

CHAPTER III

STRUCTURES AND COMPONENT SUPPORTS

This Page Intentionally Left Blank

STRUCTURES AND COMPONENT SUPPORTS

Chapter III A: Class 1 Structures

Chapter III B: Component Supports

(refined outline to be added when issued for public comment)

Explanation of September 30, 2004 changes in preliminary interim draft chapter outline and aging management review (AMR) tables: Within the AMR tables, this update process increases license renewal review efficiency by:

- Consolidating components (combining similar or equivalent components with matching materials, environment and AMP into a single line-item),
- Increasing consistency between **M**aterial/**E**nvironment/**A**ging effects/aging management **P**rogram (MEAP) combinations between systems (some existing MEAPs had multiple definitions that, based on the aging effect, could be broadened to envelope these into a single MEAP),
- Correcting any inconsistencies in the 2001 edition of the GALL Report,
- Updating references to the appropriate aging management programs, and
- Incorporating line-item changes based on approved staff SER positions or interim staff guidance.

The principal effect of this change is that the tables present the MEAP combinations at a higher level, and the prior detail within a structure or component line item is no longer explicitly presented. Consequently, the identifiers for subcomponents within a line item are no longer presented in the tables. As a result, the introductory listings of these subcomponents (originally in text preceding each table) have been deleted.

The following AMR tables contain a revised "Item" column and a new column titled "Link", which was not contained in the July 2001 revision. The "Item" number is a unique identifier that is used for traceability and, as mentioned above, no longer presents the detailed subcomponent identification. The link identifies the original item in the current version of the GALL Report when applicable (items added to this list refer to bases statements not yet available).

By January 30, 2005, the NRC staff plans to issue a revised GALL Report (NUREG-1801) and SRP-LR (NUREG-1800) for public comment. NRC anticipates re-numbering the line-items to provide an improved unique identifier as part of the public comment document. Also as part of the public comment process, the NRC will issue a NUREG documenting the basis for the proposed changes to the GALL Report and the SRP-LR. This NUREG bases document will be an aid for those reviewing the revised documents to understand what was changed and the basis for the proposed changes.

This Page Intentionally Left Blank

CLASS 1 STRUCTURES

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

This Page Intentionally Left Blank

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

A1.1 Concrete Elements

A1.2 Steel Elements

A1.3 Masonry Walls

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

Systems, Structures, and Components

Class 1 structures are organized into nine groups and are discussed separately under subheadings A1 through A9. This section addresses the elements of BWR reactor building, 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.

III A1 STRUCTURES AND COMPONENT SUPPORTS Group 1 Structures (BWR Reactor Bldg., PWR Shield Bldg., Control Rm./Bldg.)							
Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
T-10	III.A1.1-j	Concrete: All	Reinforced concrete	Air – indoor uncontrolled	Reduction of strength and modulus/ elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program For any concrete elements that exceed specified temperature limits, further evaluations are warranted. Appendix A of ACI 349-85 specifies the concrete temperature limits for normal operation or any other long-term period. The temperatures shall not exceed 150°F except for local areas which are allowed to have increased temperatures not to exceed 200°F.	Yes, if applicable
T-03	III.A1.1-c	Concrete: All	Reinforced concrete	Any	Expansion and cracking/ reaction with aggregates	Chapter XI.S6, "Structures Monitoring Program" Accessible Areas: Inspections/evaluations performed in accordance with "Structures Monitoring Program" will indicate the presence of expansion and cracking due to reaction with aggregates. Inaccessible Areas: Evaluation is needed if testing and petrographic examinations of aggregates performed in accordance with ASTM C295-54, ASTM C227-50, or ACI 201.2R-77 (NUREG-1557) demonstrate	No, if within the scope of the applicant's structures monitoring program and the stated conditions are satisfied for inaccessible areas

III A1 STRUCTURES AND COMPONENT SUPPORTS Group 1 Structures (BWR Reactor Bldg., PWR Shield Bldg., Control Rm./Bldg.)							
Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						that the aggregates are reactive.	
T-08	III.A1.1-h	Concrete: All	Reinforced concrete	Soil	Cracks and distortion due to increased stress levels from settlement	Chapter XI.S6, "Structures Monitoring Program" The initial Licensing Basis for some plants included a program to monitor settlement. If no settlement was evident during the first decade or so, the NRC may have given the licensee approval to discontinue the program. However, 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.	No, if within the scope of the applicant's structures monitoring program

