uncontrolled	Loss of material due to Wear	Fire Protection	No	A-21 A-22
64	BWR/ PWR	Steel piping, piping components, and piping elements exposed to fuel oil	Loss of material due to general, pitting, and crevice corrosion	Fire Protection and Fuel Oil Chemistry	No	A-28
65	BWR/ PWR	Reinforced concrete structural fire barriers – walls, ceilings and floors exposed to air – indoor uncontrolled	Concrete cracking and spalling due to aggressive chemical attack, and reaction with aggregates	Fire Protection and Structures Monitoring Program	No	A-90

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
66	BWR/ PWR	Reinforced concrete structural fire barriers – walls, ceilings and floors exposed to air – outdoor	Concrete cracking and spalling due to freeze thaw, aggressive chemical attack, and reaction with aggregates	Fire Protection and Structures Monitoring Program	No	A-92
67	BWR/ PWR	Reinforced concrete structural fire barriers – walls, ceilings and floors exposed to air – outdoor or air - indoor uncontrolled	Loss of material due to corrosion of embedded steel	Fire Protection and Structures Monitoring Program	No	A-91 A-93
68	BWR/ PWR	Steel piping, piping components, and piping elements exposed to raw water	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion, and fouling	Fire Water System	No	A-33
69	BWR/ PWR	Stainless steel piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting and crevice corrosion, and fouling	Fire Water System	No	A-55
70	BWR/ PWR	Copper alloy piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting, crevice, and microbiologically influenced corrosion, and fouling	Fire Water System	No	A-45
71	BWR/ PWR	Steel piping, piping components, and piping elements exposed to moist air or condensation (Internal)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	A-23
72	BWR/ PWR	Steel HVAC ducting and components internal surfaces exposed to condensation (Internal)	Loss of material due to general, pitting, crevice, and (for drip pans and drain lines) microbiologically influenced corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	A-08

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
73	BWR/ PWR	Steel crane structural girders in load handling system exposed to air- indoor uncontrolled (external)	Loss of material due to general corrosion	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	No	A-07
74	BWR/ PWR	Steel cranes - rails exposed to air – indoor uncontrolled (external)	Loss of material due to Wear	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	No	A-05
75	BWR/ PWR	Elastomer seals and components exposed to raw water	Hardening and loss of strength due to elastomer degradation; loss of material due to erosion	Open-Cycle Cooling Water System	No	AP-75 AP-76
76	BWR/ PWR	Steel piping, piping components, and piping elements (without lining/coating or with degraded lining/coating) exposed to raw water	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion, fouling, and lining/coating degradation	Open-Cycle Cooling Water System	No	A-38
77	BWR/ PWR	Steel heat exchanger components exposed to raw water	Loss of material due to general, pitting, crevice, galvanic, and microbiologically influenced corrosion, and fouling	Open-Cycle Cooling Water System	No	A-64
78	BWR/ PWR	Stainless steel, nickel alloy, and copper alloy piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting and crevice corrosion	Open-Cycle Cooling Water System	No	A-43 A-53 AP-53
79	BWR/ PWR	Stainless steel piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting and crevice corrosion, and fouling	Open-Cycle Cooling Water System	No	A-54

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report						
ID	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Related Item**
80	BWR/ PWR	Stainless steel and copper alloy piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting, crevice, and microbiologically influenced corrosion	Open-Cycle Cooling Water System	No	AP-45 AP-55
81	BWR/ PWR	Copper alloy piping, piping components, and piping elements, exposed to raw water	Loss of material due to pitting, crevice, and microbiologically influenced corrosion, and fouling	Open-Cycle Cooling Water System	No	A-44
82	BWR/ PWR	Copper alloy heat exchanger components exposed to raw water	Loss of material due to pitting, crevice, galvanic, and microbiologically influenced corrosion, and fouling	Open-Cycle Cooling Water System	No	A-65
83	BWR/ PWR	Stainless steel and copper alloy heat exchanger tubes exposed to raw water	Reduction of heat transfer due to fouling	Open-Cycle Cooling Water System	No	A-72 AP-61
84	BWR/ PWR	Copper alloy >15% Zn piping, piping components, piping elements, and heat exchanger components exposed to raw water, treated water, or closed cycle cooling water	Loss of material due to selective leaching	Selective Leaching of Materials	No	A-47 A-66 AP-32 AP-43 AP-65
85	BWR/ PWR	Gray cast iron piping, piping components, and piping elements exposed to soil, raw water, treated water, or closed-cycle cooling water	Loss of material due to selective leaching	Selective Leaching of Materials	No	A-02 A-50 A-51 AP-31
86	BWR/ PWR	Structural steel (new fuel storage rack assembly) exposed to air – indoor uncontrolled (external)	Loss of material due to general, pitting, and crevice corrosion	Structures Monitoring Program	No	A-94

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
87	PWR	Boraflex spent fuel storage racks neutron-absorbing sheets exposed to treated borated water	Reduction of neutron-absorbing capacity due to boraflex degradation	Boraflex Monitoring	No	A-86
88	PWR	Aluminum and copper alloy >15% Zn piping, piping components, and piping elements exposed to air with borated water leakage	Loss of material due to Boric acid corrosion	Boric Acid Corrosion	No	AP-1 AP-66
89	PWR	Steel bolting and external surfaces exposed to air with borated water leakage	Loss of material due to Boric acid corrosion	Boric Acid Corrosion	No	A-79 A-102
90	PWR	Stainless steel and steel with stainless steel cladding piping, piping components, piping elements, tanks, and fuel storage racks exposed to treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Water Chemistry	No	A-56 A-97 AP-82
91	PWR	Stainless steel and steel with stainless steel cladding piping, piping components, and piping elements exposed to treated borated water	Loss of material due to pitting and crevice corrosion	Water Chemistry	No	AP-79
92	BWR/ PWR	Galvanized steel piping, piping components, and piping elements exposed to air – indoor uncontrolled	None	None	NA - No AEM or AMP	AP-13

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report						
ID	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Related Item**
93	BWR/ PWR	Glass piping elements exposed to air, air – indoor uncontrolled (external), fuel oil, lubricating oil, raw water, treated water, and treated borated water	None	None	NA - No AEM or AMP	AP-14 AP-15 AP-48 AP-49 AP-50 AP-51 AP-52
94	BWR/ PWR	Stainless steel and nickel alloy piping, piping components, and piping elements exposed to air – indoor uncontrolled (external)	None	None	NA - No AEM or AMP	AP-16 AP-17
95	BWR/ PWR	Steel and aluminum piping, piping components, and piping elements exposed to air – indoor controlled (external)	None	None	NA - No AEM or AMP	AP-2 AP-36
96	BWR/ PWR	Steel and stainless steel piping, piping components, and piping elements in concrete	None	None	NA - No AEM or AMP	AP-3 AP-19
97	BWR/ PWR	Steel, stainless steel, aluminum, and copper alloy piping, piping components, and piping elements exposed to gas	None	None	NA - No AEM or AMP	AP-6 AP-9 AP-22 AP-37
98	BWR/ PWR	Steel, stainless steel, and copper alloy piping, piping components, and piping elements exposed to dried air	None	None	NA - No AEM or AMP	AP-4 AP-8 AP-20
99	PWR	Stainless steel and copper alloy <15% Zn piping, piping components, and piping elements exposed to air with borated water leakage	None	None	NA - No AEM or AMP	AP-11 AP-18

Table 3.3-2. FSAR Supplement for Aging Management of Auxiliary Systems		
Program	**Description of Program**	**Implementation Schedule***
Aboveground Steel Tanks	This program includes preventive measures to mitigate corrosion by protecting the external surface of steel components, per standard industry practice, with sealant or caulking at the interface of concrete and component. Visual inspection during periodic system walk downs should be sufficient to monitor degradation of the protective paint, coating, calking, or sealant. Verification of the effectiveness of the program by measuring the thickness of the tank bottoms ensures that significant degradation is not occurring and that the component intended function will be maintained during the period of extended operation.	Existing program
Bolting Integrity	This program relies on recommendations for a comprehensive bolting integrity program, as delineated in NUREG-1339, and industry recommendations, as delineated in the Electric Power Research Institute (EPRI) NP-5769, with the exceptions noted in NUREG-1339 for safety-related bolting. The program relies on industry recommendations for a comprehensive bolting maintenance, as delineated in the EPRI TR-104213 for pressure retaining bolting and structural bolting. The program generally includes periodic inspection of closure bolting for indication of loss of preload, cracking, and loss of material due to corrosion, rust, etc. The program also includes preventive measures to preclude or minimize loss of preload and cracking. Other aging management programs, such as XI.M1, “ASME Section XI Inservice Inspection (ISI) Subsections IWB, IWC, and IWD” and XI.S3, “ASME Section XI Subsection IWF” also manage inspection of safety-related bolting and supplement this bolting integrity program. This program covers bolting within the scope of license renewal, including:1) safety-related bolting, 2) bolting for nuclear steam supply system (NSSS) component supports, 3) bolting for other pressure retaining components, including non-safety-related bolting, and 4) structural bolting (actual measured yield strength $\geq$ 150 ksi).	Existing program

Table 3.3-2. FSAR Supplement for Aging Management of Auxiliary Systems		
Program	**Description of Program**	**Implementation Schedule***
Boraflex Monitoring	The program consists of (1) neutron attenuation testing (“blackness testing”) to determine gap formation, (2) sampling for the presence of silica in the spent fuel pool along with boron loss, and (3) monitoring and analysis of criticality to assure that the required 5% subcriticality margin is maintained. This program is implemented in response to GL 96-04.	Existing program
Boric Acid Corrosion	This program consists of (1) visual inspection external surfaces that are potentially exposed to borated water leakage, (2) timely discovery of leak path and removal of the boric acid residues, (3) assessment of the damage, and (4) follow-up inspection for adequacy. This program is implemented in response to GL 88-05 and recent operating experience.	Existing program
Buried Piping And Tanks Inspection	The program includes (1) preventive measures to mitigate corrosion, and (2) periodic inspection to manage the effects of corrosion on the pressure-retaining capacity of buried steel piping and tanks. Preventive measures are in accordance with standard industry practice for maintaining external coatings and wrappings and cathodic protection. As an alternative, buried piping and tanks are inspected visually for any evidence of damage when they are excavated during maintenance and when a pipe is dug up and inspected for any reason with a frequency that is based on operating experience.	Program should be implemented before the period of extended operation.
Buried Piping And Tanks Surveillance	The program includes preventive measures to mitigate corrosion by protecting the external surface of buried piping and components, e.g., coating, wrapping, and a cathodic protection system. The program also includes surveillance and monitoring of the coating conductance versus time or current. This program is based on standard industry practices as described in NACE-RP-0285-95 and RP-0169-96.	Existing program
BWR Reactor Water Cleanup System	The program includes inservice inspection (ISI) and monitoring and control of reactor coolant water chemistry. Related to the inspection guidelines for RWCU piping welds outboard of the second isolation valve, the program includes measures delineated in NUREG-0313, Rev. 2, and NRC Generic Letter (GL) 88-01 and ISI in conformance with the American Society of Mechanical Engineers (ASME) Section XI.	Existing program

Table 3.3-2. FSAR Supplement for Aging Management of Auxiliary Systems		
Program	**Description of Program**	**Implementation Schedule***
BWR Stress Corrosion Cracking	The program to manage intergranular stress corrosion cracking (IGSCC) in boiling water reactor coolant pressure boundary piping made of stainless steel (SS) is delineated, in part, in NUREG-0313, Rev. 2, and Nuclear Regulatory Commission (NRC) Generic Letter (GL) 88-01 and its Supplement 1. The program includes (a) preventive measures to mitigate IGSCC and (b) inspections to monitor IGSCC and its effects	Existing program
Closed-Cycle Cooling Water System	The program relies on preventive measures to minimize corrosion and SCC by maintaining inhibitors and by performing non-chemistry monitoring consisting of inspection and nondestructive evaluations based on the guidelines of EPRI-TR-107396 for closed–cycle cooling water systems.	Existing program
Compressed Air Monitoring	The program consists of inspection, monitoring, and testing of the entire system, including (1) frequent leak testing valves, piping, and other system components, especially those made of steel; and (2) preventive monitoring that checks air quality at various locations in the system to ensure that oil, water, rust, dirt, and other contaminants are kept within the specified limits. This program is in response to NRC GL 88-14 and INPO's Significant Operating Experience Report (SOER) 88-01. It also relies on the ASME OM Guide Part 17, and ISA-S7.0.1-1996 as guidance for testing and monitoring air quality and moisture.	Existing program
External Surfaces Monitoring Program	The program is based on system inspections and walkdowns. This program consists of periodic visual inspections of components such as piping, piping components, ducting, and other equipment within the scope of license renewal and subject to aging management review in order to manage aging effects. The program manages aging effects through visual inspection of external surfaces for evidence of material loss and leakage. Loss of material due to boric acid corrosion is managed by the Boric Acid Corrosion Program. Surfaces that are inaccessible during plant operations are inspected during refueling outages. Surfaces that are inaccessible during both plant operations and refueling outages are inspected at frequencies to provide reasonable assurance that effect of aging will be managed such that applicable components will perform their intended function during the period of extended operation.	Existing program

Table 3.3-2. FSAR Supplement for Aging Management of Auxiliary Systems		
Program	**Description of Program**	**Implementation Schedule***
Fire Protection	The program includes a fire barrier inspection program and a diesel-driven fire pump inspection program. The fire barrier inspection program requires periodic visual inspection of fire barrier penetration seals, fire barrier walls, ceilings, and floors, and periodic visual inspection and functional tests of fire rated doors to ensure that their operability is maintained. The diesel-driven fire pump inspection program requires that the pump be periodically tested to ensure that the fuel supply line can perform the intended function. The program also includes periodic inspection and test of halon/carbon dioxide fire suppression system.	Existing program
Fire Water System	To ensure no fouling has occurred in the fire protection system, periodic full flow flush test and system performance test are conducted to prevent corrosion from biofouling of components. Also, the system is normally maintained at required operating pressure and is monitored such that loss of system pressure is immediately detected and corrective actions initiated. The program relies on testing of water based fire protection system piping and components in accordance with applicable NFPA commitments. In addition, this program will be modified to included (1) portions of the fire protection sprinkler system that are subjected to full flow tests prior to the period of extended operation and (2) portions of the fire protection system exposed to water are internally visually inspected.	Program should be modified before the period of extended operation.
Fuel Oil Chemistry	The program relies on a combination of surveillance and maintenance procedures. Monitoring and controlling fuel oil contamination in accordance with the guidelines of ASTM Standards D1796, D2276, D2709, and D4057, maintains the fuel oil quality. Exposure to fuel oil contaminants such as water and microbiological organisms is minimized by periodic cleaning/draining of tanks and by verifying the quality of new oil before its introduction into the storage tanks.	Existing program

Table 3.3-2. FSAR Supplement for Aging Management of Auxiliary Systems		
Program	**Description of Program**	**Implementation Schedule***
Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (BWR/PWR)	The program visually inspects internal surfaces of steel piping, piping elements, ducting, and components in an internal environment (indoor uncontrolled air, condensation, and steam) that are not included in other aging management programs, for loss of material. Inspections are performed when the internal surfaces are accessible during the performance of periodic surveillance tests, during preventive maintenance activities or during scheduled outages. The program includes visual inspection to assure that existing environment conditions are not causing material degradation that could result in a loss of system intended functions.	Existing program
Inspection of Overhead Heavy Load and Light Load Handling System	The program evaluates the effectiveness of the maintenance monitoring program and the effects of past and future usage on the structural reliability of cranes and hoists. The number and magnitude of lifts made by the hoist or crane are also reviewed. Rails and girders are visually inspected on a routine basis for degradation. Functional tests are also performed to assure their integrity. These cranes must also comply with the maintenance rule requirements provided in 10 CFR 50.65.	Existing program
Lubricating Oil Analysis	This program ensures the oil environment in the mechanical systems is maintained to the required quality. The program maintains oil systems free of contaminants (primarily water and particulates) thereby preserving an environment that is not conducive to loss of material, cracking, or reduction of heat transfer. Lubricating oil testing activities include sampling and analysis of lubricating oil for detrimental contaminants. The presence of water or particulates may also be indicative of inleakage and corrosion product buildup.	Existing program
One-Time Inspection	This program verifies the effectiveness of other aging management program by determining if the aging effect is not occurring or the aging effect is progressing slowly so that the intended function will be maintained during the period of extended operation.	The inspection should be completed before the period of extended operation.

Table 3.3-2. FSAR Supplement for Aging Management of Auxiliary Systems		
Program	**Description of Program**	**Implementation Schedule***
Open-Cycle Cooling Water System	The program includes (1) surveillance and control of biofouling, (2) tests to verify heat transfer, (3) routine inspection and maintenance program, (4) system walk down inspection, and (5) review of maintenance, operating, and training practices and procedures. The program provides assurance that the open-cycle cooling water system is in compliance with General Design Criteria and Quality Assurance to ensure that the open-cycle cooling water (or service water) system can be managed for an extended period of operation. This program is in response to NRC GL 89-13.	Existing program
Plant-Specific AMP	The program should contain information associated with the basis for determining that aging effects will be managed during the period of extended operation.	Program should be implemented before the period of extended operation.
Selective Leaching of Materials	The program includes a hardness measurement of selected components that may be susceptible to selective leaching to determine whether loss of materials is occurring and whether the process will affect the ability of the components to perform their intended function for the period of extended operation. For systems subjected to environments where water is not treated (i.e., the open-cycle cooling water system and the ultimate heat sinks), the program also follows the guidance in NRC GL 89-13.	Program should be implemented before the period of extended operation.
Structures Monitoring Program	The program consists of periodic inspection and monitoring the condition of structures and structure component supports to ensure that aging degradation leading to loss of intended functions will be detected and that the extent of degradation can be determined. This program is implemented in accordance with NEI 93-01, Rev. 2 and Regulatory Guide 1.160, Rev. 2.	Existing program
Water Chemistry	This program mitigate aging effects on component surfaces that are exposed to water as process fluid, chemistry programs are used to control water impurities (e.g., chloride, fluoride, sulfate) that accelerate corrosion. The water chemistry program relies on monitoring and control of water chemistry based on EPRI guidelines.	Existing program

* An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.4 AGING MANAGEMENT OF STEAM AND POWER CONVERSION SYSTEM

Review Responsibilities

Primary- Branch assigned responsibility by PM as described in Section 3.0 of this SRP-LR.

3.4.1 Areas of Review

This section addresses the aging management review (AMR) and the associated aging management program (AMP) of the steam and power conversion system. For a recent vintage plant, the information related to the steam and power conversion system is contained in Chapter 10, "Steam and Power Conversion System," of the plant's FSAR, consistent with the "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG-0800). The steam and power conversion systems contained in this review plan section are generally consistent with those contained in NUREG-0800 except for the condenser circulating water and the condensate storage systems. For older plants, the location of applicable information is plant-specific because an older plant's FSAR may have predated NUREG-0800.

Typical steam and power conversion systems that are subject to an AMR for license renewal are steam turbine, main steam, extraction steam, feedwater, condensate, steam generator blowdown, and auxiliary feedwater. This review plan section also includes structures and components in non-safety related systems that are not connected to safety related SSCs but have a spatial relationship such that their failure could adversely impact the performance of a safety related SSC intended function. Examples of such non-safety related systems may be extraction steam, plant heating steam/auxiliary boiler and hot water heating systems.

The aging management for the steam generator is reviewed following the guidance in Section 3.1 of this SRP-LR. The aging management for portions of the BWR main steam and main feedwater systems, extending from the reactor vessel to the outermost containment isolation valve, is reviewed separately following the guidance in Section 3.1 of this SRP-LR.

The responsible review organization is to review the following LRA AMR and AMP items assigned to it, per SRP-LR Section 3.0:

AMRs
- AMR results consistent with the GALL Report
- AMR results for which further evaluation is recommended by the GALL Report
- AMR results not consistent with or not addressed in the GALL Report

AMPs
- Consistent with GALL Report AMPs
- Plant-specific AMPs

FSAR Supplement
- The responsible review organization is to review the FSAR Supplement associated with each assigned AMP.

3.4.2 Acceptance Criteria

The acceptance criteria for the areas of review describe methods for determining whether the applicant has met the requirements of the NRC's regulations in 10 CFR 54.21.

3.4.2.1 AMR Results Consistent with the GALL Report

The AMR and the AMPs applicable to the steam and power conversion system are described and evaluated in Chapter VIII of NUREG-1801 (GALL Report).

The applicant's LRA should provide sufficient information so that the NRC reviewer is able to confirm that the specific LRA AMR line-item and the associated LRA AMP are consistent with the cited GALL Report AMR line-item. The reviewer should then confirm that the LRA AMR line-item is consistent with the GALL Report AMR line-item to which it is compared.

For AMPs, if the applicant identifies an exception to any of the program elements of the cited GALL Report AMP, the LRA AMP should include a basis demonstrating how the criteria of 10 CFR 54.21(a)(3) would still be met. The NRC reviewer should then confirm that the LRA AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the LRA AMP, the reviewer identifies a difference from the GALL Report AMP that should have been identified as an exception to the GALL Report AMP, this difference should be reviewed and properly dispositioned.. The reviewer should document the disposition of all LRA-defined exceptions and staff-identified differences.

The LRA should identify any enhancements that are needed to permit an existing LRA AMP to be declared consistent with the GALL Report AMP to which the LRA AMP is compared. The reviewer is to confirm both that the enhancement, when implemented, would allow the existing LRA AMP to be consistent with the GALL Report AMP and also that the applicant has a commitment in the FSAR Supplement to implement the enhancement prior to the period of extended operation. The reviewer should document the disposition of all enhancements.

3.4.2.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

The basic acceptance criteria defined in Subsection 3.4.2.1 apply to all of the AMRs and AMPs reviewed as part of this section. In addition, if the GALL Report AMR line-item to which the LRA AMR line-item is compared identifies that further evaluation is recommended, then additional criteria apply as identified by the GALL Report for each of the following aging effect/aging mechanism combinations.

3.4.2.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). This TLAA is addressed separately in Section 4.3, "Metal Fatigue Analysis" of this SRP-LR.

3.4.2.2.2 Loss of Material due to General, Pitting, and Crevice Corrosion

1. Loss of material due to general, pitting and crevice corrosion could occur for steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water and for steel piping, piping components, and piping elements exposed to steam. The existing aging management program relies on monitoring and control of water chemistry to manage the effects of loss of material due to general, pitting, and crevice corrosion. However, control of water chemistry does not preclude loss of material due to general, pitting, and crevice corrosion at locations of stagnant flow conditions. Therefore, the

effectiveness of the water chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the water chemistry control program. A one-time inspection of select components and susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

2. Loss of material due to general, pitting and crevice corrosion could occur for steel piping, piping components, and piping elements exposed to lubricating oil. The existing aging management program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil contaminant control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lube oil chemistry control program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.4.2.2.3 Loss of Material due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion (MIC), and Fouling

Loss of material due to general, pitting, crevice, and MIC, and fouling could occur in steel piping, piping components, and piping elements exposed to raw water. The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

3.4.2.2.4 Reduction of Heat Transfer due to Fouling

1. Reduction of heat transfer due to fouling could occur for stainless steel and copper alloy heat exchanger tubes exposed to treated water. The existing aging management program relies on control of water chemistry to manage reduction of heat transfer due to fouling. However, control of water chemistry may not always have been adequate to preclude fouling. Therefore, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure that reduction of heat transfer due to fouling is not occurring. A one-time inspection is an acceptable method to ensure that reduction of heat transfer is not occurring and that the component's intended function will be maintained during the period of extended operation.

2. Reduction of heat transfer due to fouling could occur for steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil. The existing aging management program relies on monitoring and control of lube oil chemistry to mitigate reduction of heat transfer due to fouling. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil contaminant control should be verified to ensure that fouling is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of lube oil chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect

is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

3.4.2.2.5 Loss of Material due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion

1. Loss of material due to general, pitting and crevice corrosion, and MIC could occur in steel (with or without coating or wrapping) piping, piping components, piping elements and tanks exposed to soil. The buried piping and tanks inspection program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general corrosion, pitting and crevice corrosion, and MIC. The effectiveness of the buried piping and tanks inspection program should be verified to evaluate an applicant's inspection frequency and operating experience with buried components, ensuring that loss of material is not occurring.

2. Loss of material due to general, pitting and crevice corrosion, and MIC could occur in steel heat exchanger components exposed to lubricating oil. The existing aging management program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil contaminant control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lube oil chemistry control program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.4.2.2.6 Cracking due to Stress Corrosion Cracking (SCC)

Cracking due to SCC could occur in the stainless steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water greater than 60°C (>140°F), and for stainless steel piping, piping components, and piping elements exposed to steam. The existing aging management program relies on monitoring and control of water chemistry to manage the effects of cracking due to SCC. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause SCC. Therefore, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure that SCC is not occurring. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that SCC is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.4.2.2.7 Loss of Material due to Pitting and Crevice Corrosion

1. Loss of material due to pitting and crevice corrosion could occur for stainless steel, aluminum, and copper alloy piping, piping components and piping elements and for stainless steel tanks and heat exchanger components exposed to treated water. The existing aging management program relies on monitoring and control of water chemistry to manage the effects of loss of material due to pitting, and crevice corrosion. However, control of water chemistry does not preclude corrosion at locations of stagnant flow conditions. Therefore, the GALL Report recommends that the effectiveness of the water chemistry program should be verified to ensure that corrosion is not occurring. A one-time inspection

of select components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

2. Loss of material due to pitting and crevice corrosion could occur for stainless steel piping, piping components, and piping elements exposed to soil. The GALL Report recommends further evaluation of a plant-specific aging management to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

3. Loss of material due to pitting and crevice corrosion could occur for copper alloy piping, piping components, and piping elements exposed to lubricating oil. The existing aging management program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil contaminant control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lube oil chemistry control program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.4.2.2.8 Loss of Material due to Pitting, Crevice, and Microbiologically-Influenced Corrosion

Loss of material due to pitting, crevice, and MIC could occur in stainless steel piping, piping components, piping elements, and heat exchanger components exposed to lubricating oil. The existing aging management program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil contaminant control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lube oil chemistry control program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.4.2.2.9 Loss of Material due to General, Pitting, Crevice, and Galvanic Corrosion

Loss of material due to general, pitting, crevice, and galvanic corrosion can occur for steel heat exchanger components exposed to treated water. The existing aging management program relies on monitoring and control of water chemistry to manage the effects of loss of material due to general, pitting, and crevice corrosion. However, control of water chemistry does not preclude loss of material due to general, pitting, and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the water chemistry control program. A one-time inspection of select components and susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.4.2.2.10 Quality Assurance for Aging Management of Nonsafety-Related Components

Acceptance criteria are described in Branch Technical Position IQMB-1 (Appendix A.2 of this SRP-LR.)

3.4.2.3 AMR Results Not Consistent with or Not Addressed in the GALL Report

Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

3.4.2.4 FSAR Supplement

The summary description of the programs and activities for managing the effects of aging for the period of extended operation in the FSAR Supplement should be sufficiently comprehensive such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the bases for determining that aging effects will be managed during the period of extended operation. The description should also contain any future aging management activities, including enhancements and commitments, to be completed before the period of extended operation. Examples of the type of information to be included are provided in Table 3.4-2 of this SRP-LR.

3.4.3 Review Procedures

For each area of review, the following review procedures are to be followed:

3.4.3.1 AMR Results Consistent with the GALL Report

The applicant may reference the GALL Report in its LRA, as appropriate, and demonstrate that the AMRs and AMPs at its facility are consistent with those reviewed and approved in the GALL Report. The reviewer should not conduct a re-review of the substance of the matters described in the GALL Report. If the applicant has provided the information necessary to adopt the finding of program acceptability as described and evaluated in the GALL Report, the reviewer should find acceptable the applicant’s reference to the GALL Report in its LRA. In making this determination, the reviewer confirms that the applicant has provided a brief description of the system, components, materials, and environment. The reviewer also confirms that the applicant has stated that the applicable aging effects and industry and plant-specific operating experience have been reviewed by the applicant and are evaluated in the GALL Report.

Furthermore, the reviewer should confirm that the applicant has addressed operating experience identified after the issuance of the GALL Report. Performance of this review requires the reviewer to confirm that the applicant has identified those aging effects for the steam and power conversion system components that are contained in the GALL Report as applicable to its plant.

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL Report. If the applicant commits to an enhancement to make its LRA AMP consistent with a GALL Report AMP, then the reviewer is to confirm that this enhancement, when implemented, will make the LRA AMP consistent with the GALL Report AMP. If the applicant identifies, in the LRA AMP, an exception to any of the program elements of the GALL Report AMP with which the applicant is claiming to be consistent, the reviewer is to confirm that the LRA AMP with the exception will satisfy the criteria of 10 CFR 54.21(a)(3). If the reviewer identifies a difference, not identified by the LRA, between the LRA AMP and the GALL Report AMP with which the LRA claims to be consistent, the reviewer should confirm that the LRA AMP with this difference satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions or differences. The AMPs evaluated in GALL Report pertinent to the steam and power conversion system are summarized in Table 3.4-1 of this SRP-LR. In this table, the ID column provides a row identifier useful in matching the information presented in the corresponding table in the GALL Report, Vol. 1. The Related Item column identifies the item number in the GALL Report, Vol. 2, Chapters II through VIII, presenting detailed information summarized by this row.

3.4.3.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

The basic review procedures defined in Subsection 3.4.3.1 apply to all of the AMRs and AMPs provided in this section. In addition, if the GALL Report AMR line-item to which the LRA AMR line-item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL Report for each of the following aging effect/aging mechanism combinations.

3.4.3.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The reviewer reviews the evaluation of this TLAA separately following the guidance in Section 4.3 of this SRP-LR.

3.4.3.2.2 Loss of Material due to General, Pitting, and Crevice Corrosion

1. The GALL Report recommends further evaluation of programs to manage the loss of material due to general, pitting and crevice corrosion for steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water and for steel piping, piping components, and piping elements exposed to steam. The existing aging management program relies on monitoring and control of water chemistry to manage the effects of loss of material due to general, pitting, and crevice corrosion. However, control of water chemistry does not preclude corrosion from occurring at locations of stagnant flow conditions. Therefore, the effectiveness of the chemistry control program should be verified to ensure that significant degradation is not occurring and that the component's intended function will be maintained during the period of extended operation. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the program to confirm that it includes adequate measures to determine if unacceptable degradation is occurring and provide reasonable assurance that component intended functions will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components and susceptible locations to ensure that unacceptable degradation is not occurring, the reviewer verifies (1) that the applicant's selection of susceptible locations is based on appropriate considerations such as severity of conditions, time of service, and lowest design margin (2) that the proposed inspections will be performed using appropriate (volumetric and surface) techniques, for example similar to ASME Code and ASTM standards including visual, ultrasonic, and surface techniques (3) follow-up actions are to be based on the inspection results and (4) the sample size and the timing of inspections will provide reasonable assurance that, if unacceptable degradation is occurring, it will be found before applicable component intended functions can no longer be performed.

2. The GALL Report recommends further evaluation of programs to manage the loss of material due to general, pitting, and crevice corrosion for steel piping, piping components, and piping elements exposed to lubricating oil. The existing aging management program relies on monitoring and control of lubricating oil contamination to maintain contaminants within acceptable limits. The effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the program to confirm that it includes adequate measures to determine if unacceptable degradation is occurring and provide reasonable assurance that component intended functions will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components and susceptible locations to ensure that unacceptable degradation is not occurring, the reviewer verifies (1) that the applicant's selection of susceptible locations is based on appropriate considerations such as severity of conditions, time of service, and lowest design margin (2) that the proposed inspections will be performed using appropriate (volumetric and surface) techniques, for example similar to ASME Code and ASTM standards including visual, ultrasonic, and surface techniques (3) follow-up actions are to be based on the inspection results and (4) the sample size and the timing of inspections will provide reasonable assurance that, if unacceptable degradation is occurring, it will be found before applicable component intended functions can no longer be performed.

