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Protecting People and the Environment

NUREG-1801, Rev. 2

Generic Aging Lessons Learned (GALL) Report

Final Report

Office of Nuclear Reactor Regulation

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United States Nuclear Regulatory Commission

Protecting People and the Environment

NUREG-1801, Rev. 2

Generic Aging Lessons Learned (GALL) Report

Final Report

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ABSTRACT

NUREG-1801, "The Generic Aging Lessons Learned (GALL) Report" (GALL Report), contains the staff's generic evaluation of the existing plant programs and documents the technical basis for determining where existing programs are adequate without modification and where existing programs should be augmented for the period of extended operation. The evaluation results documented in the GALL Report indicate that many of the existing programs are adequate to manage the aging effects for structures or components for license renewal without change. The GALL Report also contains recommendations on specific areas for which existing programs should be augmented for license renewal. 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. The GALL Report should be treated as an approved topical report. However, if an applicant takes credit for a program in the GALL Report, it is incumbent on the applicant to ensure that the conditions and operating experience at the plant are bounded by the conditions and operating experience for which the GALL Report program was evaluated. If these bounding conditions are not met, it is incumbent on the applicant to address the additional effects of aging and augment the GALL Report aging management program(s) as appropriate. The staff will verify that the applicant's programs are consistent with those described in the GALL Report and/or with plant conditions and operating experience during the performance of an aging management program audit and review. The focus of the balance of the staff's review of a license renewal application is on those programs that an applicant has enhanced to be consistent with the GALL Report, those programs for which the applicant has taken an exception to the program described in the GALL Report, and plant-specific programs not described in the GALL Report. The information in the GALL Report has been incorporated into the NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," as directed by the Commission, to improve the efficiency of the license renewal process.

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ABBREVIATIONS

ACAR	aluminum conductor aluminum alloy reinforced
ACRS	aluminum conductor steel reinforced
ACI	American Concrete Institute
ADS	automatic depressurization system
AFW	auxiliary feedwater
ALARA	as low as reasonably achievable
AMP	aging management program
AMR	aging management review
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
B&PV	boiler and pressure vessel
B&W	Babcock & Wilcox
BWR	boiling water reactor
BWRVIP	Boiling Water Reactor Vessel and Internals Project
CASS	cast austenitic stainless steel
CB	core barrel
CCCW	closed-cycle cooling water
CE	Combustion Engineering
CEA	control element assembly
CFR	Code of Federal Regulations
CFS	core flood system
CLB	current licensing basis
CRD	control rod drive
CRDM	control rod drive mechanism
CRDRL	control rod drive return line
CRGT	control rod guide tube
CVCS	chemical and volume control system
DC	direct current
DHR	decay heat removal
DSCSS	drywell and suppression chamber spray system
EDG	emergency diesel generator
EPDM	ethylene propylene diene monosomer
EPR	ethylene-propylene rubber
EPRI	Electric Power Research Institute

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EQ	environmental qualification
FAC	flow-accelerated corrosion
FERC	Federal Energy Regulatory Commission
FRN	Federal Register Notice
FSAR	Final Safety Analysis Report
FW	feedwater
GALL	Generic Aging Lessons Learned
GE	General Electric
GL	generic letter
HDPE	high density polyethylene
HELBs	high-energy line breaks
HP	high pressure
HPCI	high-pressure coolant injection
HPCS	high-pressure core spray
HPSI	high-pressure safety injection
HVAC	heating, ventilation, and air conditioning
I&C	instrumentation and control
IASCC	irradiation assisted stress corrosion cracking
IC	isolation condenser
ID	inside diameter
IEB	inspection and enforcement bulletin
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
IR	insulation resistance
IRM	intermediate range monitor
ISI	inservice inspection
LER	licensee event report
LG	lower grid
LOCA	loss of coolant accident
LP	low pressure
LPCI	low-pressure coolant injection
LPCS	low-pressure core spray

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LPM	loose part monitoring
LPRM	low-power range monitor
LPSI	low-pressure safety injection
LRAAI	license renewal applicant action items
LRT	leak rate test
LWR	light water reactor
MFW	main feedwater
MIC	microbiologically influenced corrosion
MS	main steam
MSR	moisture separator/reheater
MT	magnetic particle testing
NDE	nondestructive examination
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association
NPAR	nuclear plant aging research
NPS	nominal pipe size
NRC	Nuclear Regulatory Commission
NRMS	normalized root mean square
NSAC	Nuclear Safety Analysis Center
NSSS	nuclear steam supply system
NUMARC	Nuclear Management and Resources Council
OCCW	open-cycle cooling water
OD	outside diameter
ODSCC	outside diameter stress corrosion cracking
OM	operation and maintenance
PT	penetrant testing
PVC	polyvinyl chloride
PWR	pressurized water reactor
PWSCC	primary water stress corrosion cracking
QA	quality assurance
RCCA	rod control cluster assemblies
RCIC	reactor core isolation cooling
RCP	reactor coolant pump
RCPB	reactor coolant pressure boundary
RCS	reactor coolant system

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RG	Regulatory Guide
RHR	residual heat removal
RMS	root mean square
RWC	reactor water cleanup
RWST	refueling water storage tank
RWT	refueling water tank
SAW	submerged arc weld
SCC	stress corrosion cracking
SDC	shutdown cooling
SFP	spent fuel pool
SG	steam generator
S/G	standards and guides
SIL	services information letter
SIT	safety injection tank
SLC	standby liquid control
SOER	significant operating experience report
SR	silicon rubber
SRM	source range monitor
SRM	staff requirements memorandum
SRP-LR	standard review plan for license renewal
SS	stainless steel
SSC	systems, structures, and components
TGSCC	transgranular stress corrosion cracking
TLAA	time-limited aging analysis
UCS	Union of Concerned Scientists
UHS	ultimate heat sink
USI	unresolved safety issue
UT	ultrasonic testing
UV	ultraviolet
XPLE	cross-linked polyethylene

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INTRODUCTION

NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," is referenced as a technical basis document in NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants" (SRP-LR). The GALL Report lists generic aging management reviews (AMRs) of systems, structures, and components (SSCs) that may be in the scope of license renewal applications (LRAs) and identifies aging management programs (AMPs) that are determined to be acceptable to manage aging effects of SSCs in the scope of license renewal, as required by 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants." If an applicant takes credit for a program in the GALL Report, it is incumbent on the applicant to ensure that the conditions and operating experience at the plant are bounded by the conditions and operating experience for which the GALL Report was evaluated. If these bounding conditions are not met, it is incumbent on the applicant to address the additional effects of aging and augment the GALL report AMPs as appropriate.

If an LRA references the GALL Report as the approach used to manage aging effect(s), the NRC staff will use the GALL Report as a basis for the LRA assessment consistent with guidance specified in the SRP-LR.

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BACKGROUND

Revision 0 of the GALL Report

By letter dated March 3, 1999, the Nuclear Energy Institute (NEI) documented the industry's views on how existing plant programs and activities should be credited for license renewal. The issue can be summarized as follows:

To what extent should the staff review existing programs relied on for license renewal to determine whether an applicant has demonstrated reasonable assurance that such programs will be effective in managing the effects of aging on the functionality of structures and components during the period of extended operation?

In a staff paper (SECY-99-148, "Credit for Existing Programs for License Renewal") dated June 3, 1999, the staff described options for crediting existing programs and recommended one option that the staff believed would improve the efficiency of the license renewal process.

By a staff requirements memorandum (SRM), dated August 27, 1999, the Commission approved the staff's recommendation and directed the staff to focus the staff review guidance in the SRP-LR on areas where existing programs should be augmented for license renewal. The staff would develop a GALL Report to document the staff's evaluation of generic existing programs. The GALL Report would document the staff's basis for determining which existing programs are adequate without modification and which existing programs should be augmented for license renewal. The GALL Report would be referenced in the SRP-LR as a basis for determining the adequacy of existing programs.

The GALL Report (Revision 0) is built on a previous report, NUREG/CR-6490, "Nuclear Power Plant Generic Aging Lessons Learned (GALL)," which is a systematic compilation of plant aging information. The GALL Report (Revision 0) extended the information in NUREG/CR-6490 to provide an evaluation of the adequacy of AMPs for license renewal. The NUREG/CR-6490 report was based on information in over 500 documents: Nuclear Plant Aging Research (NPAR) program reports sponsored by the Office of Nuclear Regulatory Research, Nuclear Management and Resources Council (NUMARC, now NEI) industry reports addressing license renewal for major structures and components, licensee event reports (LERs), information notices, generic letters, and bulletins. The staff also considered information contained in the reports provided by the Union of Concerned Scientists (UCS) in a letter dated May 5, 2000.

Following the general format of NUREG-0800 for major plant sections, except for refueling water, chilled water, residual heat removal, condenser circulating water, and condensate storage system in pressurized water reactor (PWR) and boiling water reactor (BWR) power plants, the staff reviewed the aging effects on components and structures, identified the relevant existing programs, and evaluated program attributes to manage aging effects for license renewal. The GALL Report (Revision 0) was prepared with the technical assistance of Argonne National Laboratory and Brookhaven National Laboratory. As directed in the SRM, the GALL Report (Revision 0) had the benefit of the experience of the staff members who conducted the review of the initial LRAs. Also, as directed in the SRM, the staff sought stakeholders' participation in the development of this report. The staff held many public meetings and workshops to solicit input from the public. The staff also requested comments from the public on the draft improved license renewal guidance documents, including the GALL Report, in the Federal Register Notice, Vol. 65, No. 170, August 31, 2000. The staff's analysis of stakeholder

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comments is documented in NUREG-1739. These documents can be found online at http://www.nrc.gov/reading-rm/doc-collections/.

Revision 1 of the GALL Report

Based on lessons learned from the reviews of LRAs and other public input including industry comments, the NRC staff proposed changes to the GALL Report (Revision 0) to make the GALL Report (Revision 1) more efficient. A preliminary version of Revision 1 of the GALL Report was posted on the NRC public web page on September 30, 2004. The draft revisions of the GALL Report (Vol. 1 and Vol. 2) were further refined and issued for public comment on January 31, 2005. The staff also held public meetings with stakeholders to facilitate dialogue and to discuss comments. The staff subsequently took into consideration comments received (see NUREG-1832) and incorporated its dispositions into the September 2005 version of the GALL Report (Revision 1).

Revision 2 of the GALL Report

Based on further lessons learned from the reviews of LRAs, operating experience obtained after Revision 1 was issued, and other public input including industry comments, the NRC staff proposed changes to the GALL Report (Revision 1). A preliminary version of Revision 2 of the GALL Report was posted on the NRC public web page on December 23, 2009. The draft revision of the GALL Report was further refined and issued for public comment on May 18, 2010. The staff held public meetings with stakeholders to facilitate dialogue and to discuss comments. The staff subsequently took into consideration comments received (see NUREG-1950) and incorporated their dispositions into the December 2010, Revision 2 of the GALL Report.

Revision 2 – Operating Experience Evaluation

The extended operation of nuclear reactors necessitates a thorough analysis of existing experience. An operating experience review was performed by NRC staff to identify necessary additions or modifications to the GALL Report based on this experience. Both domestic and foreign operating experience was reviewed.

The staff from the Division of License Renewal (DLR) analyzed operating experience information during a screening review of domestic operating experience, foreign operating experience from the international Incident Reporting System (IRS) database, and NRC generic communications. The information reviewed included operating experience from January 2004 to approximately April 2009.

Domestic Operating Experience: The NRC, Office of Research (RES) provided a listing of Licensee Event Reports (LERs) related to failures, cracking, degradation, etc. of passive components. These results were reviewed by NRC staff. The operating experience elements of numerous AMPs were updated to reflect relevant operating experience identified by the review. In addition, the operating experience review identified a number of examples where vibration-induced fatigue caused cracking of plant components. The staff subsequently modified GALL AMP XI.M35, "One-time Inspection of ASME Code Class 1 Small-bore Piping," to address these concerns.

Foreign Operating Experience: The international IRS, jointly operated by the International Atomic Energy Agency (IAEA) and the Nuclear Energy Agency (NEA), is used to compile and

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analyze information on NPP events and also promotes a systematic approach to collecting and disseminating the lessons learned from international operating experience. Events of safety significance and events from which lessons can be learned are reported to the IRS. The main objective of the IRS is to enhance the safety of NPPs by reducing the frequency and severity of safety significant unusual events at NPPs. NRC staff also reviewed international operating experience from: (a) the Organization for Economic Co-operation and Development (OECD) OECD/NEA Piping Failure Data Exchange database (including the data from 1970 to 2009) and (b) the OECD/NEA Stress Corrosion Cracking and Cable Aging database.

The foreign operating experience databases were queried for reports relating to aging effects in passive components. The identified reports were analyzed to determine if there were any revisions necessary for either AMR items or AMP content. Many of the reports identified MEAP combinations that were already addressed by the GALL Report. Some of the items were specific to foreign plants and not generically applicable to U.S. pressurized water reactors (PWRs) and boiling water reactors (BWRs). In addition, the IRS identified that stainless steel components are subject to chloride-induced stress corrosion cracking when they are exposed to the air-outdoor environment that involves a salt-laden atmospheric condition or salt water spray. Based on this review result, relevant SRP-LR sections were added and further evaluation is now recommended for those environmental conditions.

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OVERVIEW OF THE GALL REPORT EVALUATION PROCESS

The GALL Report contains 11 chapters and an appendix. The majority of the chapters contain summary descriptions and tabulations of evaluations of AMPs for a large number of structures and components in major plant systems found in light-water reactor nuclear power plants. The major plant systems include the containment structures (Chapter II), structures and component supports (Chapter III), reactor vessel, internals and reactor coolant system (Chapter IV), engineered safety features (Chapter V), electrical components (Chapter VI), auxiliary systems (Chapter VII), and steam and power conversion system (Chapter VIII).

Chapter I of the GALL Report addresses the application of the ASME Code for license renewal. Chapter IX contains definitions of a selection of standard terms used within the GALL Report. Chapter X contains the time-limited aging analysis evaluation of AMPs under 10 CFR 54.21(c)(1)(iii). Chapter XI contains the AMPs for the structures and mechanical and electrical components. The Appendix of the GALL Report addresses quality assurance (QA) for AMPs.

The evaluation process for the AMPs and the application of the GALL Report is described in this document. The results of the GALL effort are presented in tabular format in the GALL Report.

Table Column Headings

The following describes the information presented in each column of the tables in Chapters II through VIII contained in this report.

Column Heading	Description
Item	Identifies a unique number for the item (i.e., VII.G.A-91). The first part of the number indicates the chapter and AMR system (e.g., VII.G is in the auxiliary systems, fire protection system), and the second part is a unique chapter-specific identifier within a chapter (e.g., A-91 for auxiliary systems).
Link	For each row in the subsystem tables, this item identifies the corresponding row identifier from GALL Volume 2, Rev. 1, if the row was derived from the earlier version of this report. Otherwise, blanks indicate a new row in this revision of the GALL Report.
Structure and/ or Component	Identifies the structure or components to which the row applies.
Material	Identifies the material of construction. See Chapter IX of this report for further information.
Environment	Identifies the environment applicable to this row. See Chapter IX of this report for further information.
Aging Effect/ Mechanism	Identifies the applicable aging effect and mechanism(s). See Chapter IX of the GALL Report for more information.
Aging Management Programs	Identifies the time-limited aging analysis or AMP found acceptable for adequately managing the effects of aging. See Chapters X and XI of the GALL Report.
Further Evaluation	Identifies whether further evaluation is needed.

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The staff's evaluation of the adequacy of each generic AMP to manage certain aging effects for particular structures and components is based on its review of the following 10 program elements in each AMP.

AMP Element	Description
1. Scope of the Program	The scope of the program should include the specific structures and components subject to an AMR.
2. Preventive Actions	Preventive actions should mitigate or prevent the applicable aging effects.
3. Parameters Monitored or Inspected	Parameters monitored or inspected should be linked to the effects of aging on the intended functions of the particular structure and component.
4. Detection of Aging Effects	Detection of aging effects should occur before there is a loss of any structure and component intended function. 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 for prediction of the extent of the effects of aging 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 particular structure and component's intended functions are maintained under all current licensing basis (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	The 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 involving the AMP, including past corrective actions resulting in program enhancements or additional programs, should provide objective evidence to support a determination that the effects of aging will be adequately managed so that the structure and component intended functions will be maintained during the period of extended operation.

On the basis of its evaluation, if the staff determined that a program is adequate to manage certain aging effects for a particular structure or component without change, the "Further Evaluation" entry will indicate that no further evaluation is recommended for license renewal.

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Chapter XI of the GALL Report contains the staff's evaluation of generic aging management programs that are relied on in the GALL Report, such as the ASME Section XI inservice inspection, water chemistry, or structures monitoring program.

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APPLICATION OF THE GALL REPORT

The GALL Report is a technical basis document to the SRP-LR, which provides the staff with guidance in reviewing an LRA. 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 an LRA to demonstrate that the programs at the applicant's facility correspond to those reviewed and approved in the GALL Report.

If an applicant takes credit for a program in GALL, it is incumbent on the applicant to ensure that the plant program contains all the elements of the referenced GALL program. In addition, the conditions and operating experience at the plant must be bound by the conditions and operating experience for which the GALL program was evaluated, otherwise it is incumbent on the applicant to augment the GALL program as appropriate to address the additional aging effects. The above verifications must be documented on-site in an auditable form. The applicant must include a certification in the LRA that the verifications have been completed.

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 LRA. Use of the GALL Report is not required, but its use should facilitate both preparation of an LRA 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 CLB. 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 existing generic 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 those for which industry groups are developing generic aging management programs or investigating whether aging management is warranted.

The Appendix of the GALL Report addresses quality assurance (QA) for aging management programs. Those aspects of the aging management review process that affect the quality of safety-related structures, systems, and components are subject to the QA requirements of Appendix B to 10 CFR Part 50. For nonsafety-related structures and components subject to an AMR, the existing 10 CFR Part 50, Appendix B, QA program may be used by an applicant to address the elements of the corrective actions, confirmation process, and administrative controls for an aging management program for license renewal.

The GALL Report provides a technical basis for crediting existing plant programs and recommending areas for program augmentation and further evaluation. The incorporation of the

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GALL Report information into the SRP-LR, as directed by the Commission, should improve the efficiency of the license renewal process and better focus staff resources.

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CHAPTER I

APPLICATION OF THE ASME CODE

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The American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Division 1, Sections III (design) and XI (inservice inspection requirements) were developed and are revised periodically by industry code committees composed of representatives of utilities, reactor designers, architect-engineers, component manufacturers, insurance companies, the U.S. Nuclear Regulatory Commission (NRC), and others. In 1971, the Atomic Energy Commission (AEC), the predecessor of the NRC, incorporated the ASME Boiler and Pressure Vessel Code into the regulations in 10 CFR 50.55a through issuance of the Federal Register Notice (FRN) for the final rule (36 FR 11423 [June 12, 1971]).

The Statements of Consideration (SOCs) for the initial issuance of 10 CFR 50.55a provide the bases for AEC's endorsement and use of the ASME Code:

> "It has been generally recognized that, for boiling and pressurized water-cooled reactors, pressure vessels, piping, pumps, and valves which are part of the reactor coolant pressure boundary should, as a minimum, be designed, fabricated, inspected, and tested in accordance with the requirements of the applicable American Society of Mechanical Engineers (ASME) codes in effect at the time the equipment is purchased[.]"
>
> "Because of the safety significance of uniform early compliance by the nuclear industry with the requirements of these ASME codes and published code revisions, the Commission has adopted the following amendments to Part 50 and 115, which require that certain components and systems of water-cooled reactors important to safety comply with these codes and appropriate revisions to the codes at the earliest feasible time."
>
> "Compliance with the provisions of the amendments and the referenced codes is intended to insure a basic, sound quality level."