III A1 STRUCTURES AND COMPONENT SUPPORTS Group 1 Structures (BWR Reactor Bldg., PWR Shield Bldg., Control Rm./Bldg.)							
Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
T-05	III.A1.1-e	Concrete: Below-grade exterior; foundation	Reinforced concrete	Aggressive environment	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	<p>Inaccessible Areas: A plant-specific aging management program is required (may be a part of structures monitoring program) if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1500ppm). Examination of representative samples of below-grade concrete, when excavated for any reason, is to be included as part of a plant-specific program.</p> <p>Note: Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.</p>	Yes, a plant-specific aging management program is required for inaccessible areas as stated

III A1 STRUCTURES AND COMPONENT SUPPORTS Group 1 Structures (BWR Reactor Bldg., PWR Shield Bldg., Control Rm./Bldg.)							
Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
T-07	III.A1.1-g	Concrete: Below-grade exterior; foundation	Reinforced concrete	Aggressive environment	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	<p>Inaccessible Areas: A plant-specific aging management program is required (may be a part of structures monitoring program) if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1500ppm). Examination of representative samples of below-grade concrete, when excavated for any reason, is to be included as part of a plant-specific program.</p> <p>Note: Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.</p>	Yes, a plant-specific aging management program is required for inaccessible areas as stated

III A1 STRUCTURES AND COMPONENT SUPPORTS Group 1 Structures (BWR Reactor Bldg., PWR Shield Bldg., Control Rm./Bldg.)							
Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
T-01	III.A1.1-a	Concrete: Exterior above and below grade; foundation	Reinforced concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking/freeze-thaw	<p>Chapter XI.S6, "Structures Monitoring Program"</p> <p>Accessible Areas: Inspections performed in accordance with "Structures Monitoring Program" will indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw.</p> <p>Inaccessible Areas: Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557). Documented evidence to confirm that existing concrete has air content of 3% to 6% and subsequent inspections did not exhibit degradation related to freeze-thaw, should be considered a part of the evaluation.</p> <p>The weathering index for the continental US is shown in ASTM C33-90, Fig.1.</p>	No, if within the scope of the applicant's structures monitoring program and stated conditions are satisfied for inaccessible areas

III A1 STRUCTURES AND COMPONENT SUPPORTS Group 1 Structures (BWR Reactor Bldg., PWR Shield Bldg., Control Rm./Bldg.)							
Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
T-02	III.A1.1-b	Concrete: Exterior above and below grade; foundation	Reinforced concrete	Water – flowing	Increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide	<p>Chapter XI.S6, “Structures Monitoring Program”</p> <p>Accessible Areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of increase in porosity and permeability due to leaching of calcium hydroxide</p> <p>Inaccessible Areas: A plant –specific aging management program is required for below-grade inaccessible areas (basemat and concrete wall) if the concrete is exposed to flowing water (NUREG-1557). An aging management program is not required, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R-77</p>	No, if within the scope of the applicant’s structures monitoring program and a plant-specific aging management program is required for inaccessible areas as stated

III A1 STRUCTURES AND COMPONENT SUPPORTS Group 1 Structures (BWR Reactor Bldg., PWR Shield Bldg., Control Rm./Bldg.)							
Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
T-09	III.A1.1- l	Concrete: Foundation; subfoundation	Reinforced concrete; porous concrete	Flowing water under foundation	Reduction in foundation strength, cracking, differential settlement/ erosion of porous concrete subfoundation	Chapter XI.S6, "Structures Monitoring Program" Erosion of cement from porous concrete subsfoundations beneath containment basemats is described in IN 97-11. IN 98-26 proposes Maintenance Rule Structures Monitoring for managing this aging effect, if applicable. If a de-watering system is relied upon for control of erosion of cement from porous concrete subsfoundations, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	No, if within the scope of the applicant's structures monitoring program
T-06	III.A1.1- f	Concrete: Interior and above-grade exterior	Reinforced concrete	Aggressive environment	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	Chapter XI.S6, "Structures Monitoring Program" Accessible Areas: Inspections performed in accordance with "Structures Monitoring Program" will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack.	No, if within the scope of the applicant's structures monitoring program