3.4.3.2.3 Loss of Material due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion, and Fouling

The GALL Report recommends further evaluation of programs to manage the loss of material due to general, pitting, crevice, and MIC, and fouling for steel piping, piping components, and piping elements exposed to raw water. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate aging management program will be in place for the management of these aging effects.

3.4.3.2.4 Reduction of Heat Transfer due to Fouling

1. The GALL Report recommends further evaluation of programs to manage reduction of heat transfer due to fouling for stainless steel and copper alloy heat exchanger tubes exposed to treated water. The existing aging management program relies on control of water chemistry to mitigate reduction of heat transfer due to fouling. However, control of water chemistry may not always have been adequate to preclude fouling. Therefore, the effectiveness of the chemistry control program should be verified to ensure that significant degradation is not occurring and that the component's intended function will be maintained during the period of extended operation. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

The reviewer reviews the program to confirm that it includes adequate measures to determine if unacceptable degradation is occurring and provide reasonable assurance that component intended functions will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components and susceptible locations to ensure that unacceptable degradation is not occurring, the reviewer verifies (1) that the applicant's selection of susceptible locations is based on appropriate considerations such as severity of conditions, time of service, and lowest design margin (2) that the proposed inspections will be performed using appropriate (volumetric and surface) techniques, for example similar to ASME Code and ASTM standards including visual, ultrasonic, and surface techniques (3) follow-up actions are to be based on the inspection results and (4) the sample size and the timing of inspections will provide reasonable assurance that, if unacceptable degradation is occurring, it will be found before applicable component intended functions can no longer be performed.

2. The GALL Report recommends further evaluation of programs to manage reduction of heat transfer due to fouling for steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil. The existing aging management program relies on monitoring and control of lubricating oil contamination to maintain contaminants within acceptable limits. The effectiveness of lubricating oil control should be verified to ensure that fouling is not occurring and that the component's intended function will be maintained during the period of extended operation. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the program to confirm that it includes adequate measures to determine if unacceptable degradation is occurring and provide reasonable assurance that component intended functions will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components and susceptible locations to ensure that unacceptable degradation is not occurring, the reviewer verifies (1) that the applicant's selection of susceptible locations is based on appropriate considerations such as severity of conditions, time of service, and lowest design margin (2) that the proposed inspections will be performed using appropriate (volumetric and surface) techniques, for example similar to ASME Code and ASTM standards including visual, ultrasonic, and surface techniques (3) follow-up actions are to be based on the inspection results and (4) the sample size and the timing of inspections will provide reasonable assurance that, if unacceptable degradation is occurring, it will be found before applicable component intended functions can no longer be performed.

3.4.3.2.5 Loss of Material due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion

1. The GALL Report recommends further evaluation of programs to manage the loss of material due to general, pitting, crevice, and MIC for steel piping, piping elements, and piping components exposed to raw water. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate aging management program will be in place for the management of these aging effects.

2. The GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, crevice, and MIC of steel (with or without coating or wrapping) piping, piping components, piping elements and tanks exposed to soil. The buried piping and tanks

inspection program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general corrosion, pitting and crevice corrosion, and MIC. The reviewer reviews the applicant's program, including inspection frequency and operating experience with buried components, to assess the effectiveness of the buried piping and tanks inspection program in ensuring that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3. The GALL Report recommends further evaluation of programs to manage the loss of material due to general, pitting, crevice, and MIC for steel heat exchanger components exposed to lubricating oil. The existing aging management program relies on monitoring and control of lubricating oil contamination to maintain contaminants within acceptable limits. The effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the program to confirm that it includes adequate measures to determine if unacceptable degradation is occurring and provide reasonable assurance that component intended functions will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components and susceptible locations to ensure that unacceptable degradation is not occurring, the reviewer verifies (1) that the applicant's selection of susceptible locations is based on appropriate considerations such as severity of conditions, time of service, and lowest design margin (2) that the proposed inspections will be performed using appropriate (volumetric and surface) techniques, for example similar to ASME Code and ASTM standards including visual, ultrasonic, and surface techniques (3) follow-up actions are to be based on the inspection results and (4) the sample size and the timing of inspections will provide reasonable assurance that, if unacceptable degradation is occurring, it will be found before applicable component intended functions can no longer be performed.

3.4.3.2.6 Cracking due to Stress Corrosion Cracking

The GALL Report recommends further evaluation of programs to manage cracking due to SCC of stainless steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water greater than 60°C (>140°F), and for stainless steel piping, piping components, and piping elements exposed to steam. The existing aging management program relies on monitoring and control of water chemistry to manage the effects of cracking due to SCC. However, control of water chemistry does not preclude cracking from occurring at locations of stagnant flow conditions. Therefore, the effectiveness of the water chemistry control program should be reviewed to verify that cracking is not occurring and that the component's intended function would be maintained during the period of extended operation. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

The reviewer reviews the program to confirm that it includes adequate measures to determine if unacceptable degradation is occurring and provide reasonable assurance that component intended functions will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components and susceptible locations to ensure that unacceptable degradation is not occurring, the reviewer verifies (1) that the applicant's selection of susceptible locations is based on appropriate considerations such as severity of conditions, time of service, and lowest design margin (2) that the proposed inspections will be performed using appropriate (volumetric and surface) techniques, for example similar to ASME Code and ASTM standards including visual, ultrasonic, and surface techniques (3) follow-up actions are to be based on the inspection results and (4) the sample size and the timing of inspections will provide reasonable assurance that, if unacceptable degradation is occurring, it will be found before applicable component intended functions can no longer be performed.

3.4.3.2.7 Loss of Material due to Pitting and Crevice Corrosion

1. The GALL Report recommends further evaluation of programs to manage loss of material due to pitting and crevice corrosion for stainless steel piping, aluminum, and copper alloy piping components, piping elements, and for stainless steel tanks and heat exchanger components exposed to treated water. The existing aging management program relies on monitoring and control of water chemistry to manage corrosion. However, control of water chemistry does not preclude corrosion from occurring at locations of stagnant flow conditions. Therefore, the effectiveness of the chemistry control program should be verified to ensure that significant degradation is not occurring and that the component's intended function will be maintained during the period of extended operation. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the program to confirm that it includes adequate measures to determine if unacceptable degradation is occurring and provide reasonable assurance that component intended functions will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components and susceptible locations to ensure that unacceptable degradation is not occurring, the reviewer verifies (1) that the applicant's selection of susceptible locations is based on appropriate considerations such as severity of conditions, time of service, and lowest design margin (2) that the proposed inspections will be performed using appropriate (volumetric and surface) techniques, for example similar to ASME Code and ASTM standards including visual, ultrasonic, and surface techniques (3) follow-up actions are to be based on the inspection results and (4) the sample size and the timing of inspections will provide reasonable assurance that, if unacceptable degradation is occurring, it will be found before applicable component intended functions can no longer be performed.

2. The GALL Report recommends further evaluation of programs to manage loss of material due to pitting and crevice corrosion for stainless steel piping, piping components, piping elements exposed to soil. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate aging management program will be in place for the management of these aging effects.

3. The GALL Report recommends further evaluation of programs to manage the loss of material due to pitting and crevice corrosion for copper alloy piping, piping components, piping elements exposed to lubricating oil. The existing aging management program relies on monitoring and control of lubricating oil contamination to maintain contaminants within acceptable limits. However, control of lube oil contaminants may not always have been

adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

The reviewer reviews the program to confirm that it includes adequate measures to determine if unacceptable degradation is occurring and provide reasonable assurance that component intended functions will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components and susceptible locations to ensure that unacceptable degradation is not occurring, the reviewer verifies (1) that the applicant's selection of susceptible locations is based on appropriate considerations such as severity of conditions, time of service, and lowest design margin (2) that the proposed inspections will be performed using appropriate (volumetric and surface) techniques, for example similar to ASME Code and ASTM standards including visual, ultrasonic, and surface techniques (3) follow-up actions are to be based on the inspection results and (4) the sample size and the timing of inspections will provide reasonable assurance that, if unacceptable degradation is occurring, it will be found before applicable component intended functions can no longer be performed.

3.4.3.2.8 Loss of Material due to Pitting, Crevice, and Microbiologically-Influenced Corrosion

The GALL Report recommends further evaluation of programs to manage the loss of material due to general, pitting, crevice, and MIC for stainless steel piping, piping components, piping elements, and heat exchanger components exposed to lubricating oil. The existing aging management program relies on monitoring and control of lubricating oil contamination to maintain contaminants within acceptable limits. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

The reviewer reviews the program to confirm that it includes adequate measures to determine if unacceptable degradation is occurring and provide reasonable assurance that component intended functions will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components and susceptible locations to ensure that unacceptable degradation is not occurring, the reviewer verifies (1) that the applicant's selection of susceptible locations is based on appropriate considerations such as severity of conditions, time of service, and lowest design margin (2) that the proposed inspections will be performed using appropriate (volumetric and surface) techniques, for example similar to ASME Code and ASTM standards including visual, ultrasonic, and surface techniques (3) follow-up actions are to be based on the inspection results and (4) the sample size and the timing of inspections will provide reasonable assurance that, if unacceptable degradation is occurring, it will be found before applicable component intended functions can no longer be performed.

3.4.3.2.9 Loss of Material due to General, Pitting, Crevice, and Galvanic Corrosion

The GALL Report recommends further evaluation of programs to manage the loss of material due to general, pitting, crevice, and galvanic corrosion can occur for steel heat exchanger components exposed to treated water. The existing aging management program relies on monitoring and control of water chemistry to manage the effects of loss of material due to general, pitting, and crevice corrosion. However, control of water chemistry does not preclude loss of material due to general, pitting, and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the chemistry control program should be verified to ensure that significant degradation is not occurring and that the component's intended function will be maintained during the period of extended operation. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

The reviewer reviews the program to confirm that it includes adequate measures to determine if unacceptable degradation is occurring and provide reasonable assurance that component intended functions will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components and susceptible locations to ensure that unacceptable degradation is not occurring, the reviewer verifies (1) that the applicant's selection of susceptible locations is based on appropriate considerations such as severity of conditions, time of service, and lowest design margin (2) that the proposed inspections will be performed using appropriate (volumetric and surface) techniques, for example similar to ASME Code and ASTM standards including visual, ultrasonic, and surface techniques (3) follow-up actions are to be based on the inspection results and (4) the sample size and the timing of inspections will provide reasonable assurance that, if unacceptable degradation is occurring, it will be found before applicable component intended functions can no longer be performed.

3.4.3.2.10 Quality Assurance for Aging Management of Nonsafety-Related Components

An applicant's aging management programs for license renewal should contain the elements of corrective actions, the confirmation process, and administrative controls. Safety-related components are covered by 10 CFR Part 50, Appendix B, which is adequate to address these program elements. However, Appendix B does not apply to nonsafety-related components that are subject to an aging management review for license renewal. Nevertheless, an applicant has the option to expand the scope of its 10 CFR Part 50, Appendix B program to include these components and address these program elements. If an applicant chooses this option, the reviewer verifies that the applicant has documented such a commitment in the FSAR Supplement. If an applicant chooses alternative means, the branch responsible for quality assurance should be requested to review the applicant's proposal on a case-by-case basis.

3.4.3.3 AMR Results Not Consistent with or Not Addressed in GALL Report

The reviewer should confirm that the applicant, in its LRA, has identified applicable aging effects, listed the appropriate combination of materials and environments, and AMPs that will adequately manage the aging effects. The AMP credited by the applicant could be an AMP that is described and evaluated in the GALL Report or a plant-specific program. Review procedures are described in Branch Technical Position RSLB-1 (Appendix A.1 of this SRP-LR).

3.4.3.4 FSAR Supplement

The reviewer confirms that the applicant has provided information equivalent to that in Table 3.4-2 in the FSAR Supplement for aging management of the steam and power conversion system for license renewal. The reviewer also confirms that the applicant has provided information equivalent to that in Table 3.4-2 in the FSAR Supplement for Subsection 3.4.3.3, "AMR Results Not Consistent with or Not Addressed in GALL Report."

The staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR Supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR Supplement without prior NRC approval, provided that the applicant evaluates each such change and finds it acceptable pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR supplement before the license is renewed, no condition will be necessary.

As noted in Table 3.4-2, the applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should confirm that the applicant has identified and committed in the LRA to any future aging management activities, including enhancements and commitments, to be completed before entering the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.4.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of this section, then an evaluation finding similar to the following text should be included in the staff's safety evaluation report:

> On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated that the aging effects associated with the steam and power conversion system components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).
>
> The staff also reviewed the applicable FSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of the steam and power conversion system, as required by 10 CFR 54.21(d).

3.4.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

3.4.6 References

1. NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants,” U.S. Nuclear Regulatory Commission, July 1981.

2. NUREG-1801, “Generic Aging Lessons Learned (GALL),” U.S. Nuclear Regulatory Commission, Revision 1, September 2005.

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
1	BWR/ PWR	Steel piping, piping components, and piping elements exposed to steam or treated water	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (See subsection 3.4.2.2.1)	S-08 S-11
2	BWR/ PWR	Steel piping, piping components, and piping elements exposed to steam	Loss of material due to general, pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.4.2.2.2.1)	S-04 S-06
3	PWR	Steel heat exchanger components exposed to treated water	Loss of material due to general, pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.4.2.2.2.1)	S-19
4	BWR/ PWR	Steel piping, piping components, and piping elements exposed to treated water	Loss of material due to general, pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.4.2.2.2.1)	S-09 S-10
5	BWR	Steel heat exchanger components exposed to treated water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.4.2.2.9)	S-18
6	BWR/ PWR	Steel and stainless steel tanks exposed to treated water	Loss of material due to general (steel only) pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.4.2.2.7.1, except for steel tanks see subsection 3.4.2.2.2.1)	S-13
7	BWR/ PWR	Steel piping, piping components, and piping elements exposed to lubricating oil	Loss of material due to general, pitting and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.4.2.2.2.2)	SP-25

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
8	BWR/ PWR	Steel piping, piping components, and piping elements exposed to raw water	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, and fouling	Plant specific	Yes, plant specific (See subsection 3.4.2.2.3)	S-12
9	BWR/ PWR	Stainless steel and copper alloy heat exchanger tubes exposed to treated water	Reduction of heat transfer due to fouling	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.4.2.2.4.1)	SP-40 SP-58
10	BWR/ PWR	Steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil	Reduction of heat transfer due to fouling	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.4.2.2.4.2)	SP-53 SP-62 SP-63
11	BWR/ PWR	Buried steel piping, piping components, piping elements, and tanks (with or without coating or wrapping) exposed to soil	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	No Yes, detection of aging effects and operating experience are to be further evaluated (See subsection 3.4.2.2.5.1)	S-01
12	BWR/ PWR	Steel heat exchanger components exposed to lubricating oil	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.4.2.2.5.2)	S-17
13	BWR	Stainless steel piping, piping components, piping elements exposed to steam	Cracking due to stress corrosion cracking	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.4.2.2.6)	SP-45

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
14	BWR/ PWR	Stainless steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.4.2.2.6)	S-39 SP-17 SP-19 SP-42
15	BWR/ PWR	Aluminum and copper alloy piping, piping components, and piping elements exposed to treated water	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.4.2.2.7.1)	SP-24 SP-61
16	BWR/ PWR	Stainless steel piping, piping components, and piping elements; tanks, and heat exchanger components exposed to treated water	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.4.2.2.7.1)	S-21 S-22 SP-16
17	BWR/ PWR	Stainless steel piping, piping components, and piping elements exposed to soil	Loss of material due to pitting and crevice corrosion	Plant specific	Yes, plant specific (See subsection 3.4.2.2.7.2)	SP-37
18	BWR/ PWR	Copper alloy piping, piping components, and piping elements exposed to lubricating oil	Loss of material due to pitting and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.4.2.2.7.3)	SP-32
19	BWR/ PWR	Stainless steel piping, piping components, piping elements, and heat exchanger components exposed to lubricating oil	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.4.2.2.8)	S-20 SP-38
20	BWR/ PWR	Steel tanks exposed to air – outdoor (external)	Loss of material/ general, pitting, and crevice corrosion	Aboveground Steel Tanks	No	S-31
21	BWR/ PWR	High-strength steel closure bolting exposed to air with steam or water leakage	Cracking due to cyclic loading, stress corrosion cracking	Bolting Integrity	No	S-03

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
22	BWR/ PWR	Steel bolting and closure bolting exposed to air with steam or water leakage, air – outdoor (external), or air – indoor uncontrolled (external);	Loss of material due to general, pitting and crevice corrosion; loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	No	S-02 S-32 S-33 S-34
23	BWR/ PWR	Stainless steel piping, piping components, and piping elements exposed to closed-cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	Closed-Cycle Cooling Water System	No	SP-54
24	BWR/ PWR	Steel heat exchanger components exposed to closed cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	S-23
25	BWR/ PWR	Stainless steel piping, piping components, piping elements, and heat exchanger components exposed to closed cycle cooling water	Loss of material due to pitting and crevice corrosion	Closed-Cycle Cooling Water System	No	S-25 SP-39
26	BWR/ PWR	Copper alloy piping, piping components, and piping elements exposed to closed cycle cooling water	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	SP-8
27	BWR/ PWR	Steel, stainless steel, and copper alloy heat exchanger tubes exposed to closed cycle cooling water	Reduction of heat transfer due to fouling	Closed-Cycle Cooling Water System	No	SP-41 SP-57 SP-64
28	BWR/ PWR	Steel external surfaces exposed to air – indoor uncontrolled (external), condensation (external), or air outdoor (external)	Loss of material due to general corrosion	External Surfaces Monitoring	No	S-29 S-41 S-42
29	BWR/ PWR	Steel piping, piping components, and piping elements exposed to steam or treated water	Wall thinning due to flow-accelerated corrosion	Flow-Accelerated Corrosion	No	S-15 S-16

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
30	BWR/ PWR	Steel piping, piping components, and piping elements exposed to air outdoor (internal) or condensation (internal)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	SP-59 SP-60
31	BWR/ PWR	Steel heat exchanger components exposed to raw water	Loss of material due to general, pitting, crevice, galvanic, and microbiologically-influenced corrosion, and fouling	Open-Cycle Cooling Water System	No	S-24
32	BWR/ PWR	Stainless steel and copper alloy piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Open-Cycle Cooling Water System	No	SP-31 SP-36
33	BWR/ PWR	Stainless steel heat exchanger components exposed to raw water	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion, and fouling	Open-Cycle Cooling Water System	No	S-26
34	BWR/ PWR	Steel, stainless steel, and copper alloy heat exchanger tubes exposed to raw water	Reduction of heat transfer due to fouling	Open-Cycle Cooling Water System	No	S-27 S-28 SP-56
35	BWR/ PWR	Copper alloy >15% Zn piping, piping components, and piping elements exposed to closed cycle cooling water, raw water, or treated water	Loss of material due to selective leaching	Selective Leaching of Materials	No	SP-29 SP-30 SP-55
36	BWR/ PWR	Gray cast iron piping, piping components, and piping elements exposed to soil, treated water, or raw water	Loss of material due to selective leaching	Selective Leaching of Materials	No	SP-26 SP-27 SP-28

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
37	BWR/ PWR	Steel, stainless steel, and nickel-based alloy piping, piping components, and piping elements exposed to steam	Loss of material due to pitting and crevice corrosion	Water Chemistry	No	S-05 S-07 SP-18 SP-43 SP-46
38	PWR	Steel bolting and external surfaces exposed to air with borated water leakage	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	S-30 S-40
39	PWR	Stainless steel piping, piping components, and piping elements exposed to steam	Cracking due to stress corrosion cracking	Water Chemistry	No	SP-44
40	BWR/ PWR	Glass piping elements exposed to air, lubricating oil, raw water, and treated water	None	None	NA - No AEM or AMP	SP-9 SP-10 SP-33 SP-34 SP-35
41	BWR/ PWR	Stainless steel, copper alloy, and nickel alloy piping, piping components, and piping elements exposed to air – indoor uncontrolled (external)	None	None	NA - No AEM or AMP	SP-6 SP-11 SP-12
42	BWR/ PWR	Steel piping, piping components, and piping elements exposed to air – indoor controlled (external)	None	None	NA - No AEM or AMP	SP-1
43	BWR/ PWR	Steel and stainless steel piping, piping components, and piping elements in concrete	None	None	NA - No AEM or AMP	SP-2 SP-13
44	BWR/ PWR	Steel, stainless steel, aluminum, and copper alloy piping, piping components, and piping elements exposed to gas	None	None	NA - No AEM or AMP	SP-4 SP-5 SP-15 SP-23

Table 3.4-2 FSAR Supplement for Aging Management of Steam and Power Conversion System

Program	Description of Program	Implementation Schedule*
Aboveground Steel Tanks	This program includes preventive measures to mitigate corrosion by protecting the external surface of steel components, per standard industry practice, with sealant or caulking at the interface of concrete and component. Visual inspection during periodic system walk downs should be sufficient to monitor degradation of the protective paint, coating, calking, or sealant. Verification of the effectiveness of the program by measuring the thickness of the tank bottoms ensures that significant degradation is not occurring and that the component intended function will be maintained during the period of extended operation.	Existing program
Bolting Integrity	This program consists of guidelines on materials selection, strength and hardness properties, installation procedures, lubricants, and sealants, corrosion considerations in the selection and installation of pressure-retaining bolting for nuclear applications, and enhanced inspection techniques. This program relies on the bolting integrity program delineated in NUREG-1339 and industry's recommendations delineated in EPRI NP-5769, with the exceptions noted in NUREG-1339 for safety-related bolting and in EPRI TR-104213 for pressure retaining bolting and structural bolting.	Existing program
Boric Acid Corrosion	This program consists of (1) visual inspection external surfaces that are potentially exposed to borated water leakage, (2) timely discovery of leak path and removal of the boric acid residues, (3) assessment of the damage, and (4) follow-up inspection for adequacy. This program is implemented in response to GL 88-05 and recent operating experience.	Existing program
Buried Piping and Tanks Inspection	This program includes (a) preventive measures to mitigate corrosion, and (b) periodic inspection to manage the effects of corrosion on the pressure-retaining capacity of buried steel piping and tanks. Preventive measures are in accordance with standard industry practice for maintaining external coatings and wrappings and cathodic protection. As an alternative, buried piping and tanks are inspected when they are excavated during maintenance and when a pipe is dug up and inspected for any reason with a frequency that is based on operating experience.	Program should be implemented before the period of extended operation.

Table 3.4-2 FSAR Supplement for Aging Management of Steam and Power Conversion System

Program	Description of Program	Implementation Schedule*
Buried Piping and Tanks Surveillance	This program includes preventive measures to mitigate corrosion by protecting the external surface of buried piping and components, e.g., coating, wrapping, and a cathodic protection system. The program also includes surveillance and monitoring of the coating conductance versus time or current. This program is based on standard industry practices as described in NACE-RP-01-69.	Existing program
Closed-Cycle Cooling Water System	This program relies on preventive measures to minimize corrosion and SCC by maintaining inhibitors and by performing non-chemistry monitoring consisting of inspection and nondestructive evaluations based on the guidelines of EPRI-TR-107396 for closed-cycle cooling water systems.	Existing program
External Surfaces Monitoring Program	This program is based on system inspections and walkdowns. This program consists of periodic visual inspections of components such as piping, piping components, ducting, and other equipment within the scope of license renewal and subject to aging management review in order to manage aging effects. The program manages aging effects through visual inspection of external surfaces for evidence of loss of material. Loss of material due to boric acid corrosion is managed by the Boric Acid Corrosion Program. Surfaces that are inaccessible during plant operations are inspected during refueling outages. Surfaces that are inaccessible during both plant operations and refueling outages are inspected at frequencies to provide reasonable assurance that effect of aging will be managed such that applicable components will perform their intended function during the period of extended operation.	Existing program
Flow-Accelerated Corrosion	This program consists of (1) conduct appropriate analysis and baseline inspection, (2) determine extent of thinning, and replace/repair components, and (3) perform follow-up inspections to confirm or quantify and take longer-term corrective actions. The program relies on implementation of EPRI guidelines of NSAC-202L-R2.	Existing program

Table 3.4-2 FSAR Supplement for Aging Management of Steam and Power Conversion System

Program	Description of Program	Implementation Schedule*
Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	This program visually inspects internal surfaces of steel piping, piping elements, ducting, and components in an internal environment (indoor uncontrolled air, condensation, and steam) that are not included in other aging management programs for loss of material. Inspections are performed when the internal surfaces are accessible during the performance of periodic surveillance tests, during preventive maintenance activities or during scheduled outages. The program includes visual inspection to assure that existing environment conditions are not causing material degradation that could result in a loss of system intended functions.	Existing program
Lubricating Oil Analysis	This program ensures the oil environment in the mechanical systems is maintained to the required quality. This program maintains oil systems free of contaminants (primarily water and particulates) thereby preserving an environment that is not conducive to loss of material, cracking, or reduction of heat transfer. Lubricating oil testing activities include sampling and analysis of lubricating oil for detrimental contaminants. The presence of water or particulates may also be indicative of inleakage and corrosion product buildup.	Existing program
One-Time Inspection	This program verifies the effectiveness of other aging management program by determining if the aging effect is not occurring or the aging effect is progressing slowly so that the intended function will be maintained during the period of extended operation.	The inspection should be completed before the period of extended operation.
Open-Cycle Cooling Water System	This program includes (a) surveillance and control of biofouling, (b) tests to verify heat transfer, (c) routine inspection and maintenance program, (d) system walk down inspection, and (e) review of maintenance, operating, and training practices and procedures. The program provides assurance that the open-cycle cooling water system is in compliance with General Design Criteria and Quality Assurance to ensure that the open-cycle cooling water (or service water) system can be managed for an extended period of operation. This program is in response to NRC GL 89-13.	Existing program
Plant-specific AMP	The program should contain information associated with the bases for determining that aging effects will be managed during the period of extended operation.	Program should be implemented before the period of extended operation.

Table 3.4-2 FSAR Supplement for Aging Management of Steam and Power Conversion System

Program	Description of Program	Implementation Schedule*
Quality Assurance	The 10 CFR Part 50, Appendix B program provides for corrective actions, the confirmation process, and administrative controls for aging management programs for license renewal. The scope of this existing program will be expanded to include nonsafety-related structures and components that are subject to an aging management review for license renewal.	Program should be implemented before the period of extended operation.
Water Chemistry	This program mitigate aging effects on component surfaces that are exposed to water as process fluid, chemistry programs are used to control water impurities (e.g., chloride, fluoride, sulfate) that accelerate corrosion. The water chemistry program relies on monitoring and control of water chemistry based on EPRI guidelines.	Existing program

* An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

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3.5 AGING MANAGEMENT OF CONTAINMENTS, STRUCTURES, AND COMPONENT SUPPORTS

Review Responsibilities

Primary - Branch assigned responsibility by PM as described in SRP-LR Section 3.0.

3.5.1 Areas of Review

This section addresses the aging management review (AMR) and the associated aging management program (AMP) for containments, structures, and component supports. For a recent vintage plant, the information related to containments, structures, and component supports is contained in Chapter 3, “Design of Structures, Components, Equipment, and Systems,” of the plant’s FSAR, consistent with the “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants” (NUREG-0800) (Ref. 1). For older vintage plants, the location of applicable information is plant-specific because an older plant’s FSAR may have predated NUREG-0800. The scope of this section is PWR and BWR containment structures, safety-related and other structures, and component supports.

The PWR containment structures consist of concrete (reinforced or prestressed) and steel containments. The BWR containment structures consist of Mark I, Mark II, and Mark III steel and concrete containments (Ref. 2).

The safety-related and other structures (structures other than containments) are organized into nine groups: Group 1: BWR reactor building, PWR shield building, control room/building; Group 2: BWR reactor building with steel superstructure; Group 3: auxiliary building, diesel generator building, radwaste building, turbine building, switchgear room, yard structures (auxiliary feedwater pump house, utility/piping tunnels, security lighting poles, manholes, duct banks), SBO structures (transmission towers, startup transformer circuit breaker foundation, electrical enclosure); Group 4: containment internal structures, excluding refueling canal; Group 5: fuel storage facility, refueling canal; Group 6: water-control structures (e.g., intake structure, cooling tower, and spray pond); Group 7: concrete tanks and missile barriers; Group 8: steel tanks and missile barriers; and Group 9: BWR unit vent stack (Ref. 2).

The component supports are organized into seven groups: Group B1.1: supports for ASME Class 1 piping and components; Group B1.2: supports for ASME Class 2 and 3 piping and components; Group B1.3: supports for ASME Class MC components; Group B2: supports for cable tray, conduit, HVAC ducts, TubeTrack®, instrument tubing, non-ASME piping and components; Group B3: anchorage of racks, panels, cabinets, and enclosures for electrical equipment and instrumentation; Group B4: supports for miscellaneous equipment (e.g., EDG, HVAC components); and Group B5: supports for miscellaneous structures (e.g., platforms, pipe whip restraints, jet impingement shields, masonry walls) (Ref. 2).

The responsible review organization is to review the following license renewal application (LRA) AMR and AMP items assigned to it, per SRP-LR section 3.0, for review:

AMRs
- AMR results consistent with the GALL Report
- AMR results for which further evaluation is recommended by the GALL Report
- AMR results that are not consistent with or not addressed in the GALL Report

AMPs

- Consistent with GALL AMPs
- Plant-specific AMPs

FSAR Supplement

- The responsible review organization is to review the FSAR Supplement associated with each assigned AMP.

3.5.2 Acceptance Criteria

The acceptance criteria for the areas of review describe methods for determining whether the applicant has met the requirements of the NRC's regulations in 10 CFR 54.21.

3.5.2.1 AMR Results Consistent with the GALL Report

The AMRs and the AMPs applicable to structures and component supports are described and evaluated in Chapters II and III of the NUREG-1801, (GALL Report).

The applicant's LRA should provide sufficient information so that the reviewer is able to confirm that the specific LRA AMR line-item and the associated LRA AMP are consistent with the cited GALL Report AMR line-item. The staff reviewer should then confirm that the LRA AMR line-item is consistent with the GALL Report AMR line-item to which it is compared.

For AMPs, if the applicant identifies an exception to the cited GALL AMP, the LRA AMP should include a basis demonstrating how the criteria of 10 CFR 54.21(a)(3) would still be met. The reviewer should then confirm that the AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the AMP, the reviewer identifies a difference from the GALL Report AMP that should have been identified as an exception to the GALL Report AMP, this difference should be reviewed and properly dispositioned. The reviewer should document the disposition of all LRA-defined exceptions and staff-identified differences.

The LRA should identify any enhancements that are needed to permit an existing LRA AMP to be declared consistent with the GALL AMP to which the LRA AMP is compared. The reviewer is to confirm both that the enhancement, when implemented, would allow the existing LRA AMP to be consistent with the GALL AMP and also that the applicant has a commitment in the FSAR supplement to implement the enhancement prior to the period of extended operation. The reviewer should document the disposition of all enhancements.

3.5.2.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

The basic acceptance criteria defined in Section 3.5.2.1 apply to all of the AMRs and AMPs reviewed as part of this section. In addition, if the GALL Report AMR line-item to which the LRA AMR line-item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL Report for each of the following aging effect/aging mechanism combinations.

3.5.2.2.1 PWR and BWR Containments

3.5.2.2.1.1 Aging of Inaccessible Concrete Areas

Increases in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack, and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel could occur in inaccessible areas of PWR and BWR concrete and steel containments. The existing program relies on ASME Section XI, Subsection IWL to manage these aging effects. However, the GALL Report recommends further evaluation of plant - specific programs to manage the aging effects for inaccessible areas if the environment is aggressive. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.5.2.2.1.2 Cracks and Distortion due to Increased Stress Levels from Settlement; Reduction of Foundation Strength, Cracking and Differential Settlement due to Erosion of Porous Concrete Subfoundations, if Not Covered by Structures Monitoring Program

Cracks and distortion due to increased stress levels from settlement could occur in PWR and BWR concrete and steel containments. Also, reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations could occur in all types of PWR and BWR containments. The existing program relies on structures monitoring program to manage these aging effects. Some plants may rely on a de-watering system to lower the site ground water level. If the plant’s CLB credits a de-watering system, the GALL Report recommends verification of the continued functionality of the de-watering system during the period of extended operation. The GALL Report recommends no further evaluation if this activity is within the scope of the applicant’s structures monitoring program.