These ASME Code sections are based on the collective engineering judgment of the code committees and document the conditions that must be monitored, the inspection techniques to identify those conditions, the frequency of the inspections, and the acceptance criteria that the inspections' results must meet in order to assure the integrity of the structures and components considered in the code. The NRC has accepted this engineering judgment by endorsing the use of selected sections of the ASME Code, as incorporated in 10 CFR 50.55a.

In addition, the NRC periodically amends 10 CFR 50.55a and issues FRNs about this rule in order to endorse, by reference, newer editions and ASME Code Addenda subject to the modifications and limitations identified in 10 CFR 50.55a. At the time of this Standard Review Plan for License Renewal (SRP-LR) (NUREG-1800) and Generic Aging Lessons Learned (GALL) Report (NUREG-1801) update, the most recent editions of the ASME Code Sections III and XI were endorsed in 73 FR 52730-52750 (September 10, 2008). As stated in 65 FR 53050 (August 31, 2000):

> "To ensure that the GALL report conclusions will remain valid when future editions of the ASME Code are incorporated into the NRC regulations by the 10 CFR 50.55a rulemaking, the staff will perform an evaluation of these later editions for their adequacy for license renewal using the 10-element program evaluation described in the GALL Report as part of the 10 CFR 50.55a rulemaking."

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The staff will document this evaluation in the SOC accompanying future 10 CFR 50.55a amendments, which will be published in a FRN.

To aid applicants in the development of their license renewal applications, the staff has developed a list of aging management programs (AMPs) in the GALL Report that are based on conformance with the 10-program element criteria defined in Section A.1.2.3 of the SRP-LR. Some of the AMPs referenced in the GALL Report are based entirely or in part on compliance with the requirements of ASME Section XI, as endorsed for use through reference in 10 CFR 50.55a., The staff has determined that the referenced ASME Section XI programs or requirements provide an acceptable basis for managing the effects of aging during the period of extended operation for these AMPs, except where noted and augmented in the GALL Report.

For aging management purposes, consideration of the acceptability for license renewal of ASME Section XI editions and addenda from the 1995 edition through the 2004 Addenda are discussed in FRNs 67 FR 60520 (September 26, 2002); 69 FR 58804 (October 1, 2004); and 73 FR 52730 (September 10, 2008) (via update of 10 CFR 50.55a). These FRNs provide that ASME Section XI editions and addenda from the 1995 edition through the 2004 edition, as modified and limited in the final rule, are acceptable and the conclusions in the current GALL Report at the time of the FRN issuance remain valid. Future FRNs that amend 10 CFR 50.55a will discuss the acceptability of editions and addenda more recent than the 2004 edition for their applicability for aging management for license renewal. Therefore, except where noted and augmented in the GALL Report, the following ASME Section XI editions and addenda are acceptable and should be treated as consistent with the GALL Report: (1) from the 1995 edition to the 2004 edition, as modified and limited in 10 CFR 50.55a, and (2) more recent editions, as evaluated for their adequacy for license renewal and discussed in the accompanying FRN for 10 CFR 50.55a rulemaking endorsing those specific editions. Hence, applicants for renewal should justify any exception to use an ASME Section XI edition or addenda that is (1) earlier than the 1995 edition, (2) not endorsed in 10 CFR 50.55a, or (3) not adequate for license renewal as discussed in the FRN issuing the 10 CFR 50.55a amendment.

In some cases, the staff has determined that specific requirements in ASME Section XI need to be augmented to ensure adequate aging management consistent with the license renewal rule. Thus, some of the AMPs in the GALL Report provide for additional augmented actions. For these situations, applicants for renewal should review the recommendations in the GALL Report and discuss proposed enhancements in their LRAs.

Pursuant to 10 CFR 50.55a(g)(4), a nuclear licensee is required to amend its current licensing basis (CLB) by updating its ASME Section XI edition and addenda of record to the most recently endorsed edition and addenda referenced in 10 CFR 50.55a one year prior to entering the next 10-year internal inservice inspection (ISI) for its unit. Pursuant to 10 CFR 54.21(b), an applicant for license renewal is required to periodically submit updates of its LRA to identify any changes in its CLB that materially affect the contents of the LRA. The rule requires an update of the LRA each year following the submittal of the application and an additional update 3 months prior to the completion of the NRC's review of the LRA. If an applicant's ASME Section XI edition of record is updated under the requirements of 10 CFR 50.55a(g)(4) during the NRC's review of the LRA, the applicant should update those AMPs in the LRA that are impacted by this change in the CLB when the applicant submits the next update of the LRA required by 10 CFR 54.21(b).

The current regulatory process, including 10 CFR 50.55a, continues into the period of extended operation. The NRC Director of the Office of Nuclear Reactor Regulation (NRR) may approve a licensee-proposed alternative to ASME Section XI if it is submitted as a relief request in

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accordance with 10 CFR 50.55a(a)(3). The staff's approval of an alternative program/relief request typically does not extend beyond the current 10-year interval for which the alternative was proposed. For cases in which this interval extends beyond the initial 40-year license period into the renewed license period, the approved relief remains in effect until the end of that interval, consistent with the specific approval (60 FR 22461, 22483).

Pursuant to 10 CFR 50.55a(b)(5), licensees may apply ASME Code cases listed in NRC Regulatory Guide (RG) 1.147, through the most recent endorsed revision, without NRC approval, subject to the limitations contained in the rule. The rule permits licensees to continue to apply the Code case, or a most recent version that is incorporated by the RG, until the end of the 10-year interval. For cases in which this interval extends beyond the initial 40-year license period into the renewal period, the Code case, or a more recent endorsed version, remains in effect until the end of that interval, consistent with 10 CFR 50.55a(b)(5) and the statements of consideration for the final license renewal rule 60 FR 22461.

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CHAPTER II

CONTAINMENT STRUCTURES

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CONTAINMENT STRUCTURES

A. Pressurized Water Reactor (PWR) Containments

B. Boiling Water Reactor (BWR) Containments

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PRESSURIZED WATER REACTOR (PWR) CONTAINMENTS

A1. Concrete Containments (Reinforced and Prestressed)

A2. Steel Containments

A3. Common Components

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A1. CONCRETE CONTAINMENTS (REINFORCED AND PRESTRESSED)

Systems, Structures, and Components

This section addresses the elements of pressurized water reactor (PWR) concrete containment structures. Concrete containment structures are divided into three elements: concrete, steel, and prestressing systems.

System Interfaces

Functional interfaces include the primary containment heating and ventilation system (VII.F3), containment isolation components (V.C), and containment spray system (V.A). Physical interfaces exist with any structure, system, or component that either penetrates the containment wall, such as the main steam system (VIII.B1) and feedwater system (VIII.D1), or is supported by the containment structure, such as the polar crane (VII.B). The containment structure basemat typically provides support to the nuclear steam supply system (NSSS) components and containment internal structures.

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II	CONTAINMENT STRUCTURES
A1	Concrete Containments (Reinforced and Prestressed)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
II.A1.CP-87	II.A1-4(C-03)	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses	Concrete	Air – indoor, uncontrolled or Air – outdoor	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S2, "ASME Section XI, Subsection IWL"	No
II.A1.CP-31	II.A1-2(C-01)	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Chapter XI.S2, "ASME Section XI, Subsection IWL"	No
II.A1.CP-33	II.A1-3(C-04)	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Chapter XI.S2, "ASME Section XI, Subsection IWL"	No
II.A1.CP-32	II.A1-6(C-02)	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Chapter XI.S2, "ASME Section XI, Subsection IWL"	No
II.A1.CP-68	II.A1-7(C-05)	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses; reinforcing steel	Concrete; steel	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S2, "ASME Section XI, Subsection IWL"	No

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II CONTAINMENT STRUCTURES
A1 Concrete Containments (Reinforced and Prestressed)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
II.A1.CP-100	II.A1-4(C-03)	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses	Concrete	Air – indoor, uncontrolled or Air – outdoor or Ground water/soil	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring"	No
II.A1.CP-147	II.A1-2(C-01)	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses	Concrete	Air – outdoor or Ground water/soil	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Further evaluation is required for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557) to determine if a plant-specific aging management program is needed. A plant-specific aging management program is not required if documented evidence confirms that the existing concrete had air entrainment content (as per Table CC-2231-2 of the ASME Section III Division 2), and subsequent inspections of accessible areas did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. If this condition is not satisfied, then a plant-specific aging management program is required to manage loss of material (spalling, scaling) and cracking due to freeze-thaw of concrete in inaccessible areas. The weathering index for the continental US is shown in ASTM C33-90, Fig. 1.	Yes, for plants located in moderate to severe weathering conditions

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II CONTAINMENT STRUCTURES
A1 Concrete Containments (Reinforced and Prestressed)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
II.A1.CP-67	II.A1-3(C-04)	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed to manage cracking and expansion due to reaction with aggregate of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) as described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) For potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function.	Yes, if concrete is not constructed as stated
II.A1.CP-102	II.A1-6(C-02)	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Further evaluation is required to determine if a plant-specific aging management program is needed to manage increase in porosity, and permeability due to leaching of calcium hydroxide and carbonation of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) There is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) Evaluation determined that the observed leaching	Yes, if leaching is observed in accessible areas that impact intended function

II A1	CONTAINMENT STRUCTURES Concrete Containments (Reinforced and Prestressed)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure.	
II.A1.CP-97	II.A1-7(C-05)	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses; reinforcing steel	Concrete; steel	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring"	No
II.A1.CP-34	II.A1-1(C-08)	Concrete: dome; wall; basemat; ring girders; buttresses	Concrete	Air – indoor, uncontrolled or Air – outdoor	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program 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 elasticity due to elevated temperature. Thus, for any portions of concrete containment that exceed specified temperature limits, further evaluations are warranted. Subsection CC-3400 of ASME Section III, Division 2, 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, such as around penetrations, which are not allowed to exceed 200°F. If significant equipment loads are supported by concrete at temperatures	Yes, if temperature limits are exceeded

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II	CONTAINMENT STRUCTURES
A1	Concrete Containments (Reinforced and Prestressed)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						exceeding 150°F, an evaluation of the ability to withstand the postulated design loads is to be made. Higher temperatures than given above may be allowed in the concrete if tests and/or calculations are provided to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations.	
II.A1.CP-101	II.A1-5(C-37)	Concrete: dome; wall; basemat; ring girders; buttresses	Concrete	Soil	Cracking and distortion due to increased stress levels from settlement	Chapter XI.S2, "ASME Section XI, Subsection IWL," or Chapter XI.S6, " Structures Monitoring" 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 a de-watering system is relied upon to control settlement
II.A1.C-07	II.A1-8(C-07)	Concrete: foundation; subfoundation	Concrete; porous concrete	Water – flowing	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	Chapter XI.S6, "Structures Monitoring" 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 de-watering system through the period of extended operation.	Yes, if a de-watering system is relied upon to control settlement
II.A1.C-11	II.A1-9(C-11)	Prestressing system: tendons	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of prestress due to relaxation; shrinkage; creep; elevated temperature	Loss of tendon prestress is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.5, "Concrete Containment Tendon Prestress" for	Yes, TLAA

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II A1	CONTAINMENT STRUCTURES Concrete Containments (Reinforced and Prestressed)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1)(i) and (ii). See Chapter X.S1 of this report for meeting the requirements of 10 CFR 54.21(c)(1)(iii). For periodic monitoring of prestress, see Chapter XI.S2.	
II.A1.C-10	II.A1-10(C-10)	Prestressing system: tendons; anchorage components	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to corrosion	Chapter XI.S2, "ASME Section XI, Subsection IWL"	No
II.A1.CP-35	II.A1-11(C-09)	Steel elements (accessible areas): liner; liner anchors; integral attachments	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No
II.A1.CP-98	II.A1-11(C-09)	Steel elements (inaccessible areas): liner; liner anchors; integral attachments	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE" and Chapter XI.S4, "10 CFR Part 50, Appendix J" Additional plant-specific activities are warranted if loss of material due to corrosion is significant for inaccessible areas (embedded containment steel shell or liner). Loss of material due to corrosion is not significant if the following conditions are satisfied:	Yes, if corrosion is indicated from the IWE examinations

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II CONTAINMENT STRUCTURES
A1 Concrete Containments (Reinforced and Prestressed)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						1. Concrete meeting the requirements of ACI 318 or 349 and the guidance of 201.2R was used for the containment concrete in contact with the embedded containment shell or liner. 2. The moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with ASME Section XI, Subsection IWE requirements. 3. The concrete is monitored to ensure that it is free of penetrating cracks that provide a path for water seepage to the surface of the containment shell or liner. 4. Borated water spills and water ponding on the concrete floor are common and when detected are cleaned up or diverted to a sump in a timely manner. Operating experience has identified significant corrosion in some plants. If any of the above conditions cannot be satisfied, then a plant-specific aging management program for corrosion is necessary.	

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A2. STEEL CONTAINMENTS

Systems, Structures, and Components

This section addresses the elements of pressurized water reactor (PWR) steel containment structures. Steel containment structures are divided into two elements: steel and concrete.

System Interfaces

Functional interfaces include the primary containment heating and ventilation system (VII.F3), containment isolation components (V.C), and containment spray system (V.A). Physical interfaces exist with any structure, system, or component that either penetrates the containment wall, such as the main steam system (VIII.B1) and feedwater system (VIII.D1), or is supported by the containment structure, such as the polar crane (VII.B). The containment structure basemat typically provides support to the nuclear steam supply system (NSSS) components and containment internal structures.

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II CONTAINMENT STRUCTURES A2 Steel Containments							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
II.A2.CP-51	II.A2-2(C-28)	Concrete (accessible areas): basemat	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No
II.A2.CP-58	II.A2-3(C-38)	Concrete (accessible areas): basemat	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No
II.A2.CP-72	II.A2-4(C-25)	Concrete (accessible areas): basemat	Concrete	Ground water/soil	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring"	No
II.A2.CP-155	II.A2-6(C-30)	Concrete (accessible areas): basemat	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No
II.A2.CP-74	II.A2-7(C-43)	Concrete (accessible areas): basemat; reinforcing steel	Concrete; steel	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No

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II A2 CONTAINMENT STRUCTURES Steel Containments							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
II.A2.CP-70	II.A2-2(C-28)	Concrete (inaccessible areas): basemat	Concrete	Air – outdoor or Ground water/soil	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Further evaluation is required for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557) to determine if a plant-specific aging management program is needed. A plant-specific aging management program is not required if documented evidence confirms that the existing concrete had air entrainment content (as per Table CC-2231-2 of the ASME Section III Division 2), and subsequent inspections of accessible areas did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. If this condition is not satisfied, then a plant-specific aging management program is required to manage loss of material (spalling, scaling) and cracking due to freeze-thaw of concrete in inaccessible areas. The weathering index for the continental US is shown in ASTM C33-90, Fig. 1.	Yes, for plants located in moderate to severe weathering conditions
II.A2.CP-104	II.A2-3(C-38)	Concrete (inaccessible areas): basemat	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed to manage cracking and expansion due to reaction with aggregate of concrete in Inaccessible Areas. A plant-specific	Yes, if concrete is not constructed as stated

II CONTAINMENT STRUCTURES
A2 Steel Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						aging management program is not required if (1) as described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) For potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function.	
II.A2.CP-71	II.A2-4(C-25)	Concrete (inaccessible areas): basemat	Concrete	Ground water/soil	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring“	No
II.A2.CP-53	II.A2-6(C-30)	Concrete (inaccessible areas): basemat	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Further evaluation is required to determine if a plant-specific aging management program is needed to manage increase in porosity, and permeability due to leaching of calcium hydroxide and carbonation of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) There is evidence in the	Yes, if leaching is observed in accessible areas that impact intended function

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II CONTAINMENT STRUCTURES
A2 Steel Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						accessible areas of adjacent structures that the flowing water has not caused leaching and carbonation, or (2) Evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure.	
II.A2.CP-75	II.A2-7(C-43)	Concrete (inaccessible areas): basemat; reinforcing steel	Concrete; steel	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring"	No
II.A2.CP-69	II.A2-5(C-36)	Concrete: basemat	Concrete	Soil	Cracking and distortion due to increased stress levels from settlement	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring" 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 a de-watering system is relied upon to control settlement
II.A2.C-07	II.A2-8(C-07)	Concrete: foundation; subfoundation	Concrete; porous concrete	Water – flowing	Reduction of foundation strength and cracking due to differential settlement and	Chapter XI.S6, “ Structures Monitoring” 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	Yes, if a de-watering system is relied upon to control settlement

II CONTAINMENT STRUCTURES
A2 Steel Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
					erosion of porous concrete subfoundation	functioning of the de-watering system through the period of extended operation.	
II.A2.CP-35	II.A2-9(C-09)	Steel elements (accessible areas): liner; liner anchors; integral attachments	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No
II.A2.CP-98	II.A2-9(C-09)	Steel elements (inaccessible areas): liner; liner anchors; integral attachments	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE" and Chapter XI.S4, "10 CFR Part 50, Appendix J" Additional plant-specific activities are warranted if loss of material due to corrosion is significant for inaccessible areas (embedded containment steel shell or liner). Loss of material due to corrosion is not significant if the following conditions are satisfied: 1. Concrete meeting the requirements of ACI 318 or 349 and the guidance of 201.2R was used for the containment concrete in contact with the embedded containment shell or liner. 2. The moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with ASME Section XI, Subsection IWE requirements.	Yes, if corrosion is indicated from the IWE examinations

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II A2 CONTAINMENT STRUCTURES Steel Containments							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						3. The concrete is monitored to ensure that it is free of penetrating cracks that provide a path for water seepage to the surface of the containment shell or liner. 4. Borated water spills and water ponding on the concrete floor are common and when detected are cleaned up or diverted to a sump in a timely manner. Operating experience has identified significant corrosion in some plants. If any of the above conditions cannot be satisfied, then a plant-specific aging management program for corrosion is necessary.	

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A3. COMMON COMPONENTS

Systems, Structures, and Components

This section addresses the common components of pressurized water reactor (PWR) containment structures. The common components include penetration sleeves and bellows; dissimilar metal welds; personnel airlock; equipment hatch; seals, gaskets, and moisture barriers.

System Interfaces

Functional interfaces include the primary containment heating and ventilation system (VII.F3), containment isolation components (V.C), and containment spray system (V.A). Physical interfaces exist with any structure, system, or component that either penetrates the containment wall, such as the main steam system (VIII.B1) and feedwater system (VIII.D1), or is supported by the containment structure, such as the polar crane (VII.B). The containment structure basemat typically provides support to the nuclear steam supply system (NSSS) components and containment internal structures.