III A1 STRUCTURES AND COMPONENT SUPPORTS Group 1 Structures (BWR Reactor Bldg., PWR Shield Bldg., Control Rm./Bldg.)							
Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
T-04	III.A1.1-d	Concrete: Interior and above-grade exterior	Reinforced concrete	Air – indoor uncontrolled or air - outdoor	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	Chapter XI.S6, “Structures Monitoring Program” Accessible areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel.	No, if within the scope of the applicant’s structures monitoring program
T-12	III.A1.3-a	Masonry walls: All	Concrete block	Air – indoor uncontrolled	Cracking due to restraint shrinkage, creep, and aggressive environment	Chapter XI.S5, “Masonry Wall Program”	No
T-11	III.A1.2-a	Steel components: All structural steel	Steel	Air – indoor uncontrolled or air - outdoor	Loss of material/ corrosion	Chapter XI.S6, “Structures Monitoring Program” If protective coatings are relied upon to manage the effects of aging, the structures monitoring program is to include requirements to address protective coating monitoring and maintenance.	No, if within the scope of the applicant’s structures monitoring program

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

Systems, Structures, and Components

Class 1 structures are organized into nine groups and are discussed separately under subheadings A1 through A9. This section addresses the elements of 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.

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
T-10	III.A2.1-j	Concrete: All	Reinforced concrete	Air – indoor uncontrolled	Reduction of strength and modulus/ elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program For any concrete elements that exceed specified temperature limits, further evaluations are warranted. Appendix A of ACI 349-85 specifies the concrete temperature limits for normal operation or any other long-term period. The temperatures shall not exceed 150°F except for local areas which are allowed to have increased temperatures not to exceed 200°F.	Yes, if applicable
T-03	III.A2.1-c	Concrete: All	Reinforced concrete	Any	Expansion and cracking/ reaction with aggregates	Chapter XI.S6, “Structures Monitoring Program” Accessible Areas: Inspections/evaluations performed in accordance with “Structures Monitoring Program” will indicate the presence of expansion and cracking due to reaction with aggregates. Inaccessible Areas: Evaluation is needed if testing and petrographic examinations of aggregates performed in accordance with ASTM C295-54, ASTM C227-50, or ACI 201.2R-77 (NUREG-1557) demonstrate	No, if within the scope of the applicant’s structures monitoring program and the stated conditions are satisfied for inaccessible areas

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
						that the aggregates are reactive.	
T-08	III.A2.1-h	Concrete: All	Reinforced concrete	Soil	Cracks and distortion due to increased stress levels from settlement	Chapter XI.S6, "Structures Monitoring Program" The initial Licensing Basis for some plants included a program to monitor settlement. If no settlement was evident during the first decade or so, the NRC may have given the licensee approval to discontinue the program. However, 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.	No, if within the scope of the applicant's structures monitoring program

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
T-05	III.A2.1-e	Concrete: Below-grade exterior; foundation	Reinforced concrete	Aggressive environment	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	<p>Inaccessible Areas: A plant-specific aging management program is required (may be a part of structures monitoring program) if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1500ppm). Examination of representative samples of below-grade concrete, when excavated for any reason, is to be included as part of a plant-specific program.</p> <p>Note: Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.</p>	Yes, a plant-specific aging management program is required for inaccessible areas as stated

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
T-07	III.A2.1-g	Concrete: Below-grade exterior; foundation	Reinforced concrete	Aggressive environment	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	<p>Inaccessible Areas: A plant-specific aging management program is required (may be a part of structures monitoring program) if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1500ppm). Examination of representative samples of below-grade concrete, when excavated for any reason, is to be included as part of a plant-specific program.</p> <p>Note: Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.</p>	Yes, a plant-specific aging management program is required for inaccessible areas as stated