3.5.2.2.1.3 Reduction of Strength and Modulus of Concrete Structures due to Elevated Temperature

Reduction of strength and modulus of concrete due to elevated temperatures could occur in PWR and BWR concrete and steel containments. The implementation of 10 CFR 50.55a and ASME Section XI, Subsection IWL would not be able to identify the reduction of strength and modulus of concrete due to elevated temperature. Subsection CC-3400 of ASME Section III, Division 2, specifies the concrete temperature limits for normal operation or any other long-term period. The GALL Report recommends further evaluation of a plant-specific aging management program if any portion of the concrete containment components exceeds specified temperature limits, i.e., general area temperature greater than 66°C (150°F) and local area temperature greater than 93°C (200°F). Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.5.2.2.1.4 Loss of Material due to General, Pitting and Crevice Corrosion

Loss of material due to general, pitting and crevice corrosion could occur in steel elements of accessible and inaccessible areas for all types of PWR and BWR containments. The existing program relies on ASME Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J, to manage this aging effect. The GALL Report recommends further evaluation of plant-specific programs to manage this aging effect for inaccessible areas if corrosion is significant. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.5.2.2.1.5 Loss of Prestress due to Relaxation, Shrinkage, Creep, and Elevated Temperature

Loss of prestress forces due to relaxation, shrinkage, creep, and elevated temperature for PWR prestressed concrete containments and BWR Mark II prestressed concrete containments is a Time-Limited Aging Analysis (TLAA) as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.5, “Concrete Containment Tendon Prestress Analysis,” of this SRP-LR.

3.5.2.2.1.6 Cumulative Fatigue Damage

If included in the current licensing basis, fatigue analyses of suppression pool steel shells (including welded joints) and penetrations (including penetration sleeves, dissimilar metal welds, and penetration bellows) for all types of PWR and BWR containments and BWR vent header, vent line bellows, and downcomers are TLAAs as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.6, “Containment Liner Plates, Metal Containments, and Penetrations Fatigue Analysis,” of this SRP-LR.

3.5.2.2.1.7 Cracking due to Stress Corrosion Cracking (SCC)

Cracking due to stress corrosion cracking of stainless steel penetration sleeves, penetration bellows, and dissimilar metal welds could occur in all types of PWR and BWR containments. Cracking due to SCC could also occur in stainless steel vent line bellows for BWR containments. The existing program relies on ASME Section XI, Subsection IWE and10 CFR Part 50, Appendix J to manage this aging effect. The GALL Report recommends further evaluation of additional appropriate examinations/evaluations implemented to detect these aging effects for stainless steel penetration sleeves, penetration bellows and dissimilar metal welds, and stainless steel vent line bellows.

3.5.2.2.1.8 Cracking due to Cyclic Loading

Cracking due to cyclic loading of suppression pool steel and stainless steel shells (including welded joints) and penetrations (including penetration sleeves, dissimilar metal welds, and penetration bellows) could occur for all types of PWR and BWR containments and BWR vent header, vent line bellows and downcomers. The existing program relies on ASME Section XI, Subsection IWE and 10 CFR Part 50, Appendix J to manage this aging effect. However, VT-3 visual inspection may not detect fine cracks. The GALL Report recommends further evaluation for detection of this aging effect.

3.5.2.2.1.9 Loss of Material (Scaling, Cracking, and Spalling) due to Freeze-Thaw

Loss of material (scaling, cracking, and spalling) due to freeze-thaw could occur in PWR and BWR concrete containments. The existing program relies on ASME Section XI, Subsection IWL to manage this aging effect. The GALL Report recommends further evaluation of this aging effect for plants located in moderate to severe weathering conditions.

3.5.2.2.1.10 Cracking due to Expansion and Reaction with Aggregate, and Increase in Porosity and Permeability due to Leaching of Calcium Hydroxide

Cracking due to expansion and reaction with aggregate, and increase in porosity and permeability due to leaching of calcium hydroxide could occur in concrete elements of PWR and BWR concrete and steel containments. The existing program relies on ASME Section XI, Subsection IWL to manage these aging effects. The GALL Report recommends further evaluation if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.

3.5.2.2.2 Safety-Related and Other Structures and Component Supports

3.5.2.2.2.1 Aging of Structures Not Covered by Structures Monitoring Program

The GALL Report recommends further evaluation of certain structure/aging effect combinations if they are not covered by the structures monitoring program. This includes (1) cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for Groups 1-5, 7, 9 structures; (2) increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack for Groups 1-5, 7, 9 structures; (3) loss of material due to corrosion for Groups 1-5, 7, 8 structures; (4) loss of material (spalling, scaling) and cracking due to freeze-thaw for Groups 1-3, 5, 7-9 structures; (5) cracking due to expansion and reaction with aggregates for Groups 1-5, 7-9 structures; (6) cracks and distortion due to increased stress levels from settlement for Groups 1-3, 5-9 structures; and (7) reduction in foundation strength, cracking, differential settlement due to erosion of porous concrete subfoundation for Groups 1-3, 5-9 structures. The GALL Report recommends further evaluation only for structure/aging effect combinations that are not within the structures monitoring program.

Lock up due to wear could occur for Lubrite® radial beam seats in BWR drywell, RPV support shoes for PWR with nozzle supports, steam generator supports, and other sliding support bearings and sliding support surfaces. The existing program relies on the structures monitoring program or ASME Section XI, Subsection IWF to manage this aging effect. The GALL Report recommends further evaluation only for structure/aging effect combinations that are not within the ISI (IWF) or structures monitoring program.

3.5.2.2.2.2 Aging Management of Inaccessible Areas

1. Loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in below-grade inaccessible concrete areas of Groups 1-3, 5 and 7-9 structures. The GALL Report recommends further evaluation of this aging effect for inaccessible areas of these Groups of structures for plants located in moderate to severe weathering conditions.

2. Cracking due to expansion and reaction with aggregates could occur in below-grade inaccessible concrete areas for Groups 1-5 and 7-9 structures. The GALL Report recommends further evaluation of inaccessible areas of these Groups of structures if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.

3. Cracks and distortion due to increased stress levels from settlement and reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations could occur in below-grade inaccessible concrete areas of Groups 1-3, 5 and 7-9 structures. The existing program relies on structures monitoring program to manage

these aging effects. Some plants may rely on a de-watering system to lower the site ground water level. If the plant's CLB credits a de-watering system, the GALL Report recommends verification of the continued functionality of the de-watering system during the period of extended operation. The GALL Report recommends no further evaluation if this activity is included in the scope of the applicant's structures monitoring program.

4. Increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel could occur in below-grade inaccessible concrete areas of Groups 1-3, 5 and 7-9 structures. The GALL Report recommends further evaluation of plant-specific programs to manage these aging effects in inaccessible areas of these Groups of structures if the environment is aggressive. The acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

5. Increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide could occur in below-grade inaccessible concrete areas of Groups 1-3, 5 and 7-9 structures. The GALL Report recommends further evaluation of this aging effect for inaccessible areas of these Groups of structures if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.

3.5.2.2.2.3 Reduction of Strength and Modulus of Concrete Structures due to Elevated Temperature

Reduction of strength and modulus of concrete due to elevated temperatures could occur in PWR and BWR Group 1-5 concrete structures. For any concrete elements that exceed specified temperature limits, further evaluations are recommended. Appendix A of ACI 349-85 specifies the concrete temperature limits for normal operation or any other long-term period. The temperatures shall not exceed 150°F except for local areas, which are allowed to have increased temperatures not to exceed 200°F. The GALL Report recommends further evaluation of a plant-specific program if any portion of the safety-related and other concrete structures exceeds specified temperature limits, i.e., general area temperature greater than 66°C (150°F) and local area temperature greater than 93°C (200°F). The acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

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3.5.2.2.2.4 Aging Management of Inaccessible Areas for Group 6 Structures

The GALL Report recommends further evaluation for inaccessible areas of certain Group 6 structure/aging effect combinations as identified below, whether or not they are covered by inspections in accordance with the GALL Report, Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance.

1. Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel could occur in below-grade inaccessible concrete areas of Group 6 structures. The GALL Report recommends further evaluation of plant-specific programs to manage these aging effects in inaccessible areas if the environment is aggressive. The acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

2. Loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in below-grade inaccessible concrete areas of Group 6 structures. The GALL Report recommends further evaluation of this aging effect for inaccessible areas for plants located in moderate to severe weathering conditions.

3. Cracking due to expansion and reaction with aggregates and increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide could occur in below-grade inaccessible reinforced concrete areas of Group 6 structures. The GALL Report recommends further evaluation of inaccessible areas if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.

3.5.2.2.2.5 Cracking due to Stress Corrosion Cracking and Loss of Material due to Pitting and Crevice Corrosion

Cracking due to stress corrosion cracking and loss of material due to pitting and crevice corrosion could occur for Group 7 and 8 stainless steel tank liners exposed to standing water. The GALL Report recommends further evaluation of plant-specific programs to manage these aging effects. The acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.5.2.2.2.6 Aging of Supports Not Covered by Structures Monitoring Program

The GALL Report recommends further evaluation of certain component support/aging effect combinations if they are not covered by the structures monitoring program. This includes (1) loss of material due to general and pitting corrosion, for Groups B2-B5 supports; (2) reduction in concrete anchor capacity due to degradation of the surrounding concrete, for Groups B1-B5 supports; and (3) reduction/loss of isolation function due to degradation of vibration isolation elements, for Group B4 supports. Further evaluation is necessary only for structure/aging effect combinations not covered by the structures monitoring program.

3.5.2.2.2.7 Cumulative Fatigue Damage due to Cyclic Loading

Fatigue of component support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports is a TLAA as defined in 10 CFR 54.3 only if a CLB fatigue analysis exists. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.3, “Metal Fatigue Analysis,” of this SRP-LR.

3.5.2.2.3 Quality Assurance for Aging Management of Nonsafety-Related Components

Acceptance criteria are described in Branch Technical Position IQMB-1 (Appendix A.2 of this SRP-LR).

3.5.2.3 AMR Results Not Consistent with or Not Addressed in GALL Report

Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.5.2.4 FSAR Supplement

The summary description of the programs and activities for managing the effects of aging for the period of extended operation in the FSAR supplement should be appropriate such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the bases for determining that aging effects are managed during the period of extended operation. The description should also contain any future aging management activities, including enhancements and commitments, to be completed before the period of extended operation. Examples of the type of information required are provided in Table 3.5-2 of this SRP-LR.

3.5.3 Review Procedures

For each area of review, the following review procedures are to be followed:

3.5.3.1 AMR Results Consistent with the GALL Report

The applicant may reference the GALL Report in its LRA, as appropriate, and demonstrate that the AMRs and AMPs at its facility are consistent with those reviewed and approved in the GALL Report. The reviewer should not conduct a re-review of the substance of the matters described in the GALL Report. If the applicant has provided the information necessary to adopt the finding of program acceptability as described and evaluated in the GALL Report, the reviewer should find acceptable the applicant's reference to GALL in its LRA. In making this determination, the reviewer confirms that the applicant has provided a brief description of the system, components, materials, and environment. The reviewer also confirms that the applicant has stated that the applicable aging effects and industry and plant-specific operating experience have been reviewed by the applicant and are evaluated in the GALL Report.

Furthermore, the reviewer should confirm that the applicant has addressed operating experience identified after the issuance of the GALL Report. Performance of this review requires the reviewer to confirm that the applicant has identified those aging effects for the structures and component supports that are contained in GALL as applicable to its plant.

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL Report. If the applicant commits to an enhancement to make its LRA AMP consistent with a GALL Report AMP, then the reviewer is to confirm that this enhancement, when implemented, will make the LRA AMP consistent with the GALL Report AMP. If the applicant identifies, in the LRA AMP, an exception to the GALL Report AMP to which it is claiming to be consistent, the reviewer is to confirm that the LRA AMP with the exception will satisfy the criteria of 10 CFR 54.21(a)(3). If the reviewer identifies a difference, not identified by the LRA, between the LRA AMP and the GALL AMP, with which the LRA claims to be consistent, the reviewer should confirm that the LRA AMP with this difference satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions, or differences. The AMPs evaluated in GALL pertinent to the structures and component supports are summarized in Table 3.5-1 of this SRP-LR. In this table, the ID column provides a row identifier useful in matching the information presented in the corresponding table in the GALL Report Vol. 1. The Related Item column identifies the item number in the GALL Report Vol. 2, Chapters II through VIII, presenting detailed information summarized by this row.

3.5.3.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

The basic review procedures defined in Section 3.5.3.1 apply to all of the AMRs and AMPs provided in this section. In addition, if the GALL AMR line-item to which the LRA AMR line-item is compared identifies that further evaluation is recommended, then additional criteria apply as identified by the GALL Report for each of the following aging effect/aging mechanism combinations.

3.5.3.2.1 PWR and BWR Containments

3.5.3.2.1.1 Aging of Inaccessible Concrete Areas

The GALL Report recommends further evaluation of programs to manage aging effects in inaccessible areas if the environment is aggressive. Possible aging effects are increases in porosity and permeability, cracking and loss of material (spalling, scaling) due to aggressive chemical attack and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel in PWR and BWR concrete and steel containments. The current aging management programs that involve detecting the aging effects for inaccessible areas consist of Section XI, Subsection IWL examinations of 1992 or later edition of ASME code (Ref. 3), which is in accordance with the requirements of, and is approved in 10 CFR 50.55a. However, Subsection IWL exempts from examination portions of the concrete containments that are inaccessible (e.g., foundation, exterior walls below grades, concrete covered by liner).

To cover the inaccessible areas, 10 CFR 50.55a(b)(2)(ix) requires that the applicant evaluate the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas. In addition, the GALL Report recommends further evaluation to manage these aging effects for inaccessible areas if the below-grade environment is aggressive. Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive. The GALL Report recommends that examination of representative samples of below-grade concrete, when excavated for any reason, be performed. The reviewer reviews the applicant’s proposed aging management program to determine that, where appropriate, an effective inspection program will be implemented to ensure that these aging effects in inaccessible areas are adequately managed during the period of extended operation.

3.5.3.2.1.2 Cracks and distortion due to increased stress levels from settlement; Reduction of Foundation Strength, Cracking, and Differential Settlement due to Erosion of Porous Concrete Subfoundations, if Not Covered by Structures Monitoring Program

The GALL Report recommends aging management of (1) cracks and distortion due to increases in component stress level from settlement for PWR and BWR concrete and steel containments and (2) reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations for all types of PWR and BWR containments if not within the scope of structures monitoring program. Also, if a de-watering system is relied upon for control of settlement and erosion, then proper functioning of the de-watering system should be monitored for the period of extended operation. The reviewer reviews and confirms that, if the applicant credits a de-watering system in its CLB, the applicant has committed to monitor the functionality of the de-watering system under the applicant’s structures monitoring program. If not, the reviewer evaluates the plant-specific program for monitoring the de-watering system during the period of extended operation.

3.5.3.2.1.3 Reduction of Strength and Modulus of Concrete Structures due to Elevated Temperature

The GALL Report recommends further evaluation of programs to manage reduction of strength and modulus of concrete structures due to elevated temperature for PWR and BWR concrete and steel containments. The GALL Report notes that the implementation of ASME Section XI, Subsection IWL examinations and 10 CFR 50.55a would not be able to detect the reduction of concrete strength and modulus due to elevated temperature and also notes that no mandated aging management exists for managing this aging effect.

The GALL Report recommends that a plant-specific evaluation be performed if any portion of the concrete containment components exceeds specified temperature limits, i.e., general temperature greater than 66°C (150°F) and local area temperature greater than 93°C (200°F). The reviewer reviews and confirms that the applicant's discussion in the renewal application indicates that the affected PWR and BWR containment components are not exposed to temperature that exceeds the temperature limits. For concrete containment components that operate above these temperature limits, the reviewer reviews the applicant's proposed programs on a case-by-case basis to ensure that the effects of elevated temperature will be managed during the period of extended operation.

3.5.3.2.1.4 Loss of Material due to General, Pitting and Crevice Corrosion

The GALL Report identifies programs to manage loss of material due to general, pitting and crevice corrosion in accessible and inaccessible areas of the steel elements in drywell and torus or the steel liner and integral attachments for all types of PWR and BWR containments. The aging management program consists of ASME Section XI, Subsection IWE (Ref. 4), and 10 CFR Part 50, Appendix J, leak tests. Subsection IWE exempts from examination portions of the containments that are inaccessible, such as embedded or inaccessible portions of steel liners and steel elements in drywell and torus, and integral attachments.

To cover the inaccessible areas, 10 CFR 50.55a(b)(2)(ix) requires that the applicant shall evaluate the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas. In addition, the GALL Report recommends further evaluation of plant-specific programs to manage the aging effects for inaccessible areas if specific recommendations defined in the GALL Report cannot be satisfied. The reviewer reviews the applicant's proposed aging management program to confirm that, where appropriate, an effective inspection program has been developed and implemented to ensure that the aging effects in inaccessible areas are adequately managed.

3.5.3.2.1.5 Loss of Prestress due to Relaxation, Shrinkage, Creep, and Elevated Temperature

Loss of prestress is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.5 of this SRP-LR.

3.5.3.2.1.6 Cumulative Fatigue Damage

Fatigue analyses included in current licensing basis for the containment liner plate and penetrations are TLAAs as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.6 of this SRP-LR.

3.5.3.2.1.7 Cracking due to Stress Corrosion Cracking

The GALL Report recommends further evaluation of programs to manage cracking due to SCC for stainless steel penetration sleeves, dissimilar metal welds and penetration bellows in all types of PWR and BWR containments and BWR vent headers, vent line bellows, and downcomers. Transgranular stress corrosion cracking (TGSCC) is a concern for dissimilar metal welds. In the case of bellows assemblies, SCC may cause aging effects particularly if the material is not shielded from a corrosive environment. Containment ISI IWE and leak rate testing may not be sufficient to detect cracks, especially for dissimilar metal welds. Additional appropriate examinations to detect SCC in bellows assemblies and dissimilar metal welds are recommended to address this issue. The reviewer reviews and evaluates the applicant's proposed programs to confirm that adequate inspection methods will be implemented to ensure that cracks are detected.

5.5.3.2.1.8 Cracking due to Cyclic Loading

The GALL Report recommends further evaluation of programs to manage cracking due to cyclic loading of steel and stainless steel penetration bellows and dissimilar metal welds in all types of PWR and BWR containments and BWR suppression pool shell and downcomers. Containment ISI IWE and leak rate testing may not be sufficient to detect fine cracks, especially for penetration bellows. VT-3 visual examination may not detect fine cracks. The reviewer reviews and evaluates the applicant's proposed program to confirm that adequate inspection methods will be implemented to ensure that fine cracks are detected.

3.5.3.2.1.9 Loss of Material (Scaling, Cracking, and Spalling due to Freeze-Thaw)

The GALL Report recommends further evaluation of programs to manage loss of material (scaling, cracking, and spalling) due to freeze-thaw for concrete elements of PWR and BWR containments. Containment ISI Subsection IWL may not be sufficient for plants located in moderate to severe weathering conditions. Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557, Ref. 7). Documented evidence confirms that where the existing concrete had air content of 3% to 6%, subsequent inspection did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. The weathering index for the continental US is shown in ASTM C33-90, Fig. 1. The reviewer reviews and confirms that the applicant has satisfied the recommendations for inaccessible concrete as identified in the GALL Report. Otherwise, the reviewer reviews the applicant's proposed aging management program to verify that, where appropriate, an effective inspection program has been developed and implemented to ensure that these aging effects in inaccessible areas for plants located in moderate to severe weathering conditions are adequately managed.

3.5.3.2.1.10 Cracking due to Expansion and Reaction with Aggregate, and Increase in Porosity and Permeability due to Leaching of Calcium Hydroxide

The GALL Report recommends further evaluation of programs to manage cracking due to expansion and reaction with aggregate, and increase in porosity and permeability due to leaching of calcium hydroxide in concrete elements of PWR and BWR concrete and steel containments. The GALL Report recommends containment ISI Subsection IWL to manage these aging effects. An aging management program is not necessary, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R-77 (Ref. 8). The reviewer should confirm that the applicant has satisfied the conditions for inaccessible concrete as identified in the GALL Report. Otherwise, the reviewer reviews the applicant's proposed aging management program to verify that, where appropriate, an effective inspection program has been developed and implemented to ensure that these aging effects in inaccessible areas for concrete that was not constructed in accordance with the recommendations of ACI 201.2R-77 are adequately managed.

3.5.3.2.2 Safety-Related and Other Structures, and Component Supports

3.5.3.2.2.1 Aging of Structures Not Covered by Structures Monitoring Program

The GALL Report recommends further evaluation of certain structure/aging effect combinations if they are not covered by the structures monitoring program. This includes (1) cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for Groups 1-5, 7, 9 structures, (2) increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack for Groups 1-5, 7, 9 structures, (3) loss of material due to corrosion for Groups 1-5, 7, 8 structures, (4) loss of material (spalling, scaling) and cracking due to freeze-thaw for Groups 1-3, 5, 7-9 structures, (5) cracking due to expansion and reaction with aggregates for Groups 1-5, 7-9 structures, (6) cracks and distortion due to increased stress levels from settlement for Groups 1-3, 5-9 structures, and (7) reduction in foundation strength, cracking, differential settlement due to erosion of porous concrete subfoundation for Groups 1-3, 5-9 structures. Further evaluation is necessary only for structure/aging effect combinations not covered by the structures monitoring program. In addition, the GALL Report recommends further evaluation of structure/aging effect combination of lock-up due to wear of Group 4 Lubrite® components if they are not covered by either the ASME Section XI, Subsection IWF or the structures monitoring program.

The aging management program consists of a structures monitoring program to confirm that the CLB is maintained through periodic testing and inspection of critical plant structures, systems, and components. The reviewer confirms that the applicant has identified the structure/aging effect combinations not within the scope of the applicant's structures monitoring program developed in accordance with the guidance provided in NUMARC 93-01, Rev. 2 (Ref. 5) and RG 1.160, Rev. 2 (Ref. 6). The applicant may choose to expand the scope of its structures monitoring program to include these structure/aging effect combinations. Otherwise, the reviewer reviews and evaluates the applicant's proposed program in accordance with the guidance in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

3.5.3.2.2.2 Aging Management of Inaccessible Areas

1. The GALL Report recommends further evaluation of programs to manage loss of material (spalling, scaling) and cracking due to freeze-thaw in below-grade inaccessible concrete areas of Groups 1-3, 5, and 7-9 structures. Structures monitoring program may not be sufficient for plants located in moderate to severe weathering conditions. Further evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557). Documented evidence confirms that where the existing concrete had air content of 3% to 6% and water-to-cement ratio of 0.35-0.45, subsequent inspection did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. The weathering index for the

continental US is shown in ASTM C33-90, Fig. 1. The reviewer confirms that the applicant has satisfied the conditions for inaccessible concrete as identified in the GALL Report. Otherwise, the reviewer reviews the applicant's proposed aging management program to verify that, where appropriate, an effective inspection program has been developed and implemented to ensure that these aging effects in inaccessible areas for plants located in moderate to severe weathering conditions are adequately managed.

2. The GALL Report recommends further evaluation of programs to manage cracking due to expansion and reaction with aggregate in below-grade inaccessible concrete areas of Groups 1-5 and 7-9 structures in below-grade inaccessible concrete areas of Groups 1-3, 5, and 7-9 structures. An aging management program is not necessary, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R-77. The reviewer confirms that the applicant has satisfied the conditions for inaccessible concrete as identified in the GALL Report. Otherwise, the reviewer reviews the applicant's proposed aging management program to verify that, where appropriate, an effective inspection program has been developed and implemented to ensure that these aging effects in inaccessible areas for concrete that was not constructed in accordance with the recommendations of ACI 201.2R-77 are adequately managed.

3. The GALL Report recommends further evaluation of programs to manage cracks and distortion due to increased stress levels from settlement, and reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations could occur in below-grade inaccessible concrete areas of Groups 1-3, 5, and 7-9 structures. The initial licensing basis for some plants included a program to monitor settlement. If no settlement was evident during the first decade or so, the staff may have given the applicant approval to discontinue the program. However, if a de-watering system is relied upon for control of settlement and erosion, then the applicant is to ensure proper functioning of the de-watering system through the period of extended operation. The reviewer confirms that, if the applicant's plant credits a de-watering system in its CLB, the applicant has committed to monitor the functionality of the de-watering system under the applicant's structures monitoring program. If not, the reviewer reviews and evaluates the plant-specific program for monitoring the de-watering system during the period of extended operation.

4. The GALL Report recommends further evaluation of aging management for inaccessible concrete areas, such as foundation and exterior walls below grade exposed to an aggressive environment. Possible aging effects are increases in porosity and permeability, cracking and loss of material (spalling, scaling) due to aggressive chemical attack, and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for Groups 1-3, 5, 7-9 structures. Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive. The GALL Report recommends that examination of representative samples of below-grade concrete, when excavated for any reason, be performed. The reviewer reviews the applicant's proposed aging management program on a case-by-case basis to ensure that the intended functions will be maintained during the period of the extended operation.

5. The GALL Report recommends further evaluation of programs to manage increase in porosity and permeability due to leaching of calcium hydroxide in below-grade inaccessible concrete areas of Groups 1-3, 5, and 7-9 structures. An aging management program is not necessary, if there is documented evidence that confirms the in-place concrete was

constructed in accordance with the recommendations in ACI 201.2R-77. The reviewer confirms that the applicant has satisfied the conditions for inaccessible concrete as identified in the GALL Report. Otherwise, the reviewer reviews the applicant's proposed aging management program to determine that, where appropriate, an effective inspection program has been developed and implemented to ensure that these aging effects in inaccessible areas for concrete that was not constructed in accordance with the recommendations of ACI 201.2R-77 are adequately managed.

3.5.3.2.2.3 Reduction of Strength and Modulus of Concrete Structures due to Elevated Temperature

The GALL Report recommends further evaluation of programs to manage reduction of strength and modulus of concrete structures due to elevated temperature for PWR and BWR safety-related and other structures.

The GALL Report recommends that a plant-specific evaluation be performed if any portion of the concrete Groups 1-5 structures exceeds specified temperature limits, i.e., general temperature greater than 66°C (150°F) and local area temperature greater than 93°C (200°F). The reviewer reviews and confirms that the applicant's discussion in the license renewal application indicates that the affected PWR and BWR safety-related and other structures are not exposed to temperature that exceeds the temperature limits. For concrete structural components in Groups 1-5 structures that operate above these temperature limits, the reviewer reviews the applicant's proposed programs on a case-by-case basis to ensure that the effects of elevated temperature will be managed during the period of extended operation.

3.5.3.2.2.4 Aging Management of Inaccessible Areas for Group 6 Structures

The GALL Report recommends further evaluation for inaccessible areas of certain Group 6 structure/aging effect combinations as identified below, whether or not they are covered by inspections in accordance with the GALL Report, Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants," or the FERC / US Army Corp of Engineers dam inspections and maintenance.

1. Increases in porosity and permeability, cracking and loss of material (spalling, scaling) due to aggressive chemical attack and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel could occur in below-grade inaccessible concrete areas of Group 6 structures. Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive. The GALL Report recommends that examination of representative samples of below-grade concrete, when excavated for any reason, be performed, if the below-grade environment is aggressive. The reviewer reviews the applicant's proposed aging management program to determine that, where appropriate, an effective inspection program will be implemented to ensure that the aging effects in inaccessible areas are adequately managed during the period of extended operation.

2. Loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in below-grade inaccessible concrete areas of Group 6 structures. Further evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557, Ref. 7). Documented evidence confirms that where the existing concrete had air content of 3% to 6% and water-to-cement ratio of 0.35-0.45, subsequent

inspection did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. The weathering index for the continental US is shown in ASTM C33-90, Fig. 1. The reviewer reviews and confirms that the applicant has satisfied the conditions for inaccessible concrete as identified in the GALL Report. Otherwise, the reviewer reviews the applicant's proposed aging management program to determine that, where appropriate, an effective inspection program has been developed and implemented to ensure that these aging effects in inaccessible areas for plants located in moderate to severe weathering conditions are adequately managed.

3. Cracking due to expansion and reaction with aggregate could occur in below-grade inaccessible concrete areas of Group 6 structures and increase in porosity and permeability due to leaching of calcium hydroxide could occur in below-grade inaccessible concrete areas of Group 6 structures. An aging management program is not necessary, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R-77. The reviewer reviews and confirms that the applicant has satisfied the conditions for inaccessible concrete as identified in the GALL Report. Otherwise, the reviewer reviews the applicant's proposed aging management program to determine that, where appropriate, an effective inspection program has been developed and implemented to ensure that these aging effects in inaccessible areas for concrete that was not constructed in accordance with the recommendations of ACI 201.2R-77 are adequately managed.

3.5.3.2.2.5 Cracking due to Stress Corrosion Cracking and Loss of Material due to Pitting and Crevice Corrosion

The GALL Report recommends further evaluation of plant-specific programs to manage cracking due to SCC and loss of material due to pitting and crevice corrosion for stainless steel tank liners exposed to standing water. The reviewer reviews the applicant's proposed aging management program on a case-by-case basis to ensure that the intended functions will be maintained during the period of the extended operation.

3.5.3.2.2.6 Aging of Supports Not Covered by Structures Monitoring Program

The GALL Report recommends further evaluation of certain component support/aging effect combinations if they are not covered by the structures monitoring program. This includes (1) reduction in concrete anchor capacity due to degradation of the surrounding concrete, for Groups B1-B5 supports; (2) loss of material due to general and pitting corrosion, for Groups B2-B5 supports; and (3) reduction/loss of isolation function due to degradation of vibration isolation elements, for Group B4 supports. Further evaluation is necessary only for structure/aging effect combinations not covered by the structures monitoring program.

The aging management program consists of a structures monitoring program to verify that the CLB is maintained through periodic testing and inspection of critical plant structures, systems, and components. The reviewer confirms that the applicant has identified the component support/aging effect combinations not within the scope of the applicant's structures monitoring program developed in accordance with the guidance provided in NUMARC 93-01, Rev. 2 (Ref. 5) and RG 1.160, Rev. 2 (Ref. 6). The applicant may choose to expand the scope of its structures monitoring program to include these component support/aging effect combinations. Otherwise, the reviewer reviews and evaluates the applicant's proposed program in accordance with the guidance in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.5.3.2.2.7 Cumulative Fatigue Damage

Fatigue of support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports is a TLAA as defined in 10 CFR 54.3 only if a CLB fatigue analysis exists. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.3 of this SRP-LR.

3.5.3.2.3 Quality Assurance for Aging Management of Nonsafety-Related Components

The applicant's aging management programs for license renewal should contain the elements of corrective actions, the confirmation process, and administrative controls. Safety-related components are covered by 10 CFR Part 50 Appendix B, which is adequate to address these program elements. However, Appendix B does not apply to nonsafety-related components that are subject to an AMR for license renewal. Nevertheless, an applicant has the option to expand the scope of its 10 CFR Part 50 Appendix B program to include these components and address these program elements. If the applicant chooses this option, the reviewer verifies that the applicant has documented such a commitment in the FSAR supplement. If the applicant chooses alternative means, the branch responsible for quality assurance should be requested to review the applicant's proposal on a case-by-case basis.

3.5.3.3 AMR Results Not Consistent with or Not Addressed in GALL Report

The reviewer should confirm that the applicant, in its LRA, has identified applicable aging effects, listed the appropriate combination of materials and environments, and AMPs that will adequately manage the aging effects. The AMP credited by the applicant could be an AMP that is described and evaluated in the GALL Report or a plant-specific program. Review procedures are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.5.3.4 FSAR Supplement

The reviewer confirms that the applicant has provided information equivalent to that in Table 3.5-2 in the FSAR supplement for aging management of the containment, structures, and component Supports for license renewal. The reviewer also confirms that the applicant has provided information equivalent to that in Table 3.5-2 in the FSAR supplement for SRP-LR Subsection 3.5.3.3, "AMR Results Not Consistent with or Not Addressed in the GALL Report."

The staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR supplement before the license is renewed, no condition will be necessary.

As noted in Table 3.5-2, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should confirm that the applicant has identified and committed in the license renewal application to any future aging management activities, including enhancements and commitments, to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.5.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of this section, then an evaluation finding similar to the following text should be included in the staff's safety evaluation report:

> On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated that the aging effects associated with the containments, structures, and component supports components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).
>
> The staff also reviewed the applicable FSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of the containments, structures, and component supports, as required by 10 CFR 54.21(d).

3.5.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

3.5.6 References

1. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, July 1981.

2. NUREG-1801, "Generic Aging Lessons Learned (GALL)," U.S. Nuclear Regulatory Commission, Revision 1, September 2005.

3. American Society of Mechanical Engineers, ASME Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, Subsection IWL, Requirements for Class CC Concrete Components of Light-Water Cooled Power Plants, 2001 edition including the 2002 and 2003 Addenda. The ASME Boiler and Pressure Vessel Code, the American Society of Mechanical Engineers, New York, NY.

4. American Society of Mechanical Engineers, ASME Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, Subsection IWE, Requirements for Class MC and Metallic Liners of Class CC Components of Light-Water Cooled Power Plants, 1992 edition with 2001 edition including the 2002 and 2003 Addenda. The ASME Boiler and Pressure Vessel Code, the American Society of Mechanical Engineers, New York, NY.

5. NUMARC 93-01, Rev. 2, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants" [Line-In/Line-Out Version], Nuclear Energy Institute, April 1996.

6. NRC Regulatory Guide 1.160, Revision 2, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," March 1997.

7. NUREG-1557, October 1996, “Summary of Technical Information and Agreements from Nuclear Management and Resource Council Industry Report addressing License Renewal”.

8. ACI 201.2R 77 “Guide to Durable Concrete,” American Concrete Institute, Detroit, MI, Reapproved 1982.

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
PWR Concrete (Reinforced and Prestressed) and Steel Containments BWR Concrete and Steel (Mark I, II, and III) Containments						
1	BWR/ PWR	Concrete elements: walls, dome, basemat, ring girder, buttresses, containment (as applicable)	Aging of accessible and inaccessible concrete areas due to aggressive chemical attack, and corrosion of embedded steel	ISI (IWL) and for inaccessible concrete, an examination of representative samples of below-grade concrete, and periodic monitoring of groundwater, if the environment is non-aggressive. A plant specific program is to be evaluated if environment is aggressive.	Yes, plant-specific, if the environment is aggressive (See subsection 3.5.2.2.1.1)	C-03 C-05 C-25 C-26 C-27 C-41 C-42 C-43
2	BWR/ PWR	Concrete elements; All	Cracks and distortion due to increased stress levels from settlement	Structures Monitoring Program. If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Yes, if not within the scope of the applicant's structures monitoring program or a de-watering system is relied upon (See subsection 3.5.2.2.1.2)	C-06 C-36 C-37
3	BWR/ PWR	Concrete elements: foundation, sub-foundation	Reduction in foundation strength, cracking, differential settlement due to erosion of porous concrete	Structures Monitoring Program If a de-watering system is relied upon for control of erosion of cement from porous concrete subfoundations, then the licensee is to ensure proper functioning of the	Yes, if not within the scope of the applicant's structures monitoring program or a de-	C-07

Table 3.5-1.	**Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report**					
ID	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Related Item**
			subfoundation	de-watering system through the period of extended operation.	watering system is relied upon (See subsection 3.5.2.2.1.2)	
4	BWR/ PWR	Concrete elements: dome, wall, basemat, ring girder, buttresses, containment, concrete fill-in annulus (as applicable)	Reduction of strength and modulus of concrete due to elevated temperature	A plant-specific aging management program is to be evaluated	Yes, plant-specific if temperature limits are exceeded (See subsection 3.5.2.2.1.3)	C-08 C-33 C-34 C-35 C-50
5	BWR	Steel elements: Drywell; torus; drywell head; embedded shell and sand pocket regions; drywell support skirt; torus ring girder; downcomers; liner plate, ECCS suction header, support skirt, region shielded by diaphragm floor, suppression chamber (as applicable)	Loss of material due to general, pitting and crevice corrosion	ISI (IWE), and10 CFR Part 50, Appendix J.	Yes, if corrosion is significant for inaccessible areas (See subsection 3.5.2.2.1.4)	C-19 C-46
6	BWR/ PWR	Steel elements: steel liner, liner anchors, integral attachments	Loss of material due to general, pitting and crevice corrosion	ISI (IWE), and 10 CFR Part 50, Appendix J.	Yes, if corrosion is significant for inaccessible areas (See subsection 3.5.2.2.1.4)	C-09

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
7	BWR/ PWR	Prestressed containment tendons	Loss of prestress due to relaxation, shrinkage, creep, and elevated temperature	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (See subsection 3.5.2.2.1.5)	C-11
8	BWR	Steel and stainless steel elements: vent line, vent header, vent line bellows; downcomers;	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (See subsection 3.5.2.2.1.6)	C-21 C-48
9	BWR/ PWR	Steel, stainless steel elements, dissimilar metal welds: penetration sleeves, penetration bellows; suppression pool shell, unbraced downcomers	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (See subsection 3.5.2.2.1.6)	C-13 C-45
10	BWR/ PWR	Stainless steel penetration sleeves, penetration bellows, dissimilar metal welds	Cracking due to stress corrosion cracking	ISI (IWE) and 10 CFR Part 50, Appendix J, and additional appropriate examinations/evaluations for bellows assemblies and dissimilar metal welds.	Yes, detection of aging effects is to be evaluated (See subsection 3.5.2.2.1.7)	C-15
11	BWR	Stainless steel vent line bellows,	Cracking due to stress corrosion cracking	ISI (IWE) and 10 CFR Part 50, Appendix J, and additional appropriate examination/evaluation for bellows assemblies and dissimilar metal welds.	Yes, detection of aging effects is to be evaluated (See subsection 3.5.2.2.1.7)	C-22

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
12	BWR/ PWR	Steel, stainless steel elements, dissimilar metal welds: penetration sleeves, penetration bellows; suppression pool shell, unbraced downcomers	Cracking due to cyclic loading	ISI (IWE) and 10 CFR Part 50, Appendix J, and supplemented to detect fine cracks	Yes, detection of aging effects is to be evaluated (See subsection 3.5.2.2.1.8)	C-14 C-44
13	BWR	Steel, stainless steel elements, dissimilar metal welds: torus; vent line; vent header; vent line bellows; downcomers	Cracking due to cyclic loading	ISI (IWE) and 10 CFR Part 50, Appendix J, and supplemented to detect fine cracks	Yes, detection of aging effects is to be evaluated (See subsection 3.5.2.2.1.8)	C-20 C-47
14	BWR/ PWR	Concrete elements: dome, wall, basemat ring girder, buttresses, containment (as applicable)	Loss of material (Scaling, cracking, and spalling) due to freeze-thaw	ISI (IWL). Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557).	Yes, for inaccessible areas of plants located in moderate to severe weathering conditions (See subsection 3.5.2.2.1.9)	C-01 C-28 C-29

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report						
ID	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Related Item**
15	BWR/ PWR	Concrete elements: walls, dome, basemat, ring girder, buttresses, containment, concrete fill-in annulus (as applicable).	Cracking due to expansion and reaction with aggregate; increase in porosity, permeability due to leaching of calcium hydroxide	ISI (IWL) for accessible areas. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R.	Yes, if concrete was not constructed as stated for inaccessible areas (See subsection 3.5.2.2.1.10)	C-02 C-04 C-30 C-31 C-32 C-38 C-39 C-40 C-51
16	BWR/ PWR	Seals, gaskets, and moisture barriers	Loss of sealing and leakage through containment due to deterioration of joint seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	ISI (IWE) and 10 CFR Part 50, Appendix J	No	C-18
17	BWR/ PWR	Personnel airlock, equipment hatch and CRD hatch locks, hinges, and closure mechanisms	Loss of leak tightness in closed position due to mechanical wear of locks, hinges and closure mechanisms	10 CFR Part 50, Appendix J and Plant Technical Specifications	No	C-17
18	BWR/ PWR	Steel penetration sleeves and dissimilar metal welds; personnel airlock, equipment hatch and CRD hatch	Loss of material due to general, pitting, and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J.	No	C-12 C-16

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
19	BWR	Steel elements: stainless steel suppression chamber shell (inner surface)	Cracking due to stress corrosion cracking	ISI (IWE) and 10 CFR Part 50, Appendix J	No	C-24
20	BWR	Steel elements: suppression chamber liner (interior surface)	Loss of material due to general, pitting, and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J	No	C-49
21	BWR	Steel elements: drywell head and downcomer pipes	Fretting or lock up due to mechanical wear	ISI (IWE)	No	C-23
22	BWR/ PWR	Prestressed containment: tendons and anchorage components	Loss of material due to corrosion	ISI (IWL)	No	C-10
Safety-Related and Other Structures; and Component Supports						
23	BWR/ PWR	All Groups except Group 6: interior and above grade exterior concrete	Cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel	Structures Monitoring Program	Yes, if not within the scope of the applicant's structures monitoring program (See subsection 3.5.2.2.2.1)	T-04
24	BWR/ PWR	All Groups except Group 6: interior and above grade exterior concrete	Increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to	Structures Monitoring Program	Yes, if not within the scope of the applicant's structures monitoring	T-06

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
			aggressive chemical attack		program (See subsection 3.5.2.2.2.1)	
25	BWR/ PWR	All Groups except Group 6: steel components: all structural steel	Loss of material due to corrosion	Structures Monitoring Program. If protective coatings are relied upon to manage the effects of aging, the structures monitoring program is to include provisions to address protective coating monitoring and maintenance.	Yes, if not within the scope of the applicant's structures monitoring program (See subsection 3.5.2.2.2.1)	T-11
26	BWR/ PWR	All Groups except Group 6: accessible and inaccessible concrete: foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Structures Monitoring Program. Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557).	Yes, if not within the scope of the applicant's structures monitoring program (See subsection 3.5.2.2.2.1) or for inaccessible areas of plants located in moderate to severe weathering conditions (See subsection 3.5.2.2.2.2.1)	T-01
27	BWR/ PWR	All Groups except Group 6: accessible and inaccessible interior/exterior concrete	Cracking due to expansion due to reaction with	Structures Monitoring Program. None for inaccessible areas if concrete was constructed in	Yes, if not within the scope of the applicant's	T-03

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
			aggregates	accordance with the recommendations in ACI 201.2R-77.	structures monitoring program (See subsection 3.5.2.2.2.1) or concrete was not constructed as stated for inaccessible areas (See subsection 3.5.2.2.2.2.2)	
28	BWR/ PWR	Groups 1-3, 5-9: All	Cracks and distortion due to increased stress levels from settlement	Structures Monitoring Program. If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Yes, if not within the scope of the applicant's structures monitoring program (See subsection 3.5.2.2.2.1) or a de-watering system is relied upon (See subsection 3.5.2.2.2.2.3)	T-08
29	BWR/ PWR	Groups 1-3, 5-9: foundation	Reduction in foundation strength, cracking, differential settlement due to erosion of porous concrete	Structures Monitoring Program. If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the period of	Yes, if not within the scope of the applicant's structures monitoring program (See	T-09

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
			subfoundation	extended operation.	subsection 3.5.2.2.2.1) or a de-watering system is relied upon (See subsection 3.5.2.2.2.2.3)	
30	BWR/ PWR	Group 4: Radial beam seats in BWR drywell; RPV support shoes for PWR with nozzle supports; Steam generator supports	Lock-up due to wear	ISI (IWF) or Structures monitoring Program	Yes, if not within the scope of ISI or structures monitoring program (See subsection 3.5.2.2.2.1)	T-13
31	BWR/ PWR	Groups 1-3, 5, 7-9: below-grade concrete components, such as exterior walls below grade and foundation	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack; Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	Structures Monitoring Program; Examination of representative samples of below-grade concrete, and periodic monitoring of groundwater, if the environment is non-aggressive. A plant specific program is to be evaluated if environment is aggressive.	Yes, plant-specific, if environment is aggressive (See subsection 3.5.2.2.2.2.4)	T-05 T-07
32	BWR/ PWR	Groups 1-3, 5, 7-9: exterior above and below grade reinforced concrete foundations	Increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide	Structures monitoring Program for accessible areas. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes, if concrete was not constructed as stated for inaccessible areas (See	T-02

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report						
ID	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Related Item**
					subsection 3.5.2.2.2.2.5)	
33	BWR/ PWR	Groups 1-5: concrete	Reduction of strength and modulus of concrete due to elevated temperature	A plant-specific aging management program is to be evaluated	Yes, plant-specific if temperature limits are exceeded (See subsection 3.5.2.2.2.3)	T-10
34	BWR/ PWR	Group 6: Concrete; all	Increase in porosity and permeability, cracking, loss of material due to aggressive chemical attack; cracking, loss of bond, loss of material due to corrosion of embedded steel	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs and for inaccessible concrete, an examination of representative samples of below-grade concrete, and periodic monitoring of groundwater, if the environment is non-aggressive. A plant specific program is to be evaluated if environment is aggressive.	Yes, plant-specific if environment is aggressive (See subsection 3.5.2.2.2.4.1)	T-18 T-19
35	BWR/ PWR	Group 6: exterior above and below grade concrete foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs. Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557).	Yes, for inaccessible areas of plants located in moderate to severe weathering conditions (See subsection 3.5.2.2.2.4.2)	T-15

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
36	BWR/ PWR	Group 6: all accessible/ inaccessible reinforced concrete	Cracking due to expansion/ reaction with aggregates	Accessible areas: Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes, if concrete was not constructed as stated for inaccessible areas (See subsection 3.5.2.2.2.4.3)	T-17
37	BWR/ PWR	Group 6: exterior above and below grade reinforced concrete foundation interior slab	Increase in porosity and permeability, loss of strength due to leaching of calcium hydroxide	For accessible areas, inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes, if concrete was not constructed as stated for inaccessible areas (See subsection 3.5.2.2.2.4.3)	T-16
38	BWR/ PWR	Groups 7, 8: Tank liners	Cracking due to stress corrosion cracking; loss of material due to pitting and crevice corrosion	A plant-specific aging management program is to be evaluated	Yes, plant specific (See subsection 3.5.2.2.2.5)	T-23
39	BWR/ PWR	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to general and pitting corrosion	Structures Monitoring Program	Yes, if not within the scope of the applicant's structures monitoring program (See subsection 3.5.2.2.2.6)	T-30

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
40	BWR/ PWR	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	Reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms	Structures Monitoring Program	Yes, if not within the scope of the applicant's structures monitoring program (See Subsection 3.5.2.2.2.6)	T-29
41	BWR/ PWR	Vibration isolation elements	Reduction or loss of isolation function/ radiation hardening, temperature, humidity, sustained vibratory loading	Structures Monitoring Program	Yes, if not within the scope of the applicant's structures monitoring program (See subsection 3.5.2.2.2.6)	T-31
42	BWR/ PWR	Groups B1.1, B1.2, and B1.3: support members: anchor bolts, welds	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (See subsection 3.5.2.2.2.7)	T-26
43	BWR/ PWR	Groups 1-3, 5, 6: all masonry block walls	Cracking due to restraint shrinkage, creep, and aggressive environment	Masonry Wall Program	No	T-12
44	BWR/ PWR	Group 6 elastomer seals, gaskets, and moisture barriers	Loss of sealing due to deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	No	TP-7

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
45	BWR/ PWR	Group 6: exterior above and below grade concrete foundation; interior slab	Loss of material due to abrasion, cavitation	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance	No	T-20
46	BWR/ PWR	Group 5: Fuel pool liners	Cracking due to stress corrosion cracking; loss of material due to pitting and crevice corrosion	Water Chemistry and monitoring of spent fuel pool water level in accordance with technical specifications and leakage from the leak chase channels.	No	T-14
47	BWR/ PWR	Group 6: all metal structural members	Loss of material due to general (steel only), pitting and crevice corrosion	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance. If protective coatings are relied upon to manage aging, protective coating monitoring and maintenance provisions should be included.	No	T-21
48	BWR/ PWR	Group 6: earthen water control structures - dams, embankments, reservoirs, channels, canals, and ponds	Loss of material, loss of form due to erosion, settlement, sedimentation, frost action, waves, currents, surface runoff, Seepage	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs	No	T-22
49	BWR	Support members; welds; bolted connections; support anchorage to building structure	Loss of material/ general, pitting, and crevice corrosion	Water Chemistry and ISI(IWF)	No	TP-10
50	BWR/ PWR	Groups B2, and B4: galvanized steel, aluminum,	Loss of material due to pitting and crevice	Structures Monitoring Program	No	TP-6

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
		stainless steel support members; welds; bolted connections; support anchorage to building structure	corrosion			
51	BWR/ PWR	Group B1.1: high strength low-alloy bolts	Cracking due to stress corrosion cracking; loss of material due to general corrosion	Bolting Integrity	No	T-27 TP-9
52	BWR/ PWR	Groups B2, and B4: sliding support bearings and sliding support surfaces	Loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	Structures Monitoring Program	No	TP-1 TP-2
53	BWR/ PWR	Groups B1.1, B1.2, and B1.3: support members: welds; bolted connections; support anchorage to building structure	Loss of material due to general and pitting corrosion	ISI (IWF)	No	T-24
54	BWR/ PWR	Groups B1.1, B1.2, and B1.3: Constant and variable load spring hangers; guides; stops;	Loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	ISI (IWF)	No	T-28
55	PWR	Steel, galvanized steel, and aluminum support members; welds; bolted	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	T-25 TP-3

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report						
ID	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Related Item**
		connections; support anchorage to building structure				
56	BWR/ PWR	Groups B1.1, B1.2, and B1.3: Sliding surfaces	Loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	ISI (IWF)	No	T-32
57	BWR/ PWR	Groups B1.1, B1.2, and B1.3: Vibration isolation elements	Reduction or loss of isolation function/ radiation hardening, temperature, humidity, sustained vibratory loading	ISI (IWF)	No	T-33
58	BWR/ PWR	Galvanized steel and aluminum support members; welds; bolted connections; support anchorage to building structure exposed to air - indoor uncontrolled	None	None	NA - No AEM or AMP	TP-8 TP-11
59	BWR/ PWR	Stainless steel support members; welds; bolted connections; support anchorage to building structure	None	None	NA - No AEM or AMP	TP-4 TP-5

Table 3.5-2. FSAR Supplement for Aging Management of Structures and Component Supports

Program	Description of Program	Implementation Schedule*
Inservice Inspection (IWL)	The ASME Section XI, Subsection IWL program consists of periodic visual inspection of concrete surfaces for reinforced and prestressed concrete containments, and periodic visual inspection and sample tendon testing of unbonded post-tensioning systems for prestressed concrete containments, for signs of degradation, assessment of damage and corrective actions. Measured tendon lift-off forces are compared to predicted tendon forces calculated in accordance with RG 1.35.1. This program is in accordance with ASME Section XI, Subsection IWL, 2001 edition including the 2002 and 2003 Addenda.	Existing program
Inservice Inspection (IWE)	The ASME Section XI, Subsection IWE program consists of periodic visual, surface, and volumetric inspection of pressure retaining components of steel and concrete containments for signs of degradation, assessment of damage and corrective actions. This program is in accordance with ASME Section XI, Subsection IWE, 2001 edition including the 2002 and 2003 Addenda.	Existing program
10 CFR Part 50, Appendix J	This program consists of monitoring of leakage rates through containment liner/welds, penetrations, fittings, and other access openings for detecting degradation of containment pressure boundary. Corrective actions are taken if leakage rates exceed acceptance criteria. This program is implemented in accordance with 10 CFR Part 50 Appendix J, RG 1.163 and NEI 94-01, Rev. 0.	Existing program
Protective Coating Monitoring and Maintenance Program	This program consists of guidance for selection, application, inspection, and maintenance of protective coatings. This program is implemented in accordance with RG 1.54, Rev. 0 or Rev. 1.	Existing program
Inspection of Water-control Structures	The program consists of inspection and surveillance program for dams, slopes, canals, intake structure and other water-control structures associated with emergency cooling water systems or flood protection based on RG 1.127, Rev. 1.	Existing program

Table 3.5-2. FSAR Supplement for Aging Management of Structures and Component Supports		
Program	**Description of Program**	**Implementation Schedule***
Monitoring of leakage in fuel storage facility	This activity consists of periodic monitoring of leak chase system drain lines and leak detection sump of fuel storage facility and refueling channel to detect SCC and crevice corrosion of stainless steel liners. Alternately, the pool water level may be monitored for evidence of leakage. This activity augments the Water Chemistry Program for aging management of the spent fuel pool liner.	Existing program
Water Chemistry	To mitigate aging effects on component surfaces that are exposed to water as process fluid, chemistry programs are used to control water impurities (e.g., chloride, fluoride, and sulfate) that accelerate corrosion. The water chemistry program relies on monitoring and control of water chemistry based on EPRI guidelines of TR-103515 for water chemistry in BWRs and TR-102134 for secondary water chemistry in PWRs.	Existing program
Masonry Wall	This program consists of inspections, based on IE Bulletin 80-11 and plant-specific monitoring proposed by IN 87-67, for managing cracking of masonry walls.	Existing program
Inservice inspection (IWF)	This program consists of periodic visual examination of component supports for signs of degradation, evaluation, and corrective actions. This program is in accordance with ASME Section XI, Subsection IWF, 2001 edition including the 2002 and 2003 Addenda.	Existing program
Boric Acid Corrosion	The program consists of (1) visual inspection of external surfaces that are potentially exposed to borated water leakage, (2) timely discovery of leak path and removal of the boric acid residues, (3) assessment of the damage, and (4) follow-up inspection for adequacy. This program is implemented in response to GL 88-05.	Existing program

Table 3.5-2. FSAR Supplement for Aging Management of Structures and Component Supports

Program	Description of Program	Implementation Schedule*
Bolting Integrity	This program consists of guidelines on materials selection, strength and hardness properties, installation procedures, lubricants, and sealants, corrosion considerations in the selection and installation of pressure-retaining bolting for nuclear applications, and enhanced inspection techniques. This program relies on the bolting integrity program delineated in NUREG-1339 and industry's recommendations delineated in EPRI NP-5769, with the exceptions noted in NUREG-1339 for safety-related bolting and in EPRI TR-104213 for pressure retaining bolting and structural bolting.	Existing program
Structures Monitoring	The program consists of periodic inspection and monitoring the condition of structures and structure component supports to ensure that aging degradation leading to loss of intended functions will be detected and that the extent of degradation can be determined. This program is implemented in accordance with NUMARC 93-01, Rev. 2 and RG 1.160, Rev. 2.	Existing program
Plant-specific	The description should contain information associated with the basis for determining that aging effects will be managed during the period of extended operation.	Program should be implemented before the period of extended operation.
Quality Assurance	The 10 CFR Part 50 App. B program provides for corrective actions, confirmation process, and administrative controls for aging management programs for license renewal. The scope of this existing program will be expanded to include nonsafety-related structures and components that are subject to an AMR for license renewal.	Program should be implemented before the period of extended operation

* An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.6 AGING MANAGEMENT OF ELECTRICAL AND INSTRUMENTATION AND CONTROLS

Review Responsibilities

Primary- Branches assigned responsibility by PM as described in SRP-LR Section 3.0 of this SRP-LR.

3.6.1 Areas of Review

This section addresses the aging management review (AMR) and the associated aging management program (AMP) of the electrical and instrumentation and controls (I&C). For a recent vintage plant, the information related to the Electrical and I&C is contained in Chapter 7, “Instrumentation and Controls,” and Chapter 8, “Electric Power,” of the plant’s FSAR, consistent with the “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants” (NUREG-0800) (Ref. 1). For older plants, the location of applicable information is plant-specific because an older plant’s FSAR may have predated NUREG-0800. Typical electrical and I&C components that are subject to an AMR for license renewal are electrical cables and connections, metal enclosed buses, fuse holders, high voltage insulators, transmission conductors and connections, and switchyard bus and connections.

The responsible review organization is to review the following license renewal application (LRA) AMR and AMP items assigned to it, per SRP-LR Section 3.0:

AMRs
- AMR results consistent with the GALL Report
- AMR results for which further evaluation is recommended by the GALL Report
- AMR results not consistent with or not addressed in the GALL Report

AMPs
- Consistent with GALL Report AMPs
- Plant-specific AMPs

FSAR Supplement
- The responsible review organization is to review the FSAR Supplement associated with each assigned AMP.

3.6.2 Acceptance Criteria

The acceptance criteria for the areas of review describe methods for determining whether the applicant has met the requirements of the NRC’s regulations in 10 CFR 54.21.

3.6.2.1 AMR Results Consistent with the GALL Report

The AMRs and the AMPs applicable to the electrical and I&C components are described and evaluated in Chapter VI of (GALL Report).

The applicant’s LRA should provide sufficient information so that the NRC reviewer is able to confirm that the specific LRA AMR line-item and the associated LRA AMP are consistent with the cited GALL Report AMR line-item. The staff reviewer should then confirm that the LRA AMR line-item is consistent with the GALL Report AMR line-item to which it is compared.

For AMPs, if the applicant identifies an exception to any of the program elements of the cited GALL Report AMP, the LRA AMP should include a basis demonstrating how the criteria of 10 CFR 54.21(a)(3) would still be met. The NRC reviewer should then confirm that the LRA AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the LRA AMP, the reviewer identifies a difference from the GALL Report AMP that should have been identified as an exception to the GALL Report AMP, this difference should be reviewed and properly dispositioned. The reviewer should document the disposition of all LRA-defined exceptions and staff-identified differences.

The LRA should identify any enhancements that are needed to permit an existing LRA AMP to be declared consistent with the GALL Report AMP to which the LRA AMP is compared. The reviewer is to confirm both that the enhancement, when implemented, would allow the existing LRA AMP to be consistent with the GALL AMP and also that the applicant has a commitment in the FSAR supplement to implement the enhancement prior to the period of extended operation. The reviewer should document the disposition of all enhancements.

3.6.2.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

The basic acceptance criteria defined in Section 3.6.2.1 apply to all of the AMRs and AMPs reviewed as part of this section. In addition, if the GALL Report AMR line-item to which the LRA AMR line-item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL Report for each of the following aging effect/aging mechanism combinations.

3.6.2.2.1 Electrical Equipment Subject to Environmental Qualification

Environmental qualification is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The evaluation of this TLAA is addressed separately in Section 4.4, "Environmental Qualification (EQ) of Electrical Equipment" of this SRP-LR.

3.6.2.2.2 Degradation of Insulator Quality due to Presence of Any Salt Deposits and Surface Contamination, and Loss of Material due to Mechanical Wear

Degradation of insulator quality due to presence of any salt deposits and surface contamination could occur in high voltage insulators. The GALL Report recommends further evaluation of a plant-specific aging management program for plants located such that the potential exists for salt deposits or surface contamination (e.g., in the vicinity of salt water bodies or industrial pollution). Loss of material due to mechanical wear caused by wind blowing on transmission conductors could occur in high voltage insulators. The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR)

3.6.2.2.3 Loss of Material due to Wind Induced Abrasion and Fatigue, Loss of Conductor Strength due to Corrosion, and Increased Resistance of Connection due to Oxidation or Loss of Pre-load

Loss of material due to wind induced abrasion and fatigue, loss of conductor strength due to corrosion, and increased resistance of connection due to oxidation or loss of pre-load could occur in transmission conductors and connections, and in switchyard bus and connections. The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.6.2.2.4 Quality Assurance for Aging Management of Nonsafety-Related Components

Acceptance criteria are described in Branch Technical Position IQMB-1 (Appendix A.2 of this SRP-LR).

3.6.2.3 AMR Results Not Consistent with or Not Addressed in the GALL Report

Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this standard review plan).

3.6.2.4 FSAR Supplement

The summary description of the programs and activities for managing the effects of aging for the period of extended operation in the FSAR Supplement should be sufficiently comprehensive such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the bases for determining that aging effects are managed during the period of extended operation. The description should also contain any future aging management activities, including enhancements and commitments, to be completed before entering the period of extended operation. Examples of the type of information required are provided in Table 3.6-2 of this SRP-LR.

3.6.3 Review Procedures

For each area of review, the following review procedures are to be followed:

3.6.3.1 AMR Results Consistent with the GALL Report

The applicant may reference the GALL Report in its LRA, as appropriate, and demonstrate that the AMRs and AMPs at its facility are consistent with those reviewed and approved in the GALL Report. The reviewer should not conduct a re-review of the substance of the matters described in the GALL Report. If the applicant has provided the information necessary to adopt the finding of program acceptability as described and evaluated in the GALL Report, the reviewer should find acceptable the applicant's reference to GALL Report in its LRA. In making this determination, the reviewer confirms that the applicant has provided a brief description of the system, components, materials, and environment. The reviewer also confirms that the applicant has stated that the applicable aging effects and industry and plant-specific operating experience have been reviewed by the applicant and are evaluated in the GALL Report.

Furthermore, the reviewer should confirm that the applicant has addressed operating experience identified after the issuance of the GALL Report. Performance of this review requires the reviewer to confirm that the applicant has identified those aging effects for the electrical and I&C components that are contained in GALL as applicable to its plant.

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL Report. If the applicant commits to an enhancement to make its LRA AMP consistent with a GALL AMP, then the reviewer is to confirm that this enhancement when implemented will indeed make the LRA AMP consistent with the GALL AMP. If the applicant identifies, in the LRA AMP, an exception to any of the program elements of the GALL AMP with which the applicant is claiming to be consistent, the reviewer is to confirm that the LRA AMP with the exception will satisfy the criteria of 10 CFR 54.21(a)(3). If the reviewer identifies a difference, not identified by the LRA, between the LRA AMP and the GALL AMP, with which the LRA claims to be consistent, the reviewer should confirm that the LRA AMP with this difference satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions or differences. The AMPs evaluated in GALL pertinent to the electrical and I&C components are summarized in Table 3.6-1 of this SRP-LR. In this table, the ID column provides a row identifier useful in matching the information presented in the corresponding table in the GALL Report Vol. 1. The related item column identifies the item number in the GALL Report Vol. 2, Chapters II through VIII, presenting detailed information summarized by this row.

3.6.3.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

The basic review procedures defined in Section 3.6.3.1 apply to all of the AMRs and AMPs provided in this section. In addition, if the GALL AMR line-item to which the LRA AMR line-item is compared identifies that further evaluation is recommended, then additional criteria apply as identified by the GALL Report for each of the following aging effect/aging mechanism combinations.

3.6.3.2.1 Electrical Equipment Subject to Environmental Qualification

Environmental qualification is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The staff reviews the evaluation of this TLAA separately following the guidance in Section 4.4 of this SRP-LR.

3.6.3.2.2 Degradation of Insulator Quality due to Presence of Any Salt Deposits and Surface Contamination, and Loss of Material due to Mechanical Wear

The GALL Report recommends a plant-specific aging management program for the management of degradation of insulator quality due to presence of any salt deposits and surface contamination for plants located such that the potential exists for salt deposits or surface contamination (e.g., in the vicinity of salt water bodies or industrial pollution), and loss of material due to mechanical wear caused by wind blowing on transmission conductors in high voltage insulators. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.6.3.2.3 Loss of Material due to Wind Induced Abrasion and Fatigue, Loss of Conductor Strength due to Corrosion, and Increased Resistance of Connection due to Oxidation or Loss of Pre-load

The GALL Report recommends a plant-specific aging management program for the management of loss of material due to wind induced abrasion and fatigue, loss of conductor strength due to corrosion, and increased resistance of connection due to oxidation or loss of pre-load in transmission conductors and connections, and in switchyard bus and connections. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.6.3.2.4 Quality Assurance for Aging Management of Nonsafety-Related Components

The applicant's aging management programs for license renewal should contain the elements of corrective actions, the confirmation process, and administrative controls. Safety-related components are covered by 10 CFR Part 50, Appendix B, which is adequate to address these program elements. However, Appendix B does not apply to non safety-related components that are subject to an AMR for license renewal. Nevertheless, the applicant has the option to expand the scope of its 10 CFR Part 50, Appendix B program to include these components and address these program elements. If the applicant chooses this option, the reviewer confirms that the applicant has documented such a commitment in the FSAR supplement. If the applicant chooses alternative means, the branch responsible for quality assurance should be requested to review the applicant's proposal on a case-by-case basis.