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II CONTAINMENT STRUCTURES
A3 Common Components

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
II.A3.CP-40	II.A3-7(C-18)	Moisture barriers (caulking, flashing, and other sealants)	Elastomers, rubber and other similar materials	Air – indoor, uncontrolled	Loss of sealing due to wear, damage, erosion, tear, surface cracks, or other defects	Chapter XI.S1, "ASME Section XI, Subsection IWE"	No
II.A3.CP-36	II.A3-1(C-12)	Penetration sleeves	Steel; dissimilar metal welds	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No
II.A3.CP-38	II.A3-2(C-15)	Penetration sleeves; penetration bellows	Stainless steel; dissimilar metal welds	Air – indoor, uncontrolled or Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	Yes, detection of aging effects is to be evaluated
II.A3.CP-37	II.A3-3(C-14)	penetration sleeves; penetration bellows	Steel; stainless steel; dissimilar metal welds	Air – indoor, uncontrolled or Air – outdoor	Cracking due to cyclic loading (CLB fatigue analysis does not exist)	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No
II.A3.C-13	II.A3-4(C-13)	Penetration sleeves; penetration bellows	Steel; stainless steel; dissimilar metal welds	Air – indoor, uncontrolled or Air – outdoor	Cumulative fatigue damage due to fatigue (Only if CLB fatigue analysis exists)	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.6, "Containment Liner Plate and Penetration Fatigue Analysis" for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
II.A3.C-16	II.A3-6(C-16)	Personnel airlock, equipment hatch, CRD hatch	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No

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II CONTAINMENT STRUCTURES A3 Common Components							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
II.A3.CP-39	II.A3-5(C-17)	Personnel airlock, equipment hatch, CRD hatch: locks, hinges, and closure mechanisms	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of leak tightness due to mechanical wear of locks, hinges and closure mechanisms	Chapter XI.S1, “ASME Section XI, Subsection IWE,” and Chapter XI.S4, “10 CFR Part 50, Appendix J”	No
II.A3.CP-150		Pressure-retaining bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S1, “ASME Section XI, Subsection IWE,” and Chapter XI.S4, “10 CFR Part 50, Appendix J”	No
II.A3.CP-148		Pressure-retaining bolting	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, “ASME Section XI, Subsection IWE”	No
II.A3.CP-41	II.A3-7(C-18)	Seals and gaskets	Elastomers, rubber and other similar materials	Air – indoor, uncontrolled or Air – outdoor	Loss of sealing due to wear, damage, erosion, tear, surface cracks, or other defects	Chapter XI.S4, “10 CFR Part 50, Appendix J "	No
II.A3.CP-152		Service Level I coatings	Coatings	Air – indoor, uncontrolled	Loss of coating integrity due to blistering, cracking, flaking, peeling, or physical damage	Chapter XI.S8, "Protective Coating Monitoring and Maintenance"	No

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BOILING WATER REACTOR (BWR) CONTAINMENTS

B1. Mark I Containments

B2. Mark II Containments

B3. Mark III Containments

B4. Common Components

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B1. MARK I CONTAINMENTS

Systems, Structures, and Components

This section addresses the elements of boiling water reactor (BWR) Mark I containment structures. Steel containments are discussed in II.B1.1 and concrete containments are discussed in II.B1.2.

System Interfaces

Functional interfaces include the primary containment heating and ventilation system (VII.F3), containment isolation components (V.C), and standby gas treatment system (V.B). Physical interfaces exist with any structure, system, or component that either penetrates the containment wall, such as the main steam system (VIII.B2) and feedwater system (VIII.D2), or is supported by the containment structure. The containment structure basemat may provide support to the NSSS components and containment internal structures.

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II CONTAINMENT STRUCTURES
B1.1 Mark I Steel Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
II.B1.1.CP-43	II.B1.1-2(C-19)	Steel elements (accessible areas): drywell shell; drywell head; drywell shell in sand pocket regions;	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No
II.B1.1.C-23	II.B1.1-1(C-23)	Steel elements: drywell head; downcomers	Steel	Air – indoor, uncontrolled	Fretting or lockup due to mechanical wear	Chapter XI.S1, "ASME Section XI, Subsection IWE"	No
II.B1.1.CP-44		Steel elements: drywell support skirt	Steel	Concrete	None	None	No
II.B1.1.CP-109	II.B1.1-2(C-19)	Steel elements: torus ring girders; downcomers;	Steel	Air – indoor, uncontrolled or Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE" Plant specific aging management program is required if plant operating experience identified significant corrosion of the torus ring girders and downcomers. If protective coating is credited for preventing corrosion of the torus shell, the coating should be included in scope of license renewal and subject to aging management review.	Yes, if corrosion is significant
II.B1.1.CP-48	II.B1.1-2(C-19)	Steel elements: torus shell	Steel	Air – indoor, uncontrolled or Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J" Significant corrosion of the torus shell	Yes, if corrosion is significant Recoating of the torus is

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II CONTAINMENT STRUCTURES B1.1 Mark I Steel Containments							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						and degradation of its protective coating are identified in IN 88-82. Other industrywide operating indicates a number of incidences of torus corrosion. License renewal applicants are advised to address their plant specific operating experience related to the torus shell corrosion. If the identified corrosion is significant, a plant specific aging management is required. If protective coating is credited for preventing corrosion of the torus shell, the coating should be included in scope of license renewal and subject to aging management review .	recommended.
II.B1.1.CP-49	II.B1.1-3(C-20)	Steel elements: torus; vent line; vent header; vent line bellows; downcomers	Steel; stainless steel	Air – indoor, uncontrolled	Cracking due to cyclic loading (CLB fatigue analysis does not exist)	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No
II.B1.1.C-21	II.B1.1-4(C-21)	Steel elements: torus; vent line; vent header; vent line bellows; downcomers	Steel; stainless steel	Air – indoor, uncontrolled	Cumulative fatigue damage due to fatigue (Only if CLB fatigue analysis exists)	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.6, "Containment Liner Plate and Penetration Fatigue Analysis" for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
II.B1.1.CP-50	II.B1.1-5(C-22)	Steel elements: vent line bellows	Stainless steel	Air – indoor, uncontrolled	Cracking due to stress corrosion cracking	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No

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II CONTAINMENT STRUCTURES
B1.2 Mark I Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
II.B1.2.CP-79	II.B1.2-2(C-41)	Concrete (accessible areas): basemat; reinforcing steel	Concrete; steel	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No
II.B1.2.CP-59	II.B1.2-4(C-39)	Concrete (accessible areas): containment; wall; basemat	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No
II.B1.2.CP-54	II.B1.2-6(C-31)	Concrete (accessible areas): containment; wall; basemat	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No
II.B1.2.CP-80	II.B1.2(C-41)	Concrete (inaccessible areas): basemat; reinforcing steel	Concrete; steel	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
II.B1.2.CP-99	II.B1.2-4(C-39)	Concrete (inaccessible areas): containment; wall; basemat	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed to manage cracking and expansion due to reaction with aggregate of concrete in Inaccessible Areas. A plant-specific	Yes, if concrete is not constructed as stated

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II CONTAINMENT STRUCTURES
B1.2 Mark I Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						aging management program is not required if (1) as described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) For potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function.	
II.B1.2.CP-110	II.B1.2-6(C-31)	Concrete (inaccessible areas): containment; wall; basemat	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Further evaluation is required to determine if a plant-specific aging management program is needed to manage increase in porosity, and permeability due to leaching of calcium hydroxide and carbonation of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) There is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) Evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure.	Yes, if leaching is observed in accessible areas that impact intended function

II CONTAINMENT STRUCTURES
B1.2 Mark I Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
II.B1.2.CP-105	II.B1.2-1(C-06)	Concrete elements, all	Concrete	Soil	Cracking and distortion due to increased stress levels from settlement	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring" 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 a de-watering system is relied upon to control settlement
II.B1.2.CP-106	II.B1.2-5(C-26)	Concrete: containment; wall; basemat	Concrete	Air – indoor, uncontrolled or Air – outdoor	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring"	No
II.B1.2.CP-57	II.B1.2-3(C-35)	Concrete: containment; wall; basemat	Concrete	Air – indoor, uncontrolled or Air – outdoor	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program The implementation of 10 CFR 50.55a and ASME Code, Section XI, Subsection IWL would not be able to identify the reduction of strength and modulus due to elevated temperature. Thus, for any portions of concrete containment that exceed specified temperature limits, further evaluations are warranted. Subsection CC-3400 of ASME Section III, Division 2, specifies the concrete temperature limits for normal	Yes, if temperature limits are exceeded

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II CONTAINMENT STRUCTURES
B1.2 Mark I Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						operation or any other long-term period. The temperatures shall not exceed 150°F except for local areas, such as around penetrations, which are not allowed to exceed 200°F. If significant equipment loads are supported by concrete at temperatures exceeding 150°F, an evaluation of the ability to withstand the postulated design loads is to be made. Higher temperatures than given above may be allowed in the concrete if tests and/or calculations are provided to evaluate the reduction in strength and modulus of elasticity, and these reductions are applied to the design calculations.	
II.B1.2.C-07	II.B1.2-7(C-07)	Concrete: foundation; subfoundation	Concrete; porous concrete	Water – flowing	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	Chapter XI.S6, "Structures Monitoring" 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 de-watering system through the period of extended operation.	Yes, if a de-watering system is relied upon to control settlement
II.B1.2.CP-46	II.B1.2-8(C-46)	Steel elements (accessible areas): suppression chamber;	Steel	Air – indoor, uncontrolled or Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No

II CONTAINMENT STRUCTURES
B1.2 Mark I Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
		drywell; drywell head; embedded shell; region shielded by diaphragm floor (as applicable)					
II.B1.2.CP-114		Steel elements (inaccessible areas): support skirt	Steel	Concrete	None	None	No
II.B1.2.CP-63	II.B1.2-8(C-46)	Steel elements (inaccessible areas): suppression chamber; drywell; drywell head; embedded shell; region shielded by diaphragm floor (as applicable)	Steel	Air – indoor, uncontrolled or Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE" and Chapter XI.S4, "10 CFR Part 50, Appendix J" Additional plant-specific activities are warranted if loss of material due to corrosion is significant for inaccessible areas (embedded containment steel shell or liner). Loss of material due to corrosion is not significant if the following conditions are satisfied: 1. Concrete meeting the requirements of ACI 318 or 349 and the guidance of 201.2R was used for the concrete in contact with the embedded containment shell or liner. 2. The moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with ASME Section XI,	Yes, if corrosion is indicated from the IWE examinations

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II CONTAINMENT STRUCTURES
B1.2 Mark I Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						Subsection IWE requirements. 3. The concrete is monitored to ensure that it is free of penetrating cracks that provide a path for water seepage to the surface of the containment shell or liner. 4. Borated water spills and water ponding on the concrete floor are common and when detected are cleaned up or diverted to a sump in a timely manner. Operating experience has identified significant corrosion in some plants. If any of the above conditions cannot be satisfied, then a plant-specific aging management program for corrosion is necessary.	
II.B1.2.CP-117	II.B1.2-8(C-46)	Steel elements: downcomer pipes	Steel	Air – indoor, uncontrolled or Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE"	No
II.B1.2.C-23	II.B1.2-9(C-23)	Steel elements: drywell head; downcomers	Steel	Air – indoor, uncontrolled	Fretting or lockup due to mechanical wear	Chapter XI.S1, "ASME Section XI, Subsection IWE"	No
II.B1.2.C-49	II.B1.2-10(C-49)	Steel elements: suppression chamber (torus) liner (interior surface)	Steel; stainless steel	Air – indoor, uncontrolled or Treated water	Loss of material due to general (steel only), pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No

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B2. MARK II CONTAINMENTS

Systems, Structures, and Components

This section addresses the elements of boiling water reactor (BWR) Mark II containment structures. Mark II steel containments are discussed in II.B2.1. Mark II concrete containments are discussed in II.B2.2.

System Interfaces

Functional interfaces include the primary containment heating and ventilation system (VII.F3), containment isolation components (V.C), and standby gas treatment system (V.B). Physical interfaces exist with any structure, system, or component that either penetrates the containment wall, such as the main steam system (VIII.B2) and feedwater system (VIII.D2), or is supported by the containment structure. The containment structure basemat may provide support to the NSSS components and containment internal structures.

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II CONTAINMENT STRUCTURES
B2.1 Mark II Steel Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
II.B2.1.CP-46	II.B2.1-1(C-46)	Steel elements (accessible areas): suppression chamber; drywell; drywell head; embedded shell; region shielded by diaphragm floor (as applicable)	Steel	Air – indoor, uncontrolled or Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No
II.B2.1.CP-114		Steel elements (inaccessible areas): support skirt	Steel	Concrete	None	None	No
II.B2.1.CP-63	II.B2.1-1(C-46)	Steel elements (inaccessible areas): suppression chamber; drywell; drywell head; embedded shell; region shielded by diaphragm floor (as applicable)	Steel	Air – indoor, uncontrolled or Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE" and Chapter XI.S4, "10 CFR Part 50, Appendix J" Additional plant-specific activities are warranted if loss of material due to corrosion is significant for inaccessible areas (embedded containment steel shell or liner). Loss of material due to corrosion is not significant if the following conditions are satisfied: 1. Concrete meeting the requirements of ACI 318 or 349 and the guidance of	Yes, if corrosion is indicated from the IWE examinations

II B2.1	CONTAINMENT STRUCTURES Mark II Steel Containments						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						201.2R was used for the concrete in contact with the embedded containment shell or liner. 2. The moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with ASME Section XI, Subsection IWE requirements. 3. The concrete is monitored to ensure that it is free of penetrating cracks that provide a path for water seepage to the surface of the containment shell or liner. 4. Borated water spills and water ponding on the concrete floor are common and when detected are cleaned up or diverted to a sump in a timely manner. Operating experience has identified significant corrosion in some plants. If any of the above conditions cannot be satisfied, then a plant-specific aging management program for corrosion is necessary.	
II.B2.1.CP-117	II.B2.1-1(C-46)	Steel elements: downcomer pipes	Steel	Air – indoor, uncontrolled or Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, “ASME Section XI, Subsection IWE”	No
II.B2.1.C-23	II.B2.1-2(C-23)	Steel elements: drywell head; downcomers	Steel	Air – indoor, uncontrolled	Fretting or lockup due to	Chapter XI.S1, “ASME Section XI, Subsection IWE”	No

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II B2.1	CONTAINMENT STRUCTURES Mark II Steel Containments						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
					mechanical wear		
II.B2.1.CP-107	II.B2.1-3(C-44)	Suppression pool shell	Steel; stainless steel; dissimilar metal welds	Air – indoor, uncontrolled or Treated Water	Cracking due to cyclic loading (CLB fatigue analysis does not exist)	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No
II.B2.1.C-45	II.B2.1-4(C-45)	Suppression pool shell; unbraced downcomers	Steel; stainless steel; dissimilar metal welds	Air – indoor, uncontrolled	Cumulative fatigue damage due to fatigue (Only if CLB fatigue analysis exists)	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.6, "Containment Liner Plate and Penetration Fatigue Analysis" for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
II.B2.1.CP-142	II.B2.1-3(C-44)	Unbraced downcomers	Steel; stainless steel; dissimilar metal welds	Air – indoor, uncontrolled or Treated water	Cracking due to cyclic loading (CLB fatigue analysis does not exist)	Chapter XI.S1, "ASME Section XI, Subsection IWE"	No

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II CONTAINMENT STRUCTURES
B2.2 Mark II Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
II.B2.2.CP-79	II.B2.2-2(C-41)	Concrete (accessible areas): basemat; reinforcing steel	Concrete; steel	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No
II.B2.2.CP-59	II.B2.2-4(C-39)	Concrete (accessible areas): containment; wall; basemat	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No
II.B2.2.CP-54	II.B2.2-6(C-31)	Concrete (accessible areas): containment; wall; basemat	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No
II.B2.2.CP-80	II.B2.2-2(C-41)	Concrete (inaccessible areas): basemat; reinforcing steel	Concrete; steel	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
II.B2.2.CP-99	II.B2.2-4(C-39)	Concrete (inaccessible areas): containment; wall; basemat	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed to manage cracking and expansion due to reaction with aggregate of concrete in Inaccessible Areas. A plant-specific aging management program is not	Yes, if concrete is not constructed as stated

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II CONTAINMENT STRUCTURES
B2.2 Mark II Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						required if (1) as described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) For potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function.	
II.B2.2.CP-110	II.B2.2-6(C-31)	Concrete (inaccessible areas): containment; wall; basemat	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Further evaluation is required to determine if a plant-specific aging management program is needed to manage increase in porosity, and permeability due to leaching of calcium hydroxide and carbonation of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) There is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) Evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure.	Yes, if leaching is observed in accessible areas that impact intended function
II.B2.2.CP-105	II.B2.2-1(C-06)	Concrete elements, all	Concrete	Soil	Cracking and distortion due to increased	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring"	Yes, if a de-watering system is

II CONTAINMENT STRUCTURES
B2.2 Mark II Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
					stress levels from settlement	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.	relied upon to control settlement
II.B2.2.CP-106	II.B2.2-5(C-26)	Concrete: containment; wall; basemat	Concrete	Air – indoor, uncontrolled or Air – outdoor	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring"	No
II.B2.2.CP-57	II.B2.2-3(C-35)	Concrete: containment; wall; basemat	Concrete	Air – indoor, uncontrolled or Air – outdoor	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program 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 due to elevated temperature. Thus, for any portions of concrete containment that exceed specified temperature limits, further evaluations are warranted. Subsection CC-3400 of ASME Section III, Division 2, 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, such as around penetrations, which are not allowed to exceed 200°F. If	Yes, if temperature limits are exceeded

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II CONTAINMENT STRUCTURES
B2.2 Mark II Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						significant equipment loads are supported by concrete at temperatures exceeding 150°F, an evaluation of the ability to withstand the postulated design loads is to be made. Higher temperatures than given above may be allowed in the concrete if tests and/or calculations are provided to evaluate the reduction in strength and modulus of elasticity, and these reductions are applied to the design calculations.	
II.B2.2.C-07	II.B2.2-7(C-07)	Concrete: foundation; subfoundation	Concrete; porous concrete	Water – flowing	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	Chapter XI.S6, "Structures Monitoring" 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 de-watering system through the period of extended operation.	Yes, if a de-watering system is relied upon to control settlement
II.B2.2.C-11	II.B2.2-8(C-11)	Prestressing system: tendons	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of prestress due to relaxation; shrinkage; creep; elevated temperature	Loss of tendon prestress is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.5, "Concrete Containment Tendon Prestress" for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1)(i) and (ii). See Chapter X.S1 of this report for meeting the requirements of 10 CFR 54.21(c)(1)(iii).	Yes, TLAA

II B2.2	CONTAINMENT STRUCTURES Mark II Concrete Containments						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						For periodic monitoring of prestress, see Chapter XI.S2.	
II.B2.2.C-10	II.B2.2-9(C-10)	Prestressing system: tendons; anchorage components	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to corrosion	Chapter XI.S2, "ASME Section XI, Subsection IWL"	No
II.B2.2.CP-46	II.B2.2-10(C-46)	Steel elements (accessible areas): suppression chamber; drywell; drywell head; embedded shell; region shielded by diaphragm floor (as applicable)	Steel	Air – indoor, uncontrolled or Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No
II.B2.2.CP-114		Steel elements (inaccessible areas): support skirt	Steel	Concrete	None	None	No
II.B2.2.CP-63	II.B2.2-10(C-46)	Steel elements (inaccessible areas): suppression chamber; drywell; drywell head; embedded shell; region	Steel	Air – indoor, uncontrolled or Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE" and Chapter XI.S4, "10 CFR Part 50, Appendix J" Additional plant-specific activities are warranted if loss of material due to corrosion is significant for inaccessible	Yes, if corrosion is indicated from the IWE examinations

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II CONTAINMENT STRUCTURES
B2.2 Mark II Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
		shielded by diaphragm floor (as applicable)				areas (embedded containment steel shell or liner). Loss of material due to corrosion is not significant if the following conditions are satisfied: 1. Concrete meeting the requirements of ACI 318 or 349 and the guidance of 201.2R was used for the concrete in contact with the embedded containment shell or liner. 2. The moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with ASME Section XI, Subsection IWE requirements. 3. The concrete is monitored to ensure that it is free of penetrating cracks that provide a path for water seepage to the surface of the containment shell or liner. 4. Borated water spills and water ponding on the concrete floor are common and when detected are cleaned up or diverted to a sump in a timely manner. Operating experience has identified significant corrosion in some plants. If any of the above conditions cannot be satisfied, then a plant-specific aging management program for corrosion is necessary.	