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
T-01	III.A2.1-a	Concrete: Exterior above and below grade; foundation	Reinforced concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking/freeze-thaw	<p>Chapter XI.S6, “Structures Monitoring Program”</p> <p>Accessible Areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw.</p> <p>Inaccessible Areas: Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557). Documented evidence to confirm that existing concrete has air content of 3% to 6% and subsequent inspections did not exhibit degradation related to freeze-thaw, should be considered a part of the evaluation.</p> <p>The weathering index for the continental US is shown in ASTM C33-90, Fig.1.</p>	No, if within the scope of the applicant’s structures monitoring program and stated conditions are satisfied for inaccessible areas

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
T-02	III.A2.1-b	Concrete: Exterior above and below grade; foundation	Reinforced concrete	Water – flowing	Increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide	<p>Chapter XI.S6, “Structures Monitoring Program”</p> <p>Accessible Areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of increase in porosity and permeability due to leaching of calcium hydroxide</p> <p>Inaccessible Areas: A plant –specific aging management program is required for below-grade inaccessible areas (basemat and concrete wall) if the concrete is exposed to flowing water (NUREG-1557). An aging management program is not required, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R-77</p>	No, if within the scope of the applicant’s structures monitoring program and a plant-specific aging management program is required for inaccessible areas as stated

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
T-09	III.A2.1- l	Concrete: Foundation; subfoundation	Reinforced concrete; porous concrete	Flowing water under foundation	Reduction in foundation strength, cracking, differential settlement/ erosion of porous concrete subfoundation	Chapter XI.S6, "Structures Monitoring Program" Erosion of cement from porous concrete subfoundations beneath containment basemats is described in IN 97-11. IN 98-26 proposes Maintenance Rule Structures Monitoring for managing this aging effect, if applicable. 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.	No, if within the scope of the applicant's structures monitoring program
T-06	III.A2.1- f	Concrete: Interior and above-grade exterior	Reinforced concrete	Aggressive environment	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	Chapter XI.S6, "Structures Monitoring Program" Accessible Areas: Inspections performed in accordance with "Structures Monitoring Program" will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack.	No, if within the scope of the applicant's structures monitoring program

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
T-04	III.A2.1-d	Concrete: Interior and above-grade exterior	Reinforced concrete	Air – indoor uncontrolled or air - outdoor	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	Chapter XI.S6, “Structures Monitoring Program” Accessible areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel.	No, if within the scope of the applicant’s structures monitoring program
T-12	III.A2.3-a	Masonry walls: All	Concrete block	Air – indoor uncontrolled	Cracking due to restraint shrinkage, creep, and aggressive environment	Chapter XI.S5, “Masonry Wall Program”	No
T-11	III.A2.2-a	Steel components: All structural steel	Steel	Air – indoor uncontrolled or air - outdoor	Loss of material/ corrosion	Chapter XI.S6, “Structures Monitoring Program” If protective coatings are relied upon to manage the effects of aging, the structures monitoring program is to include requirements to address protective coating monitoring and maintenance.	No, if within the scope of the applicant’s structures monitoring program

This Page Intentionally Left Blank

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

Class 1 structures are organized into nine groups and are discussed separately under subheadings A1 through A9. This section addresses the elements of auxiliary building, diesel generator building, radwaste building, turbine building, switchgear room, yard structures, and 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.

III STRUCTURES AND COMPONENT SUPPORTS							
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)							
Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
T-10	III.A3.1-j	Concrete: All	Reinforced concrete	Air – indoor uncontrolled	Reduction of strength and modulus/ elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program For any concrete elements that exceed specified temperature limits, further evaluations are warranted. Appendix A of ACI 349-85 specifies the concrete temperature limits for normal operation or any other long-term period. The temperatures shall not exceed 150°F except for local areas which are allowed to have increased temperatures not to exceed 200°F.	Yes, if applicable
T-03	III.A3.1-c	Concrete: All	Reinforced concrete	Any	Expansion and cracking/ reaction with aggregates	Chapter XI.S6, “Structures Monitoring Program” Accessible Areas: Inspections/evaluations performed in accordance with “Structures Monitoring Program” will indicate the presence of expansion and cracking due to reaction with aggregates. Inaccessible Areas: Evaluation is needed if testing and petrographic examinations of aggregates performed in accordance with ASTM C295-54,	No, if within the scope of the applicant’s structures monitoring program and the stated conditions are satisfied for inaccessible areas