3.6.3.3 AMR Results Not Consistent with or Not Addressed in GALL Report

The reviewer should confirm that the applicant, in the license renewal application, has identified applicable aging effects, listed the appropriate combination of materials and environments, and aging management programs that will adequately manage the aging effects. The aging management program credited could be an AMP that is described and evaluated in the GALL Report or a plant-specific program. Review procedures are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

3.6.3.4 FSAR Supplement

The reviewer confirms that the applicant has provided information equivalent to that in Table 3.6-2 in the FSAR supplement for aging management of the Electrical and I&C System for license renewal. The reviewer also confirms that the applicant has provided information equivalent to that in Table 3.6-2 in the FSAR supplement for Section 3.6.3.3, "AMR Results Not Consistent with or Not Addressed in the GALL Report."

The staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR supplement before the license is renewed, no condition will be necessary.

As noted in Table 3.6-2, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should confirm that the applicant has identified and committed in the license renewal application to any future aging management activities, including enhancements and commitments to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.6.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of this section, then an evaluation finding similar to the following text should be included in the staff's safety evaluation report:

On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated that the aging effects associated with the electrical and instrumentation and controls components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable FSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of electrical and instrumentation and controls, as required by 10 CFR 54.21(d).

3.6.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

3.6.6 References

1. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, July 1981.

2. NUREG-1801, "Generic Aging Lessons Learned (GALL)," U.S. Nuclear Regulatory Commission, Revision 1, September 2005.

Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
1	BWR/ PWR	Electrical equipment subject to 10 CFR 50.49 environmental qualification (EQ) requirements	Degradation due to various aging mechanisms	Environmental Qualification Of Electric Components	Yes, TLAA (See subsection 3.6.2.2.1)	L-05
2	BWR/ PWR	Electrical cables, connections and fuse holders (insulation) not subject to 10 CFR 50.49 EQ requirements	Reduced insulation resistance and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	Electrical Cables and Connections Not Subject To 10 CFR 50.49 EQ Requirements	No	L-01 LP-03
3	BWR/ PWR	Conductor insulation for electrical cables and connections used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements that are sensitive to reduction in conductor insulation resistance (IR)	Reduced insulation resistance and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	Electrical Cables And Connections Used In Instrumentation Circuits Not Subject To 10 CFR 50.49 EQ Requirements	No	L-02
4	BWR/ PWR	Conductor insulation for inaccessible medium voltage (2 kV to 35 kV) cables (e.g., installed in conduit or direct buried) not subject to 10 CFR 50.49 EQ requirements	Localized damage and breakdown of insulation leading to electrical failure due to moisture intrusion, water trees	Inaccessible Medium Voltage Cables Not Subject To 10 CFR 50.49 EQ Requirements	No	L-03

Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
5	PWR	Connector contacts for electrical connectors exposed to borated water leakage	Corrosion of connector contact surfaces due to intrusion of borated water	Boric Acid Corrosion	No	L-04
6	BWR/ PWR	Fuse Holders (Not Part of a Larger Assembly): Fuse holders – metallic clamp	Fatigue due to ohmic heating, thermal cycling, electrical transients, frequent manipulation, vibration, chemical contamination, corrosion, and oxidation	Fuse Holders	No	LP-01
7	BWR/ PWR	Metal enclosed bus - Bus/connections	Loosening of bolted connections due to thermal cycling and ohmic heating	Metal Enclosed Bus	No	LP-04
8	BWR/ PWR	Metal enclosed bus – Insulation/insulators	Reduced insulation resistance and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	Metal Enclosed Bus	No	LP-05
9	BWR/ PWR	Metal enclosed bus – Enclosure assemblies	Loss of material due to general corrosion	Structures Monitoring Program	No	LP-06

Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
10	BWR/ PWR	Metal enclosed bus – Enclosure assemblies	Hardening and loss of strength due to elastomers degradation	Structures Monitoring Program	No	LP-10
11	BWR/ PWR	High voltage insulators	Degradation of insulation quality due to presence of any salt deposits and surface contamination, Loss of material caused by mechanical wear due to wind blowing on transmission conductors	A plant-specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.6.2.2.2)	LP-07 LP-11
12	BWR/ PWR	Transmission conductors and connections, Switchyard bus and connections	Loss of material due to wind induced abrasion and fatigue, Loss of conductor strength due to corrosion, Increased resistance of connection due to oxidation or loss of preload	A plant-specific aging management program is to be evaluated.	Yes, plant specific (see subsection 3.6.2.2.3)	LP-08 LP-09

Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
13	BWR/ PWR	Cable Connections – Metallic parts	Loosening of bolted connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation	Electrical Cable Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements	No	LP-12
14	BWR/ PWR	Fuse Holders (Not Part of a Larger Assembly) Insulation material	None	None	NA - No AEM or AMP	LP-02

Table 3.6-2. FSAR Supplement for Aging Management of Electrical and Instrumentation and Control System

Program	Description of Program	Implementation Schedule*
Non-Environmentally Qualified Electrical Cables and Connections exposed to an adverse localized environment caused by heat, radiation, or moisture.	Accessible electrical cables and connections installed in adverse localized environments are visually inspected at least once every 10 years for cable and connection jacket surface anomalies, such as embrittlement, discoloration, cracking, swelling, or surface contamination, which are precursor indications of conductor insulation aging degradation from heat, radiation or moisture. An adverse localized environment is a condition in a limited plant area that is significantly more severe than the specified service condition for the electrical cable or connection.	First inspection for license renewal should be completed before the period of extended operation.
Non-Environmentally Qualified Electrical Cables and Connections used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance, and are exposed to an adverse localized environment caused by heat, radiation, or moisture.	Electrical cables and connections used in circuits with sensitive, low-level signals, such as radiation monitoring and nuclear instrumentation, are calibrated as part of the instrumentation loop calibration at the normal calibration frequency, which provides sufficient indication of the need for corrective actions based on acceptance criteria related to instrumentation loop performance. The review of calibration results is performed once every 10 years. In cases where cables are not part of calibration or surveillance program, a proven cable test (such as insulation resistance tests, time domain reflectometry tests, or other tests judged to be effective) for detecting deterioration of the insulation system are performed. The test frequency is based on engineering evaluation not to exceed 10 years.	First review of calibration results or cable tests for license renewal should be completed before the period of extended operation.

Table 3.6-2. FSAR Supplement for Aging Management of Electrical and Instrumentation and Control System

Program	Description of Program	Implementation Schedule*
Non-Environmentally Qualified Inaccessible Medium-Voltage Cables exposed to an adverse localized environment caused by moisture and voltage exposure	In-scope, medium-voltage cables exposed to significant moisture and significant voltage are tested at least once every 10 years to provide an indication of the condition of the conductor insulation. The specific type of test performed will be determined prior to the initial test, and is to be a proven test for detecting deterioration of the insulation system due to wetting, such as power factor, partial discharge, or polarization index, as described in EPRI TR-103834-P1-2, or other testing that is state-of-the-art at the time the test is performed. Significant moisture is defined as periodic exposures that last more than a few days (e.g., cable in standing water). Periodic exposures that last less than a few days (e.g., normal rain and drain) are not significant. Significant voltage exposure is defined as being subjected to system voltage for more than 25% of the time. The moisture and voltage exposures described as significant in these definitions are not significant for medium-voltage cables that are designed for these conditions (e.g., continuous wetting and continuous energization are not significant for submarine cables). In addition, inspection for water collection is performed based on actual plant experience with water accumulation in the manholes. However, the inspection frequency should be at least once every two years.	First tests or first inspections for license renewal should be completed before the period of extended operation.
Boric Acid Corrosion	The program consists of (1) visual inspection of external surfaces that are potentially exposed to borated water leakage, (2) timely discovery of leak path and removal of the boric acid residues, (3) assessment of the damage, and (4) follow-up inspection for adequacy. This program is implemented in response to GL 88-05.	Existing program.
Plant-specific AMP	The description should contain information associated with the basis for determining that aging effects will be managed during the period of extended operation.	Program should be implemented before the period of extended operation.
Fuse Holders	Fuse holders within the scope of license renewal will be tested at least once every 10 years to provide an indication of degradation of the metallic clamp portion of the fuse holders. Testing may include thermography, contact resistance testing, or other appropriate testing methods.	First tests for license renewal should be completed before the period of extended operation.

Table 3.6-2. FSAR Supplement for Aging Management of Electrical and Instrumentation and Control System

Program	Description of Program	Implementation Schedule*
Metal Enclosed Bus	Internal portions of MEBs are visually inspected for cracks, corrosion, foreign debris, excessive dust buildup, and evidence of moisture intrusion. The bus insulation is inspected for signs of embrittlement, cracking, melting, swelling, or discoloration, which may indicate overheating or aging degradation. The (internal) bus supports are inspected for structural integrity and signs of cracks. A sample of accessible bolted connections on the internal bus work is checked for loose connection by using thermography, or by measuring connection resistance using a low range ohmmeter. These inspections are performed at least once every 10 years. As an alternative to thermography or measuring connection resistance of bolted connections, those bolted connections covered with heat shrink tape, sleeving, insulating boots, etc., may use visual inspection of insulation material to detect surface anomalies, such as discoloration, cracking, chipping or surface contamination. When this alternative visual inspection is used to check bolted connections, the inspections are performed once every five years.	First inspection for license renewal should be completed before the period of extended operation.
Non-Environmentally Qualified Electrical Cable Connections	A representative sample of electrical cable connections within the scope of license renewal will be tested at least once every 10 years. Testing may include thermography, contact resistance testing, or other appropriate testing methods.	First tests for license renewal should be completed before the period of extended operation.
Structures Monitoring Program	The program consists of periodic inspection and monitoring the condition of structures and structure component supports to ensure that aging degradation leading to loss of intended functions will be detected and that the extent of degradation can be determined. This program is implemented in accordance with NUMARC 93-01, Rev. 2 and RG 1.160, Rev. 2.	Existing program.
Quality assurance	The 10 CFR Part 50, Appendix B program provides for corrective actions, the confirmation process, and administrative controls for aging management programs for license renewal. The scope of this existing program will be expanded to include non safety-related structures and components that are subject to an AMR for license renewal.	Program should be implemented before the period of extended operation.

Table 3.6-2. FSAR Supplement for Aging Management of Electrical and Instrumentation and Control System

Program	Description of Program	Implementation Schedule*

* An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

CHAPTER 4

TIME-LIMITED AGING ANALYSES

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4.1 IDENTIFICATION OF TIME-LIMITED AGING ANALYSES

Review Responsibilities

Primary - Branch responsible for the TLAA issues
Secondary - Other branches responsible for engineering, as appropriate

4.1.1 Areas of Review

This review plan section addresses the identification of time-limited aging analyses (TLAAs). The technical review of TLAAs is addressed in section 4.2 through 4.7. As explained in more detail below, the list of TLAAs are certain plant-specific safety analyses that are based on an explicitly assumed 40-year plant life (for example, aspects of the reactor vessel design). Pursuant to 10 CFR 54.21(c)(1), a license renewal applicant is required to provide a list of TLAAs, as defined in 10 CFR 54.3. The area relating to the identification of TLAAs is reviewed.

TLAAs may have developed since issuance of a plant's operating license. As indicated in 10 CFR 54.30, the adequacy of the plant's CLB, which includes TLAAs, is not an area within the scope of the license renewal review. Any question regarding the adequacy of the CLB must be addressed under the backfit rule (10 CFR 50.109) and is separate from the license renewal process.

In addition, pursuant to 10 CFR 54.21(c)(2), an applicant must provide a list of plant-specific exemptions granted under 10 CFR 50.12 that are based on TLAAs. However, the initial license renewal applicants have found no such exemptions for their plants.

It is an applicant's option to include more analyses than those required by 10 CFR 54.21(c)(1). The staff should focus its review to confirm that the applicant did not omit any TLAAs, as defined in 10 CFR 54.3.

Pursuant to 10 CFR 54.21(d), each application is to include a FSAR Supplement summary description for each TLAA that is identified in accordance with 10 CFR 54.3.

4.1.2 Acceptance Criteria

The acceptance criteria for the areas of review described in Subsection 4.1.1 of this review plan section delineate acceptable methods for meeting the requirements of the NRC's regulations in 10 CFR 54.21(c)(1). For the applicant's list of exemptions to be acceptable, the staff should have reasonable assurance that there has been no omission of TLAAs from that list.

Pursuant to 10 CFR 54.3, TLAAs are those licensee calculations and analyses that:

1. Involve systems, structures, and components within the scope of license renewal, as delineated in 10 CFR 54.4(a);

2. Consider the effects of aging;

3. Involve time-limited assumptions defined by the current operating term, for example, 40 years;

4. Were determined to be relevant by the licensee in making a safety determination;

5. Involve conclusions or provide the basis for conclusions related to the capability of the system, structure, or component to perform its intended function(s), as delineated in 10 CFR 54.4(b); and

6. Are contained or incorporated by reference in the CLB.

The reviewer is to review the FSAR Supplement for each TLAA that has been identified as being within the scope of the LRA, as defined in 10 CFR 54.3.

4.1.3 Review Procedures

For each area of review described in Subsection 4.1.1, the reviewer should adhere to the following review procedures:

The reviewer should use the plant UFSAR and other CLB documents, such as staff SERs, in performing the review. The reviewer should select analyses that the applicant did not identify as TLAAs that are likely to meet the six criteria identified in Subsection 4.1.2. The reviewer verifies that the selected analyses, not identified by the applicant as TLAAs, do not meet at least one of the following criteria (Ref. 1).

Sections 4.2 through 4.6 identify typical types of TLAAs for most plants. Information on the licensee's methodology for identifying TLAAs may also be useful in identifying calculations that did not meet six criteria below.

1. Involve systems, structures, and components within the scope of license renewal, as delineated in 10 CFR 54.4(a). Chapter 2 of this standard review plan provides the reviewer guidance on the scoping and screening methodology, and on plant level and various system level scoping results.

2. Consider the effects of aging. The effects of aging include, but are not limited to: loss of material, loss of toughness, loss of prestress, settlement, cracking, and loss of dielectric properties.

3. Involve time-limited assumptions defined by the current operating term (for example, 40 years). The defined operating term should be explicit in the analysis. Simply asserting that a component is designed for a service life or plant life is not sufficient. The assertion should be supported by calculations or other analyses that explicitly include a time limit.

4. Were determined to be relevant by the licensee in making a safety determination. Relevancy is a determination that the applicant should make based on a review of the information available. A calculation or analysis is relevant if it can be shown to have a direct bearing on the action taken as a result of the analysis performed. Analyses are also relevant if they provide the basis for a licensee's safety determination and, in the absence of the analyses, the licensee might have reached a different safety conclusion.

5. Show capability of the system, structure, or component to perform its intended function(s), as delineated. Involve conclusions or provide the basis for conclusions related to 10 CFR 54.4(b). Analyses that do not affect the intended functions of systems, structures, or components are not TLAAs.

6. Are contained or incorporated by reference in the CLB. The CLB includes the technical specifications as well as design basis information (as defined in 10 CFR 50.2) or licensee commitments documented in the plant-specific documents contained or incorporated by reference in the CLB including, but not limited to: the FSAR, NRC SERs, the fire protection plan/hazards analyses, correspondence to and from the NRC, the quality assurance plan, and topical reports included as references to the FSAR. Calculations and analyses that are not in the CLB or not incorporated by reference in the CLB are not TLAAs. If a code of record is in the FSAR for particular groups of structures or components, reference material includes all calculations called for by that code of record for those structures and components.

TLAAs that need to be addressed are not necessarily those analyses that have been previously reviewed or approved by the NRC. The following examples illustrate TLAAs that need to be addressed and were not previously reviewed and approved by the NRC:

- The FSAR states that the design complies with a certain national code and standard. A review of the code and standard reveals that it calls for an analysis or calculation. Some of these calculations or analysis will be TLAAs. The actual calculation was performed by the licensee to meet the code and standard. The specific calculation was not referenced in the FSAR. The NRC had not reviewed the calculation.

- In response to a generic letter, a licensee submitted a letter to the NRC committing to perform a TLAA that would address the concern in the generic letter. The NRC had not documented a review of the licensee’s response and had not reviewed the actual analysis.

The following examples illustrate analyses that are *not* TLAAs and need not be addressed under 10 CFR 54.21(c):

- Population projections (Section 2.1.3 of NUREG-0800) (Ref. 2).

- Cost-benefit analyses for plant modifications.

- Analysis with time-limited assumptions defined short of the current operating term of the plant, for example, an analysis for a component based on a service life that would not reach the end of the current operating term.

The number and type of TLAAs vary depending on the plant-specific CLB. All six criteria set forth in 10 CFR 54.3 (and repeated in Subsection 4.1.2 of this review plan section) must be satisfied to conclude that a calculation or analysis is a TLAA. Table 4.1-1 provides examples of how these six criteria may be applied (Ref. 1). Table 4.1-2 provides a list of potential TLAAs (60 FR 22480). Table 4.1-3 provides a list of other plant-specific TLAAs that have been identified by the initial license renewal applicants. Tables 4.1-2 and 4.1-3 provide examples of analyses that potentially could be TLAAs for a particular plant. However, TLAAs are plant-specific and depend on an applicant’s CLB. It is not expected that all applicants would identify all the analyses in these tables as TLAAs for their plants. Also, an applicant may have performed specific TLAAs for its plant that are not shown in these tables.

Staff members from other branches of the Division of Engineering will be reviewing the application in their assigned areas without examining the identification of TLAAs. However, they may come across situations in which they may question why the applicant did not identify certain analyses as TLAAs. The reviewer should coordinate the resolution of any such questions with these other staff members and determine whether these analyses should be evaluated as TLAAs.

In order to determine whether there is reasonable assurance that the applicant has identified the TLAAs for its plant, the reviewer should find that the analyses omitted from the applicant's list are not TLAAs.

Should an applicant identify a TLAA that is also a basis for a plant-specific exemption granted pursuant to 10 CFR 50.12 and the exemption is in effect, the reviewer verifies that the applicant has also identified that exemption pursuant to 10 CFR 54.21(c)(2). However, the initial license renewal applicants have found no such exemptions for their plants.

4.1.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of this section, and whether the staff's evaluation supports conclusions of the following type, to be included in the staff's safety evaluation report:

> On the basis of its review, as discussed above, the staff concludes that the applicant has provided an acceptable list of TLAAs as defined in 10 CFR 54.3, and that no 10 CFR 50.12 exemptions have been granted on the basis of a TLAA, as defined in 10 CFR 54.3.

4.1.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

4.1.6 References

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

2. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports Nuclear Power Plants," July 1981.

Table 4.1-1. Identification of Potential Time-Limited Aging Analyses and Basis for Disposition

Example	Disposition
NRC correspondence requests a utility to justify that unacceptable cumulative wear did not occur during the design life of control rods.	Does not qualify as a TLAA because the design life of control rods is less than 40 years. Therefore, does not meet criterion (3) of the TLAA definition in 10 CFR 54.3.
Maximum wind speed of 100 mph is expected to occur once per 50 years.	Not a TLAA because it does not involve an aging effect.
Correspondence from the utility to the NRC states that the membrane on the containment basemat is certified by the vendor to last for 40 years.	The membrane was not credited in any safety evaluation, and therefore the analysis is not considered a TLAA. This example does not meet criterion (4) of the TLAA definition in 10 CFR 54.3.
Fatigue usage factor for the pressurizer surge line was determined not to be an issue for the current license period in response to NRC Bulletin 88-11.	This example is a TLAA because it meets all 6 criteria in the definition of TLAA in 10 CFR 54.3. The utility's fatigue design basis relies on assumptions defined by the 40-year operating life for this component, which is the current operating term.
Containment tendon lift-off forces are calculated for the 40-year life of the plant. These data are used during Technical Specification surveillance for comparing measured to predicted lift-off forces.	This example is a TLAA because it meets all 6 criteria of the TLAA definition in 10 CFR 54.3. The lift-off force curves are currently limited to 40-year values, and are needed to perform a required Technical Specification surveillance.

Table 4.1-2. Potential Time-Limited Aging Analyses

Reactor vessel neutron embrittlement
Concrete containment tendon prestress
Metal fatigue
Environmental qualification of electrical equipment
Metal corrosion allowance
Inservice flaw growth analyses that demonstrate structure stability for 40 years
Inservice local metal containment corrosion analyses
High-energy line-break postulation based on fatigue cumulative usage factor

Table 4.1-3. Additional Examples of Plant-Specific TLAAs as Identified by the Initial License Renewal Applicants

Intergranular separation in the heat-affected zone (HAZ) of reactor vessel low-alloy steel under austenitic SS cladding.
Low-temperature overpressure protection (LTOP) analyses
Fatigue analysis for the main steam supply lines to the turbine-driven auxiliary feedwater pumps
Fatigue analysis of the reactor coolant pump flywheel
Fatigue analysis of polar crane
Flow-induced vibration endurance limit for the reactor vessel internals
Transient cycle count assumptions for the reactor vessel internals
Ductility reduction of fracture toughness for the reactor vessel internals
Leak before break
Fatigue analysis for the containment liner plate
Containment penetration pressurization cycles
Reactor vessel circumferential weld inspection relief (BWR)

4.2 REACTOR VESSEL NEUTRON EMBRITTLEMENT ANALYSIS

Review Responsibilities

Primary - Branch responsible for the TLAA issues
Secondary - Branch responsible for reactor systems

4.2.1 Areas of Review

During plant service, neutron irradiation reduces the fracture toughness of ferritic steel in the reactor vessel beltline region of light-water nuclear power reactors. Areas of review to ensure that the reactor vessel has adequate fracture toughness to prevent brittle failure during normal and off-normal operating conditions are (1) upper-shelf energy, (2) PTS for PWRs, (3) heat-up and cool-down (pressure-temperature limits) curves, (4) BWR Vessel and Internals Project (VIP) VIP-05 analysis for elimination of circumferential weld inspection and analysis of the axial welds, and (5) other plant-specific TLAAs on reactor vessel neutron embrittlement.

The adequacy of the analyses for these five areas is reviewed for the period of extended operation.

The branch responsible for reactor systems should review neutron fluence and dosimetry information in the application.

4.2.2 Acceptance Criteria

The acceptance criteria for the areas of review described in Subsection 4.2.1 of this review plan section delineate acceptable methods for meeting the requirements of the NRC's regulation in 10 CFR 54.21(c)(1).

4.2.2.1 Time-Limited Aging Analysis

Pursuant to 10 CFR 54.21(c)(1)(i) - (iii), an applicant must demonstrate one of the following:

(i) The analyses remain valid for the period of extended operation;

(ii) The analyses have been projected to the end of the extended period of operation; or

(iii) The effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

For the first three areas of review for the analysis of reactor vessel neutron embrittlement, the specific acceptance criteria depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii).

4.2.2.1.1 Upper-Shelf Energy (USE)

10 CFR Part 50 Appendix G (Ref. 1) paragraph IV.A.1 requires that the reactor vessel beltline materials must have a Charpy upper-shelf energy of no less than 68 J (50 ft-lb) throughout the life of the reactor vessel, unless otherwise approved by the NRC. An applicant may take any one of the following three approaches:

4.2.2.1.1.1 10 CFR 54.21(c)(1)(i)

The reactor vessel components evaluated in the existing upper-shelf energy analysis or NRC-approved equivalent margins analysis (EMA) are re-evaluated to demonstrate the existing analysis remains valid during the period of extended operation because the neutron fluence projected to the end of the period of extended operation is bound by the fluence assumed in the existing analysis.

4.2.2.1.1.2 10 CFR 54.21(c)(1)(ii)

The reactor vessel components evaluated in the existing upper-shelf energy analysis or NRC-approved equivalent margins analysis (EMA) are reevaluated to consider the period of extended operation in accordance with 10 CFR Part 50, Appendix G.

10 CFR Part 50, Appendix G, Section IV.A.1 (the rule) requires licensees to take further corrective actions for those cases where the 75 ft-lb unirradiated USE (UUSE) criterion or 50 ft-lbs end-of-life USE criterion cannot be met (i.e., when the respective UUSE value falls below 75 ft-lb or the EOL USE falls below 50 ft-lb). When this occurs, the rule requires a licensee to submit a supplemental analysis for NRC approval for any case where the UUSE value is less than 75 ft-lb or where the projected USE value for a given material is projected to be less than the 50 ft-lb acceptance criteria at the expiration of the operating license. Thus, if the USE value for a PWR RV material, as projected to the expiration of the period of extended operation, falls below either the 50 ft-lb acceptance criterion or the USE value criterion specified in a previously NRC-approved EMA, or where the %-drop in USE value for a BWR RV material, as projected to the expiration of the period of extended operation, falls below that %-drop in USE value approved by the NRC in its safety evaluation of the BWRVIP's generic EMA for BWRs, an applicant will need to submit a plant-specific engineering analysis (usually an EMA) for NRC approval as supplemental information for license renewal. Otherwise, failure to meet the USE requirements of 10 CFR Part 50, Appendix for the RV materials as evaluated using the neutron fluence that are projected for the period of extended operation mandates imposition of additional commitments or license condition on USE for the license renewal application.

4.2.2.1.1.3 10 CFR 54.21(c)(1)(iii)

Acceptance criteria under 10 CFR 54.21(c)(1)(iii) have yet to be developed. They will be evaluated on a case-by-case basis to ensure that the aging effects will be managed such that the intended function(s) will be maintained during the period of extended operation.

4.2.2.1.2 Pressurized Thermal Shock (for PWRs)

For PWRs, 10 CFR 50.61 (Ref. 2) requires that the "reference temperature" for reactor vessel beltline materials evaluated at end of life (EOL) fluence, RT_{PTS}, be less than the "PTS screening criteria" at the expiration date of the operating license, unless otherwise approved by the NRC. The "PTS screening criteria" are 132°C (270°F) for plates, forgings, and axial weld materials, and 149°C (300°F) for circumferential weld materials. The regulations require updating of the PTS assessment upon a request for a change in the expiration date of a facility's operating license, or change of the projected material neutron fluence or change in the material properties in any of the reactor vessel beltline materials. Therefore, the RT_{PTS} value must be calculated for the entire life of the facility, including the period of extended operation. The PTS TLAA may be handled as follows.

4.2.2.1.2.1 10 CFR 54.21(c)(1)(i)

The existing PTS analysis remains valid during the period of extended operation because the neutron fluence projected to the end of the period of extended operation is bound by the fluence assumed in the existing analysis.

4.2.2.1.2.2 10 CFR 54.21(c)(1)(ii)

The PTS analysis is reevaluated to consider the period of extended operation in accordance with 10 CFR 50.61. An analysis is performed in accordance with RG 1.154 (Ref. 3) if the "PTS screening criteria" in 10 CFR 50.61 are exceeded during the period of extended operation.

4.2.2.1.2.3 10 CFR 54.21(c)(1)(iii)

The staff position for license renewal on this option is described in a May 27, 2004 letter from L.A. Reyes (EDO) to the Commission (Ref. 13) which states that if the applicant does not extend the TLAA, the applicant should provide an assessment of the current licensing basis TLAA for PTS, a discussion of the flux reduction program implemented in accordance with 10 CFR 50.61(b)(3), if necessary, and an identification of the viable options that exist for managing the aging effect in the future.

4.2.2.1.3 Pressure-Temperature (P-T) Limits

10 CFR Part 50, Appendix G (Ref. 1) requires that the reactor pressure vessel (RPV) be maintained within established pressure-temperature (P-T) limits including during any condition of normal operation. This includes heatup and cooldown. These limits specify the maximum allowable pressure as a function of reactor coolant temperature. As the reactor pressure vessel becomes embrittled and its fracture toughness is reduced, the allowable pressure (given the required minimum temperature) is reduced.

P-T limits are TLAAs for the application if the plant currently has P-T limit curves approved for the expiration of the current period of operation (i.e., 32 EFPY or other licensed EFPY values at expiration of the current license). However, the P-T limits for the period of extended operation will not need to be submitted as part of the LRA since the P-T limits will need to be updated through the 10 CFR 50.90 licensing process when necessary for P-T limits that are located in the limiting conditions of operation (LCOs) of the Technical Specifications (TS). For those plants that have approved pressure-temperature limit reports (PTLRs), the P-T limits for the period of extended operation will be updated at the appropriate time through the plant's Administrative Section of the TS and the plant's PTLR process. In either case, the 10 CFR 50.90 or the PTLR processes, which constitute the current licensing basis will ensure that the P-T limits for the period of extended operation will be updated prior to expiration of the P-T limit curves for the current period of operation.

P-T limits may be handled as follows.

4.2.2.1.3.1 10 CFR 54.21(c)(1)(i)

The existing P-T limits are valid during the period of extended operation because the neutron fluence projected to the end of the period of extended operation is bound by the fluence assumed in the existing analysis.

4.2.2.1.3.2 10 CFR 54.21(c)(1)(ii)

The P-T limits are reevaluated to consider the period of extended operation in accordance with 10 CFR Part 50, Appendix G (Ref. 1).

4.2.2.1.3.3 10 CFR 54.21(c)(1)(iii)

Updated P-T limits for the period of extended operation must be available prior to entering the period of extended operation. The 10 CFR 50.90 process for P-T limits located in the LCOs or the Administrative Controls Process for P-T limits that are administratively amended through a PTLR process can be considered adequate aging management programs within the scope of 10 CFR 54.21(c)(1)(iii) such that P-T limits will be maintained through the period of extended operation.

4.2.2.1.4 Elimination of Circumferential Weld Inspection (for BWRs)

Some BWRs have an approved technical alternative which eliminates the reactor vessel circumferential shell weld inspections for the current license term because they satisfy the limiting conditional failure probability for the circumferential welds at the expiration of the current license, based on BWRVIP-05 and the extent of neutron embrittlement (Refs. 4-6). An applicant for renewal of a license to operate such a BWR may provide justification to extend this relief into the period of extended operation in accordance with BWRVIP-74 (Ref 7). The staff's review of BWRVIP-74 (Ref. 7) is contained in an October 18, 2001 letter to C.Terry, BWRVIP Chairman (Ref. 11). Section A.4.5 of Report BWRVIP-74 indicates that the staff's SER conservatively evaluated BWR RPV's to have 64 effective full power years (EFPY), which is 10 EFPY greater than what is realistically expected for the end of the license renewal period. Since this was a generic analysis, a licensee relying on BWRVIP-74 should provide plant-specific information to demonstrate that the circumferential beltline weld materials meet the criteria specified in the report and that operator training and procedures will be utilized during the license renewal term to limit the frequency for cold over-pressure events.

4.2.2.1.5 Axial Welds (for BWRs)

The staff's SER contained in a letter to Carl Terry dated March 7, 2000, "Supplement to Final Safety Evaluation of the BWR Vessel and Internals Project BWRVIP-05 Report" (Ref. 8) discussed the staff's concern related to RPV failure frequency for axial welds and the BWRVIP's analysis of the RPV failure frequency of axial welds. The SER indicates that the RPV failure frequency due to failure of the limiting axial welds in the BWR fleet at the end of 40 years of operation is less than 5×10^{-6} per reactor year, given the assumptions on flaw density, distribution, and location described in the SER. Since the BWRVIP analysis was generic, a licensee relying on BWRVIP-74 should monitor axial beltline weld embrittlement. The applicant may provide plant-specific information to demonstrate that the axial beltline weld materials at the extended period of operation meet the criteria specified in the report or have a program to monitor axial weld embrittlement relative to the values specified by the staff in its May 7, 2000, (Ref. 8) letter.

4.2.2.2 FSAR Supplement

The specific criterion for meeting 10 CFR 54.21(d) is:

The summary description of the evaluation of TLAAs for the period of extended operation in the FSAR supplement is appropriate such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the TLAAs regarding the basis for determining that the applicant has made the demonstration required by 10 CFR 54.21(c)(1).