II CONTAINMENT STRUCTURES
B2.2 Mark II Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
II.B2.2.CP-117	II.B2.2-10(C-46)	Steel elements: downcomer pipes	Steel	Air – indoor, uncontrolled or Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE"	No
II.B2.2.C-23	II.B2.2-11(C-23)	Steel elements: drywell head; downcomers	Steel	Air – indoor, uncontrolled	Fretting or lockup due to mechanical wear	Chapter XI.S1, "ASME Section XI, Subsection IWE"	No
II.B2.2.C-49	II.B2.2-12(C-49)	Steel elements: suppression chamber (torus) liner (interior surface)	Steel; stainless steel	Air – indoor, uncontrolled or Treated water	Loss of material due to general (steel only), pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No
II.B2.2.CP-64	II.B2.2-13(C-47)	Steel elements: vent header; downcomers	Steel; stainless steel	Air – indoor, uncontrolled or Treated water	Cracking due to cyclic loading (CLB fatigue analysis does not exist)	Chapter XI.S1, "ASME Section XI, Subsection IWE"	No
II.B2.2.C-48	II.B2.2-14(C-48)	Steel elements: vent header; downcomers	Steel; stainless steel	Air – indoor, uncontrolled or Treated water	Cumulative fatigue damage due to fatigue (Only if CLB fatigue analysis exists)	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.6, "Containment Liner Plate and Penetration Fatigue Analysis" for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA

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B3. MARK III CONTAINMENTS

B3.1 Steel Containments

B3.2 Concrete Containments

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B3. MARK III CONTAINMENTS

Systems, Structures, and Components

This section addresses the elements of boiling water reactor (BWR) Mark III containment structures. Mark III steel containments are discussed in II.B3.1. Mark III concrete containments are discussed in II.B3.2.

System Interfaces

Functional interfaces include the primary containment heating and ventilation system (VII.F3), containment isolation components (V.C), and standby gas treatment system (V.B). Physical interfaces exist with any structure, system, or component that either penetrates the containment wall, such as the main steam system (VIII.B2) and feedwater system (VIII.D2), or is supported by the containment structure. The containment structure basemat may provide support to the NSSS components and containment internal structures.

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II CONTAINMENT STRUCTURES
B3.1 Mark III Steel Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
II.B3.1.CP-72	II.B3.1-1(C-25)	Concrete (accessible areas): basemat	Concrete	Ground water/soil	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring"	No
II.B3.1.CP-156	II.B3.1-3(C-30)	Concrete (accessible areas): basemat	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No
II.B3.1.CP-66	II.B3.1-5(C-51)	Concrete (accessible areas): basemat, concrete fill-in annulus	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No
II.B3.1.CP-74	II.B3.1-6(C-43)	Concrete (accessible areas): basemat; reinforcing steel	Concrete; steel	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No
II.B3.1.CP-71	II.B3.1-1(C-25)	Concrete (inaccessible areas): basemat	Concrete	Ground water/soil	Increase in porosity and permeability; cracking; loss of material (spalling,	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring“	No

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II B3.1 CONTAINMENT STRUCTURES Mark III Steel Containments							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
					scaling) due to aggressive chemical attack		
II.B3.1.CP-53	II.B3.1-3(C-30)	Concrete (inaccessible areas): basemat	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Further evaluation is required to determine if a plant-specific aging management program is needed to manage increase in porosity, and permeability due to leaching of calcium hydroxide and carbonation of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) There is evidence in the accessible areas of adjacent structures that the flowing water has not caused leaching and carbonation, or (2) Evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure.	Yes, if leaching is observed in accessible areas that impact intended function
II.B3.1.CP-83	II.B3.1-5(C-51)	Concrete (inaccessible areas): basemat, concrete fill-in annulus	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed to manage cracking and expansion due to reaction with aggregate of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) as described in NUREG-1557, investigations, tests, and petrographic examinations of	Yes, if concrete is not constructed as stated

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II CONTAINMENT STRUCTURES
B3.1 Mark III Steel Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						aggregates performed in accordance with ASTM C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) For potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function.	
II.B3.1.CP-75	II.B3.1-6(C-43)	Concrete (inaccessible areas): basemat; reinforcing steel	Concrete; steel	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring"	No
II.B3.1.CP-69	II.B3.1-2(C-36)	Concrete: basemat	Concrete	Soil	Cracking and distortion due to increased stress levels from settlement	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring" 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 a de-watering system is relied upon to control settlement
II.B3.1.CP-65	II.B3.1-4(C-50)	Concrete: basemat, concrete fill-in annulus	Concrete	Air – indoor, uncontrolled or Air – outdoor	Reduction of strength and modulus due to elevated temperature	Plant-specific aging management program The implementation of 10 CFR 50.55a and ASME Section	Yes, if temperature limits are exceeded

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II CONTAINMENT STRUCTURES
B3.1 Mark III Steel Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
					(>150°F general; >200°F local)	XI, Subsection IWL would not be able to identify the reduction of strength and modulus of elasticity due to elevated temperature. Thus, for any portions of concrete containment that exceed specified temperature limits, further evaluations are warranted. Subsection CC-3400 of ASME Section III, Division 2, 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, such as around penetrations, which are not allowed to exceed 200°F. If significant equipment loads are supported by concrete at temperatures exceeding 150°F, an evaluation of the ability to withstand the postulated design loads is to be made. Higher temperatures than given above may be allowed in the concrete if tests and/or calculations are provided to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations.	
II.B3.1.C-07	II.B3.1-7(C-07)	Concrete: foundation; subfoundation	Concrete; porous concrete	Water – flowing	Reduction of foundation strength and cracking	Chapter XI.S6, “Structures Monitoring” If a de-watering system is relied upon for control of erosion of cement from	Yes, if a de-watering system is relied upon to

II CONTAINMENT STRUCTURES
B3.1 Mark III Steel Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
					due to differential settlement and erosion of porous concrete subfoundation	porous concrete subfoundations, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	control settlement
II.B3.1.CP-43	II.B3.1-8(C-19)	Steel elements (accessible areas): drywell shell; drywell head	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No
II.B3.1.CP-113	II.B3.1-8(C-19)	Steel elements (inaccessible areas): drywell shell; drywell head; and drywell shell	Steel	Air – indoor, uncontrolled or Concrete	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	Yes, if corrosion is indicated from the IWE examinations
II.B3.1.C-24	II.B3.1-9(C-24)	Steel elements: suppression chamber shell (interior surface)	Stainless steel	Air – indoor, uncontrolled	Cracking due to stress corrosion cracking	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No
II.B3.1.CP-158	II.B3.1-8(C-19)	Steel elements: suppression chamber shell (interior surface)	Steel	Air – indoor, uncontrolled or Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE" Plant-specific aging management program is required if plant operating experience identified significant corrosion. If protective coating is credited for preventing corrosion, the coating should be included in scope of license renewal and subject to aging management review.	Yes, if corrosion is significant

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II CONTAINMENT STRUCTURES
B3.2 Mark III Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
II.B3.2.CP-84	II.B3.2-5(C-27)	Concrete (accessible areas): dome; wall; basemat	Concrete	Air – indoor, uncontrolled or Air – outdoor or Ground water/soil	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring"	No
II.B3.2.CP-52	II.B3.2-3(C-29)	Concrete (accessible areas): dome; wall; basemat	Concrete	Air – outdoor or Ground water/soil	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No
II.B3.2.CP-60	II.B3.2-4(C-40)	Concrete (accessible areas): dome; wall; basemat	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No
II.B3.2.CP-55	II.B3.2-6(C-32)	Concrete (accessible areas): dome; wall; basemat	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No
II.B3.2.CP-88	II.B3.2-7(C-42)	Concrete (accessible areas): dome; wall; basemat; reinforcing steel	Concrete; steel	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No

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II CONTAINMENT STRUCTURES
B3.2 Mark III Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
II.B3.2.CP-73	II.B3.2-5(C-27)	Concrete (inaccessible areas): dome; wall; basemat	Concrete	Air – indoor, uncontrolled or Air – outdoor or Ground water/soil	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring"	No
II.B3.2.CP-135	II.B3.2-3(C-29)	Concrete (inaccessible areas): dome; wall; basemat	Concrete	Air – outdoor or Ground water/soil	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Further evaluation is required for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557) to determine if a plant-specific aging management program is needed. A plant-specific aging management program is not required if documented evidence confirms that the existing concrete had air entrainment content (as per Table CC-2231-2 of the ASME Section III Division 2), and subsequent inspections of accessible areas did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. If this condition is not satisfied, then a plant-specific aging management program is required to manage loss of material (spalling, scaling) and cracking due to freeze-thaw of concrete in inaccessible areas. The weathering index for the	Yes, for plants located in moderate to severe weathering conditions

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II CONTAINMENT STRUCTURES
B3.2 Mark III Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						continental US is shown in ASTM C33-90, Fig. 1.	
II.B3.2.CP-121	II.B3.2-4(C-40)	Concrete (inaccessible areas): dome; wall; basemat	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed to manage cracking and expansion due to reaction with aggregate of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) as described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) For potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function.	Yes, if concrete is not constructed as stated
II.B3.2.CP-122	II.B3.2-6(C-32)	Concrete (inaccessible areas): dome; wall; basemat	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Further evaluation is required to determine if a plant-specific aging management program is needed to manage increase in porosity, and permeability due to leaching of calcium hydroxide and carbonation of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) There is	Yes, if leaching is observed in accessible areas that impact intended function

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II CONTAINMENT STRUCTURES
B3.2 Mark III Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) Evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure.	
II.B3.2.CP-89	II.B3.2-7(C-42)	Concrete (inaccessible areas): dome; wall; basemat; reinforcing steel	Concrete; steel	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring"	No
II.B3.2.CP-105	II.B3.2-1(C-06)	Concrete elements, all	Concrete	Soil	Cracking and distortion due to increased stress levels from settlement	Chapter XI.S2, “ASME Section XI, Subsection IWL,” or Chapter XI.S6, " Structures Monitoring" 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 a de-watering system is relied upon to control settlement
II.B3.2.CP-108	II.B3.2-2(C-33)	Concrete: dome; wall; basemat	Concrete	Air – indoor, uncontrolled or Air – outdoor	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program 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 elasticity due to elevated temperature.	Yes, if temperature limits are exceeded

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II CONTAINMENT STRUCTURES
B3.2 Mark III Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						Thus, for any portions of concrete containment that exceed specified temperature limits, further evaluations are warranted. Subsection CC-3400 of ASME Section III, Division 2, 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, such as around penetrations, which are not allowed to exceed 200°F. If significant equipment loads are supported by concrete at temperatures exceeding 150°F, an evaluation of the ability to withstand the postulated design loads is to be made. Higher temperatures than given above may be allowed in the concrete if tests and/or calculations are provided to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations.	
II.B3.2.C-07	II.B3.2-8(C-07)	Concrete: foundation; subfoundation	Concrete; porous concrete	Water – flowing	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	Chapter XI.S6, “Structures Monitoring” 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 de-watering system through the period of extended operation.	Yes, if a de-watering system is relied upon to control settlement

II CONTAINMENT STRUCTURES
B3.2 Mark III Concrete Containments

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
II.B3.2.CP-35	II.B3.2-9(C-09)	Steel elements (accessible areas): liner; liner anchors; integral attachments	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No
II.B3.2.CP-98	II.B3.2-9(C-09)	Steel elements (inaccessible areas): liner; liner anchors; integral attachments	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE" and Chapter XI.S4, "10 CFR Part 50, Appendix J" Additional plant-specific activities are warranted if loss of material due to corrosion is significant for inaccessible areas (embedded containment steel shell or liner). Loss of material due to corrosion is not significant if the following conditions are satisfied: 1. Concrete meeting the requirements of ACI 318 or 349 and the guidance of 201.2R was used for the containment concrete in contact with the embedded containment shell or liner. 2. The moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with ASME Section XI, Subsection IWE requirements. 3. The concrete is monitored to ensure that it is free of penetrating cracks that provide a path for water seepage to the surface of the	Yes, if corrosion is indicated from the IWE examinations

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II B3.2 CONTAINMENT STRUCTURES Mark III Concrete Containments							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						containment shell or liner. 4. Borated water spills and water ponding on the concrete floor are common and when detected are cleaned up or diverted to a sump in a timely manner. Operating experience has identified significant corrosion in some plants. If any of the above conditions cannot be satisfied, then a plant-specific aging management program for corrosion is necessary.	
II.B3.2.C-24	II.B3.2-10(C-24)	Steel elements: suppression chamber shell (interior surface)	Stainless steel	Air – indoor, uncontrolled	Cracking due to stress corrosion cracking	Chapter XI.S1, “ASME Section XI, Subsection IWE,” and Chapter XI.S4, “10 CFR Part 50, Appendix J”	No

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B4. COMMON COMPONENTS

Systems, Structures, and Components

This section addresses the common components of boiling water reactor (BWR) containments. The common components include penetration sleeves and bellows; dissimilar metal welds; personnel airlock; equipment hatch; CRD hatch; seals, gaskets, and moisture barriers.

System Interfaces

Functional interfaces include the primary containment heating and ventilation system (VII.F3), containment isolation components (V.C), and standby gas treatment system (V.B). Physical interfaces exist with any structure, system, or component that either penetrates the containment wall, such as the main steam system (VIII.B2) and feedwater system (VIII.D2), or is supported by the containment structure. The containment structure basemat may provide support to the NSSS components and containment internal structures.

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II B4	CONTAINMENT STRUCTURES Common Components						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
II.B4.CP-40	II.B4-7(C-18)	Moisture barriers (caulking, flashing, and other sealants)	Elastomers, rubber and other similar materials	Air – indoor, uncontrolled	Loss of sealing due to wear, damage, erosion, tear, surface cracks, or other defects	Chapter XI.S1, "ASME Section XI, Subsection IWE"	No
II.B4.CP-36	II.B4-1(C-12)	Penetration sleeves	Steel; dissimilar metal welds	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No
II.B4.CP-38	II.B4-2(C-15)	Penetration sleeves; penetration bellows	Stainless steel; dissimilar metal welds	Air – indoor, uncontrolled or Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	Yes, detection of aging effects is to be evaluated
II.B4.CP-37	II.B4-3(C-14)	penetration sleeves; penetration bellows	Steel; stainless steel; dissimilar metal welds	Air – indoor, uncontrolled or Air – outdoor	Cracking due to cyclic loading (CLB fatigue analysis does not exist)	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No
II.B4.C-13	II.B4-4(C-13)	Penetration sleeves; penetration bellows	Steel; stainless steel; dissimilar metal welds	Air – indoor, uncontrolled or Air – outdoor	Cumulative fatigue damage due to fatigue (Only if CLB fatigue analysis exists)	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.6, "Containment Liner Plate and Penetration Fatigue Analysis" for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
II.B4.C-16	II.B4-6(C-16)	Personnel airlock, equipment hatch, CRD hatch	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No

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II B4	CONTAINMENT STRUCTURES Common Components						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
II.B4.CP-39	II.B4-5(C-17)	Personnel airlock, equipment hatch, CRD hatch: locks, hinges, and closure mechanisms	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of leak tightness due to mechanical wear of locks, hinges and closure mechanisms	Chapter XI.S1, “ASME Section XI, Subsection IWE,” and Chapter XI.S4, “10 CFR Part 50, Appendix J”	No
II.B4.CP-150		Pressure-retaining bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S1, “ASME Section XI, Subsection IWE,” and Chapter XI.S4, “10 CFR Part 50, Appendix J”	No
II.B4.CP-148		Pressure-retaining bolting	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, “ASME Section XI, Subsection IWE”	No
II.B4.CP-41	II.B4-7(C-18)	Seals and gaskets	Elastomers, rubber and other similar materials	Air – indoor, uncontrolled or Air – outdoor	Loss of sealing due to wear, damage, erosion, tear, surface cracks, or other defects	Chapter XI.S4, “10 CFR Part 50, Appendix J "	No
II.B4.CP-152		Service Level I coatings	Coatings	Air – indoor, uncontrolled	Loss of coating integrity due to blistering, cracking, flaking, peeling, or physical damage	Chapter XI.S8, "Protective Coating Monitoring and Maintenance"	No

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CHAPTER III

STRUCTURES AND COMPONENT SUPPORTS

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STRUCTURES AND COMPONENT SUPPORTS

Chapter III A: Safety Related and Other Structures

Safety-related structures are those defined pursuant to 10 CFR 54.4(a)(1), and the other structures are those defined pursuant to 10 CFR 54.4(a)(2) and 10 CFR 54.4(a)(3). Structures in this section are organized into nine groups and are discussed separately under subheadings A1 through A9.

Chapter III B: Component Supports

Component supports include supports for ASME piping and components; supports for cable trays, conduit, HVAC ducts, TubeTrack®, instrument tubing, non-ASME piping and components; anchorage of racks, panels, cabinets, and enclosures for electrical equipment and instrumentation; supports for emergency diesel generator (EDG) and HVAC system components; and supports for platforms, pipe whip restraints, jet impingement shields, masonry walls, and other miscellaneous structures.

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III.A SAFETY RELATED AND OTHER STRUCTURES

A1. Group 1 Structures (BWR Reactor Bldg., PWR Shield Bldg., Control Room/Bldg.)

A2. Group 2 Structures (BWR Reactor Bldg. with Steel Superstructure)

A3. Group 3 Structures (Auxiliary Bldg., Diesel Generator Bldg., Radwaste Bldg., Turbine Bldg., Switchgear Rm.,Yard Structures, such as AFW Pumphouse, Utility/Piping Tunnels, Security/Lighting Poles, Manholes, Duct Banks; SBO Structures, such as Transmission Towers, Startup Towers Circuit Breaker Foundation, Electrical Enclosure)

A4. Group 4 Structures (Containment Internal Structures, excluding Refueling Canal)

A5. Group 5 Structures (Fuel Storage Facility, Refueling Canal)

A6. Group 6 Structures (Water-Control Structures)

A7. Group 7 Structures (Concrete Tanks and Missile Barriers)

A8. Group 8 Structures (Steel Tanks and Missile Barriers)

A9. Group 9 Structures (BWR Unit Vent Stack)

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A1. GROUP 1 STRUCTURES (BWR REACTOR BLDG., PWR SHIELD BLDG., CONTROL ROOM/BLDG.)

Systems, Structures, and Components

This section addresses the elements of the boiling water reactor (BWR) reactor building, pressurized water reactor (PWR) shield building, and control room/building. For this group, the applicable structural elements are concrete, steel, and masonry walls. The aging management review is presented for each applicable combination of structural element and aging effect.

System Interfaces

Physical interfaces exist with any system or component that either penetrates the structure wall or is supported by the structure wall, floor, and roof. The direct interface is through the system or component supports that are anchored to the structure. Structures also protect housed systems or components from internal and external design basis events. In the case of tanks, there is a functional interface with the associated system. Water-control structures are integral parts of the systems that provide plant cooling water and residual heat removal.