III STRUCTURES AND COMPONENT SUPPORTS 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)							
Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
						ASTM C227-50, or ACI 201.2R-77 (NUREG-1557) demonstrate that the aggregates are reactive.	
T-08	III.A3.1-h	Concrete: All	Reinforced concrete	Soil	Cracks and distortion due to increased stress levels from settlement	Chapter XI.S6, "Structures Monitoring Program" The initial Licensing Basis for some plants included a program to monitor settlement. If no settlement was evident during the first decade or so, the NRC may have given the licensee approval to discontinue the program. However, 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.	No, if within the scope of the applicant's structures monitoring program

III STRUCTURES AND COMPONENT SUPPORTS 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)							
Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
T-05	III.A3.1-e	Concrete: Below-grade exterior; foundation	Reinforced concrete	Aggressive environment	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	<p>Inaccessible Areas: A plant-specific aging management program is required (may be a part of structures monitoring program) if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1500ppm). Examination of representative samples of below-grade concrete, when excavated for any reason, is to be included as part of a plant-specific program.</p> <p>Note: Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.</p>	Yes, a plant-specific aging management program is required for inaccessible areas as stated

III STRUCTURES AND COMPONENT SUPPORTS 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)							
Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
T-07	III.A3.1-g	Concrete: Below-grade exterior; foundation	Reinforced concrete	Aggressive environment	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	<p>Inaccessible Areas: A plant-specific aging management program is required (may be a part of structures monitoring program) if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1500ppm). Examination of representative samples of below-grade concrete, when excavated for any reason, is to be included as part of a plant-specific program.</p> <p>Note: Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.</p>	Yes, a plant-specific aging management program is required for inaccessible areas as stated

III STRUCTURES AND COMPONENT SUPPORTS							
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)							
Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
T-01	III.A3.1-a	Concrete: Exterior above and below grade; foundation	Reinforced concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking/freeze-thaw	<p>Chapter XI.S6, “Structures Monitoring Program”</p> <p>Accessible Areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw.</p> <p>Inaccessible Areas: Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557). Documented evidence to confirm that existing concrete has air content of 3% to 6% and subsequent inspections did not exhibit degradation related to freeze-thaw, should be considered a part of the evaluation.</p> <p>The weathering index for the continental US is shown in ASTM C33-90, Fig.1.</p>	No, if within the scope of the applicant's structures monitoring program and stated conditions are satisfied for inaccessible areas

III STRUCTURES AND COMPONENT SUPPORTS 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)							
Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
T-02	III.A3.1-b	Concrete: Exterior above and below grade; foundation	Reinforced concrete	Water – flowing	Increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide	Chapter XI.S6, “Structures Monitoring Program” Accessible Areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of increase in porosity and permeability due to leaching of calcium hydroxide Inaccessible Areas: A plant –specific aging management program is required for below-grade inaccessible areas (basemat and concrete wall) if the concrete is exposed to flowing water (NUREG-1557). An aging management program is not required, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R-77	No, if within the scope of the applicant’s structures monitoring program and a plant-specific aging management program is required for inaccessible areas as stated

III STRUCTURES AND COMPONENT SUPPORTS							
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)							
Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
T-09	III.A3.1- l	Concrete: Foundation; subfoundation	Reinforced concrete; porous concrete	Flowing water under foundation	Reduction in foundation strength, cracking, differential settlement/ erosion of porous concrete subfoundation	Chapter XI.S6, "Structures Monitoring Program" Erosion of cement from porous concrete subfoundations beneath containment basemats is described in IN 97-11. IN 98-26 proposes Maintenance Rule Structures Monitoring for managing this aging effect, if applicable. 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.	No, if within the scope of the applicant's structures monitoring program
T-06	III.A3.1- f	Concrete: Interior and above-grade exterior	Reinforced concrete	Aggressive environment	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	Chapter XI.S6, "Structures Monitoring Program" Accessible Areas: Inspections performed in accordance with "Structures Monitoring Program" will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack.	No, if within the scope of the applicant's structures monitoring program