4.2.3 Review Procedures

For each area of review described in Subsection 4.2.1, the following review procedures should be followed.

4.2.3.1 Time-Limited Aging Analysis

For the first three areas of review for the analysis of reactor vessel neutron embrittlement, the review procedures depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii). For each area, the applicant's three options under section 54.21(c)(1) are discussed in turn, as follows.

4.2.3.1.1 Upper-Shelf Energy

4.2.3.1.1.1 10 CFR 54.21(c)(1)(i)

The projected neutron fluence at the end of the period of extended operation is reviewed to verify that it is bound by the fluence assumed in the existing upper-shelf energy analysis.

4.2.3.1.1.2 10 CFR 54.21(c)(1)(ii)

The documented results of the revised upper-shelf energy analysis based on the projected neutron fluence at the end of the period of extended operation are reviewed for compliance with 10 CFR Part 50, Appendix G. The applicant may use RG 1.99 Rev. 2 (Ref. 9) to project upper-shelf energy to the end of the period of extended operation. The applicant may also use ASME Code Section XI Appendix K (Ref. 10) for the purpose of performing an equivalent margins analysis to demonstrate that adequate protection for ductile failure will be maintained to the end of the period of extended operation. The staff should review the applicant's methodology for this evaluation. Branch Position MTEB 5-2 in Standard Review Plan Section 5.3.2, "Pressure Temperature limits," provides additional NRC positions on estimations of USE values for reactor vessel beltline materials.

The staff should confirm that the applicant has provided sufficient information for all Upper Shelf Energy (USE) and/or equivalent margins analysis calculations for the period of extended operation as follows:

Neutron Fluence: The applicant should have identified: (1) the neutron fluence at the 1/4T location for each beltline material at the expiration of the license renewal period; (2) the methodology used in determining the neutron fluence, and identified (3) whether the methodology followed the guidance in Regulatory Guide (RG) 1.190 (Ref. 12).

To confirm that the USE analysis meets the requirements of Appendix G of 10 CFR Part 50 at the end of the license renewal period, the staff should determine whether:

1. For each beltline material, the applicant has provided the unirradiated Charpy USE, and the projected Charpy USE at the end of the license renewal period, and whether

the drop in Charpy USE was determined using the limit lines in Figure 2 of RG 1.99, Revision 2 or from surveillance data and the percentage copper.

2. If an equivalent margins analysis was used to demonstrate compliance with the USE requirements in Appendix G of 10 CFR Part 50, the applicant has provided the analysis or identified an approved topical report that contains the analysis. Information the staff will consider to assess the equivalent margins analysis includes: the unirradiated USE (if available) for the limiting material, its copper content, the fluence (1/4T and at 1 inch depth), the EOLE USE (if available), the operating temperature in the downcomer at full power, the vessel radius, the vessel wall thickness, the J-applied analysis for Service Level C and D, the vessel accumulation pressure, and the vessel bounding heatup/cooldown rate during normal operation.

For Boiling Water Reactors, the staff should confirm that the beltline materials are evaluated in accordance with Renewal Applicant Action Items 10, 11 and 12 in the staff's SER, for BWRVIP-74 (Letter to C. Terry dated October 18, 2001) (Ref.11). The applicant should also identify whether there are two or more surveillance material samples available that are relevant to the RPV beltline materials. If there are two or more data points for a surveillance material, the applicant should provide analyses of the data to determine whether the data is consistent with the RG 1.99, Revision 2 methodology that was utilized in the BWRVIP-74 analyses.

4.2.3.1.1.3 10 CFR 54.21(c)(1)(iii)

The applicant's proposal to demonstrate that the effects of aging on the intended function(s) will be adequately managed for the period of extended operation will be reviewed on a case-by-case basis.

4.2.3.1.2 Pressurized Thermal Shock (for PWRs)

4.2.3.1.2.1 10 CFR 54.21(c)(1)(i)

The projected neutron fluence at the end of the period of extended operation is reviewed to verify that it is bound by the fluence assumed in the existing PTS analysis.

4.2.3.1.2.2 10 CFR 54.21(c)(1)(ii)

The documented results of the revised PTS analysis based on the projected neutron fluence at the end of the period of extended operation are reviewed for compliance with 10 CFR 50.61.

The staff should confirm that the applicant has provided sufficient information for Pressurized Thermal Shock for the period of extended operation as follows:

Neutron Fluence: Identified the neutron fluence at the inside surface and the 1/4T location for each beltline material at the expiration of the license renewal period. Identified the methodology used in determining the neutron fluence and identified whether the methodology followed the guidance in Regulatory Guide (RG) 1.190 (Ref. 12).

There are two methodologies from 10 CFR 50.61 that can be used in the PTS analysis based on the projected neutron fluence at the end of the period of extended operation. RT_{NDT} is the reference temperature (NDT means nil-ductility temperature) used as an indexing parameter to determine the fracture toughness and the amount of embrittlement of a material. RT_{PTS} is the reference temperature used in the PTS analysis and is related to RT_{NDT} at the end of the facility's operating license.

The first methodology does not rely on plant-specific surveillance data to calculate delta RT_{NDT} (i.e., the mean value of the adjustment or shift in reference temperature caused by irradiation). The delta RT_{NDT} is determined by multiplying a chemistry factor from the tables in 10 CFR 50.61 by a fluence factor calculated from the neutron flux using an equation.

The second methodology relies on plant-specific surveillance data to determine the delta RT_{NDT}. In this methodology, two or more sets of surveillance data are needed. A surveillance datum consists of a measured delta RT_{NDT} for corresponding neutron fluence. 10 CFR 50.61 specifies a procedure and a criterion for determining whether the surveillance data are credible. For the surveillance data to be defined as credible, the difference in the predicted value and the measured value for delta RT_{NDT} must be less than 28°F for weld metal. When a credible surveillance data set exists, the chemistry factor can be determined from these data in lieu of a value from the table in 10 CFR 50.61. Then the standard deviation of the increase in the RT_{NDT} can be reduced from 28°F to 14°F for welds.

To confirm that the Pressurized Thermal Shock analysis results in RT_{PTS} values below the screening criteria in 10 CFR 50.61 at the end of the license renewal period, the applicant should provide the following:

1. For each beltline material provide the unirradiated RT_{NDT}, the method of calculating the unirradiated RT_{NDT} (either generic or plant-specific), the margin, the chemistry factor, the method of calculating the chemistry factor, the mean value for the shift in transition temperature and the RT_{PTS} value.

2. If there are two or more data for a surveillance material that is from the same heat of material as the beltline material, provide analyses to determine whether the data are credible in accordance with RG 1.99, Revision 2 and whether the margin value used in the analysis is appropriate.

3. If a surveillance program does not include the vessel beltline controlling material, but two or more data seta are available from other beltline materials, then provide an analysis of the data in accordance with Regulatory Guide 1.99, Revision 2, Regulatory Position C.2.1, to show that the results either bound or are comparable to the values that would be calculated for the same materials using Regulatory Position C.1.1..

If the "PTS screening criteria" in 10 CFR 50.61 are exceeded during the period of extended operation, an analysis based on RG 1.154 (Ref. 3) is reviewed**.**

4.2.3.1.2.3 10 CFR 54.21(c)(1)(iii)

The applicant's proposal to demonstrate that the effects of aging on the intended function(s) will be adequately managed for the period of extended operation will be reviewed on a case-by-case basis.

The license renewal application should provide an assessment of the current licensing basis TLAA for PTS, a discussion of the flux reduction program implemented in accordance with

§50.61(b)(3), if necessary, and an identification of the viable options that exist for managing the aging effect in the future.

A. The applicant should explain its core management plans (e.g., operation with a low leakage core design and/or integral burnable neutron absorbers) from now through the end of the period of extended operation. Based on this core management strategy, the applicant should:

    (1) Identify the material in the RPV which has limiting RT_{PTS} value,
    (2) Provide the projected fluence value for the limiting material at end of license extended (EOLE),
    (3) Provide the projected RT_{PTS} value for the limiting material at EOLE, and
    (4) Provide the projected date and fluence values at which the limiting material will exceed the screening criteria in §50.61.

B. The applicant should discuss aging management programs that it intends to implement which will actively "manage" the condition of the facility's RPV, and hence, the risk associated with PTS. This discussion would be expected to address, at least, the facility's reactor pressure vessel material surveillance program.

C. The applicant should briefly discuss the options that it is considering with respect to "resolving" the PTS issue through EOLE. It is anticipated that this discussion would include some or all of the following:

    (1) Plant modifications (e.g., heating of ECCS injection water) which could limit the risk associated with postulated PTS events [see §50.61(b)(4) and/or (b)(6)],
    (2) More detailed safety analyses (e.g., using Regulatory Guide 1.154) which may be performed to show that the PTS risk for the facility is acceptably low through EOLE [see §50.61(b)(4)],
    (3) More advanced material property evaluation (e.g., use of Master Curve technology) to demonstrate greater fracture resistance for the limiting material [applies to §50.61(b)(4)] and/or,
    (4) The potential for RPV thermal annealing in accordance with §50.66 [see §50.61(b)(7)].

4.2.3.1.3 Pressure-Temperature (P-T) Limits

4.2.3.1.3.1 10 CFR 54.21(c)(1)(i)

The documented results of the projected neutron fluence at the end of the period of extended operation are reviewed to verify that it is bound by the embrittlement assumed in the existing P-T limit analysis.

4.2.3.1.3.2 10 CFR 54.21(c)(1)(ii)

The documented results of the revised P-T limit analysis based on the projected reduction in fracture toughness at the end of the period of extended operation is reviewed for compliance with 10 CFR Part 50, Appendix G.

4.2.3.1.3.3 10 CFR 54.21(c)(1)(iii)

Not applicable.

4.2.3.1.4 Elimination of Circumferential Weld Inspection (for BWRs)

To demonstrate that the vessel has not been embrittled beyond the basis for the technical alternative and that cold over-pressure events are not likely to occur during the license renewal term, the applicant should provide: (1) a comparison of the neutron fluence, initial RT_{NDT}, chemistry factor amounts of copper and nickel, delta RT_{NDT}, and mean RT_{NDT} of the limiting circumferential weld at the end of the license renewal period to the 64 EFPY reference case in Appendix E of the staff's SER for BWRVIP-74 (Ref. 11), (2) an estimate of conditional failure probability of the RPV at the end of the license renewal term based on the comparison of the mean RT_{NDT} for the limiting circumferential welds and the reference case, and (3) a description of procedures and training that will be utilized during the license renewal term to limit the frequency of cold over-pressure events to the amount specified in the staff's SER for BWRVIP-74 (Ref. 11). The staff should ensure that the applicant's plant is bound by the BWRVIP-74 analysis and that the applicant has committed to actions that are the basis for the staff approval.

4.2.3.1.5 Axial Welds (for BWRs)

To demonstrate that the vessel has not been embrittled beyond the basis for the staff and BWRVIP analyses, the applicant should provide: (1) a comparison of the neutron fluence, initial RT_{NDT}, chemistry factor amounts of copper and nickel, delta RT_{NDT}, and mean RT_{NDT} of the limiting axial weld at the end of the license renewal period to the reference case in the BWRVIP and staff analyses and (2) an estimate of conditional failure probability of the RPV at the end of the license renewal term based on the comparison of the mean RT_{NDT} for the limiting axial welds and the reference case. If this comparison does not indicate that the RPV failure frequency for axial welds is less than 5×10^{-6} per reactor year, the applicant should provide a probabilistic analysis to determine the RPV failure frequency for axial welds. Consistent with the staff's supplemental safety evaluation report (SER) on Topical Report BWRVIP-05, dated May 7, 2000, the staff should ensure that the applicant's plant is bounded by the BWRVIP-05 analysis or that the applicant has committed to a program to monitor axial weld embrittlement relative to the values specified by the staff in its May 7, 2000, SER.

4.2.3.2 FSAR Supplement

The reviewer verifies that the applicant has provided information to be included in the FSAR supplement that includes a summary description of the evaluation of the reactor vessel neutron embrittlement TLAA. Table 4.2-1 of this review plan section contains examples of acceptable FSAR supplement information for this TLAA. The reviewer verifies that the applicant has provided a FSAR supplement with information equivalent to that in Table 4.2-1.

The staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR supplement before the license is renewed, no condition will be necessary.

As noted in Table 4.2-1, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities, including enhancements and commitments to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

4.2.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of this section and whether the staff's evaluation supports conclusions of the following type, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), to be included in the staff's safety evaluation report:

> On the basis of its review, as discussed above, the staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1), that, for the reactor vessel neutron embrittlement TLAA, [choose which is appropriate] (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation. The staff also concludes that the FSAR Supplement contains an appropriate summary description of the reactor vessel neutron embrittlement TLAA evaluation for the period of extended operation as reflected in the license condition.

4.2.5 IMPLEMENTATION

Except in those cases in which the applicant proposes an acceptable alternative method, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

4.2.6 References

1. 10 CFR Part 50 Appendix G, "Fracture Toughness Requirements."

2. 10 CFR 50.61, "Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events."

3. Regulatory Guide 1.154, "Format and Content of Plant-Specific Pressurized Thermal Shock Safety Analysis Reports for Pressurized Water Reactors," January 1987.

4. BWRVIP-05, "BWR Vessel and Internals Project, BWR Reactor Pressure Vessel Shell Weld Inspection Recommendations (BWRVIP-05)," Boiling Water Reactor Owners Group, September 28, 1995.

5. Letter to Carl Terry of Niagara Mohawk Power Company, from Gus C. Lainas of NRC, dated July 28, 1998.

6. Generic Letter 98-05, “Boiling Water Reactor Licensees Use of the BWRVIP-05 Report to Request Relief from Augmented Examination Requirements on Reactor Pressure Vessel Circumferential Shell Welds,” Nuclear Regulatory Commission, November 10, 1998.

7. BWRVIP-74, “BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines,” Boiling Water Reactor Owners Group, September 1999.

8. Letter to Carl Terry of Niagara Mohawk Power Company, from Jack R. Strosnider, Jr., of NRC, dated March 7, 2000.

9. Regulatory Guide 1.99 Rev. 2, “Radiation Embrittlement of Reactor Vessel Materials,” May, 1988.

10. Appendix K of ASME Code, Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components.”

11. Letter to Carl Terry of Niagara Mohawk Power Company, BWRVIP Chairman, from Christopher Grimes, of NRC, dated October 18, 2001.

12. Regulatory Guide 1.190 Rev. 0, “Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence,” March 2001.

13. Letter to the Commission from L.A. Reyes (EDO), dated May 27, 2004 (ADAMS accession number ML041190564)

Table 4.2-1. Examples of FSAR Supplement for Reactor Vessel Neutron Embrittlement TLAA Evaluation

TLAA	Description of Evaluation	Implementation Schedule*
Upper-shelf energy	10 CFR Part 50 Appendix G paragraph IV.A.1 requires that the reactor vessel beltline materials must have Charpy upper-shelf energy of no less than 50 ft-lb (68 J) throughout the life of the reactor vessel unless otherwise approved by the NRC. The upper-shelf energy has been determined to exceed 50 ft-lb (68 J) to the end of the period of extended operation.	Completed
Pressurized thermal shock (for PWRs)	For PWRs, 10 CFR 50.61 requires the "reference temperature RT_{PTS}" for reactor vessel beltline materials be less than the "PTS screening criteria" at the expiration date of the operating license unless otherwise approved by the NRC. The "PTS screening criteria" are 270°F (132°C) for plates, forgings, and axial weld materials, or 300°F (149°C) for circumferential weld materials. The "reference temperature" has been determined to be less than the "PTS screening criteria" at the end of the period of extended operation.	Completed
Pressure-temperature (P-T) limits	10 CFR Part 50 Appendix G requires that heatup and cooldown of the RPV be accomplished within established P-T limits. These limits specify the maximum allowable pressure as a function of reactor coolant temperature. As the RPV becomes embrittled and its fracture toughness is reduced, the allowable pressure is reduced. 10 CFR Part 50 Appendix G requires periodic update of P-T limits based on projected embrittlement and data from a material surveillance program. The P-T limits will be updated to consider the period of extended operation.	Update should be completed before the period of extended operation.
Elimination of circumferential weld inspection and analysis of axial welds (for BWRs)	NRC has granted relief from the reactor vessel circumferential shell weld inspections because the applicant has demonstrated through plant-specific analysis that the plant meets BWRVIP-74 as approved by the NRC and has provided sufficient information that the probability of vessel failure due to embrittlement of axial welds is low.	Completed
Other miscellaneous TLAAs on RV neutron embrittlement	Provide sufficient information on how the calculations for plant-specific TLAAs were performed, what the limiting TLAA parameter was calculated to be in accordance with the neutron fluence projected for the period of extended operation, and why the TLAA is acceptable under either 10 CFR 54.21 (c)(1)(i), (ii), or (iii).	

* An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

4.3 METAL FATIGUE ANALYSIS

Review Responsibilities

Primary - Branch responsible for the TLAA issues
Secondary - None

4.3.1 Areas of Review

A metal component subjected to cyclic loading at loads less than the static design load may fail because of fatigue. Metal fatigue of components may have been evaluated based on an assumed number of transients or cycles for the current operating term. The validity of such metal fatigue analysis is reviewed for the period of extended operation.

The metal fatigue analysis review includes, as appropriate, a review of in service flaw growth analyses, reactor vessel underclad cracking analysis, reactor vessel internals fatigue analysis, postulated high energy line break, leak-before-break, RCP flywheel, and metal bellows.

4.3.1.1 Time-Limited Aging Analysis

Metal components may be designed or analyzed based on requirements in the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code or the American National Standards Institute (ANSI) guidance. These codes contain explicit metal fatigue or cyclic considerations based on TLAAs.

4.3.1.1.1 ASME Section III, Class 1

ASME Class 1 components, which include core support structures, are analyzed for metal fatigue. ASME Section III (Ref. 1) requires a fatigue analysis for Class 1 components that considers all transient loads based on the anticipated number of transients. A Section III Class 1 fatigue analysis requires the calculation of the “cumulative usage factor” (CUF) based on the fatigue properties of the materials and the expected fatigue service of the component. The ASME Code limits the CUF to a value of less than or equal to one for acceptable fatigue design. The fatigue resistance of these components during the period of extended operation is an area of review.

4.3.1.1.2 ANSI B31.1

ANSI B31.1 (Ref. 2) applies only to piping. It does not call for an explicit fatigue analysis. It specifies allowable stress levels based on the number of anticipated thermal cycles. The specific allowable stress reductions due to thermal cycles are listed in Table 4.3-1. For example, the allowable stress would be reduced by a factor of 1.0, i.e., no reduction, for piping that is not expected to experience more than 7,000 thermal cycles during plant service, but would be reduced to half of the maximum allowable static stress for 100,000 or more thermal cycles. The fatigue resistance of these components during the period of extended operation is an area of review.

4.3.1.1.3 Other Evaluations Based on CUF

The codes also contain metal fatigue analysis criteria based on a CUF calculation [the 1969 edition of ANSI B31.7 (Ref. 3) for Class 1 piping, ASME NC-3200 vessels, ASME NE-3200

Class MC components, and metal bellows designed to ASME NC-3649.4(e)(3), ND-3649.4(e)(3), or NE-3366.2(e)(3)]. For these components, the discussion relating to ASME Section III, Class 1 in Subsection 4.3.1.1.1 of this review plan section applies.

4.3.1.1.4 ASME Section III, Class 2 and 3

ASME Section III, Class 2 and 3 piping cyclic design requirements are similar to the guidance in ANSI B31.1. The discussion relating to B31.1 in Subsection 4.3.1.1.2 of this review plan section applies.

4.3.1.2 Generic Safety Issue

The fatigue design criteria for nuclear power plant components have changed as the industry consensus codes and standards have developed. The fatigue design criteria for a specific component depend on the version of the design code that applied to that component, i.e., the code of record. There is a concern that the effects of the reactor coolant environment on the fatigue life of components were not adequately addressed by the code of record.

The NRC has decided that the adequacy of the code of record relating to metal fatigue is a potential safety issue to be addressed by the current regulatory process for operating reactors (Refs. 4 and 5). The effects of fatigue for the initial 40-year reactor license period were studied and resolved under Generic Safety Issue (GSI)-78, "Monitoring of Fatigue Transient Limits for reactor coolant system," and GSI-166, "Adequacy of Fatigue Life of Metal Components" (Ref. 6). GSI-78 addressed whether fatigue monitoring was necessary at operating plants. As part of the resolution of GSI-166, an assessment was made of the significance of the more recent fatigue test data on the fatigue life of a sample of components in plants where Code fatigue design analysis had been performed. The efforts on fatigue life estimation and ongoing issues under GSI-78 and GSI-166 for 40-year plant life were addressed separately under a staff generic task action plan (Refs. 7 and 8). The staff documented its completion of the fatigue action plan in SECY-95-245 (Ref. 9).

SECY-95-245 was based on a study described in NUREG/CR-6260, "Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components" (Ref. 10). In NUREG/CR-6260, sample locations with high fatigue usage were evaluated. Conservatisms in the original fatigue calculations, such as actual cycles versus assumed cycles, were removed, and the fatigue usage was recalculated using a fatigue curve considering the effects of the environment. The staff found that most of the locations would have a CUF of less than the ASME Code limit of 1.0 for 40 years. On the basis of the component assessments, supplemented by a 40-year risk study, the staff concluded that a backfit of the environmental fatigue data to operating plants could not be justified. However, because the staff was less certain that sufficient excessive conservatisms in the original fatigue calculations could be removed to account for an additional 20 years of operation for renewal, the staff recommended in SECY-95-245 that the samples in NUREG/CR-6260 should be evaluated considering environmental effects for license renewal. GSI-190, "Fatigue Evaluation of Metal Components for 60-year Plant Life," was established to address the residual concerns of GSI-78 and GSI-166 regarding the environmental effects on fatigue of pressure boundary components for 60 years of plant operation.

The scope of GSI-190 included design basis fatigue transients. It studied the probability of fatigue failure and its effect on core damage frequency (CDF) of selected metal components for 60-year plant life. The results showed that some components have cumulative probabilities of crack initiation and through-wall growth that approach one within the 40- to 60-year period. The maximum failure rate (through-wall cracks per year) was in the range of 10^{-2} per year, and those failures were generally associated with high cumulative usage factor locations and components with thinner walls, i.e., pipes more vulnerable to through-wall cracks. In most cases, the leakage from these through-wall cracks is small and not likely to lead to core damage. It was concluded that no generic regulatory action is necessary and that GSI-190 is resolved based on results of probabilistic analyses and sensitivity studies, interactions with the industry (NEI and EPRI), and different approaches available to licensees to manage the effects of aging (Refs. 11 and 12).

However, the calculations supporting resolution of this issue, which included consideration of environmental effects, indicate the potential for an increase in the frequency of pipe leaks as plants continue to operate. Thus, the staff concluded that licensees are to address the effects of coolant environment on component fatigue life as aging management programs are formulated in support of license renewal.

The applicant's consideration of the effects of coolant environment on component fatigue life for license renewal is an area of review.

4.3.1.3 FSAR Supplement

Detailed information on the evaluation of TLAAs is contained in the renewal application. A summary description of the evaluation of TLAAs for the period of extended operation is contained in the applicant's FSAR supplement. The FSAR supplement is an area of review.

4.3.2 Acceptance Criteria

The acceptance criteria for the areas of review described in Subsection 4.3.1 of this review plan section delineate acceptable methods for meeting the requirements of the NRC's regulations in 10 CFR 54.21(c)(1).

4.3.2.1 Time-Limited Aging Analysis

Pursuant to 10 CFR 54.21(c)(1)(i) - (iii), an applicant must demonstrate one of the following:

(i) the analyses remain valid for the period of extended operation,

(ii) the analyses have been projected to the end of the extended period of operation, or

(iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Specific acceptance criteria for metal fatigue are:

4.3.2.1.1 ASME Section III, Class 1

For components designed or analyzed to ASME Class 1 requirements, the acceptance criteria, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), are:

4.3.2.1.1.1 10 CFR 54.21(c)(1)(i)

The existing CUF calculations remain valid because the number of assumed transients would not be exceeded during the period of extended operation.

4.3.2.1.1.2 10 CFR 54.21(c)(1)(ii)

The CUF calculations have been reevaluated based on an increased number of assumed transients to bound the period of extended operation. The resulting CUF remains less than or equal to unity for the period of extended operation.

4.3.2.1.1.3 10 CFR 54.21(c)(1)(iii)

In Chapter X of the GALL report (Ref. 13), the staff has evaluated a program for monitoring and tracking the number of critical thermal and pressure transients for the selected reactor coolant system components. The staff has determined that this program is an acceptable aging management program to address metal fatigue of the reactor coolant system components according to 10 CFR 54.21(c)(1)(iii). The GALL report may be referenced in a license renewal application and should be treated in the same manner as an approved topical report. In referencing the GALL report, the applicant should indicate that the material referenced is applicable to the specific plant involved and should provide the information necessary to adopt the finding of program acceptability as described and evaluated in the report. The applicant should also verify that the approvals set forth in the GALL report for the generic program apply to the applicant's program.

4.3.2.1.2 ANSI B31.1

For piping designed or analyzed to B31.1, the acceptance criteria, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), are:

4.3.2.1.2.1 10 CFR 54.21(c)(1)(i)

The existing fatigue strength reduction factors remain valid because the number of cycles would not be exceeded during the period of extended operation.

4.3.2.1.2.2 10 CFR 54.21(c)(1)(ii)

The fatigue strength reduction factors have been reevaluated based on an increased number of assumed thermal cycles and the stress reduction factors (e.g., Table 4.3-1) given in the applicant's code of record to bound the period of extended operation. The adjusted fatigue strength reduction factors are such that the component design basis remains valid during the period of extended operation.

4.3.2.1.2.3 10 CFR 54.21(c)(1)(iii)

The effects of aging on the intended function(s) will be adequately managed for the period of extended operation. The component could be replaced and the allowable stresses for the replacement will be sufficient as specified by the code during the period of extended operation.

Alternative acceptance criteria under 10 CFR 54.21(c)(1)(iii) have yet to be developed. They will be evaluated on a case-by-case basis to ensure that the aging effects will be managed such that the intended functions(s) will be maintained during the period of extended operation.

4.3.2.1.3 Other Evaluations Based on CUF

The acceptance criteria in Subsection 4.3.2.1.1 of this review plan section apply.

4.3.2.1.4 ASME Section III, Class 2 and 3

The acceptance criteria in Subsection 4.3.2.1.2 of this review plan section apply.

4.3.2.2 Generic Safety Issue

The staff recommendation for the closure of GSI-190 is contained in a December 26, 1999 memorandum from Ashok Thadani to William Travers (Ref. 11). The staff recommended that licensees address the effects of the coolant environment on component fatigue life as aging management programs are formulated in support of license renewal. One method acceptable to the staff for satisfying this recommendation is to assess the impact of the reactor coolant environment on a sample of critical components. These critical components should include, as a minimum, those selected in NUREG/CR-6260 (Ref. 10). The sample of critical components can be evaluated by applying environmental correction factors to the existing ASME Code fatigue analyses. Formulas for calculating the environmental life correction factors for carbon and low-alloy steels are contained in NUREG/CR-6583 (Ref. 14) and those for austenitic SSs are contained in NUREG/CR-5704 (Ref. 15).

4.3.2.3 FSAR Supplement

The specific criterion for meeting 10 CFR 54.21(d) is:

> The summary description of the evaluation of TLAAs for the period of extended operation in the FSAR supplement is appropriate such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the TLAAs regarding the basis for determining that the applicant has made the demonstration required by 10 CFR 54.21(c)(1).

4.3.3 Review Procedures

For each area of review described in Subsection 4.3.1, the following review procedures should be followed:

4.3.3.1 Time-Limited Aging Analysis

4.3.3.1.1 ASME Section III, Class 1

For components designed or analyzed to ASME Class 1 requirements, the review procedures, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), are:

4.3.3.1.1.1 10 CFR 54.21(c)(1)(i)

The operating transient experience and a list of the assumed transients used in the existing CUF calculations for the current operating term are reviewed to ensure that the number of assumed transients would not be exceeded during the period of extended operation.

4.3.3.1.1.2 10 CFR 54.21(c)(1)(ii)

The operating transient experience and a list of the increased number of assumed transients projected to the end of the period of extended operation are reviewed to ensure that the transient projection is adequate. The revised CUF calculations based on the projected number of assumed transients are reviewed to ensure that the CUF remains less than or equal to one at the end of the period of extended operation.

The code of record should be used for the reevaluation, or the applicant may update to a later code edition pursuant to 10 CFR 50.55a. In the latter case, the reviewer verifies that the requirements in 10 CFR 50.55a are met.

4.3.3.1.1.3 10 CFR 54.21(c)(1)(iii)

The applicant may reference the GALL report in its license renewal application, as appropriate. The review should verify that the applicant has stated that the report is applicable to its plant with respect to its program that monitors and tracks the number of critical thermal and pressure transients for the selected reactor coolant system components. The reviewer verifies that the applicant has identified the appropriate program as described and evaluated in the GALL report. The reviewer also ensures that the applicant has stated that its program contains the same program elements that the staff evaluated and relied upon in approving the corresponding generic program in the GALL report. No further staff evaluation is necessary.

4.3.3.1.2 ANSI B31.1

For piping designed or analyzed to ANSI B31.1 guidance, the review procedures, depending on the applicant’s choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), are:

4.3.3.1.2.1 10 CFR 54.21(c)(1)(i)

The operating cyclic experience and a list of the assumed thermal cycles used in the existing allowable stress determination are reviewed to ensure that the number of assumed thermal cycles would not be exceeded during the period of extended operation.

4.3.3.1.2.2 10 CFR 54.21(c)(1)(ii)

The operating cyclic experience and a list of the increased number of assumed thermal cycles projected to the end of the period of extended operation are reviewed to ensure that the thermal cycle projection is adequate. The revised allowable stresses based on the projected number of assumed thermal cycles and the stress reduction factors given in the applicant’s code of record are reviewed to ensure that they remain sufficient as specified by the code during the period of extended operation. Typical stress reduction factors based on thermal cycles are given in Table 4.3-1.

The code of record should be used for the reevaluation, or the applicant may use the criteria of 10 CFR 50.55a. In the latter case, the reviewer verifies that the requirements in 10 CFR 50.55a are met.

4.3.3.1.2.3 10 CFR 54.21(c)(1)(iii)

The applicant's proposed program to ensure that the effects of aging on the intended function(s) will be adequately managed for the period of extended operation is reviewed. If the applicant proposed a component replacement before it exceeds the assumed thermal cycles, the reviewer verifies that the allowable stresses for the replacement will remain sufficient as specified by the code during the period of extended operation. Other applicant-proposed programs will be reviewed on a case-by-case basis.

4.3.3.1.3 Other Evaluations Based on CUF

The review procedures in Subsection 4.3.3.1.1 of this review plan section apply.

4.3.3.1.4 ASME Section III, Class 2 and 3

The review procedures in Subsection 4.3.3.1.2 of this review plan section apply.

4.3.3.2 Generic Safety Issue

The reviewer verifies that the applicant has addressed the staff recommendation for the closure of GSI-190 contained in a December 26, 1999 memorandum from Ashok Thadani to William Travers (Ref. 11). The reviewer verifies that the applicant has addressed the effects of the coolant environment on component fatigue life as aging management programs are formulated in support of license renewal. If an applicant has chosen to assess the impact of the reactor coolant environment on a sample of critical components, the reviewer verifies the following:

1. The critical components include, as a minimum, those selected in NUREG/CR-6260 (Ref. 10).

2. The sample of critical components has been evaluated by applying environmental correction factors to the existing ASME Code fatigue analyses.

3. Formulas for calculating the environmental life correction factors are those contained in NUREG/CR–6583 (Ref. 14) for carbon and low-alloy steels, and in NUREG/CR-5704 (Ref. 15) for austenitic SSs, or an approved technical equivalent.