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III A1	STRUCTURES AND COMPONENT SUPPORTS Group 1 Structures (BWR Reactor Bldg., PWR Shield Bldg., Control Room/Bldg.)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
III.A1.TP-25	III.A1-2(T-03)	Concrete (accessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Chapter XI.S6, "Structures Monitoring"	No
III.A1.TP-27	III.A1-4(T-05)	Concrete (accessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
III.A1.TP-23	III.A1-6(T-01)	Concrete (accessible areas): exterior above- and below-grade; foundation	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Chapter XI.S6, "Structures Monitoring"	No
III.A1.TP-24	III.A1-7(T-02)	Concrete (accessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Chapter XI.S6, "Structures Monitoring"	No
III.A1.TP-26	III.A1-9(T-04)	Concrete (accessible areas): interior and above-grade exterior	Concrete	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
III.A1.TP-204	III.A1-2(T-03)	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed to manage cracking and expansion due to	Yes, if concrete is not constructed as stated

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III A1	STRUCTURES AND COMPONENT SUPPORTS Group 1 Structures (BWR Reactor Bldg., PWR Shield Bldg., Control Room/Bldg.)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						reaction with aggregate of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) as described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) For potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function.	
III.A1.TP-212	III.A1-4(T-05)	Concrete (inaccessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
III.A1.TP-29	III.A1-5(T-07)	Concrete (inaccessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S6, "Structures Monitoring"	No
III.A1.TP-67	III.A1-7(T-02)	Concrete (inaccessible areas): exterior	Concrete	Water – flowing	Increase in porosity and permeability; loss	Further evaluation is required to determine if a plant-specific aging management program is needed to	Yes, if leaching is observed in

III A1	STRUCTURES AND COMPONENT SUPPORTS Group 1 Structures (BWR Reactor Bldg., PWR Shield Bldg., Control Room/Bldg.)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
		above- and below-grade; foundation			of strength due to leaching of calcium hydroxide and carbonation	manage increase in porosity, and permeability due to leaching of calcium hydroxide and carbonation of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) There is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) Evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure.	accessible areas that impact intended function
III.A1.TP-108	III.A1-6(T-01)	Concrete (inaccessible areas): foundation	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Further evaluation is required for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557) to determine if a plant-specific aging management program is needed. A plant-specific aging management program is not required if documented evidence confirms that the existing concrete had air entrainment content (as per Table CC-2231-2 of the ASME Section III Division 2), and subsequent inspections of accessible areas did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. If this condition is not satisfied, then a plant-specific aging management program is required to manage loss of	Yes, for plants located in moderate to severe weathering conditions

III A1	STRUCTURES AND COMPONENT SUPPORTS Group 1 Structures (BWR Reactor Bldg., PWR Shield Bldg., Control Room/Bldg.)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						material (spalling, scaling) and cracking due to freeze-thaw of concrete in inaccessible areas. The weathering index for the continental US is shown in ASTM C33-90, Fig. 1.	
III.A1.TP-114	III.A1-1(T-10)	Concrete: all	Concrete	Air – indoor, uncontrolled	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program Subsection CC-3400 of ASME Section III, Division 2, and Appendix A of ACI 349 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, such as around penetrations, where the temperatures are not allowed to exceed 200°F. If significant equipment loads are supported by concrete at temperatures exceeding 150°F, an evaluation of the ability to withstand the postulated design loads is to be made. Higher temperatures than those given above may be allowed in the concrete if tests and/or calculations are provided to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations.	Yes, if temperature limits are exceeded
III.A1.TP-30	III.A1-3(T-08)	Concrete: all	Concrete	Soil	Cracking and distortion due to increased	Chapter XI.S6, “Structures Monitoring” If a de-watering system is relied upon for control of settlement, then the licensee	Yes, if a de-watering system is

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III A1	STRUCTURES AND COMPONENT SUPPORTS Group 1 Structures (BWR Reactor Bldg., PWR Shield Bldg., Control Room/Bldg.)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
					stress levels from settlement	is to ensure proper functioning of the de-watering system through the period of extended operation.	relied upon to control settlement
III.A1.TP-31	III.A1-8(T-09)	Concrete: foundation; subfoundation	Concrete; porous concrete	Water – flowing under foundation	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	Chapter XI.S6, “Structures Monitoring” 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 a de-watering system is relied upon to control settlement
III.A1.TP-28	III.A1-10(T-06)	Concrete: interior; above-grade exterior	Concrete	Air – indoor, uncontrolled or Air – outdoor	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S6, "Structures Monitoring"	No
III.A1.TP-300		High-strength structural bolting	Low-alloy steel, actual measured yield strength ≥ 150 ksi (1,034 MPa)	Air – indoor, uncontrolled or Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.S6, "Structures Monitoring“ Note: ASTM A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. SCC potential need not be evaluated for these bolts.	No
III.A1.T-12	III.A1-11(T-12)	Masonry walls: all	Concrete block	Air – indoor, uncontrolled or Air – outdoor	Cracking due to restraint shrinkage, creep, and aggressive environment	Chapter XI.S5, “Masonry Walls”	No

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III	STRUCTURES AND COMPONENT SUPPORTS
A1	Group 1 Structures (BWR Reactor Bldg., PWR Shield Bldg., Control Room/Bldg.)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.A1.TP-302	III.A1-12(T-11)	Steel components: all structural steel	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to corrosion	Chapter XI.S6, “Structures Monitoring” 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.	No
III.A1.TP-261		Structural bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S6, "Structures Monitoring"	No
III.A1.TP-248		Structural bolting	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.A1.TP-274		Structural bolting	Steel; galvanized steel	Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No

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A2. GROUP 2 STRUCTURES (BWR REACTOR BLDG. WITH STEEL SUPERSTRUCTURE)

Systems, Structures, and Components

This section addresses the elements of the boiling water reactor (BWR) reactor building with steel superstructure. For this group, the applicable structural elements are identified: concrete, steel, and masonry walls. The aging management review is presented for each applicable combination of structural element and aging effect.

System Interfaces

Physical interfaces exist with any system or component that either penetrates the structure wall or is supported by the structure wall, floor, and roof. The direct interface is through the system or component supports that are anchored to the structure. Structures also protect housed systems and components from internal and external design basis events. In the case of tanks, there is a functional interface with the associated system. Water-control structures are integral parts of the systems that provide plant cooling water and residual heat removal.

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III	STRUCTURES AND COMPONENT SUPPORTS
A2	Group 2 Structures (BWR Reactor Bldg. with Steel Superstructure)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.A2.TP-25	III.A2-2(T-03)	Concrete (accessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Chapter XI.S6, "Structures Monitoring"	No
III.A2.TP-27	III.A2-4(T-05)	Concrete (accessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
III.A2.TP-23	III.A2-6(T-01)	Concrete (accessible areas): exterior above- and below-grade; foundation	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Chapter XI.S6, "Structures Monitoring"	No
III.A2.TP-24	III.A2-7(T-02)	Concrete (accessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Chapter XI.S6, "Structures Monitoring"	No
III.A2.TP-26	III.A2-9(T-04)	Concrete (accessible areas): interior and above-grade exterior	Concrete	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No

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III STRUCTURES AND COMPONENT SUPPORTS
A2 Group 2 Structures (BWR Reactor Bldg. with Steel Superstructure)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.A2.TP-204	III.A2-2(T-03)	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed to manage cracking and expansion due to reaction with aggregate of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) as described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) For potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function.	Yes, if concrete is not constructed as stated
III.A2.TP-212	III.A2-4(T-05)	Concrete (inaccessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
III.A2.TP-29	III.A2-5(T-07)	Concrete (inaccessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Increase in porosity and permeability; cracking; loss of material (spalling, scaling)	Chapter XI.S6, "Structures Monitoring"	No

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III A2 STRUCTURES AND COMPONENT SUPPORTS Group 2 Structures (BWR Reactor Bldg. with Steel Superstructure)							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
					due to aggressive chemical attack		
III.A2.TP-67	III.A2-7(T-02)	Concrete (inaccessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Further evaluation is required to determine if a plant-specific aging management program is needed to manage increase in porosity, and permeability due to leaching of calcium hydroxide and carbonation of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) There is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) Evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure.	Yes, if leaching is observed in accessible areas that impact intended function
III.A2.TP-108	III.A2-6(T-01)	Concrete (inaccessible areas): foundation	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Further evaluation is required for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557) to determine if a plant-specific aging management program is needed. A plant-specific aging management program is not required if documented evidence confirms that the existing concrete had air entrainment content (as per Table CC-2231-2 of the ASME Section III Division 2), and subsequent inspections of accessible areas did not	Yes, for plants located in moderate to severe weathering conditions

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III STRUCTURES AND COMPONENT SUPPORTS
A2 Group 2 Structures (BWR Reactor Bldg. with Steel Superstructure)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. If this condition is not satisfied, then a plant-specific aging management program is required to manage loss of material (spalling, scaling) and cracking due to freeze-thaw of concrete in inaccessible areas. The weathering index for the continental US is shown in ASTM C33-90, Fig. 1.	
III.A2.TP-114	III.A2-1(T-10)	Concrete: all	Concrete	Air – indoor, uncontrolled	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program Subsection CC-3400 of ASME Section III, Division 2, and Appendix A of ACI 349 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, such as around penetrations, where the temperatures are not allowed to exceed 200°F. If significant equipment loads are supported by concrete at temperatures exceeding 150°F, an evaluation of the ability to withstand the postulated design loads is to be made. Higher temperatures than those given above may be allowed in the concrete if tests and/or calculations are provided	Yes, if temperature limits are exceeded

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III A2	STRUCTURES AND COMPONENT SUPPORTS Group 2 Structures (BWR Reactor Bldg. with Steel Superstructure)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations.	
III.A2.TP-30	III.A2-3(T-08)	Concrete: all	Concrete	Soil	Cracking and distortion due to increased stress levels from settlement	Chapter XI.S6, “Structures Monitoring” 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 a de-watering system is relied upon to control settlement
III.A2.TP-31	III.A2-8(T-09)	Concrete: foundation; subfoundation	Concrete; porous concrete	Water – flowing under foundation	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	Chapter XI.S6, “Structures Monitoring” 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 a de-watering system is relied upon to control settlement
III.A2.TP-28	III.A2-10(T-06)	Concrete: interior; above-grade exterior	Concrete	Air – indoor, uncontrolled or Air – outdoor	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S6, "Structures Monitoring"	No
III.A2.TP-300		High-strength structural bolting	Low-alloy steel, actual measured yield strength ≥ 150 ksi	Air – indoor, uncontrolled or Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.S6, "Structures Monitoring“ Note: ASTM A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. SCC potential need not be evaluated	No

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III A2	STRUCTURES AND COMPONENT SUPPORTS Group 2 Structures (BWR Reactor Bldg. with Steel Superstructure)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
			(1,034 MPa)			for these bolts.	
III.A2.T-12	III.A2-11(T-12)	Masonry walls: all	Concrete block	Air – indoor, uncontrolled or Air – outdoor	Cracking due to restraint shrinkage, creep, and aggressive environment	Chapter XI.S5, “Masonry Walls”	No
III.A2.TP-302	III.A2-12(T-11)	Steel components: all structural steel	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to corrosion	Chapter XI.S6, “Structures Monitoring” 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.	No
III.A2.TP-261		Structural bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S6, "Structures Monitoring"	No
III.A2.TP-248		Structural bolting	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.A2.TP-274		Structural bolting	Steel; galvanized steel	Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No

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A3. GROUP 3 STRUCTURES (AUXILIARY BLDG., DIESEL GENERATOR BLDG., RADWASTE BLDG., TURBINE BLDG., SWITCHGEAR RM., YARD STRUCTURES, SUCH AS AFW PUMPHOUSE, UTILITY/PIPING TUNNELS, SECURITY/LIGHTING POLES, MANHOLES, DUCT BANKS; SBO STRUCTURES, SUCH AS TRANSMISSION TOWERS, STARTUP TOWERS CIRCUIT BREAKER FOUNDATION, ELECTRICAL ENCLOSURE)

Systems, Structures, and Components

This section addresses the elements of the auxiliary building, diesel generator building, radwaste building, turbine building, switchgear room, yard structures, and station blackout (SBO) structures. For this group, the applicable structural elements are identified: concrete, steel, and masonry walls. The aging management review is presented for each applicable combination of structural element and aging effect.

System Interfaces

Physical interfaces exist with any system or component that either penetrates the structure wall or is supported by the structure wall, floor, and roof. The direct interface is through the system or component supports that are anchored to the structure. Structures also protect housed systems and components from internal and external design basis events. In the case of tanks, there is a functional interface with the associated system. Water-control structures are integral parts of the systems that provide plant cooling water and residual heat removal.

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III A3	STRUCTURES AND COMPONENT SUPPORTS Group 3 Structures (Auxiliary Bldg., Diesel Generator Bldg., Radwaste Bldg., Turbine Bldg., Switchgear Rm., Yard Structures such as AFW Pumphouse, Utility/Piping Tunnels, Security/Lighting Poles, Manholes, Duct Banks; SBO Structures such as Transmission Towers, Startup Towers Circuit Breaker foundation, Electrical Enclosure)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
III.A3.TP-25	III.A3-2(T-03)	Concrete (accessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Chapter XI.S6, "Structures Monitoring"	No
III.A3.TP-27	III.A3-4(T-05)	Concrete (accessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
III.A3.TP-23	III.A3-6(T-01)	Concrete (accessible areas): exterior above- and below-grade; foundation	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Chapter XI.S6, "Structures Monitoring"	No
III.A3.TP-24	III.A3-7(T-02)	Concrete (accessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Chapter XI.S6, "Structures Monitoring"	No
III.A3.TP-26	III.A3-9(T-04)	Concrete (accessible areas): interior and above-grade exterior	Concrete	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No

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III A3	STRUCTURES AND COMPONENT SUPPORTS Group 3 Structures (Auxiliary Bldg., Diesel Generator Bldg., Radwaste Bldg., Turbine Bldg., Switchgear Rm., Yard Structures such as AFW Pumphouse, Utility/Piping Tunnels, Security/Lighting Poles, Manholes, Duct Banks; SBO Structures such as Transmission Towers, Startup Towers Circuit Breaker foundation, Electrical Enclosure)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
III.A3.TP-204	III.A3-2(T-03)	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed to manage cracking and expansion due to reaction with aggregate of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) as described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) For potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function.	Yes, if concrete is not constructed as stated
III.A3.TP-212	III.A3-4(T-05)	Concrete (inaccessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
III.A3.TP-29	III.A3-5(T-07)	Concrete (inaccessible areas): below-grade exterior;	Concrete	Ground water/soil	Increase in porosity and permeability; cracking; loss of	Chapter XI.S6, "Structures Monitoring"	No

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III A3	STRUCTURES AND COMPONENT SUPPORTS Group 3 Structures (Auxiliary Bldg., Diesel Generator Bldg., Radwaste Bldg., Turbine Bldg., Switchgear Rm., Yard Structures such as AFW Pumphouse, Utility/Piping Tunnels, Security/Lighting Poles, Manholes, Duct Banks; SBO Structures such as Transmission Towers, Startup Towers Circuit Breaker foundation, Electrical Enclosure)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
		foundation			material (spalling, scaling) due to aggressive chemical attack		
III.A3.TP-67	III.A3-7(T-02)	Concrete (inaccessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Further evaluation is required to determine if a plant-specific aging management program is needed to manage increase in porosity, and permeability due to leaching of calcium hydroxide and carbonation of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) There is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) Evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure.	Yes, if leaching is observed in accessible areas that impact intended function
III.A3.TP-108	III.A3-6(T-01)	Concrete (inaccessible areas): foundation	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Further evaluation is required for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557) to determine if a plant-specific aging management program is needed. A plant-specific aging management program is not required if documented evidence confirms that the existing concrete had air	Yes, for plants located in moderate to severe weathering conditions

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III A3	STRUCTURES AND COMPONENT SUPPORTS Group 3 Structures (Auxiliary Bldg., Diesel Generator Bldg., Radwaste Bldg., Turbine Bldg., Switchgear Rm., Yard Structures such as AFW Pumphouse, Utility/Piping Tunnels, Security/Lighting Poles, Manholes, Duct Banks; SBO Structures such as Transmission Towers, Startup Towers Circuit Breaker foundation, Electrical Enclosure)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						entrainment content (as per Table CC-2231-2 of the ASME Section III Division 2), and subsequent inspections of accessible areas did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. If this condition is not satisfied, then a plant-specific aging management program is required to manage loss of material (spalling, scaling) and cracking due to freeze-thaw of concrete in inaccessible areas. The weathering index for the continental US is shown in ASTM C33-90, Fig. 1.	
III.A3.TP-114	III.A3-1(T-10)	Concrete: all	Concrete	Air – indoor, uncontrolled	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program Subsection CC-3400 of ASME Section III, Division 2, and Appendix A of ACI 349 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, such as around penetrations, where the temperatures are not allowed to exceed 200°F. If significant equipment loads are supported by concrete at temperatures exceeding 150°F, an evaluation of the	Yes, if temperature limits are exceeded

III A3	STRUCTURES AND COMPONENT SUPPORTS Group 3 Structures (Auxiliary Bldg., Diesel Generator Bldg., Radwaste Bldg., Turbine Bldg., Switchgear Rm., Yard Structures such as AFW Pumphouse, Utility/Piping Tunnels, Security/Lighting Poles, Manholes, Duct Banks; SBO Structures such as Transmission Towers, Startup Towers Circuit Breaker foundation, Electrical Enclosure)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						ability to withstand the postulated design loads is to be made. Higher temperatures than those given above may be allowed in the concrete if tests and/or calculations are provided to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations.	
III.A3.TP-30	III.A3-3(T-08)	Concrete: all	Concrete	Soil	Cracking and distortion due to increased stress levels from settlement	Chapter XI.S6, “Structures Monitoring” 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 a de-watering system is relied upon to control settlement
III.A3.TP-31	III.A3-8(T-09)	Concrete: foundation; subfoundation	Concrete; porous concrete	Water – flowing under foundation	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	Chapter XI.S6, “Structures Monitoring” 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 a de-watering system is relied upon to control settlement
III.A3.TP-28	III.A3-10(T-06)	Concrete: interior; above-grade exterior	Concrete	Air – indoor, uncontrolled or Air – outdoor	Increase in porosity and permeability; cracking; loss of material (spalling, scaling)	Chapter XI.S6, "Structures Monitoring"	No

III A3	STRUCTURES AND COMPONENT SUPPORTS Group 3 Structures (Auxiliary Bldg., Diesel Generator Bldg., Radwaste Bldg., Turbine Bldg., Switchgear Rm., Yard Structures such as AFW Pumphouse, Utility/Piping Tunnels, Security/Lighting Poles, Manholes, Duct Banks; SBO Structures such as Transmission Towers, Startup Towers Circuit Breaker foundation, Electrical Enclosure)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
					due to aggressive chemical attack		
III.A3.TP-300		High-strength structural bolting	Low-alloy steel, actual measured yield strength ≥ 150 ksi (1,034 MPa)	Air – indoor, uncontrolled or Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.S6, "Structures Monitoring“ Note: ASTM A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. SCC potential need not be evaluated for these bolts.	No
III.A3.T-12	III.A3-11(T-12)	Masonry walls: all	Concrete block	Air – indoor, uncontrolled or Air – outdoor	Cracking due to restraint shrinkage, creep, and aggressive environment	Chapter XI.S5, “Masonry Walls”	No
III.A3.TP-302	III.A3-12(T-11)	Steel components: all structural steel	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to corrosion	Chapter XI.S6, “Structures Monitoring” 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.	No
III.A3.TP-219		Steel components: piles	Steel	Ground water/soil	Loss of material due to corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.A3.TP-261		Structural bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S6, "Structures Monitoring"	No

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III A3	STRUCTURES AND COMPONENT SUPPORTS Group 3 Structures (Auxiliary Bldg., Diesel Generator Bldg., Radwaste Bldg., Turbine Bldg., Switchgear Rm., Yard Structures such as AFW Pumphouse, Utility/Piping Tunnels, Security/Lighting Poles, Manholes, Duct Banks; SBO Structures such as Transmission Towers, Startup Towers Circuit Breaker foundation, Electrical Enclosure)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
III.A3.TP-248		Structural bolting	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.A3.TP-274		Structural bolting	Steel; galvanized steel	Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No

OAGI0001390_00113

A4. GROUP 4 STRUCTURES (CONTAINMENT INTERNAL STRUCTURES, EXCLUDING REFUELING CANAL)

Systems, Structures, and Components

This section addresses the elements of the containment internal structures, excluding refueling canal. For this group, the applicable structural elements are identified: concrete and steel elements. The aging management review is presented for each applicable combination of structural element and aging effect.