III STRUCTURES AND COMPONENT SUPPORTS 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)							
Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
T-04	III.A3.1-d	Concrete: Interior and above-grade exterior	Reinforced concrete	Air – indoor uncontrolled or air - outdoor	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring Program" Accessible areas: Inspections performed in accordance with "Structures Monitoring Program" will indicate the presence of cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel.	No, if within the scope of the applicant's structures monitoring program
T-12	III.A3.3-a	Masonry walls: All	Concrete block	Air – indoor uncontrolled	Cracking due to restraint shrinkage, creep, and aggressive environment	Chapter XI.S5, "Masonry Wall Program"	No
T-11	III.A3.2-a	Steel components: All structural steel	Steel	Air – indoor uncontrolled or air - outdoor	Loss of material/ corrosion	Chapter XI.S6, "Structures Monitoring Program" If protective coatings are relied upon to manage the effects of aging, the structures monitoring program is to include requirements to address protective coating monitoring and maintenance.	No, if within the scope of the applicant's structures monitoring program

This Page Intentionally Left Blank

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

Systems, Structures, and Components

Class 1 structures are organized into nine groups and are discussed separately under subheadings A1 through A9. This section addresses the elements of 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.

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
T-10	III.A4.1-c	Concrete: All	Reinforced concrete	Air – indoor uncontrolled	Reduction of strength and modulus/ elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program For any concrete elements that exceed specified temperature limits, further evaluations are warranted. Appendix A of ACI 349-85 specifies the concrete temperature limits for normal operation or any other long-term period. The temperatures shall not exceed 150°F except for local areas which are allowed to have increased temperatures not to exceed 200°F.	Yes, if applicable
T-03	III.A4.1-b	Concrete: All	Reinforced concrete	Any	Expansion and cracking/ reaction with aggregates	Chapter XI.S6, “Structures Monitoring Program” Accessible Areas: Inspections/evaluations performed in accordance with “Structures Monitoring Program” will indicate the presence of expansion and cracking due to reaction with aggregates. Inaccessible Areas: Evaluation is needed if testing and petrographic examinations of aggregates performed in accordance with ASTM C295-54, ASTM C227-50, or ACI 201.2R-77 (NUREG-1557) demonstrate that	No, if within the scope of the applicant’s structures monitoring program and the stated conditions are satisfied for inaccessible areas

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
						the aggregates are reactive.	
T-06	III.A4.1-a	Concrete: Interior and above-grade exterior	Reinforced concrete	Aggressive environment	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	Chapter XI.S6, "Structures Monitoring Program" Accessible Areas: Inspections performed in accordance with "Structures Monitoring Program" will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack.	No, if within the scope of the applicant's structures monitoring program

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
T-04	III.A4.1-d	Concrete: Interior and above-grade exterior	Reinforced concrete	Air – indoor uncontrolled or air - outdoor	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	Chapter XI.S6, “Structures Monitoring Program” Accessible areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel.	No, if within the scope of the applicant’s structures monitoring program
T-11	III.A4.2-a	Steel components: All structural steel	Steel	Air – indoor uncontrolled or air - outdoor	Loss of material/ corrosion	Chapter XI.S6, “Structures Monitoring Program” If protective coatings are relied upon to manage the effects of aging, the structures monitoring program is to include requirements to address protective coating monitoring and maintenance.	No, if within the scope of the applicant’s structures monitoring program

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
T-13	III.A4.2-b	Steel components: Radial beam seats in BWR drywell; RPV support shoes for PWR with nozzle supports; Steam generator supports	Lubrite	Air – indoor uncontrolled	Lock-up/ wear	Chapter XI.S3, "ASME Section XI, Subsection IWF" or Chapter XI.S6, "Structures Monitoring Program"	No, if within the scope of Section XI, IWF or structures monitoring program

This Page Intentionally Left Blank

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

Systems, Structures, and Components

Class 1 structures are organized into nine groups and are discussed separately under subheadings A1 through A9. This section addresses the elements of 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.