4.3.3.3 FSAR Supplement

The reviewer verifies that the applicant has provided information, to be included in the FSAR supplement that includes a summary description of the evaluation of the metal fatigue TLAA. Table 4.3-2 contains examples of acceptable FSAR supplement information for this TLAA. The reviewer verifies that the applicant has provided a FSAR supplement with information equivalent to that in Table 4.3-2.

The staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR supplement before the license is renewed, no condition will be necessary.

As noted in Table 4.3-2, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities, including enhancements and commitments to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

4.3.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of this section and whether the staff's evaluation supports conclusions of the following type, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), to be included in the staff's safety evaluation report:

> On the basis of its review, as discussed above, the staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1), that, for the metal fatigue TLAA, [choose which is appropriate] (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation. The staff also concludes that the FSAR Supplement contains an appropriate summary description of the metal fatigue TLAA evaluation for the period of extended operation as reflected in the license condition.

4.3.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

4.3.6 References

1. ASME Boiler and Pressure Vessel Code, Section III, "Rules for Construction of Nuclear Power Plant Components," American Society of Mechanical Engineers.

2. ANSI/ASME B31.1, "Power Piping," American National Standards Institute.

3. ANSI/ASME B31.7-1969, "Nuclear Power Piping," American National Standards Institute.

4. SECY-93-049, "Implementation of 10 CFR Part 54, 'Requirements for Renewal of Operating Licenses for Nuclear Power Plants,'" March 1, 1993.

5. Staff Requirements Memorandum from Samuel J. Chilk, dated June 28, 1993.

6. NUREG-0933, "A Prioritization of Generic Safety Issues," Supplement 20, July 1996.

7. Letter from William T. Russell of NRC to William Rasin of the Nuclear Management and Resources Council, dated July 30, 1993.

8. SECY-94-191, “Fatigue Design of Metal Components,” July 26, 1994.

9. SECY-95-245, “Completion of The Fatigue Action Plan,” September 25, 1995.

10. NUREG/CR-6260, “Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components,” March 1995.

11. Letter from Ashok C. Thadani of the Office of Nuclear Regulatory Research to William D. Travers, Executive Director of Operations, dated December 26, 1999.

12. NUREG/CR-6674, “Fatigue Analysis of Components for 60-Year Plant Life,” June 2000.

13. NUREG-1801, “Generic Aging Lessons Learned (GALL),” U.S. Nuclear Regulatory Commission, March 2001.

14. NUREG/CR-6583, “Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low–Alloy Steels,” March 1998.

15. NUREG/CR-5704, “Effects of LWR Coolant Environments on Fatigue Design Curves of Austenitic Stainless Steels,” April 1999.

Table 4.3-1. Stress Range Reduction Factors

Number of Equivalent Full Temperature Cycles	Stress Range Reduction Factor
7,000 and less	1.0
7,000 to 14,000	0.9
14,000 to 22,000	0.8
22,000 to 45,000	0.7
45,000 to 100,000	0.6
100,000 and over	0.5

Table 4.3-2. Example of FSAR Supplement for Metal Fatigue TLAA Evaluation

10 CFR 54.21(c)(1)(iii) Example

TLAA	Description of Evaluation	Implementation Schedule*
Metal fatigue	The aging management program monitors and tracks the number of critical thermal and pressure test transients, and monitors the cycles for the selected reactor coolant system components. The aging management program will address the effects of the coolant environment on component fatigue life by assessing the impact of the reactor coolant environment on a sample of critical components that include, as a minimum, those components selected in NUREG/CR-6260. The sample of critical components can be evaluated by applying environmental correction factors to the existing ASME Code fatigue analyses. Formulas for calculating the environmental life correction factors are contained in NUREG/CR-6583 for carbon and low-alloy steels and in NUREG/CR-5704 for austenitic SSs.	Evaluation should be completed before the period of extended operation

* An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

4.4 ENVIRONMENTAL QUALIFICATION (EQ) OF ELECTRIC EQUIPMENT

Review Responsibilities

Primary- Branch responsible for electrical engineering
Secondary – Plant Systems Branch (Mechanical Equipment only)

4.4.1 Areas of Review

The NRC has established environmental qualification requirements in 10 CFR Part 50, Appendix A, Criterion 4, and 10 CFR 50.49. Section 50.49 specifically requires each nuclear power plant licensee to establish a program to qualify certain electric equipment (not including equipment located in mild environments) so that such equipment, in its end-of-life condition, will meet its performance specifications during and following design basis accidents under the most severe environmental conditions postulated at the equipment's location after such an accident. Such conditions include, among others, conditions resulting from loss of coolant accidents (LOCAs), high energy line breaks (HELBs), and post-LOCA radiation. Equipment qualified by test must be preconditioned by aging to its end-of-life condition (i.e., the condition at the end of the current operating term). Those components with a qualified life equal to or greater than the duration of the current operating term are covered by TLAAs.

In a related subject, some nuclear power plants have mechanical equipment that was qualified in accordance with the provisions of Criterion 4 of Appendix A to 10 CFR Part 50. If a plant has qualified mechanical equipment, it is typically documented in the plant's master EQ list. If this qualified mechanical equipment requires a performance of a TLAA, it should be performed in accordance with the provisions of SRP-LR Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses." If a TLAA of qualified mechanical equipment is necessary, usually it will involve assessments of the environmental effects on components such as seals, gaskets, lubricants, fluids for hydraulic systems, or diaphragms.

4.4.1.1 Time-Limited Aging Analysis

All operating plants must meet the requirements of 10 CFR 50.49 for certain important-to-safety electrical components. 10 CFR 50.49 defines the scope of components to be included, requires the preparation and maintenance of a list of in-scope components, and requires the preparation and maintenance of a qualification file that includes component performance specifications, electrical characteristics, and environmental conditions. 10 CFR 50.49(e)(5) contains provisions for aging that require, in part, consideration of all significant types of aging degradation that can affect component functional capability. 10 CFR 50.49(e) also requires component replacement or refurbishment prior to the end of designated life, unless additional life is established through ongoing qualification. 10 CFR 50.49(f) establishes four methods of demonstrating qualification for aging and accident conditions. 10 CFR 50.49(k) and (l) permit different qualification criteria to apply based on plant and component vintage. Supplemental environmental qualification regulatory guidance for compliance with these different qualification criteria is provided in RG 1.89, Rev. 1, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants" (Ref. 1), the Division of Operating Reactors (DOR) Guidelines (Ref. 2), and NUREG-0588 (Ref. 3). The principal nuclear industry qualification standards for electric equipment are IEEE STD. 323-1971 (Ref. 4) and IEEE STD. 323-1974 (Ref. 5). These standards contain explicit environmental qualification considerations based on TLAAs. Compliance with 10 CFR 50.49 provides reasonable assurance that the component can perform its intended functions during accident conditions after experiencing the effects of in-service aging.

4.4.1.1.1 DOR Guidelines

The qualification of electric equipment that is subject to significant known degradation due to aging where a qualified life was previously required to be established in accordance with Section 5.2.4 of the DOR Guidelines will be reviewed for the period of extended operation according to those requirements. If a qualified life was not previously established, the qualification will be reviewed in accordance with section 7 of the DOR Guidelines.

4.4.1.1.2 NUREG-0588, CATEGORY II (IEEE STD. 323-1971)

The qualification of certain electric equipment important to safety for which qualification was required in accordance with NUREG-0588, Category II, will be reviewed for conformance to those requirements for the period of extended operation to assess the validity of the extended qualification. These requirements include IEEE STD. 382-1972 (Ref. 6) for valve operators, and IEEE STD. 334-1971 (Ref. 7.)

4.4.1.1.3 NUREG-0588, CATEGORY I (IEEE STD. 323-1974)

The qualification of certain electric equipment important to safety for which qualification was required in accordance with NUREG-0588, Category I, will be reviewed for conformance to those requirements for the period of extended operation to assess the validity of the extended qualification.

4.4.1.2 Generic Safety Issue

Regulatory Issue Summary (RIS) 2003-09 was issued on May 2, 2003, (Ref. 16) to inform addressees of the results of the technical assessment of GSI-168, "Environmental Qualification of Electrical Equipment," (Ref. 10). This RIS requires no action on the part of the addressees.

4.4.1.3 FSAR Supplement

The detailed information on the evaluation of TLAAs is contained in the renewal application. A summary description of the evaluation of TLAAs for the period of extended operation is contained in the applicant's FSAR supplement. The FSAR supplement is an area of review.

4.4.2 Acceptance Criteria

The acceptance criteria for the areas of review described in Subsection 4.4.1 of this review plan section delineate acceptable methods for meeting the requirements of the NRC's regulations in 10 CFR 54.21(c)(1).

4.4.2.1 Time-Limited Aging Analysis

Pursuant to 10 CFR 54.21(c)(1)(i) - (iii), an applicant must demonstrate one of the following:

(i) the analyses remain valid for the period of extended operation,

(ii) the analyses have been projected to the end of the extended period of operation, or

(iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Specific acceptance criteria for environmental qualification of certain electric equipment important to safety analyzed to Section 5.2.4 of the DOR Guidelines; NUREG-0588, Category II (Section 4); or NUREG-0588, Category I, depend on the applicant's choice, that is, 10 CFR 54.21(c)(1)(i), (ii), or (iii), and are:

4.4.2.1.1 10 CFR 54.21(c)(1)(i)

The existing qualification is based on previous testing, analysis, or operating experience, or combinations thereof, that demonstrate that the equipment is qualified for the period of extended operation. For option (i), the aging evaluation existing at the time of the renewal application for the component remains valid for the period of extended operation, and no further evaluation is necessary.

4.4.2.1.2 10 CFR 54.21(c)(1)(ii)

Qualification of the equipment is extended for the period of extended operation by testing, analysis, or operating experience, or combinations thereof, in accordance with the CLB. For option (ii), a reanalysis of the aging evaluation is performed in order to project the qualification of the component through the period of extended operation. Important reanalysis attributes of an aging evaluation include analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions if acceptance criteria are not met. These reanalysis attributes are discussed in Table 4.4-1.

4.4.2.1.3 10 CFR 54.21(c)(1)(iii)

In Chapter X of the GALL report (Ref. 14), the staff has evaluated the environmental qualification program (10 CFR 50.49) and determined that it is an acceptable aging management program to address environmental qualification according to 10 CFR 54.21(c)(1)(iii). The GALL report may be referenced in a license renewal application, and should be treated in the same manner as an approved topical report. However, the GALL report contains one acceptable way and is not the only way to manage aging for license renewal. In referencing the GALL report, the applicant should indicate that the material referenced is applicable to the specific plant involved and should provide the information necessary to adopt the finding of program acceptability as described and evaluated in the report. The applicant should also verify that the approvals set forth in the GALL report for the generic program apply to the applicant's program.

4.4.2.2 Generic Safety Issue

Not applicable.

4.4.2.3 FSAR Supplement

The specific criterion for meeting 10 CFR 54.21(d) is:

The summary description of the evaluation of TLAAs for the period of extended operation in the FSAR supplement is appropriate such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the TLAA regarding the basis for determining that the applicant has made the demonstration required by 10 CFR 54.21(c)(1).

4.4.3 Review Procedures

For each area of review described in Subsection 4.4.1, the following review procedures should be followed:

4.4.3.1 Time-Limited Aging Analysis

For electric equipment qualified to the requirements of 10 CFR 50.49, the review procedures, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), are:

4.4.3.1.1 10 CFR 54.21(c)(1)(i)

The documented results, test data, analyses, etc., of the previous qualification, which consisted of an appropriate combination of testing, analysis, and operating experience, are reviewed to confirm that the original qualified life remains valid for the period of extended operation.

4.4.3.1.2 10 CFR 54.21(c)(1)(ii)

The results of projecting the qualification to the end of the period of extended operation will be reviewed. The qualification methods include testing, analysis, operating experience, or combinations thereof.

The reanalysis of an aging evaluation is normally performed to extend the qualification by reducing excess conservatisms incorporated in the prior evaluation. Such a reanalysis is performed on a routine basis as part of an environmental qualification program. A component life-limiting condition may be due to thermal, radiation, or cyclical aging; the vast majority of component aging limits are based on thermal conditions. Conservatisms may exist in aging evaluation parameters, such as the assumed ambient temperature of the component, unrealistically low activation energy, or in the application of a component (de-energized versus energized). The reanalysis of an aging evaluation is documented in accordance with the plant's quality assurance program which provides for the verification of assumptions and conclusions. For reanalysis, the reviewer verifies that an applicant has completed its reanalysis, addressing attributes of analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions if acceptance criteria are not met (See Table 4.4-1). The reviewer also verifies that the reanalysis has been completed in a timely manner prior to the end of qualified life.

4.4.3.1.3 10 CFR 54.21(c)(1)(iii)

The applicant may reference the GALL report in its license renewal application, as appropriate. The review should verify that the applicant has stated that the report is applicable to its plant with respect to its environmental qualification program. The reviewer verifies that the applicant has identified the appropriate program as described and evaluated in the GALL report. The reviewer also ensures that the applicant has stated that its environmental qualification program contains the same program elements that the staff evaluated and relied upon in approving the corresponding generic program in the GALL report. No further staff evaluation is necessary. If the applicant does not reference the GALL report in its renewal application, additional staff evaluation is necessary to determine whether the applicant's program is acceptable for this area of review.

4.4.3.2 Generic Safety Issue

Not applicable.

4.4.3.3 FSAR Supplement

The reviewer verifies that the applicant has provided information to be included in the FSAR supplement that includes a summary description of the TLAA evaluation of the environmental qualification of electric equipment. Table 4.4-2 contains examples of acceptable FSAR supplement information for this TLAA. The reviewer verifies that the applicant has provided a FSAR supplement with information equivalent to that in Table 4.4-2.

The staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR supplement, at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. The staff will review any such changes when the next update is submitted. If the applicant updates the FSAR to include the final FSAR supplement before the license is renewed, no condition will be necessary.

As noted in Table 4.4-2, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities, including enhancements and commitments to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

4.4.4 Evaluation of Findings

The reviewer determines whether that the applicant has provided information sufficient to satisfy the provisions of this section and whether the staff's evaluation supports conclusions of the following type, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), to be included in the staff's safety evaluation report:

> On the basis of its review, as discussed above, the staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.2 (c)(1), that, for the environmental qualification of Electric Equipment TLAA, [choose which is appropriate] (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation. The staff also concludes that the FSAR Supplement contains an appropriate

summary description of the environmental qualification of electric equipment TLAA evaluation for the period of extended operation as reflected in the license condition.

4.4.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specific portions of the NRC's regulations, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

4.4.6 References

1. Regulatory Guide 1.89, Rev. 1, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants," June 1984.

2. "Guidelines for Evaluating Environmental Qualification of Class 1E Electrical Equipment in Operating Reactors," (DOR Guidelines), November 1979.

3. NUREG-0588, "Interim Staff Position on Environmental Qualification of Safety-Related Equipment," July 1981.

4. IEEE STD. 323-1971, "IEEE Trial Use Standard; General Guide for Qualifying Class 1E Equipment for Nuclear Power Generating Stations."

5. IEEE STD. 323-1974, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations."

6. IEEE STD. 382-1972, "Standard for Qualification of Actuators for Power Operated Valve Assemblies with Safety Related Functions for Nuclear Power Plants."

7. IEEE STD. 334-1971, "IEEE Standard for Type Tests of Continuous Duty Class 1E Motors for Nuclear Power Generating Stations."

8. Deleted.

9. Deleted.

10. NUREG-0933, "A Prioritization of Generic Safety Issues," Supplement 20, July 1996.

11. Deleted.

12. Deleted.

13. Deleted.

14. NUREG-1801, "Generic Aging Lessons Learned (GALL)," U.S. Nuclear Regulatory Commission, July 2001.
15. Deleted.

16. NRC Regulatory Issue Summary 2003-09, "Environmental Qualification of Low-Voltage Instrumentation and Control Cables" dated May 2, 2003.

Table 4.4-1. Environmental Qualification Reanalysis Attributes

Reanalysis Attributes	Description
Analytical methods	The analytical models used in the reanalysis of an aging evaluation should be the same as those previously applied during the prior evaluation. The Arrhenius methodology is an acceptable thermal model for performing a thermal aging evaluation. The analytical method used for a radiation aging evaluation is to demonstrate qualification for the total integrated dose (that is, normal radiation dose for the projected installed life plus accident radiation dose). For license renewal, one acceptable method of establishing the 60-year normal radiation dose is to multiply the 40 year normal radiation dose by 1.5 (that is, 60 years/40 years). The result is added to the accident radiation dose to obtain the total integrated dose for the component. For cyclical aging, a similar approach may be used. Other models may be justified on a case-by-case basis.
Data collection and reduction methods	Reducing excess conservatisms in the component service conditions (for example, temperature, radiation, cycles) used in the prior aging evaluation is the chief method used for a reanalysis. Temperature data used in an aging evaluation should be conservative and based on plant design temperatures or on actual plant temperature data. When used, plant temperature data can be obtained in several ways, including monitors used for technical specification compliance, other installed monitors, measurements made by plant operators during rounds, and temperature sensors on large motors (while the motor is not running). A representative number of temperature measurements are conservatively evaluated to establish the temperatures used in an aging evaluation. Plant temperature data may be used in an aging evaluation in different ways, such as (a) directly applying the plant temperature data in the evaluation, or (b) using the plant temperature data to demonstrate conservatism when using plant design temperatures for an evaluation. Any changes to material activation energy values as part of a reanalysis should be justified. Similar methods of reducing excess conservatisms in the component service conditions used in prior aging evaluations can be used for radiation and cyclical aging.
Underlying assumptions	Environmental qualification component aging evaluations contain sufficient conservatisms to account for most environmental changes occurring due to plant modifications and events. When unexpected adverse conditions are identified during operational or maintenance activities that affect the environment of a qualified component, the affected environmental qualification component is evaluated, and appropriate corrective actions are taken, which may include changes to the qualification bases and conclusions.
Acceptance criteria and corrective actions	The reanalysis of an aging evaluation should extend the qualification of the component. If the qualification cannot be extended by reanalysis, the component must be refurbished, replaced, or requalified prior to exceeding the current qualified life. A reanalysis should be performed in a timely manner (such that sufficient time is available to refurbish, replace, or requalify the component if the reanalysis is unsuccessful).

Table 4.4-2. Examples of FSAR Supplement for Environmental Qualification of Electric Equipment TLAA Evaluation

10 CFR 54.21(c)(1)(i) Example

TLAA	Description of Evaluation	Implementation Schedule*
Environmental qualification of electric equipment	The original environmental qualification qualified life has been shown to remain valid for the period of extended operation.	Completed

10 CFR 54.21(c)(1)(ii) Example

TLAA	Description of Evaluation	Implementation Schedule*
Environmental qualification of electric equipment	The environmental qualification has been projected to the end of the period of extended operation. Reanalysis addresses attributes of analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions.	Completed

10 CFR 54.21(c)(1)(iii) Example

TLAA	Description of Evaluation	Implementation Schedule*
Environmental qualification of electric equipment	The existing environmental qualification process, in accordance with 10 CFR 50.49, will adequately manage aging of environmental qualification equipment for the period of extended operation because equipment will be replaced prior to reaching the end of its qualified life. Reanalysis addresses attributes of analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, corrective actions if acceptance criteria are not met, and the period of time prior to the end of qualified life when the reanalysis will be completed.	Existing program

* An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

4.5 CONCRETE CONTAINMENT TENDON PRESTRESS ANALYSIS

Review Responsibilities

Primary - Branch responsible for structural engineering
Secondary - None

4.5.1 Areas of Review

The prestressing tendons in prestressed concrete containments lose their prestressing forces with time due to creep and shrinkage of concrete, and relaxation of the prestressing steel. During the design phase, engineers estimate these losses to arrive at the end of operating life (Refs. 1 and 2), normally forty years. The operating experiences with the trend of prestressing forces indicate that the prestressing tendons lose their prestressing forces at a rate higher than predicted due to sustained high temperature (Ref. 3). Thus, it is necessary to ensure that the applicant addresses existing TLAAs for the extended period of operation.

The adequacy of the prestressing forces in prestressed concrete containments is reviewed for the period of extended operation.

4.5.2 Acceptance Criteria

The acceptance criteria for the area of review described in Subsection 4.5.1 of this review plan section delineate acceptable methods for meeting the requirements of the NRC's regulations in 10 CFR 54.21(c)(1).

4.5.2.1 Time-Limited Aging Analysis

Pursuant to 10 CFR 54.21(c)(1)(i) - (iii), an applicant must demonstrate one of the following:

(i) The analyses remain valid for the period of extended operation;

(ii) The analyses have been projected to the end of the extended period of operation; or

(iii) The effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Accordingly, the specific options for satisfying the acceptance criterion are:

4.5.2.1.1 10 CFR 54.21(c)(1)(i)

The existing prestressing force evaluation remains valid because (1) losses of the prestressing force are less than the predicted losses as evidenced from the trend lines constructed from the recent inspection, (2) the period of evaluation covers the period of extended operation, and (3) the trend lines of the measured prestressing forces remain above the minimum required prestress force specified at anchorages for each group of tendons for the period of extended operation.

4.5.2.1.2 10 CFR 54.21(c)(1)(ii)

The trend line of prestressing forces for each group of tendons developed for 40 years of operation should be extended to 60 years. The applicant should demonstrate that the trend lines of the measured prestressing forces will stay above the design Minimum Required Value (MRV) in the CLB for each group of tendons during the period of extended operation (Ref. 4). If this cannot be done, the applicant should develop a systematic plan for retensioning selected tendons so that the trend lines will remain above the minimum required prestress force specified at anchorages for each group of tendons during the period of extended operation, or perform a reanalysis of containment to demonstrate design adequacy.

4.5.2.1.3 10 CFR 54.21(c)(1)(iii)

In Chapter X of the GALL report (Ref. 4), the staff has evaluated a program that assesses the concrete containment tendon prestressing forces, and has determined that it is an acceptable aging management program to address concrete containment tendon prestress according to 10 CFR 54.21(c)(1)(iii), except for operating experience. The GALL report recommends further evaluation of the applicant's operating experience related to the containment prestress force. However, the GALL report contains one acceptable way and not the only way to manage aging for license renewal.

The GALL report may be referenced in a license renewal application, and should be treated in the same manner as an approved topical report. However, the GALL report contains one acceptable way and not the only way to manage aging for license renewal.
In referencing the GALL report, an applicant should indicate that the material referenced is applicable to the specific plant involved and should provide the information necessary to adopt the finding of program acceptability as described and evaluated in the report. An applicant should also verify that the approvals set forth in the GALL report for the generic program apply to the applicant's program.

4.5.2.2 FSAR Supplement

The specific criterion for meeting 10 CFR 54.21(d) is:

The summary description of the evaluation of TLAAs for the period of extended operation in the FSAR supplement is appropriate such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the TLAAs regarding the basis for determining that the applicant has made the demonstration required by 10 CFR 54.21(c)(1).

4.5.3 Review Procedures

For each area of review described in Subsection 4.5.1 of this review plan section, the following review procedures should be followed:

4.5.3.1 Time-Limited Aging Analysis

For a concrete containment prestressing tendon system, the review procedures, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), are:

4.5.3.1.1 10 CFR 54.21(c)(1)(i)

The results of a recent inspection to measure the amount of prestress loss are reviewed to ensure that the reduction of prestressing force is less than the predicted loss in the existing analysis. The reviewer verifies that the trend line of the measured prestressing force when plotted on the predicted prestressing force curve shows that the existing analysis will cover the period of extended operation.

4.5.3.1.2 10 CFR 54.21(c)(1)(ii)

The reviewer reviews the trend lines of the measured prestressing forces to ensure that individual tendon lift-off forces (rather than average lift-off forces of the tendon group) are considered in the regression analysis, as discussed in IN 99-10 (Ref. 3). Either the reviewer verifies that the trend lines will stay above the minimum required prestressing forces for each group of tendons during the period of extended operation or, if the trend lines fall below the minimum required prestressing forces during this period, the reviewer verifies that the applicant has a systematic plan for retensioning the tendons to ensure that the trend lines will return to being, and remain, above the minimum required prestressing forces for each group of tendons during the period of extended operation. If the applicant chooses to reanalyze the containment, the reviewer verifies that the design adequacy is maintained in the period of extended operation.

4.5.3.1.3 10 CFR 54.21(c)(1)(iii)

An applicant may reference the GALL report in its license renewal application, as appropriate. The reviewer should verify that the applicant has stated that the report is applicable to its plant with respect to its program that assesses the concrete containment tendon prestressing forces. The reviewer verifies that the applicant has identified the appropriate program (i.e., GALL Chapter X.S1) as described and evaluated in the GALL report. The reviewer also ensures that the applicant has stated that its program contains the same program elements that the staff evaluated and relied upon in approving the corresponding generic program in the GALL report.

The GALL report recommends further evaluation of the applicant's operating experience related to the containment prestress force. The applicant's program should incorporate the relevant operating experience that occurred at the applicant's plant as well as at other plants. The applicant should consider applicable portions of the experience with prestressing systems described in Information Notice 99-10 (Ref. 3). Tendon operating experience could vary among plants with prestressed concrete containments. The difference could be due to the prestressing system design (for example, button-heads, wedge or swaged anchorages), environment, or type of reactor (PWR or BWR). The reviewer reviews the applicant's program to verify that the applicant has adequately considered plant-specific operating experience.

If the applicant does not reference the GALL report in its renewal application, additional staff evaluation is necessary to determine whether the applicant's program is acceptable for this area of review.

4.5.3.2 FSAR Supplement

The reviewer verifies that the applicant has provided information, to be included in the FSAR supplement, that includes a summary description of the evaluation of tendon prestress TLAA. Table 4.5-1 of this review plan section contains examples of acceptable FSAR supplement information for this TLAA. The reviewer verifies that the applicant has provided a FSAR supplement with information equivalent to that in Table 4.5-1.

The staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR supplement before the license is renewed, no condition will be necessary.

As noted in Table 4.5-1, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities, including enhancements and commitments to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

4.5.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of this section and whether the staff's evaluation supports conclusions of the following type, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), to be included in the staff's safety evaluation report:

> On the basis of its review, as discussed above, the staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1), that, for the concrete containment tendon prestress TLAA, [choose which is appropriate] (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation. The staff also concludes that the FSAR Supplement contains an appropriate description of the concrete containment tendon prestress TLAA evaluation for the period of extended operation as reflected in the license condition.

4.5.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

4.5.6 References

1. Regulatory Guide 1.35, Rev. 3, "Inspection of Ungrouted Tendons in Prestressed Concrete Containments," July 1990.

2. Regulatory Guide 1.35.1, "Determining Prestressing Forces for Inspection of Prestressed Concrete Containments," July 1990.

3. NRC Information Notice 99-10, “Degradation of Prestressing Tendon Systems in Prestressed Concrete Containments,” April 1999.

4. NUREG-1801, “Generic Aging Lessons Learned (GALL),” U.S. Nuclear Regulatory Commission, Revision 1, September 2005.

Table 4.5-1. Examples of FSAR Supplement for Concrete Containment Tendon Prestress TLAA Evaluation

10 CFR 54.21(c)(1)(i) and 10 CFR 54.21(c)(1)(ii) **Example**

TLAA	Description of Evaluation	Implementation Schedule*
Concrete containment tendon prestress	The prestressing tendons are used to impart compressive forces in the prestressed concrete containments to resist the internal pressure inside the containment that would be generated in the event of a LOCA. The prestressing forces generated by the tendons diminish over time due to losses in prestressing forces in the tendons and in the surrounding concrete. The prestressing force evaluation has been determined to remain valid to the end of the period of extended operation, and the trend lines of the measured prestressing forces will stay above the minimum required prestressing forces for each group of tendons to the end of this period.	Completed

10 CFR 54.21(c)(1)(iii) Example

TLAA	Description of Evaluation	Implementation Schedule*
Concrete containment tendon prestress	The prestressing tendons are used to impart compressive forces in the prestressed concrete containments to resist the internal pressure inside the containment that would be generated in the event of a LOCA. The prestressing forces generated by the tendons diminish over time due to losses of prestressing forces in the tendons and in the surrounding concrete. The aging management program developed to monitor the prestressing forces should ensure that, during each inspection, the trend lines of the measured prestressing forces show that they meet the requirements of 10 CFR 50.55a(b)(2)(ix)(B). If the trend lines cross the PLLs, corrective actions will be taken. The program will also incorporate any plant-specific and industry operating experience.	Program should be implemented before the period of extended operation.
* An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.		

4.6 CONTAINMENT LINER PLATE, METAL CONTAINMENTS, AND PENETRATIONS FATIGUE ANALYSIS

Review Responsibilities

Primary - Branch responsible for structural engineering
Secondary - Branch responsible for mechanical engineering

4.6.1 Areas of Review

The interior surface of a concrete containment structure is lined with thin metallic plates to provide a leak-tight barrier against the uncontrolled release of radioactivity to the environment, as required by 10 CFR Part 50. The thickness of the liner plates is generally between 1/4 in. (6.2 mm) and 3/8 in. (9.5 mm). The liner plates are attached to the concrete containment wall by stud anchors or structural rolled shapes or both. The design process assumes that the liner plates do not carry loads. However, normal loads, such as from concrete shrinkage, creep, and thermal changes, imposed on the concrete containment structure, are transferred to the liner plates through the anchorage system. Internal pressure and temperature loads are directly applied to the liner plates. Thus, under design-base conditions, the liner plates could experience significant strains. Some plants may have metal containments instead of concrete containments with liner plates.

Fatigue of the liner plates or metal containments may be considered in the design based on an assumed number of loading cycles for the current operating term. The cyclic loads include reactor building interior temperature variation during the heatup and cooldown of the reactor coolant system, a LOCA, annual outdoor temperature variations, thermal loads due to the high energy containment penetration piping lines (such as steam and feedwater lines), seismic loads, and pressurization due to periodic Type A integrated leak rate tests.

High energy piping penetrations and the fuel transfer canal in some plants are equipped with bellow assemblies. These are designed to accommodate relative movements between the containment wall (including the liner) and the adjoining structures. The penetrations have sleeves (up to 10 feet in length, with a 2 to 3-inch annulus around the piping) to penetrate the concrete containment wall and allow movement of the piping system. Dissimilar metal welds connect the piping penetrations to the bellows to provide leak-tight penetrations.

The containment liner plates, metal containments, penetration sleeves (including dissimilar metal welds), and penetration bellows may be designed in accordance with requirements of Section III of the ASME Boiler and Pressure Vessel Code. If a plant’s code of record requires a fatigue analysis, then this analysis may be a TLAA and must be evaluated in accordance with 10 CFR 54.21(c)(1) to ensure that the effects of aging on the intended functions will be adequately managed for the period of extended operation.

The adequacy of the fatigue analyses of the containment liner plates (including welded joints), metal containments, penetration sleeves, dissimilar metal welds, and penetration bellows is reviewed in this section for the period of extended operation. The fatigue analyses of the pressure boundary of process piping are reviewed separately following the guidance in Section 4.3, “Metal Fatigue,” of this review plan.

4.6.1.1 Time-Limited Aging Analysis

The containment liner plates (including welded joints), metal containments, penetration sleeves, dissimilar metal welds, and penetration bellows may be designed and/or analyzed in accordance with ASME code requirements. The ASME code contains explicit metal fatigue or cyclic considerations based on TLAAs. Specific requirements are contained in the design code of reference for each plant.

4.6.1.1.1 ASME Section III, MC or Class 1

ASME Section III Division 2, "Code for Concrete Reactor Vessel and Containments," Subsection CC, "Concrete Containment," and Division 1, Subsection NE, "Class MC Components," (Ref. 1) require a fatigue analysis for liner plates, metal containments, and penetrations that considers all cyclic loads based on the anticipated number of cycles. Containment components may also be designed to ASME Section III Class 1 requirements. A Section III, MC or Class 1 fatigue analysis requires the calculation of the cumulative usage factor (CUF) based on the fatigue properties of the materials and the expected fatigue service of the component. The ASME code limits the CUF to a value less than or equal to one for acceptable fatigue design. The fatigue resistance of the liner plates or metal containments, and penetrations during the period of extended operation is an area of review.