System Interfaces

Physical interfaces exist with any system or component that either penetrates the structure wall or is supported by the structure wall, floor, and roof. The direct interface is through the system or component supports that are anchored to the structure. Structures also protect housed systems and components from internal and external design basis events. In the case of tanks, there is a functional interface with the associated system. Water-control structures are integral parts of the systems that provide plant cooling water and residual heat removal.

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III STRUCTURES AND COMPONENT SUPPORTS
A4 Group 4 Structures (Containment Internal Structures, excluding Refueling Canal)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.A4.TP-25	III.A4-2(T-03)	Concrete (accessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Chapter XI.S6, "Structures Monitoring"	No
III.A4.TP-26	III.A4-3(T-04)	Concrete (accessible areas): interior and above-grade exterior	Concrete	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
III.A4.TP-204	III.A4-2(T-03)	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed to manage cracking and expansion due to reaction with aggregate of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) as described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) For potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function.	Yes, if concrete is not constructed as stated

III STRUCTURES AND COMPONENT SUPPORTS
A4 Group 4 Structures (Containment Internal Structures, excluding Refueling Canal)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.A4.TP-305		Concrete (inaccessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Further evaluation is required to determine if a plant-specific aging management program is needed to manage increase in porosity, and permeability due to leaching of calcium hydroxide and carbonation of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) There is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) Evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure.	Yes, if leaching is observed in accessible areas that impact intended function
III.A4.TP-114	III.A4-1(T-10)	Concrete: all	Concrete	Air – indoor, uncontrolled	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program Subsection CC-3400 of ASME Section III, Division 2, and Appendix A of ACI 349 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, such as around penetrations, where the temperatures are not allowed to exceed 200°F. If significant equipment loads are supported by concrete at temperatures exceeding 150°F, an evaluation of the ability to withstand the postulated design	Yes, if temperature limits are exceeded

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III A4	STRUCTURES AND COMPONENT SUPPORTS Group 4 Structures (Containment Internal Structures, excluding Refueling Canal)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						loads is to be made. Higher temperatures than those given above may be allowed in the concrete if tests and/or calculations are provided to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations.	
III.A4.TP-304		Concrete: all	Concrete	Soil	Cracking and distortion due to increased stress levels from settlement	Chapter XI.S6, “Structures Monitoring” 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 a de-watering system is relied upon to control settlement
III.A4.TP-28	III.A4-4(T-06)	Concrete: interior; above-grade exterior	Concrete	Air – indoor, uncontrolled or Air – outdoor	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S6, "Structures Monitoring"	No
III.A4.TP-300		High-strength structural bolting	Low-alloy steel, actual measured yield strength ≥ 150 ksi (1,034 MPa)	Air – indoor, uncontrolled or Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.S6, "Structures Monitoring“ Note: ASTM A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. SCC potential need not be evaluated for these bolts.	No

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III	STRUCTURES AND COMPONENT SUPPORTS
A4	Group 4 Structures (Containment Internal Structures, excluding Refueling Canal)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.A4.TP-301		Service Level I coatings	Coatings	Air – indoor, uncontrolled	Loss of coating integrity due to blistering, cracking, flaking, peeling, physical damage	Chapter XI.S8, "Protective Coating Monitoring and Maintenance"	No
III.A4.TP-35	III.A4-6(T-13)	Sliding surfaces: radial beam seats in BWR drywell	Lubrite; Fluorogold; Lubrofluor	Air – indoor, uncontrolled	Loss of mechanical function due to corrosion, distortion, dirt, overload, wear	Chapter XI.S6, "Structures Monitoring"	No
III.A4.TP-302	III.A4-5(T-11)	Steel components: all structural steel	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to corrosion	Chapter XI.S6, “Structures Monitoring” 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.	No
III.A4.TP-261		Structural bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S6, "Structures Monitoring"	No
III.A4.TP-248		Structural bolting	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.A4.TP-274		Structural bolting	Steel; galvanized steel	Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No

OAGI0001390_00118

A5. GROUP 5 STRUCTURES (FUEL STORAGE FACILITY, REFUELING CANAL)

Systems, Structures, and Components

This section addresses the elements of the fuel storage facility and refueling canal. For this group, the applicable structural elements are identified: concrete, steel, and masonry walls. The aging management review is presented for each applicable combination of structural element and aging effect.

System Interfaces

Physical interfaces exist with any system or component that either penetrates the structure wall or is supported by the structure wall, floor, and roof. The direct interface is through the system or component supports that are anchored to the structure. Structures also protect housed systems and components from internal and external design basis events. In the case of tanks, there is a functional interface with the associated system. Water-control structures are integral parts of the systems that provide plant cooling water and residual heat removal.

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III STRUCTURES AND COMPONENT SUPPORTS
A5 Group 5 Structures (Fuel Storage Facility, Refueling Canal)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.A5.TP-25	III.A5-2(T-03)	Concrete (accessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Chapter XI.S6, "Structures Monitoring"	No
III.A5.TP-27	III.A5-4(T-05)	Concrete (accessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
III.A5.TP-23	III.A5-6(T-01)	Concrete (accessible areas): exterior above- and below-grade; foundation	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Chapter XI.S6, "Structures Monitoring"	No
III.A5.TP-24	III.A5-7(T-02)	Concrete (accessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Chapter XI.S6, "Structures Monitoring"	No
III.A5.TP-26	III.A5-9(T-04)	Concrete (accessible areas): interior and above-grade exterior	Concrete	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No

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III STRUCTURES AND COMPONENT SUPPORTS
A5 Group 5 Structures (Fuel Storage Facility, Refueling Canal)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.A5.TP-204	III.A5-2(T-03)	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed to manage cracking and expansion due to reaction with aggregate of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) as described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) For potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function.	Yes, if concrete is not constructed as stated
III.A5.TP-212	III.A5-4(T-05)	Concrete (inaccessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
III.A5.TP-29	III.A5-5(T-07)	Concrete (inaccessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Increase in porosity and permeability; cracking; loss of material (spalling, scaling)	Chapter XI.S6, "Structures Monitoring"	No

III STRUCTURES AND COMPONENT SUPPORTS
A5 Group 5 Structures (Fuel Storage Facility, Refueling Canal)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
					due to aggressive chemical attack		
III.A5.TP-67	III.A5-7(T-02)	Concrete (inaccessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Further evaluation is required to determine if a plant-specific aging management program is needed to manage increase in porosity, and permeability due to leaching of calcium hydroxide and carbonation of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) There is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) Evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure.	Yes, if leaching is observed in accessible areas that impact intended function
III.A5.TP-108	III.A5-6(T-01)	Concrete (inaccessible areas): foundation	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Further evaluation is required for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557) to determine if a plant-specific aging management program is needed. A plant-specific aging management program is not required if documented evidence confirms that the existing concrete had air entrainment content (as per Table CC-2231-2 of the ASME Section III Division 2), and subsequent inspections of accessible areas did not	Yes, for plants located in moderate to severe weathering conditions

III A5 STRUCTURES AND COMPONENT SUPPORTS Group 5 Structures (Fuel Storage Facility, Refueling Canal)							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. If this condition is not satisfied, then a plant-specific aging management program is required to manage loss of material (spalling, scaling) and cracking due to freeze-thaw of concrete in inaccessible areas. The weathering index for the continental US is shown in ASTM C33-90, Fig. 1.	
III.A5.TP-114	III.A5-1(T-10)	Concrete: all	Concrete	Air – indoor, uncontrolled	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program Subsection CC-3400 of ASME Section III, Division 2, and Appendix A of ACI 349 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, such as around penetrations, where the temperatures are not allowed to exceed 200°F. If significant equipment loads are supported by concrete at temperatures exceeding 150°F, an evaluation of the ability to withstand the postulated design loads is to be made. Higher temperatures than those given above may be allowed in the concrete if tests and/or calculations are provided	Yes, if temperature limits are exceeded

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III STRUCTURES AND COMPONENT SUPPORTS
A5 Group 5 Structures (Fuel Storage Facility, Refueling Canal)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations.	
III.A5.TP-30	III.A5-3(T-08)	Concrete: all	Concrete	Soil	Cracking and distortion due to increased stress levels from settlement	Chapter XI.S6, “Structures Monitoring” 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 a de-watering system is relied upon to control settlement
III.A5.TP-31	III.A5-8(T-09)	Concrete: foundation; subfoundation	Concrete; porous concrete	Water – flowing under foundation	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	Chapter XI.S6, “Structures Monitoring” 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 a de-watering system is relied upon to control settlement
III.A5.TP-28	III.A5-10(T-06)	Concrete: interior; above-grade exterior	Concrete	Air – indoor, uncontrolled or Air – outdoor	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S6, "Structures Monitoring"	No
III.A5.TP-300		High-strength structural bolting	Low-alloy steel, actual measured yield strength ≥ 150 ksi	Air – indoor, uncontrolled or Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.S6, "Structures Monitoring“ Note: ASTM A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. SCC potential need not be evaluated	No

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III A5	STRUCTURES AND COMPONENT SUPPORTS Group 5 Structures (Fuel Storage Facility, Refueling Canal)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
			(1,034 MPa)			for these bolts.	
III.A5.T-12	III.A5-11(T-12)	Masonry walls: all	Concrete block	Air – indoor, uncontrolled or Air – outdoor	Cracking due to restraint shrinkage, creep, and aggressive environment	Chapter XI.S5, “Masonry Walls”	No
III.A5.TP-34		Masonry walls: all	Concrete block	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Chapter XI.S5, “Masonry Walls”	No
III.A5.TP-302	III.A5-12(T-11)	Steel components: all structural steel	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to corrosion	Chapter XI.S6, “Structures Monitoring” 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.	No
III.A5.T-14	III.A5-13(T-14)	Steel components: fuel pool liner	Stainless steel	Treated water or Treated borated water	Cracking due to stress corrosion cracking; Loss of material due to pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," and monitoring of the spent fuel pool water level in accordance with technical specifications and leakage from the leak chase channels.	No, unless leakages have been detected through the SFP liner that cannot be accounted for from the leak chase channels
III.A5.TP-261		Structural bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S6, "Structures Monitoring"	No

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III	STRUCTURES AND COMPONENT SUPPORTS
A5	Group 5 Structures (Fuel Storage Facility, Refueling Canal)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.A5.TP-248		Structural bolting	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.A5.TP-274		Structural bolting	Steel; galvanized steel	Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No

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A6. GROUP 6 STRUCTURES (WATER-CONTROL STRUCTURES)

Systems, Structures, and Components

This section addresses the elements of water-control structures. For this group, the applicable structural elements are identified: concrete, steel, masonry walls, and earthen water-control structures. The aging management review is presented for each applicable combination of structural element and aging effect.

System Interfaces

Physical interfaces exist with any system or component that either penetrates the structure wall or is supported by the structure wall, floor, and roof. The direct interface is through the system or component supports that are anchored to the structure. Structures also protect housed systems and components from internal and external design basis events. In the case of tanks, there is a functional interface with the associated system. Water-control structures are integral parts of the systems that provide plant cooling water and residual heat removal.

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III STRUCTURES AND COMPONENT SUPPORTS
A6 Group 6 Structures (Water-Control Structures)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.A6.TP-38	III.A6-1(T-18)	Concrete (accessible areas): all	Concrete	Air – indoor, uncontrolled or Air – outdoor or Ground water/soil	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	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 programs.	No
III.A6.TP-36	III.A6-5(T-15)	Concrete (accessible areas): exterior above- and below-grade; foundation	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	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 programs.	No
III.A6.TP-37	III.A6-6(T-16)	Concrete (accessible areas): exterior above- and below-grade; foundation; interior slab	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	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 programs.	No
III.A6.TP-104	III.A6-1(T-18)	Concrete (inaccessible areas): all	Concrete	Air – indoor, uncontrolled or Air – outdoor or Ground water/soil	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
III.A6.TP-220	III.A6-2(T-17)	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed to manage cracking and expansion due to reaction with aggregate of concrete in Inaccessible Areas. A plant-specific	Yes, if concrete is not constructed as stated

III STRUCTURES AND COMPONENT SUPPORTS
A6 Group 6 Structures (Water-Control Structures)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						aging management program is not required if (1) as described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) For potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function.	
III.A6.TP-107	III.A6-3(T-19)	Concrete (inaccessible areas): all	Concrete	Ground water/soil	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S6, "Structures Monitoring"	No
III.A6.TP-110	III.A6-5(T-15)	Concrete (inaccessible areas): exterior above- and below-grade; foundation; interior slab	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Further evaluation is required for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557) to determine if a plant-specific aging management program is needed. A plant-specific aging management program is not required if documented evidence confirms that the existing concrete	Yes, for plants located in moderate to severe weathering conditions

III A6 STRUCTURES AND COMPONENT SUPPORTS Group 6 Structures (Water-Control Structures)							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						had air entrainment content (as per Table CC-2231-2 of the ASME Section III Division 2), and subsequent inspections of accessible areas did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. If this condition is not satisfied, then a plant-specific aging management program is required to manage loss of material (spalling, scaling) and cracking due to freeze-thaw of concrete in inaccessible areas. The weathering index for the continental US is shown in ASTM C33-90, Fig. 1.	
III.A6.TP-109	III.A6-6(T-16)	Concrete (inaccessible areas): exterior above- and below-grade; foundation; interior slab	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Further evaluation is required to determine if a plant-specific aging management program is needed to manage increase in porosity, and permeability due to leaching of calcium hydroxide and carbonation of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) There is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) Evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on	Yes, if leaching is observed in accessible areas that impact intended function

III A6	STRUCTURES AND COMPONENT SUPPORTS Group 6 Structures (Water-Control Structures)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						the intended function of the concrete structure.	
III.A6.TP-30	III.A6-4(T-08)	Concrete: all	Concrete	Soil	Cracking and distortion due to increased stress levels from settlement	Chapter XI.S6, "Structures Monitoring" 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 a de-watering system is relied upon to control settlement
III.A6.T-20	III.A6-7(T-20)	Concrete: exterior above- and below-grade; foundation; interior slab	Concrete	Water – flowing	Loss of material due to abrasion; cavitation	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 programs.	No
III.A6.TP-31	III.A6-8(T-09)	Concrete: foundation; subfoundation	Concrete; porous concrete	Water – flowing under foundation	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	Chapter XI.S6, "Structures Monitoring" 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 a de-watering system is relied upon to control settlement
III.A6.T-22	III.A6-9(T-22)	Earthen water-control structures: dams; embankments; reservoirs; channels; canals and ponds	Various	Water – flowing or standing	Loss of material; loss of form due to erosion, settlement, sedimentation, frost action, waves, currents,	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 programs.	No

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III A6	STRUCTURES AND COMPONENT SUPPORTS Group 6 Structures (Water-Control Structures)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
					surface runoff, seepage		
III.A6.TP-223		Group 6: Wooden Piles; sheeting	Wood	Air – outdoor or Water – flowing or standing or Ground water/soil	Loss of material; change in material properties due to weathering, chemical degradation, and insect infestation repeated wetting and drying, fungal decay	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 programs.	No
III.A6.T-12	III.A6-10(T-12)	Masonry walls: all	Concrete block	Air – indoor, uncontrolled or Air – outdoor	Cracking due to restraint shrinkage, creep, and aggressive environment	Chapter XI.S5, “Masonry Walls”	No
III.A6.TP-7	III.A6-12(TP-7)	Seals; gasket; moisture barriers (caulking, flashing, and other sealants)	Elastomers (such as EPDM rubber)	Various	Loss of sealing due to deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	Chapter XI.S6, "Structures Monitoring"	No
III.A6.TP-261		Structural bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S6, "Structures Monitoring"	No

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III A6	STRUCTURES AND COMPONENT SUPPORTS Group 6 Structures (Water-Control Structures)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
III.A6.TP-248		Structural bolting	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.A6.TP-221		Structural bolting	Steel	Air – indoor, uncontrolled or Air – outdoor or Water – flowing or standing	Loss of material due to general, pitting, and crevice corrosion	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 programs.	No

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A7. GROUP 7 STRUCTURES (CONCRETE TANKS AND MISSILE BARRIERS)

Systems, Structures, and Components

This section addresses the elements of concrete tanks and missile barriers. For this group, the applicable structural elements are identified: concrete and steel. The aging management review is presented for each applicable combination of structural element and aging effect.

System Interfaces

Physical interfaces exist with any system or component that either penetrates the structure wall or is supported by the structure wall, floor, and roof. The direct interface is through the system or component supports that are anchored to the structure. Structures also protect housed systems and components from internal and external design basis events. In the case of tanks, there is a functional interface with the associated system. Water-control structures are integral parts of the systems that provide plant cooling water and residual heat removal.