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
T-10	III.A5.1-j	Concrete: All	Reinforced concrete	Air – indoor uncontrolled	Reduction of strength and modulus/ elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program For any concrete elements that exceed specified temperature limits, further evaluations are warranted. Appendix A of ACI 349-85 specifies the concrete temperature limits for normal operation or any other long-term period. The temperatures shall not exceed 150°F except for local areas which are allowed to have increased temperatures not to exceed 200°F.	Yes, if applicable
T-03	III.A5.1-c	Concrete: All	Reinforced concrete	Any	Expansion and cracking/ reaction with aggregates	Chapter XI.S6, “Structures Monitoring Program” Accessible Areas: Inspections/evaluations performed in accordance with “Structures Monitoring Program” will indicate the presence of expansion and cracking due to reaction with aggregates. Inaccessible Areas: Evaluation is needed if testing and petrographic examinations of aggregates performed in accordance with ASTM C295-54, ASTM C227-50, or ACI 201.2R-77 (NUREG-1557) demonstrate	No, if within the scope of the applicant’s structures monitoring program and the stated conditions are satisfied for inaccessible areas

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
						that the aggregates are reactive.	
T-08	III.A5.1-h	Concrete: All	Reinforced concrete	Soil	Cracks and distortion due to increased stress levels from settlement	Chapter XI.S6, "Structures Monitoring Program" The initial Licensing Basis for some plants included a program to monitor settlement. If no settlement was evident during the first decade or so, the NRC may have given the licensee approval to discontinue the program. However, 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.	No, if within the scope of the applicant's structures monitoring program

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
T-05	III.A5.1-e	Concrete: Below-grade exterior; foundation	Reinforced concrete	Aggressive environment	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	<p>Inaccessible Areas: A plant-specific aging management program is required (may be a part of structures monitoring program) if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1500ppm). Examination of representative samples of below-grade concrete, when excavated for any reason, is to be included as part of a plant-specific program.</p> <p>Note: Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.</p>	Yes, a plant-specific aging management program is required for inaccessible areas as stated

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
T-07	III.A5.1-g	Concrete: Below-grade exterior; foundation	Reinforced concrete	Aggressive environment	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	<p>Inaccessible Areas: A plant-specific aging management program is required (may be a part of structures monitoring program) if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1500ppm). Examination of representative samples of below-grade concrete, when excavated for any reason, is to be included as part of a plant-specific program.</p> <p>Note: Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.</p>	Yes, a plant-specific aging management program is required for inaccessible areas as stated

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
T-01	III.A5.1-a	Concrete: Exterior above and below grade; foundation	Reinforced concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking/freeze-thaw	<p>Chapter XI.S6, “Structures Monitoring Program”</p> <p>Accessible Areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw.</p> <p>Inaccessible Areas: Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557). Documented evidence to confirm that existing concrete has air content of 3% to 6% and subsequent inspections did not exhibit degradation related to freeze-thaw, should be considered a part of the evaluation.</p> <p>The weathering index for the continental US is shown in ASTM C33-90, Fig.1.</p>	No, if within the scope of the applicant’s structures monitoring program and stated conditions are satisfied for inaccessible areas

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
T-02	III.A5.1-b	Concrete: Exterior above and below grade; foundation	Reinforced concrete	Water – flowing	Increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide	<p>Chapter XI.S6, “Structures Monitoring Program”</p> <p>Accessible Areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of increase in porosity and permeability due to leaching of calcium hydroxide</p> <p>Inaccessible Areas: A plant –specific aging management program is required for below-grade inaccessible areas (basemat and concrete wall) if the concrete is exposed to flowing water (NUREG-1557). An aging management program is not required, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R-77</p>	No, if within the scope of the applicant’s structures monitoring program and a plant-specific aging management program is required for inaccessible areas as stated