4.6.1.1.2 Other Evaluations Based on CUF

Other evaluations also contain metal fatigue analysis requirements based on a CUF calculation, such as metal bellows designed to ASME NC-3649.4(e)(3) or NE-3366.2(e)(3). For these cases, the discussion relating to ASME Section III, MC or Class 1, in Subsection 4.6.1.1.1 of this review plan section, applies.

4.6.1.2 FSAR Supplement

Detailed information on the evaluation of TLAAs is contained in the renewal application. A summary description of the evaluation of TLAAs for the period of extended operation is contained in the applicant's FSAR supplement. The FSAR supplement is an area of review.

4.6.2 Acceptance Criteria

The acceptance criteria for the areas of review described in Subsection 4.6.1 of this review plan section delineate acceptable methods for meeting the requirements of the NRC's regulations in 10 CFR 54.21(c)(1).

4.6.2.1 Time-Limited Aging Analysis

Pursuant to 10 CFR 54.21(c)(1), an applicant must demonstrate one of the following:

(i) The analyses remain valid for the period of extended operation;

(ii) The analyses have been projected to the end of the extended period of operation; or

(iii) The effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Specific acceptance criteria for fatigue of containment liner plates, metal containments, liner plate weld joints, dissimilar metal welds, penetration sleeves, and penetration bellows are:

4.6.2.1.1 ASME Section III, MC or Class 1

For containment liner plates, metal containments, and penetrations designed or analyzed to ASME MC or Class 1 requirements, the acceptance criteria, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), are:

4.6.2.1.1.1 10 CFR 54.21(c)(1)(i)

The existing CUF calculations remain valid because the number of assumed cyclic loads will not be exceeded during the period of extended operation.

4.6.2.1.1.2 10 CFR 54.21(c)(1)(ii)

CLB fatigue analysis, per ASME Code Section III, was conducted for a 40-year life. The CUF calculations should be reevaluated based on an increased number of assumed cyclic loads to cover the period of extended operation. All cyclic loads considered in the original fatigue analyses (including Type A and Type B leak rate tests) should be reevaluated and revised as necessary. The revised analysis should show that the CUF will not exceed one, as required by the ASME code, during the period of extended operation.

4.6.2.1.1.3 10 CFR 54.21(c)(1)(iii)

The effects of aging on the intended function(s) will be adequately managed for the period of extended operation. The component could be replaced; the CUF for the replacement must be less than or equal to one during the period of extended operation.

An alternative aging management program provided by the applicant will be evaluated on a case-by-case basis to ensure that the aging effects will be managed such that the intended functions(s) will be maintained during the period of extended operation. In cases where a mitigation or inspection program is proposed, the aging management program may be evaluated against the 10 elements described in Branch Technical Position RLSB-1 (Appendix A.1 of this standard review plan).

4.6.2.1.2 Other Evaluations Based on CUF

The acceptance criteria in Subsection 4.6.2.1.2 of this review plan section apply.

4.6.2.2 FSAR Supplement

The specific criterion for meeting 10 CFR 54.21(d) is:

The summary description of the evaluation of TLAAs for the period of extended operation in the FSAR supplement is appropriate such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the TLAAs regarding the basis for determining that the applicant has made the demonstration required by 10 CFR 54.21(c)(1).

4.6.3 Review Procedures

For each area of review described in Subsection 4.6.1 of this review plan section, the following review procedures should be followed:

4.6.3.1 Time-Limited Aging Analysis

4.6.3.1.1 ASME Section III, MC or Class 1

For containment liner plates, metal containments, and penetrations designed or analyzed to ASME MC or Class 1 requirements, the review procedures, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), are:

4.6.3.1.1.1 10 CFR 54.2l(c)(1)(i)

The number of assumed transients used in the existing CUF calculations for the current operating term is compared to the extrapolation to 60 years of operation of the number of operating transients experienced to date. The comparison confirms that the number of transients in the existing analyses will not be exceeded during the period of extended operation.

4.6.3.1.1.2 10 CFR 54.21(c)(1)(ii)

Operating transient experience and a list of the increased number of assumed cyclic loads projected to the end of the period of extended operation are reviewed to ensure that the cyclic load projection is adequate. The revised CUF calculations based on the projected number of assumed cyclic loads are reviewed to ensure that the CUF remains less than one at the end of the period of extended operation.

The code of record should be used for the reevaluation, or the applicant may update to a later code edition pursuant to 10 CFR 50.55a. In the latter case, the reviewer verifies that the requirements in 10 CFR 50.55a are met.

4.6.3.1.1.3 10 CFR 54.21(c)(1)(iii)

The applicant's proposed aging management program to ensure that the effects of aging on the intended function(s) will be adequately managed for the period of extended operation is reviewed. If the applicant proposed a component replacement before its CUF exceeds one, the reviewer verifies that the CUF for the replacement will remain less than or equal to one during the period of extended operation.

Other applicant proposed programs will be reviewed on a case-by-case basis.

4.6.3.1.2 Other Evaluations Based on CUF

The review procedures in Subsection 4.6.3.1 of this review plan section apply.

4.6.3.2 FSAR Supplement

The reviewer verifies that the applicant has provided information, to be included in the FSAR supplement that includes a summary description of the evaluation of containment liner plate, metal containments, and penetrations fatigue TLAA. Table 4.6-1 of this review plan section contains examples of acceptable FSAR supplement information for this TLAA. The reviewer verifies that the applicant has provided a FSAR supplement with information equivalent to that in Table 4.6-1.

The staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR supplement before the license is renewed, no condition will be necessary.

As noted in Table 4.6-1, the applicant need not incorporate the implementation schedule into its FSAR. However, the review should verify that the applicant has identified and committed in the license renewal application to any future aging management activities, including enhancements and commitm ents to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

4.6.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of this section and whether the staff's evaluation supports conclusions of the following type, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), to be included in the staff's safety evaluation report:

> On the basis of its review, as discussed above, the staff evaluation concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1), that, for the containment liner plate or metal containment, and penetrations fatigue TLAA, [choose which is appropriate] (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation. The staff also concludes that the FSAR Supplement contains an appropriate summary description of the containment liner plate or metal containment, and penetrations fatigue TLAA evaluation for the period of extended operation as reflected in the license condition.

4.6.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

4.6.6 References

1. ASME Boiler and Pressure Vessel Code, Section III, Division 2, "Code for Concrete Reactor Vessels and Containments," Subsection CC, "Concrete Containment," and Division 1, Subsection NE, "MC Components," American Society of Mechanical Engineers, New York, New York, 1989 or other editions as approved in 10 CFR 50.55a.

Table 4.6-1. Examples of FSAR Supplement for Containment Liner Plates, Metal Containments, and Penetrations Fatigue TLAA Evaluation

10 CFR 54.21(c)(1)(i) Example

TLAA	Description of Evaluation	Implementation Schedule*
Containment liner plates (or metal containment) and penetrations fatigue	The containment liner plates (or metal containment), liner weld joints, penetration sleeves, dissimilar metal welds, and penetration bellows provide a leak-tight barrier. A Section III, MC or Class 1 fatigue analysis limits the CUF to a value less than or equal to one for acceptable fatigue design. The existing CUF evaluation has been determined to remain valid because the number of assumed cyclic loads would not be exceeded during the period of extended operation.	Completed

10 CFR 54.21(c)(1)(ii) Example

TLAA	Description of Evaluation	Implementation Schedule*
Containment liner plates (or metal containment) and penetrations fatigue	The containment liner plates (or metal containment), liner weld joints, penetration sleeves, dissimilar metal welds, and penetration bellows provide a leak-tight barrier. A Section III, MC or Class 1 fatigue analysis limits the CUF to a value less than or equal to one for acceptable fatigue design. The CUF calculations have been reevaluated based on an increased number of assumed cyclic loads to cover the period of extended operation. The revised CUF will not exceed one during the period of extended operation.	Completed

10 CFR 54.21(c)(1)(iii) Example

TLAA	Description of Evaluation	Implementation Schedule*
Containment liner plates (or metal containment) and penetrations fatigue	The containment liner plates (or metal containment), liner weld joints, penetration sleeves, dissimilar metal welds, and penetration bellows provide a leak-tight barrier. A Section III, MC or Class 1 fatigue analysis limits the CUF to a value less than or equal to one for acceptable fatigue design. If the component is replaced, the CUF for the replacement will be shown to be less than one during the period of extended operation.	Program should be implemented before the period of extended operation.

Note: All containment components need not meet the same requirement. It is likely that the liner plate and the bellows may be evaluated per 10CFR54.21(c)(1)(i), while high energy penetrations may be evaluated per 10CFR54.21(c)(1)(ii).

* An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

4.7 OTHER PLANT-SPECIFIC TIME-LIMITED AGING ANALYSES

Review Responsibilities

Primary - Branch responsible for the TLAA issues
Secondary - Other branches responsible for systems, as appropriate

4.7.1 Areas of Review

There are certain plant-specific safety analyses that may have been based on an explicitly assumed 40-year plant life (for example, aspects of the reactor vessel design) and may, therefore, be time-limited aging analyses (TLAAs.) Pursuant to 10 CFR 54.21(c), a license renewal applicant is required to evaluate TLAAs. The definition of TLAAs is provided in 10 CFR 54.3 and in Section 4.1 of this standard review plan.

TLAAs may have evolved since issuance of a plant's operating license, and are plant-specific. As indicated in 10 CFR 54.30, the adequacy of the plant's CLB, which includes TLAAs, is not an area within the scope of the license renewal review. Any question regarding the adequacy of the CLB must be addressed under the backfit rule (10 CFR 50.109) and is separate from the license renewal process.

License renewal reviews focus on the period of extended operation. Pursuant to 10 CFR 54.30, if the reviews required by 10 CFR 54.21(a) or (c) show that there is not reasonable assurance during the current license term that licensed activities will be conducted in accordance with the CLB, the licensee is required to take measures under its current license to ensure that the intended function of those systems, structures, or components will be maintained in accordance with the CLB throughout the term of the current license. The adequacy of the measures for the term of the current license is not within the scope of the license renewal review.

Pursuant to 10 CFR 54.21(c), an applicant must provide a listing of TLAAs and plant-specific exemptions that are based on TLAAs. The staff reviews the applicant's identification of TLAAs and exemptions separately, following the guidance in Section 4.1 of this standard review plan.

Based on lessons learned in the review of the initial license renewal applications, the staff has developed review procedures for the evaluation of certain TLAAs. If an applicant identifies these TLAAs as applicable to its plant, the staff reviews them separately, following the guidance in Sections 4.2 through 4.6. The reviewer reviews other TLAAs that are identified by the applicant, following the generic guidance in this section. For particular systems, the reviewers from branches responsible for those systems may be requested to assist in the review, as appropriate.

The following areas relating to a TLAA are reviewed:

4.7.1.1 Time-Limited Aging Analysis

The evaluation of the TLAA for the period of extended operation is reviewed.

4.7.1.2 FSAR Supplement

The FSAR supplement summarizing the evaluation of the TLAA for the period of extended operation in accordance with 10 CFR 54.21(d) is reviewed.

4.7.2 Acceptance Criteria

The acceptance criteria for the areas of review described in Subsection 4.7.1 of this section delineate acceptable methods for meeting the requirements of the NRC's regulations in 10 CFR 54.21(c)(1).

4.7.2.1 Time-Limited Aging Analysis

Pursuant to 10 CFR 54.21(c)(1)(i) - (iii), an applicant must demonstrate one of the following for the TLAAs:

(i) The analyses remain valid for the period of extended operation;

(ii) The analyses have been projected to the end of the extended period of operation; or

(iii) The effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

4.7.2.2 FSAR Supplement

The specific criterion for meeting 10 CFR 54.21(d) is:

The summary description of the evaluation of TLAAs for the period of extended operation in the FSAR supplement is appropriate such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the TLAAs regarding the basis for determining that the applicant has made the demonstration required by 10 CFR 54.21 (c)(1).

4.7.3 Review Procedures

For certain applicants, plant-specific analyses may meet the definition of a TLAA as given in 10 CFR54.3. The concern for License Renewal is that these analyses may not have properly considered the length of the extended period of operation, the consideration of which may change conclusions with regard to safety and the capability of SSCs within the scope of the Rule to perform or one or more safety functions. The review of these TLAAs will provide the assurance that the aging effect is properly addressed through the period of extended operation.

For each area of review described in Subsection 4.7.1 of this review plan section, the following review procedures are followed:

4.7.3.1 Time-Limited Aging Analysis

For each TLAA identified, the review procedures depend on the applicant's choice of methods of compliance from those identified in 10 CFR 54.21(c)(1)(i), (ii), or (iii), as follows:

4.7.3.1.1 10 CFR 54.21(c)(1)(i)

Justification provided by the applicant is reviewed to verify that the existing analyses are valid for the period of extended operation. The existing analyses should be shown to be bounding even during the period of extended operation.

The applicant should describe the TLAA with respect to the objectives of the analysis, assumptions used in the analysis, conditions, acceptance criteria, relevant aging effects, and intended function(s). The applicant should show that (1) conditions and assumptions used in the analysis already address the relevant aging effects for the period of extended operation, and (2) acceptance criteria are maintained to provide reasonable assurance that the intended function(s) is maintained for renewal. Thus, no reanalysis is necessary for renewal.

In some instances, the applicant may identify activities to be performed to verify the assumption basis of the calculation, such as cycle counting. An evaluation of that activity should be provided by the applicant. The reviewer should assure that the applicant's activity is sufficient to confirm the calculation assumptions for the 60-year period.

If the TLAA must be modified or recalculated to extend the period of evaluation to consider the period of extended operation, the reevaluation should be addressed under 10 CFR 54.21(c)(1)(ii).

4.7.3.1.2 10 CFR 54.21(c)(1)(ii)

The documented results of the revised analyses are reviewed to verify that their period of evaluation is extended such that they are valid for the period of extended operation, for example, 60 years. The applicable analysis technique can be the one that is in effect in the plant's CLB at the time of filing of the renewal application.

The applicant may recalculate the TLAA using a 60-year period to show that the TLAA acceptance criteria continue to be satisfied for the period of extended operation. The applicant may also revise the TLAA by recognizing and reevaluating any overly conservative conditions and assumptions. Examples include relaxing overly conservative assumptions in the original analysis, using new or refined analytical techniques, and performing the analysis using a 60-year period. The applicant shall provide a sufficient description of the analysis and document the results of the reanalysis to show that it is satisfactory for the 60-year period.

As applicable, the plant's code of record should be used for the reevaluation, or the applicant may update to a later code edition pursuant to 10 CFR 50.55a. In the latter case, the reviewer verifies that the requirements in 10 CFR 50.55a are met.

In some cases, the applicant may identify activities to be performed to verify the assumption basis of the calculation, such as cycle counting. An evaluation of that activity should be provided by the applicant. The reviewer should assure that the applicant's activity is sufficient to confirm the calculation assumptions for the 60-year period.

4.7.3.1.3 10 CFR 54.21(c)(1)(iii)

Under this option, the applicant would propose to manage the aging effects associated with the TLAA by an aging management program in the same manner as would be described in the IPA in 10 CFR 54.21(a)(3). The reviewer reviews the applicant's aging management program to verify that the effects of aging on the intended function(s) will be adequately managed consistent with the CLB for the period of extended operation.

The applicant should identify the structures and components associated with the TLAA. The TLAA should be described with respect to the objectives of the analysis, conditions, assumptions used, acceptance criteria, relevant aging effects, and intended function(s). In cases where a mitigation or inspection program is proposed, the reviewer may use the guidance provided in Branch Technical Position RLSB-1 of this standard review plan to ensure that the effects of aging on the structure and component intended function(s) are adequately managed for the period of extended operation.

4.7.3.2 FSAR Supplement

The reviewer verifies that the applicant has provided information, to be included in the FSAR supplement that includes a summary description of the evaluation of each TLAA. Each such summary description is reviewed to verify that it is appropriate such that later changes can be controlled by 10 CFR 50.59. The description should contain information that the TLAAs have been dispositioned for the period of extended operation. Sections 4.2 through 4.6 of this standard review plan contain examples of acceptable FSAR supplement information for TLAA evaluation.

The staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR supplement before the license is renewed, no condition will be necessary.

As noted in Sections 4.2 through 4.6, an applicant need not incorporate the implementation schedule into its FSAR. However, the review should verify that the applicant has identified and committed in the license renewal application to any future aging management activities, including enhancements and commitments to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

4.7.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of this section and whether the staff's evaluation supports conclusions of the following type, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), to be included in the staff's safety evaluation report:

> On the basis of its review, as discussed above, the staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1), that, for the (name of specific) TLAA, [choose which is appropriate] (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation. The staff also concludes that the FSAR Supplement contains an appropriate summary description of this TLAA evaluation for the period of extended operation as reflected in the license condition.

4.7.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

4.7.6 References

None

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APPENDIX A

BRANCH TECHNICAL POSITIONS

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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 (AMR) will be adequately managed so that their intended functions will be maintained consistent with the CLB for the period of extended operation. The purpose of this branch technical position (RLSB-1) 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. For example, coating programs prevent external corrosion of a tank. Mitigation programs attempt to slow the effects of aging. For example, water chemistry programs mitigate internal corrosion of piping. Condition monitoring programs inspect for the presence and extent of aging effects. Examples are the visual examination of concrete structures for cracking, and the ultrasonic examination 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, the ability of the tubes of heat balances on heat exchangers to transfer heat is tested. More than one type of aging management program may be 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 degradations that have 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 intended function(s) of structures and components should also be considered.

2. Relevant aging information may be contained in, but is 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; GSIs/unresolved safety issues (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 applicable and an applicant determines that it is not applicable to its plant, the reviewer may question the absence of this aging effect unless the applicant has provided the basis for this determination in its license renewal application. However, in questioning the absence of the aging effect, a reference and/or basis which provides relevance to aid the applicant in addressing the question should be provided. For example, the question could cite a previous application review, NRC generic communications, engineering judgment, relevant research information, or other industry experience as the basis for the question. Simply citing that the aging effect is listed in the GALL report is not a sufficient basis. For example, the aging effect is applicable to a PWR component, but the applicant's plant is a BWR and does not have such a component. In this example, using the GALL report merely as a checklist is not relevant.

4. An aging effect may not have been identified in the GALL report, if it arises out of industry experience after the issuance of the GALL report. The reviewer should ensure that the applicant has evaluated the latest industry experience to identify all applicable aging effects.

5. An aging effect should be identified as applicable for license renewal even if there is a prevention 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 AMR should consider the adequacy of the water chemistry, coating, or cathodic protection as an aging management program.

6. 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 IPA.

7. 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. Specific aging effects from abnormal events need not be postulated 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.

   DBEs are abnormal events; they include: design basis pipe break, 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; 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 (see 10 CFR Part 50 Appendix B) to ensure functionality of the equipment. The equipment degradation is not due to aging; corrective action is not necessary solely for the period of extended operation.

   However, 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 bolted connections should be evaluated for license renewal.

An aging effect due to an abnormal event does not preclude that aging effect from occurring during normal operation for the period of extended operation. For example, a certain PWR licensee 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 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 Program 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 AMR, 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 of which the program manages the aging.

A.1.2.3.2 Preventive Actions

1. The activities for prevention and mitigation programs 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. More than one type of aging management program may 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 and 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 thickness and detection and sizing of cracks.

3. For a performance monitoring program, a link should be established between the degradation of the particular structure or component intended function(s) and the parameter(s) being monitored. An example of linking the degradation of a passive component intended function with the performance being monitored is linking the fouling of heat exchanger tubes with the heat transfer intended function. This could be monitored by periodic heat balances. Since this example deals only with one intended function of the tubes, 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 ensure 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 DBE loads. Thus, a DBE, 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 that 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. This includes aspects such as method or technique (e.g., visual, volumetric, surface inspection), frequency, sample size, data collection and timing of new/one-time inspections to ensure timely detection of aging effects. Provide information that links the parameters to be monitored or inspected to the aging effects being managed.

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.

3. This program element describes “when,” “where,” and “how” program data are collected (i.e., all aspects of activities to collect data as part of the program).

4. The method or technique and frequency may be linked to plant-specific or industry-wide operating experience. Provide justification, including codes and standards referenced, that the technique and frequency are adequate to detect the aging effects before a loss of SC intended function. A program based solely on detecting SC failures is not considered an effective aging management program.

5. When sampling is used to inspect a group of SCs, provide the basis for the inspection population and sample size. The inspection population should be based on such aspects of the SCs as a similarity of materials of construction, fabrication, procurement, design, installation, operating environment, or aging effects. The sample size should be based on such aspects of the SCs as the specific aging effect, location, existing technical information, system and structure design, materials of construction, service environment, or previous failure history. The samples should be biased toward locations most susceptible to the specific aging effect of concern in the period of extended operation. Provisions should also be included on expanding the sample size when degradation is detected in the initial sample.

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 thus effect timely corrective or mitigative actions. Plant-specific and/or industry-wide operating experience may be considered in evaluating the appropriateness of the technique and frequency.

2. This program element describes “how” the data collected are evaluated and may also include trending for a forward look. This includes an evaluation of the results against the acceptance criteria and a prediction regarding the rate of degradation in order to confirm that timing of the next scheduled inspection will occur before a loss of SC intended function. Although aging indicators may be quantitative or qualitative, aging indicators should be quantified, to the extent possible, to allow trending. The parameter or indicator trended should be described. The methodology for analyzing the inspection or test results against the acceptance criteria should be described. Trending is a comparison of the current monitoring results with previous monitoring results in order to make predictions for the future.

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, before 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 specific numerical values, or could consist of a discussion of the process for calculating specific numerical values of conditional acceptance criteria to ensure that the structure and component intended function(s) will be maintained under all CLB design conditions. Information from available references may be cited.

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. Acceptance criteria, which do permit degradation, are based on maintaining the intended function under all CLB design loads.

4. Qualitative inspections should be performed to same predetermined criteria as quantitative inspections by personnel in accordance with ASME Code and through approved site specific programs.

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. It should ensure that preventive actions are adequate and that appropriate corrective actions have been completed and are effective.

2. The effectiveness of prevention and mitigation programs should be verified periodically. 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 were completed, the root cause determination was performed, and recurrence is prevented.

A.1.2.3.9 Administrative Controls

1. The administrative controls of the program should be described. They 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 must 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 considered. 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 at all) in intercepting aging degradation in a timely manner. This information should provide objective evidence to support the conclusion that the effects of aging will be managed adequately 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, “Industry Guideline for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule,” Nuclear Energy Institute, March 2001

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 AMR for license renewal.
2. Preventive actions	Preventive actions should prevent or mitigate aging degradation.
3. Parameters monitored or inspected	Parameters monitored or inspected should be linked to the degradation of the particular structure or component intended function(s).
4. Detection of aging effects	Detection of aging effects should occur before there is a loss of structure or component intended function(s). This includes aspects such as method or technique (i.e., visual, volumetric, surface inspection), frequency, sample size, data collection and timing of new/one-time inspections to ensure timely detection of aging effects.
5. Monitoring and trending	Monitoring and trending should provide predictability of the extent of degradation, and timely corrective or mitigative actions.
6. Acceptance criteria	Acceptance criteria, against which the need for corrective action will be evaluated, should ensure that the structure or 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 the conclusion that the effects of aging will be managed adequately so that the structure and component intended function(s) will be maintained during the period of extended operation.

A.2 QUALITY ASSURANCE FOR AGING MANAGEMENT PROGRAMS (BRANCH TECHNICAL POSITION IQMB-1)

A.2.1 Background

The license renewal applicant is required to demonstrate that the effects of aging on structures and components subject to an Aging Management Review (AMR) will be managed adequately to ensure that their intended functions will be maintained consistent with the CLB of the facility for the period of extended operation. Therefore, those aspects of the AMR process that affect quality of safety-related structures, systems, and components are subject to the quality assurance (QA) requirements of 10 CFR Part 50 Appendix B. For nonsafety-related structures and components subject to an AMR, the existing 10 CFR Part 50 Appendix B QA program may be used by the applicant to address the elements of corrective actions, the confirmation process, and administrative controls, as described in Appendix A.1 (Branch Technical Position RLSB-1). The confirmation process should ensure that preventive actions are adequate and that appropriate corrective actions have been completed and are effective. Administrative controls should provide a formal review and approval process. Reference 1 describes how a license renewal applicant can rely on the existing requirements in 10 CFR Part 50 Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to satisfy these program elements/attributes. The purpose of this branch technical position (IQMB-1) is to describe an acceptable process for implementing the corrective actions, the confirmation process, and administrative controls elements of aging management programs for license renewal.

A.2.2 Branch Technical Position

1. Safety-related structures and components are subject to 10 CFR Part 50 Appendix B requirements, which are adequate to address all quality-related aspects of an aging management program consistent with the CLB of the facility for the period of extended operation.

2. For nonsafety-related structures and components that are subject to an AMR for license renewal, an applicant has an option to expand the scope of its 10 CFR Part 50 Appendix B program to include these structures and components to address corrective actions, the confirmation process, and administrative controls for aging management during the period of extended operation. The reviewer should verify that the applicant has documented such a commitment in the FSAR supplement in accordance with 10 CFR 54.21(d).

3. If an applicant chooses to have alternative means to address corrective actions, the confirmation process, and administrative controls for managing aging of nonsafety-related structures and components that are subject to an AMR for license renewal, the applicant's proposal should be reviewed on a case-by-case basis following the guidance in Appendix A.1 (Branch Technical Position RLSB-1.)

A.2.3 References

1. Draft NUREG-1801, "Generic Aging Lessons Learned (GALL)," U.S. Nuclear Regulatory Commission, Revision 1, September 2005.

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A.3 GENERIC SAFETY ISSUES RELATED TO AGING (BRANCH TECHNICAL POSITION RLSB-2)

A.3.1 Background

Unresolved Safety Issues (USIs) and Generic Safety Issues (GSIs) are identified and tracked in the NRC's formal resolution process set forth in NUREG-0933, "A Prioritization of Generic Safety Issues," which is updated periodically (Ref. 1). Appendix B to NUREG-0933 contains a listing of those issues that are applicable to operating and future plant. NUREG-0933 is a source of information on generic concerns identified by the NRC. Some of these concerns may be related to the effects of aging or Time-Limited Aging Analyses (TLAAs) for systems, structures, or components within the scope of license renewal review. The purpose of this branch technical position (RLSB-2) is to address the license renewal treatment of an aging effect or a TLAA which is a subject of an USI or a GSI (60 FR 22484).

Table A.3-1 provides examples to help determine whether a USI or GSI should or should not be specifically addressed for license renewal, based on lessons learned from the staff review of the initial license renewal applications. However, two of these examples (GSI-23 and -190) have been resolved by the staff. They are included in the examples for illustrative purposes.

A.3.2 Branch Technical Position

A.3.2.1 Treatment of GSIs

1. The license renewal rule requires that aging effects be managed to ensure that the structure and component intended function(s) are maintained and that TLAAs are evaluated for license renewal. Thus, all applicable aging effects of structures and components subject to an AMR and all TLAAs must be evaluated, regardless of whether they are associated with GSIs or USIs.

2. USIs and HIGH- and MEDIUM-priority issues described in NUREG-0933 Appendix B (Ref. 1) that involve aging effects for structures and components subject to an AMR or TLAAs should be specifically addressed. The version of NUREG-0933 that is current on the date 6 months before the date of the license renewal application should be used to identify such issues. Prior to Safety Evaluation Report (SER) completion, any new issues contained in later versions of NUREG-0933 should be reviewed and resolved if determined to be applicable to the applicant's plant. New issues may be addressed by using one of the approaches described in Position A.3.2.2 below.

3. New generic safety issues, designated as USI, HIGH-, or MEDIUM- priority after the application has been submitted, that involve aging effects for structures and components subject to an aging management review or TLAA should be submitted in the annual update of the application.

4. During the preparation and review of a license renewal application, an applicant or the NRC may become aware of an aging management or TLAA issue that may be generically applicable to other nuclear plants. If issues may have generic applicability (but are not yet part of the formal GSIs resolution process as identified in NUREG-0933), an applicant should still address the issue to demonstrate that the effects of aging are or will be managed adequately or that TLAAs have been evaluated for the period of extended operation.

A.3.2.2 Approaches for Addressing GSIs (60 FR 22484)

One of the following approaches may be used:

1. If resolution has been achieved before issuance of a renewed license, implementation of that resolution is incorporated within the license renewal application. The plant-specific implementation information should be provided.

2. A technical rationale is provided that demonstrates that the CLB will be maintained until some later time in the period of extended operation, at which point one or more reasonable options (for example, replacement, analytical evaluation, or a surveillance/maintenance program) would be available to adequately manage the effects of aging. An applicant would have to describe the basis for concluding that the CLB is maintained during the period of extended operation, and briefly describe options that are technically feasible during the period of extended operation to manage the effects of aging, but would not have to preselect which option would be used.

3. An aging management program is developed that, for that plant, incorporates a resolution to the aging effects issue.

4. An amendment of the CLB (as a separate action outside the license renewal application) is proposed that, if approved, would remove the intended function(s) from the CLB. The proposed CLB amendment is reviewed under 10 CFR Part 50 and is not a review area for license renewal.

A.3.3 References

1. NUREG-0933, “A Prioritization of Generic Safety Issues.”

2. NRC Regulatory Issue Summary 2000-02, “Closure of Generic Safety Issue 23, Reactor Coolant Pump Seal Failure,” February 15, 2000.

3. Letter from Ashok C. Thadani of the Office of Nuclear Regulatory Research, NRC, to William D. Travers, Executive Director of Operations, NRC, dated December 26, 1999.

4. SECY 94-225, “Issuance of Proposed Rulemaking Package on GSI-23, Reactor Coolant Pump Seal Failure,” August 26, 1994.

5. Information Notice 93-61, “Excessive Reactor Coolant Leakage Following a Seal Failure in a Reactor Coolant Pump or Reactor Recirculation Pump,” August 9, 1993.

6. Deleted.

7 NRC Regulatory Issue Summary 2003-09, “Environmental Qualification of Low-Voltage Instrumentation and Control Cables” dated May 2, 2003.

Table A.3-1. Examples of Generic Safety Issues that Should/Should Not Be Specifically Addressed for License Renewal and Basis for Disposition

Example	Disposition
GSI-23, "Reactor Coolant Pump Seal Failures"	This issue relates to reactor coolant pump seal failures, which challenge the makeup capacity of the emergency core cooling system in PWRs. Although GSI-23 originally addressed seal performance both during normal operation and during loss of seal cooling conditions, it has been modified to address only seal performance during loss of seal cooling conditions (Refs. 4 and 5). Loss of all seal cooling may cause the reactor coolant pump seals to fail or leak excessively. Because the reactor coolant pump seal performance during loss of seal cooling conditions is not an issue that involves AMR or TLAA, GSI-23 need not be specifically addressed for license renewal (Ref. 2).
GSI-168, "Environmental Qualification of Electrical Equipment"	This issue relates to aging of electrical equipment that is subject to environmental qualification requirements. Environmental qualification is a TLAA for license renewal. Regulatory Issue Summary (RIS) 2003-09 was issued on May 2, 2003, to inform addresses of the results of the technical assessment of GSI-168, "Environmental Qualification of Electrical Equipment". This RIS requires no action on the part of the addressees (Ref. 7)
GSI-173.A, "Spent Fuel Storage Pool: Operating Experience"	This issue relates to the potential for a sustained loss of spent fuel pool cooling capacity and the potential for a substantial loss of spent fuel pool coolant inventory. The staff evaluated the issue and concluded that no actions will be taken for operating plants. As indicated in NUREG-0933, the staff is pursuing regulatory improvement changes to RG 1.13, "Spent Fuel Storage Facility Design Basis," and NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants." Thus, GSI-173.A need not be specifically addressed for license renewal.
GSI-190, "Fatigue Evaluation of Metal Components for 60-Year Plant Life"	This issue relates to environmental effects on fatigue of reactor coolant system components for 60 years. Fatigue is also a TLAA for license renewal. Thus, GSI-190 was specifically addressed for license renewal by the initial license renewal applicants. This GSI has now been resolved (Ref. 3).

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