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III	STRUCTURES AND COMPONENT SUPPORTS
A7	Group 7 Structures (Concrete Tanks and Missile Barriers)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.A7.TP-25	III.A7-1(T-03)	Concrete (accessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Chapter XI.S6, "Structures Monitoring"	No
III.A7.TP-27	III.A7-3(T-05)	Concrete (accessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
III.A7.TP-23	III.A7-5(T-01)	Concrete (accessible areas): exterior above- and below-grade; foundation	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Chapter XI.S6, "Structures Monitoring"	No
III.A7.TP-24	III.A7-6(T-02)	Concrete (accessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Chapter XI.S6, "Structures Monitoring"	No
III.A7.TP-26	III.A7-8(T-04)	Concrete (accessible areas): interior and above-grade exterior	Concrete	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No

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III STRUCTURES AND COMPONENT SUPPORTS
A7 Group 7 Structures (Concrete Tanks and Missile Barriers)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.A7.TP-204	III.A7-1(T-03)	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed to manage cracking and expansion due to reaction with aggregate of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) as described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) For potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function.	Yes, if concrete is not constructed as stated
III.A7.TP-212	III.A7-3(T-05)	Concrete (inaccessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
III.A7.TP-29	III.A7-4(T-07)	Concrete (inaccessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Increase in porosity and permeability; cracking; loss of material (spalling, scaling)	Chapter XI.S6, "Structures Monitoring"	No

III STRUCTURES AND COMPONENT SUPPORTS
A7 Group 7 Structures (Concrete Tanks and Missile Barriers)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
					due to aggressive chemical attack		
III.A7.TP-67	III.A7-6(T-02)	Concrete (inaccessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Further evaluation is required to determine if a plant-specific aging management program is needed to manage increase in porosity, and permeability due to leaching of calcium hydroxide and carbonation of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) There is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) Evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure.	Yes, if leaching is observed in accessible areas that impact intended function
III.A7.TP-108	III.A7-5(T-01)	Concrete (inaccessible areas): foundation	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Further evaluation is required for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557) to determine if a plant-specific aging management program is needed. A plant-specific aging management program is not required if documented evidence confirms that the existing concrete had air entrainment content (as per Table CC-2231-2 of the ASME Section III Division 2), and subsequent inspections of accessible areas did not	Yes, for plants located in moderate to severe weathering conditions

III STRUCTURES AND COMPONENT SUPPORTS
A7 Group 7 Structures (Concrete Tanks and Missile Barriers)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. If this condition is not satisfied, then a plant-specific aging management program is required to manage loss of material (spalling, scaling) and cracking due to freeze-thaw of concrete in inaccessible areas. The weathering index for the continental US is shown in ASTM C33-90, Fig. 1.	
III.A7.TP-30	III.A7-2(T-08)	Concrete: all	Concrete	Soil	Cracking and distortion due to increased stress levels from settlement	Chapter XI.S6, “Structures Monitoring” 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 a de-watering system is relied upon to control settlement
III.A7.TP-31	III.A7-7(T-09)	Concrete: foundation; subfoundation	Concrete; porous concrete	Water – flowing under foundation	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	Chapter XI.S6, “Structures Monitoring” 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 a de-watering system is relied upon to control settlement
III.A7.TP-28	III.A7-9(T-06)	Concrete: interior; above-grade exterior	Concrete	Air – indoor, uncontrolled or Air – outdoor	Increase in porosity and permeability; cracking; loss of material (spalling, scaling)	Chapter XI.S6, "Structures Monitoring"	No

III A7	STRUCTURES AND COMPONENT SUPPORTS Group 7 Structures (Concrete Tanks and Missile Barriers)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
					due to aggressive chemical attack		
III.A7.TP-300		High-strength structural bolting	Low-alloy steel, actual measured yield strength ≥ 150 ksi (1,034 MPa)	Air – indoor, uncontrolled or Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.S6, "Structures Monitoring“ Note: ASTM A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. SCC potential need not be evaluated for these bolts.	No
III.A7.TP-302	III.A7-10(T-11)	Steel components: all structural steel	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to corrosion	Chapter XI.S6, “Structures Monitoring” 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.	No
III.A7.T-23	III.A7-11(T-23)	Steel components: tank liner	Stainless steel	Water – standing	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
III.A7.TP-261		Structural bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S6, "Structures Monitoring"	No
III.A7.TP-248		Structural bolting	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No

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III A7 STRUCTURES AND COMPONENT SUPPORTS Group 7 Structures (Concrete Tanks and Missile Barriers)							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
III.A7.TP-274		Structural bolting	Steel; galvanized steel	Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No

A8. GROUP 8 STRUCTURES (STEEL TANKS AND MISSILE BARRIERS)

Systems, Structures, and Components

This section addresses the elements of steel tanks and missile barriers. For this group, the applicable structural elements are identified: concrete and steel. The aging management review is presented for each applicable combination of structural element and aging effect.

System Interfaces

Physical interfaces exist with any system or component that either penetrates the structure wall or is supported by the structure wall, floor, and roof. The direct interface is through the system or component supports that are anchored to the structure. Structures also protect housed systems and components from internal and external design basis events. In the case of tanks, there is a functional interface with the associated system. Water-control structures are integral parts of the systems that provide plant cooling water and residual heat removal.

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III	STRUCTURES AND COMPONENT SUPPORTS
A8	Group 8 Structures (Steel Tanks and Missile Barriers)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.A8.TP-25	III.A8-1(T-03)	Concrete (accessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Chapter XI.S6, "Structures Monitoring"	No
III.A8.TP-27	III.A8-3(T-05)	Concrete (accessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
III.A8.TP-23	III.A8-5(T-01)	Concrete (accessible areas): exterior above- and below-grade; foundation	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Chapter XI.S6, "Structures Monitoring"	No
III.A8.TP-24	III.A8-6(T-02)	Concrete (accessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Chapter XI.S6, "Structures Monitoring"	No
III.A8.TP-204	III.A8-1(T-03)	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed to manage cracking and expansion due to reaction with aggregate of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) as described in NUREG-	Yes, if concrete is not constructed as stated

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III A8	STRUCTURES AND COMPONENT SUPPORTS Group 8 Structures (Steel Tanks and Missile Barriers)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) For potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function.	
III.A8.TP-212	III.A8-3(T-05)	Concrete (inaccessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
III.A8.TP-29	III.A8-4(T-07)	Concrete (inaccessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S6, "Structures Monitoring"	No
III.A8.TP-67	III.A8-6(T-02)	Concrete (inaccessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide	Further evaluation is required to determine if a plant-specific aging management program is needed to manage increase in porosity, and permeability due to leaching of calcium hydroxide and carbonation of concrete	Yes, if leaching is observed in accessible areas that impact

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III A8	STRUCTURES AND COMPONENT SUPPORTS Group 8 Structures (Steel Tanks and Missile Barriers)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
					and carbonation	in Inaccessible Areas. A plant-specific aging management program is not required if (1) There is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) Evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure.	intended function
III.A8.TP-108	III.A8-5(T-01)	Concrete (inaccessible areas): foundation	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Further evaluation is required for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557) to determine if a plant-specific aging management program is needed. A plant-specific aging management program is not required if documented evidence confirms that the existing concrete had air entrainment content (as per Table CC-2231-2 of the ASME Section III Division 2), and subsequent inspections of accessible areas did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. If this condition is not satisfied, then a plant-specific aging management program is required to manage loss of material (spalling, scaling) and cracking due to freeze-thaw of concrete in inaccessible areas.	Yes, for plants located in moderate to severe weathering conditions

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III A8	STRUCTURES AND COMPONENT SUPPORTS Group 8 Structures (Steel Tanks and Missile Barriers)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						The weathering index for the continental US is shown in ASTM C33-90, Fig. 1.	
III.A8.TP-30	III.A8-2(T-08)	Concrete: all	Concrete	Soil	Cracking and distortion due to increased stress levels from settlement	Chapter XI.S6, “Structures Monitoring” 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 a de-watering system is relied upon to control settlement
III.A8.TP-31	III.A8-7(T-09)	Concrete: foundation; subfoundation	Concrete; porous concrete	Water – flowing under foundation	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	Chapter XI.S6, “Structures Monitoring” 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 a de-watering system is relied upon to control settlement
III.A8.TP-300		High-strength structural bolting	Low-alloy steel, actual measured yield strength ≥ 150 ksi (1,034 MPa)	Air – indoor, uncontrolled or Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.S6, "Structures Monitoring“ Note: ASTM A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. SCC potential need not be evaluated for these bolts.	No
III.A8.TP-302	III.A8-8(T-11)	Steel components: all structural steel	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to corrosion	Chapter XI.S6, “Structures Monitoring” 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.	No

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III STRUCTURES AND COMPONENT SUPPORTS
A8 Group 8 Structures (Steel Tanks and Missile Barriers)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.A8.T-23	III.A8-9(T-23)	Steel components: tank liner	Stainless steel	Water – standing	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
III.A8.TP-261		Structural bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S6, "Structures Monitoring"	No
III.A8.TP-248		Structural bolting	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.A8.TP-274		Structural bolting	Steel; galvanized steel	Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No

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A9. GROUP 9 STRUCTURES (BWR UNIT VENT STACK)

Systems, Structures, and Components

This section addresses the elements of the boiling water reactor (BWR) unit vent stack. For this group, the applicable structural element is identified: concrete. The aging management review is presented for each applicable combination of structural element and aging effect.

System Interfaces

Physical interfaces exist with any system or component that either penetrates the structure wall or is supported by the structure wall, floor, and roof. The direct interface is through the system or component supports that are anchored to the structure. Structures also protect housed systems and components from internal and external design basis events. In the case of tanks, there is a functional interface with the associated system. Water-control structures are integral parts of the systems that provide plant cooling water and residual heat removal.

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III	STRUCTURES AND COMPONENT SUPPORTS
A9	Group 9 Structures (BWR Unit Vent Stack)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.A9.TP-25	III.A9-1(T-03)	Concrete (accessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Chapter XI.S6, "Structures Monitoring"	No
III.A9.TP-27	III.A9-3(T-05)	Concrete (accessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
III.A9.TP-23	III.A9-5(T-01)	Concrete (accessible areas): exterior above- and below-grade; foundation	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Chapter XI.S6, "Structures Monitoring"	No
III.A9.TP-24	III.A9-6(T-02)	Concrete (accessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Chapter XI.S6, "Structures Monitoring"	No
III.A9.TP-26	III.A9-8(T-04)	Concrete (accessible areas): interior and above-grade exterior	Concrete	Air – indoor, uncontrolled or Air – outdoor	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No

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III STRUCTURES AND COMPONENT SUPPORTS
A9 Group 9 Structures (BWR Unit Vent Stack)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.A9.TP-204	III.A9-1(T-03)	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed to manage cracking and expansion due to reaction with aggregate of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) as described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) For potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function.	Yes, if concrete is not constructed as stated
III.A9.TP-212	III.A9-3(T-05)	Concrete (inaccessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No
III.A9.TP-29	III.A9-4(T-07)	Concrete (inaccessible areas): below-grade exterior; foundation	Concrete	Ground water/soil	Increase in porosity and permeability; cracking; loss of material (spalling, scaling)	Chapter XI.S6, "Structures Monitoring"	No

III STRUCTURES AND COMPONENT SUPPORTS
A9 Group 9 Structures (BWR Unit Vent Stack)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
					due to aggressive chemical attack		
III.A9.TP-67	III.A9-6(T-02)	Concrete (inaccessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Further evaluation is required to determine if a plant-specific aging management program is needed to manage increase in porosity, and permeability due to leaching of calcium hydroxide and carbonation of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) There is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) Evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure.	Yes, if leaching is observed in accessible areas that impact intended function
III.A9.TP-108	III.A9-5(T-01)	Concrete (inaccessible areas): foundation	Concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Further evaluation is required for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557) to determine if a plant-specific aging management program is needed. A plant-specific aging management program is not required if documented evidence confirms that the existing concrete had air entrainment content (as per Table CC-2231-2 of the ASME Section III Division 2), and subsequent inspections of accessible areas did not	Yes, for plants located in moderate to severe weathering conditions

III A9 STRUCTURES AND COMPONENT SUPPORTS Group 9 Structures (BWR Unit Vent Stack)							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
						exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. If this condition is not satisfied, then a plant-specific aging management program is required to manage loss of material (spalling, scaling) and cracking due to freeze-thaw of concrete in inaccessible areas. The weathering index for the continental US is shown in ASTM C33-90, Fig. 1.	
III.A9.TP-30	III.A9-2(T-08)	Concrete: all	Concrete	Soil	Cracking and distortion due to increased stress levels from settlement	Chapter XI.S6, “Structures Monitoring” 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 a de-watering system is relied upon to control settlement
III.A9.TP-31	III.A9-7(T-09)	Concrete: foundation; subfoundation	Concrete; porous concrete	Water – flowing under foundation	Reduction in foundation strength, cracking due to differential settlement, erosion of porous concrete subfoundation	Chapter XI.S6, “Structures Monitoring” 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 a de-watering system is relied upon to control settlement
III.A9.TP-28	III.A9-9(T-06)	Concrete: interior; above-grade exterior	Concrete	Air – indoor, uncontrolled or Air – outdoor	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive	Chapter XI.S6, "Structures Monitoring"	No

III A9	STRUCTURES AND COMPONENT SUPPORTS Group 9 Structures (BWR Unit Vent Stack)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
					chemical attack		
III.A9.TP-300		High-strength structural bolting	Low-alloy steel, actual measured yield strength ≥ 150 ksi (1,034 MPa)	Air – indoor, uncontrolled or Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.S6, "Structures Monitoring“ Note: ASTM A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. SCC potential need not be evaluated for these bolts.	No
III.A9.TP-261		Structural bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S6, "Structures Monitoring"	No
III.A9.TP-248		Structural bolting	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.A9.TP-274		Structural bolting	Steel; galvanized steel	Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No

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III.B COMPONENT SUPPORTS

B1. Supports for ASME Piping and Components

B2. Supports for Cable Trays, Conduit, HVAC Ducts, TubeTrack®, Instrument Tubing, Non-ASME Piping and Components

B3. Anchorage of Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation

B4. Supports for Emergency Diesel Generator (EDG), HVAC System Components, and Other Miscellaneous Mechanical Equipment

B5. Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Miscellaneous Structures

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B1. SUPPORTS FOR ASME PIPING AND COMPONENTS

B1.1 Class 1

B1.2 Class 2 and 3

B1.3 Class MC (BWR Containment Supports)

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B1. SUPPORTS FOR ASME PIPING AND COMPONENTS

Systems, Structures, and Components

This section addresses supports and anchorage for ASME piping systems and components. It is subdivided into Class 1 (III.B1.1), Class 2 and 3 (III.B1.2), and Class MC (III.B1.3). Applicable aging effects are identified and the aging management review is presented for each applicable combination of support component and aging effect.

System Interfaces

Physical interfaces exist with the structure, system, or component being supported and with the building structural element to which the support is anchored. A primary function of supports is to provide anchorage of the supported element for internal and external design basis events so that the supported element can perform its intended function.

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III B1.1 STRUCTURES AND COMPONENT SUPPORTS Class 1							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
III.B1.1.TP-42	III.B1.1-1(T-29)	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	Concrete; grout	Air – indoor, uncontrolled or Air – outdoor	Reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms	Chapter XI.S6, "Structures Monitoring"	No
III.B1.1.T-28	III.B1.1-2(T-28)	Constant and variable load spring hangers; guides; stops	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.1.TP-41	III.B1.1-3(T-27)	High-strength structural bolting	Low-alloy steel, actual measured yield strength ≥ 150 ksi (1,034 MPa)	Air – indoor, uncontrolled	Cracking due to stress corrosion cracking	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.1.TP-45	III.B1.1-5(T-32)	Sliding surfaces	Lubrite®; graphitic tool steel; Fluorogold; Lubrofluor	Air – indoor, uncontrolled or Air – outdoor	Loss of mechanical function due to corrosion, distortion, dirt, debris, overload, wear	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No

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III B1.1	STRUCTURES AND COMPONENT SUPPORTS Class 1						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
III.B1.1.TP-229		Structural bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.1.TP-232		Structural bolting	Stainless steel	Treated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.1.TP-226		Structural Bolting	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.1.TP-235		Structural bolting	Steel; galvanized steel	Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.1.TP-8	III.B1.1-6(TP-8) III.B1.1-7(TP-11) III.B1.1-9(TP-5)	Support members; welds; bolted connections; support anchorage to building structure	Aluminum; galvanized steel; stainless steel	Air – indoor, uncontrolled	None	None	No
III.B1.1.TP-3	III.B1.1-8(TP-3)	Support members; welds; bolted connections; support anchorage to building structure	Galvanized steel; aluminum	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No

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III B1.1 STRUCTURES AND COMPONENT SUPPORTS Class 1							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
III.B1.1.TP-4	III.B1.1-10(TP-4)	Support members; welds; bolted connections; support anchorage to building structure	Stainless steel	Air with borated water leakage	None	None	No
III.B1.1.T-26	III.B1.1-12(T-26)	Support members; welds; bolted connections; support anchorage to building structure	Steel	Air – indoor, uncontrolled	Cumulative fatigue damage due to fatigue (Only if CLB fatigue analysis exists)	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
III.B1.1.T-24	III.B1.1-13(T-24)	Support members; welds; bolted connections; support anchorage to building structure	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to general and pitting corrosion	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.1.T-25	III.B1.1-14(T-25)	Support members; welds; bolted connections; support anchorage to building structure	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No

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III B1.1	STRUCTURES AND COMPONENT SUPPORTS Class 1						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
III.B1.1.TP-10	III.B1.1-11(TP-10)	Support members; welds; bolted connections; support anchorage to building structure	Steel; stainless steel	Treated water <60C (<140 F)	Loss of material due to general (steel only), pitting, and crevice corrosion	Chapter XI.M2, “Water Chemistry,” for BWR water, and Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.1.T-33	III.B1.1-15(T-33)	Vibration isolation elements	Non-metallic (e.g., rubber)	Air – indoor, uncontrolled or Air – outdoor	Reduction or loss of isolation function due to radiation hardening, temperature, humidity, sustained vibratory loading	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No

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III B1.2 STRUCTURES AND COMPONENT SUPPORTS Class 2 and 3							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
III.B1.2.TP-42	III.B1.2-1(T-29)	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	Concrete; grout	Air – indoor, uncontrolled or Air – outdoor	Reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms	Chapter XI.S6, "Structures Monitoring"	No
III.B1.2.T-28	III.B1.2-2(T-28)	Constant and variable load spring hangers; guides; stops	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.2.TP-45	III.B1.2-3(T-32)	Sliding surfaces	Lubrite®; graphitic tool steel; Fluorogold; Lubrofluor	Air – indoor, uncontrolled or Air – outdoor	Loss of mechanical function due to corrosion, distortion, dirt, debris, overload, wear	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.2.TP-229		Structural bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No

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III B1.2	STRUCTURES AND COMPONENT SUPPORTS Class 2 and 3						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
III.B1.2.TP-232		Structural bolting	Stainless steel	Treated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.2.TP-226		Structural Bolting	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.2.TP-235		Structural bolting	Steel; galvanized steel	Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.2.TP-8	III.B1.2-4(TP-8) III.B1.2-5(TP-11) III.B1.2-7(TP-5)	Support members; welds; bolted connections; support anchorage to building structure	Aluminum; galvanized steel; stainless steel	Air – indoor, uncontrolled	None	None	No
III.B1-2.TP-3	III.B1.2-6(TP-3)	Support members; welds; bolted connections; support anchorage to building structure	Galvanized steel; aluminum	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
III.B1.2.TP-4	III.B1.2-8(TP-4)	Support members; welds; bolted connections; support	Stainless steel	Air with borated water leakage	None	None	No

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III B1.2	STRUCTURES AND COMPONENT SUPPORTS Class 2 and 3						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
		anchorage to building structure					
III.B1.2.T-26	III.B1.2-9(T-26)	Support members; welds; bolted connections; support anchorage to building structure	Steel	Air – indoor, uncontrolled	Cumulative fatigue damage due to fatigue (Only if CLB fatigue analysis exists)	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
III.B1.2.T-24	III.B1.2-10(T-24)	Support members; welds; bolted connections; support anchorage to building structure	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to general and pitting corrosion	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.2.T-25	III.B1.2-11(T-25)	Support members; welds; bolted connections; support anchorage to building structure	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
III.B1.2.T-33	III.B1.2-12(T-33)	Vibration isolation elements	Non-metallic (e.g., rubber)	Air – indoor, uncontrolled or Air – outdoor	Reduction or loss of isolation function due to radiation hardening, temperature,	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No

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III B1.2 STRUCTURES AND COMPONENT SUPPORTS Class 2 and 3							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
					humidity, sustained vibratory loading		

III B1.3 STRUCTURES AND COMPONENT SUPPORTS Class MC (BWR Containment Supports)							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
III.B1.3.TP-42	III.B1.3-1(T-29)	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	Concrete; grout	Air – indoor, uncontrolled or Air – outdoor	Reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms	Chapter XI.S6, "Structures Monitoring"	No
III.B1.3.T-28	III.B1.3-2(T-28)	Constant and variable load spring hangers; guides; stops	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.3.TP-45	III.B1.3-3(T-32)	Sliding surfaces	Lubrite®; graphitic tool steel; Fluorogold; Lubrofluor	Air – indoor, uncontrolled or Air – outdoor	Loss of mechanical function due to corrosion, distortion, dirt, debris, overload, wear	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.3.TP-229		Structural bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.3.TP-232		Structural bolting	Stainless steel	Treated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.S3, “ASME Section XI, Subsection IWF”	No

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III B1.3 STRUCTURES AND COMPONENT SUPPORTS Class MC (BWR Containment Supports)							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
III.B1.3.TP-226		Structural bolting	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.3.TP-235		Structural bolting	Steel; galvanized steel	Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1-3.TP-8	III.B1.3-4(TP-8) III.B1.3-5(TP-11) III.B1.3-7(TP-5)	Support members; welds; bolted connections; support anchorage to building structure	Aluminum; galvanized steel; stainless steel	Air – indoor, uncontrolled	None	None	No
III.B1.3.TP-3	III.B1.3-6(TP-3)	Support members; welds; bolted connections; support anchorage to building structure	Galvanized steel; aluminum	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
III.B1.3.TP-4	III.B1.3-8(TP-4)	Support members; welds; bolted connections; support anchorage to building structure	Stainless steel	Air with borated water leakage	None	None	No

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III B1.3	STRUCTURES AND COMPONENT SUPPORTS Class MC (BWR Containment Supports)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
III.B1.3.T-26	III.B1.3-9(T-26)	Support members; welds; bolted connections; support anchorage to building structure	Steel	Air – indoor, uncontrolled	Cumulative fatigue damage due to fatigue (Only if CLB fatigue analysis exists)	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
III.B1.3.T-24	III.B1.3-10(T-24)	Support members; welds; bolted connections; support anchorage to building structure	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to general and pitting corrosion	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No
III.B1.3.T-33	III.B1.3-11(T-33)	Vibration isolation elements	Non-metallic (e.g., rubber)	Air – indoor, uncontrolled or Air – outdoor	Reduction or loss of isolation function due to radiation hardening, temperature, humidity, sustained vibratory loading	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No

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B2. SUPPORTS FOR CABLE TRAYS, CONDUIT, HVAC DUCTS, TUBETRACK®, INSTRUMENT TUBING, NON-ASME PIPING AND COMPONENTS

Systems, Structures, and Components

This section addresses supports and anchorage for cable trays, conduit, heating, ventilation, and air-conditioning (HVAC) ducts, TubeTrack®, instrument tubing, and non-ASME piping and components. Applicable aging effects are identified and the aging management review is presented for each applicable combination of support component and aging effect.

System Interfaces

Physical interfaces exist with the structure, system, or component being supported and with the building structural element to which the support is anchored. A primary function of supports is to provide anchorage of the supported element for internal and external design basis events so that the supported element can perform its intended function.

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III STRUCTURES AND COMPONENT SUPPORTS
B2 Supports for Cable Trays, Conduit, HVAC Ducts, TubeTrack, Instrument Tubing, Non-ASME Piping and Components

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.B2.TP-42	III.B2-1(T-29)	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	Concrete; grout	Air – indoor, uncontrolled or Air – outdoor	Reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms	Chapter XI.S6, "Structures Monitoring"	No
III.B2.TP-300		High-strength structural bolting	Low-alloy steel, actual measured yield strength ≥ 150 ksi (1,034 MPa)	Air – indoor, uncontrolled or Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.S6, "Structures Monitoring“ Note: ASTM A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. SCC potential need not be evaluated for these bolts.	No
III.B2.TP-46	III.B2-2(TP-1)	Sliding support bearings; sliding support surfaces	Lubrite®; graphitic tool steel; Fluorogold; Lubrofluor	Air – indoor, uncontrolled	Loss of mechanical function due to corrosion, distortion, dirt, debris, overload, wear	Chapter XI.S6, "Structures Monitoring"	No
III.B2.TP-47	III.B2-3(TP-2)	Sliding support bearings; sliding support surfaces	Lubrite®; graphitic tool steel; Fluorogold; Lubrofluor	Air – outdoor	Loss of mechanical function due to corrosion, distortion, dirt, debris, overload, wear	Chapter XI.S6, "Structures Monitoring"	No

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III STRUCTURES AND COMPONENT SUPPORTS B2 Supports for Cable Trays, Conduit, HVAC Ducts, TubeTrack, Instrument Tubing, Non-ASME Piping and Components							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
III.B2.TP-261		Structural bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S6, "Structures Monitoring"	No
III.B2.TP-248		Structural bolting	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.B2.TP-274		Structural bolting	Steel; galvanized steel	Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.B2.TP-8	III.B2-4(TP-8) III.B2-8(TP-5) III.B2-5(TP-11)	Support members; welds; bolted connections; support anchorage to building structure	Aluminum; galvanized steel; stainless steel	Air – indoor, uncontrolled	None	None	No
III.B2.TP-3	III.B2-6(TP-3)	Support members; welds; bolted connections; support anchorage to building structure	Galvanized steel; aluminum	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
III.B2.TP-6	III.B2-7(TP-6)	Support members; welds; bolted connections; support anchorage to	Galvanized steel; aluminum; stainless steel	Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No

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III B2	STRUCTURES AND COMPONENT SUPPORTS Supports for Cable Trays, Conduit, HVAC Ducts, TubeTrack, Instrument Tubing, Non-ASME Piping and Components						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
		building structure					
III.B2.TP-4	III.B2-9(TP-4)	Support members; welds; bolted connections; support anchorage to building structure	Stainless steel	Air with borated water leakage	None	None	No
III.B2.TP-43	III.B2-10(T-30)	Support members; welds; bolted connections; support anchorage to building structure	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to general and pitting corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.B2.T-25	III.B2-11(T-25)	Support members; welds; bolted connections; support anchorage to building structure	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No

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B3. ANCHORAGE OF RACKS, PANELS, CABINETS, AND ENCLOSURES FOR ELECTRICAL EQUIPMENT AND INSTRUMENTATION

Systems, Structures, and Components

This section addresses supports and anchorage for racks, panels, cabinets, and enclosures for electrical equipment and instrumentation. Applicable aging effects are identified and the aging management review is presented for each applicable combination of support component and aging effect.

System Interfaces

Physical interfaces exist with the structure, system, or component being supported and with the building structural element to which the support is anchored. A primary function of supports is to provide anchorage of the supported element for internal and external design basis events so that the supported element can perform its intended function.

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III STRUCTURES AND COMPONENT SUPPORTS
B3 Anchorage of Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.B3.TP-42	III.B3-1(T-29)	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	Concrete; grout	Air – indoor, uncontrolled or Air – outdoor	Reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms	Chapter XI.S6, "Structures Monitoring"	No
III.B3.TP-300		High-strength structural bolting	Low-alloy steel, actual measured yield strength ≥ 150 ksi (1,034 MPa)	Air – indoor, uncontrolled or Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.S6, "Structures Monitoring“ Note: ASTM A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. SCC potential need not be evaluated for these bolts.	No
III.B3.TP-261		Structural bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S6, "Structures Monitoring"	No
III.B3.TP-248		Structural bolting	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.B3.TP-274		Structural bolting	Steel; galvanized steel	Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.B3.TP-8	III.B3-2(TP-8) III.B3-5(TP-5)	Support members; welds; bolted connections;	Aluminum; galvanized steel; stainless	Air – indoor, uncontrolled	None	None	No

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III B3	STRUCTURES AND COMPONENT SUPPORTS Anchorage of Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
	III.B3-3(TP-11)	support anchorage to building structure	steel				
III.B3.TP-3	III.B3-4(TP-3)	Support members; welds; bolted connections; support anchorage to building structure	Galvanized steel; aluminum	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
III.B3.TP-4	III.B3-6(TP-4)	Support members; welds; bolted connections; support anchorage to building structure	Stainless steel	Air with borated water leakage	None	None	No
III.B3.TP-43	III.B3-7(T-30)	Support members; welds; bolted connections; support anchorage to building structure	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to general and pitting corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.B3.T-25	III.B3-8(T-25)	Support members; welds; bolted connections; support	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No

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III B3	STRUCTURES AND COMPONENT SUPPORTS Anchorage of Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
		anchorage to building structure					

OAGI0001390_00174

B4. SUPPORTS FOR EMERGENCY DIESEL GENERATOR (EDG), HVAC SYSTEM COMPONENTS, AND OTHER MISCELLANEOUS MECHANICAL EQUIPMENT

Systems, Structures, and Components

This section addresses supports and anchorage for the emergency diesel generator (EDG) and HVAC system components, and other miscellaneous mechanical equipment. Applicable aging effects are identified and the aging management review is presented for each applicable combination of support component and aging effect.

System Interfaces

Physical interfaces exist with the structure, system, or component being supported and with the building structural element to which the support is anchored. A primary function of supports is to provide anchorage of the supported element for internal and external design basis events so that the supported element can perform its intended function.

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III	STRUCTURES AND COMPONENT SUPPORTS
B4	Supports for Emergency Diesel Generator (EDG), HVAC System Components, and Other Miscellaneous Mechanical Equipment

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.B4.TP-42	III.B4-1(T-29)	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	Concrete; grout	Air – indoor, uncontrolled or Air – outdoor	Reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms	Chapter XI.S6, "Structures Monitoring"	No
III.B4.TP-300		High-strength structural bolting	Low-alloy steel, actual measured yield strength ≥ 150 ksi (1,034 MPa)	Air – indoor, uncontrolled or Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.S6, "Structures Monitoring“ Note: ASTM A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. SCC potential need not be evaluated for these bolts.	No
III.B4.TP-46	III.B4-2(TP-1)	Sliding support bearings; sliding support surfaces	Lubrite®; graphitic tool steel; Fluorogold; Lubrofluor	Air – indoor, uncontrolled	Loss of mechanical function due to corrosion, distortion, dirt, debris, overload, wear	Chapter XI.S6, "Structures Monitoring"	No
III.B4.TP-47	III.B4-3(TP-2)	Sliding support bearings; sliding support surfaces	Lubrite®; graphitic tool steel; Fluorogold; Lubrofluor	Air – outdoor	Loss of mechanical function due to corrosion, distortion, dirt, debris, overload, wear	Chapter XI.S6, "Structures Monitoring"	No

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III	STRUCTURES AND COMPONENT SUPPORTS
B4	Supports for Emergency Diesel Generator (EDG), HVAC System Components, and Other Miscellaneous Mechanical Equipment

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
III.B4.TP-261		Structural bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S6, "Structures Monitoring"	No
III.B4.TP-248		Structural bolting	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.B4.TP-274		Structural bolting	Steel; galvanized steel	Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.B4.TP-8	III.B4-4(TP-8) III.B4-8(TP-5) III.B4-5(TP-11)	Support members; welds; bolted connections; support anchorage to building structure	Aluminum; galvanized steel; stainless steel	Air – indoor, uncontrolled	None	None	No
III.B4.TP-3	III.B4-6(TP-3)	Support members; welds; bolted connections; support anchorage to building structure	Galvanized steel; aluminum	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
III.B4.TP-6	III.B4-7(TP-6)	Support members; welds; bolted connections; support anchorage to	Galvanized steel; aluminum; stainless steel	Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No

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III B4	STRUCTURES AND COMPONENT SUPPORTS Supports for Emergency Diesel Generator (EDG), HVAC System Components, and Other Miscellaneous Mechanical Equipment						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
		building structure					
III.B4.TP-4	III.B4-9(TP-4)	Support members; welds; bolted connections; support anchorage to building structure	Stainless steel	Air with borated water leakage	None	None	No
III.B4.TP-43	III.B4-10(T-30)	Support members; welds; bolted connections; support anchorage to building structure	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to general and pitting corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.B4.T-25	III.B4-11(T-25)	Support members; welds; bolted connections; support anchorage to building structure	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
III.B4.TP-44	III.B4-12(T-31)	Vibration isolation elements	Non-metallic (e.g., rubber)	Air – indoor, uncontrolled or Air – outdoor	Reduction or loss of isolation function due to radiation hardening, temperature,	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No

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III B4	STRUCTURES AND COMPONENT SUPPORTS Supports for Emergency Diesel Generator (EDG), HVAC System Components, and Other Miscellaneous Mechanical Equipment						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
					humidity, sustained vibratory loading		

OAGI0001390_00179

B5. SUPPORTS FOR PLATFORMS, PIPE WHIP RESTRAINTS, JET IMPINGEMENT SHIELDS, MASONRY WALLS, AND OTHER MISCELLANEOUS STRUCTURES

Systems, Structures, and Components

This section addresses supports and anchorage for platforms, pipe whip restraints, jet impingement shields, masonry walls, and other miscellaneous structures. Applicable aging effects are identified and the aging management review is presented for each applicable combination of support component and aging effect.

System Interfaces

Physical interfaces exist with the structure, system, or component being supported and with the building structural element to which the support is anchored. A primary function of supports is to provide anchorage of the supported element for internal and external design basis events so that the supported element can perform its intended function.

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III B5	STRUCTURES AND COMPONENT SUPPORTS Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Miscellaneous Structures						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
III.B5.TP-42	III.B5-1(T-29)	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	Concrete; grout	Air – indoor, uncontrolled or Air – outdoor	Reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms	Chapter XI.S6, "Structures Monitoring"	No
III.B5.TP-300		High-strength structural bolting	Low-alloy steel, actual measured yield strength ≥ 150 ksi (1,034 MPa)	Air – indoor, uncontrolled or Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.S6, "Structures Monitoring“ Note: ASTM A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. SCC potential need not be evaluated for these bolts.	No
III.B5.TP-261		Structural bolting	Any	Any environment	Loss of preload due to self-loosening	Chapter XI.S6, "Structures Monitoring"	No
III.B5.TP-248		Structural bolting	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.B5.TP-274		Structural bolting	Steel; galvanized steel	Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.B5.TP-8	III.B5-2(TP-8) III.B5-5(TP-5)	Support members; welds; bolted connections;	Aluminum; galvanized steel; stainless	Air – indoor, uncontrolled	None	None	No

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III B5	STRUCTURES AND COMPONENT SUPPORTS Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Miscellaneous Structures						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
	III.B5-3(TP-11)	support anchorage to building structure	steel				
III.B5.TP-3	III.B5-4(TP-3)	Support members; welds; bolted connections; support anchorage to building structure	Galvanized steel; aluminum	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
III.B5.TP-4	III.B5-6(TP-4)	Support members; welds; bolted connections; support anchorage to building structure	Stainless steel	Air with borated water leakage	None	None	No
III.B5.TP-43	III.B5-7(T-30)	Support members; welds; bolted connections; support anchorage to building structure	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to general and pitting corrosion	Chapter XI.S6, "Structures Monitoring"	No
III.B5.T-25	III.B5-8(T-25)	Support members; welds; bolted connections; support	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No

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III B5	STRUCTURES AND COMPONENT SUPPORTS Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Miscellaneous Structures						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
		anchorage to building structure					

OAGI0001390_00183

CHAPTER IV

REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM

OAGI0001390_00184

MAJOR PLANT SECTIONS

A1. Reactor Vessel (Boiling Water Reactor)

A2. Reactor Vessel (Pressurized Water Reactor)

B1. Reactor Vessel Internals (Boiling Water Reactor)

B2. Reactor Vessel Internals (PWR) - Westinghouse

B3. Reactor Vessel Internals (PWR) - Combustion Engineering

B4. Reactor Vessel Internals (PWR) - Babcock and Wilcox

C1. Reactor Coolant Pressure Boundary (Boiling Water Reactor)

C2. Reactor Coolant System and Connected Lines (Pressurized Water Reactor)

D1. Steam Generator (Recirculating)

D2. Steam Generator (Once-Through)

E. Common Miscellaneous Material/Environment Combinations

OAGI0001390_00185

A1. REACTOR VESSEL (BOILING WATER REACTOR)

Systems, Structures, and Components

This section addresses the boiling water reactor (BWR) pressure vessel and consists of the vessel shell and flanges, attachment welds, top and bottom heads, nozzles (including safe ends) for the reactor coolant recirculating system and connected systems (such as high and low pressure core spray, high and low pressure coolant injection, main steam, and feedwater systems), penetrations for control rod drive (CRD) stub tubes, instrumentation, standby liquid control, flux monitor, drain lines, and control rod drive mechanism housings. The support skirt and attachment welds for vessel supports are also included in the following table for the BWR vessel. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all structures and components that comprise the reactor vessel are governed by Group A Quality Standards.

Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in IV.E.

System Interfaces

The systems that interface with the reactor vessel include the reactor vessel internals (IV.B1), the reactor coolant pressure boundary (IV.C1), the emergency core cooling system (V.D2), and the standby liquid control system (VII.E2).

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IV	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
A1	Reactor Vessel (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.A1.R-68	IV.A1-1(R-68)	Nozzle safe ends and welds: high-pressure core spray; low pressure core spray; control rod drive return line; recirculating water; low pressure coolant injection or RHR injection mode	Stainless steel; nickel alloy	Reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	Chapter XI.M7, “BWR Stress Corrosion Cracking,” and Chapter XI.M2, “Water Chemistry”	No
IV.A1.R-66	IV.A1-2(R-66)	Nozzles: control rod drive return line	Steel (with or without stainless steel cladding)	Reactor coolant	Cracking due to cyclic loading	Chapter XI.M6, “BWR Control Rod Drive Return Line Nozzle”	No
IV.A1.R-65	IV.A1-3(R-65)	Nozzles: feedwater	Steel (with or without stainless steel cladding)	Reactor coolant	Cracking due to cyclic loading	Chapter XI.M5, “BWR Feedwater Nozzle”	No

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IV A1	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Reactor Vessel (BWR)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.A1.R-67	IV.A1-4(R-67)	Nozzles: low-pressure coolant injection or RHR injection mode	Steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Neutron irradiation embrittlement is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for all ferritic materials that have a neutron fluence greater than 1E17 n/cm^2 (E >1 MeV) at the end of the period of extended operation. In accordance with approved BWRVIP-74, the TLAA is to evaluate the impact of neutron embrittlement on: (a) the adjusted reference temperature values used for calculation of the plant's pressure-temperature limits, (b) the need for inservice inspection of circumferential welds, and (c) the Charpy upper shelf energy or the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G The applicant may choose to demonstrate that the materials of the nozzles are not controlling for the TLAA evaluations. See the Standard Review Plan, Section 4.2 "Reactor Vessel Neutron Embrittlement" for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
A1 Reactor Vessel (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.A1.RP-369	IV.A1-5(R-69)	Penetrations: control rod drive stub tubes; in core monitor housings; jet pump instrument; standby liquid control; flux monitor	Stainless steel; nickel alloy	Reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, cyclic loading	Chapter XI.M8, "BWR Penetrations," and Chapter XI.M2, "Water Chemistry"	No
IV.A1.RP-371	IV.A1-5(R-69)	Penetrations: drain line	Stainless steel; nickel alloy	Reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, cyclic loading	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and Chapter XI.M2, "Water Chemistry"	No
IV.A1.R-70	IV.A1-6(R-70)	Pressure vessel support skirt and attachment welds	Steel	Air – indoor, uncontrolled	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
IV.A1.R-04	IV.A1-7(R-04)	Reactor vessel components: flanges; nozzles; penetrations; safe ends; thermal sleeves; vessel shells, heads and welds	Steel (with or without nickel-alloy or stainless steel cladding); stainless steel; nickel alloy	Reactor coolant	Cumulative fatigue damage due to fatigue	Fatigue is a TLAA evaluated for the period of extended operation, and for Class 1 components environmental effects on fatigue are to be addressed. (See SRP, Sec 4.3 "Metal Fatigue," for acceptable methods to comply with 10 CFR 54.21(c)(1))	Yes, TLAA

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