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
T-09	III.A5.1- l	Concrete: Foundation; subfoundation	Reinforced concrete; porous concrete	Flowing water under foundation	Reduction in foundation strength, cracking, differential settlement/ erosion of porous concrete subfoundation	Chapter XI.S6, "Structures Monitoring Program" Erosion of cement from porous concrete subfoundations beneath containment basemats is described in IN 97-11. IN 98-26 proposes Maintenance Rule Structures Monitoring for managing this aging effect, if applicable. 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.	No, if within the scope of the applicant's structures monitoring program
T-06	III.A5.1- f	Concrete: Interior and above-grade exterior	Reinforced concrete	Aggressive environment	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	Chapter XI.S6, "Structures Monitoring Program" Accessible Areas: Inspections performed in accordance with "Structures Monitoring Program" will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack.	No, if within the scope of the applicant's structures monitoring program

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
T-04	III.A5.1-d	Concrete: Interior and above-grade exterior	Reinforced concrete	Air – indoor uncontrolled or air - outdoor	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	Chapter XI.S6, “Structures Monitoring Program” Accessible areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel.	No, if within the scope of the applicant’s structures monitoring program
T-12	III.A5.3-a	Masonry walls: All	Concrete block	Air – indoor uncontrolled	Cracking due to restraint shrinkage, creep, and aggressive environment	Chapter XI.S5, “Masonry Wall Program”	No
T-11	III.A5.2-a	Steel components: All structural steel	Steel	Air – indoor uncontrolled or air - outdoor	Loss of material/ corrosion	Chapter XI.S6, “Structures Monitoring Program” If protective coatings are relied upon to manage the effects of aging, the structures monitoring program is to include requirements to address protective coating monitoring and maintenance.	No, if within the scope of the applicant’s structures monitoring program
T-14	III.A5.2-b	Steel components: Fuel pool liner	Stainless steel	Water – standing	Cracking/ stress corrosion cracking Loss of material/pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry Program” and monitoring of the spent fuel pool water level	No

This Page Intentionally Left Blank

A6. GROUP 6 STRUCTURES (WATER-CONTROL STRUCTURES)

Systems, Structures, and Components

Class 1 structures are organized into nine groups and are discussed separately under subheadings A1 through A9. 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.

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
T-19	III.A6.1-e	Concrete: All	Reinforced concrete	Aggressive environment	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	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 As described in NUREG-1557, corrosion of exterior above-grade and interior embedded steel is not significant if the steel is not exposed to an aggressive environment (concrete pH <11.5 or chlorides >500 ppm). If such steel is exposed to an aggressive environment, corrosion is not significant if the concrete in which the steel is embedded has a low water-to-cement ratio (0.35-0.45), adequate air entrainment (3-6%), low permeability, and is designed in accordance with ACI 318-63 or ACI 349-85. Therefore, if these conditions are satisfied, aging management is not required.	No

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
T-18	III.A6.1-d	Concrete: All	Reinforced concrete	Air – indoor uncontrolled or air - outdoor	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	<p>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.</p> <p>As described in NUREG-1557, corrosion of exterior above-grade and interior embedded steel is not significant if the steel is not exposed to an aggressive environment (concrete pH <11.5 or chlorides >500 ppm). If such steel is exposed to an aggressive environment, corrosion is not significant if the concrete in which the steel is embedded has a low water-to-cement ratio (0.35-0.45), adequate air entrainment (3-6%), low permeability, and is designed in accordance with ACI 318-63 or ACI 349-85. Therefore, if these conditions are satisfied, aging management is not required.</p>	No

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
T-17	III.A6.1-c	Concrete: All	Reinforced concrete	Any	Expansion and cracking/ reaction with aggregates	<p>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</p> <p>As described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that those aggregates do not react within reinforced concrete. For potentially reactive aggregates, aggregate-reinforced concrete reaction is not significant if the concrete was constructed in accordance with ACI 201.2R-77.</p> <p>Therefore, if these conditions are satisfied, aging management is not required.</p>	No

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
T-08	III.A6.1-f	Concrete: All	Reinforced concrete	Soil	Cracks and distortion due to increased stress levels from settlement	Chapter XI.S6, "Structures Monitoring Program" The initial Licensing Basis for some plants included a program to monitor settlement. If no settlement was evident during the first decade or so, the NRC may have given the licensee approval to discontinue the program. However, 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.	No, if within the scope of the applicant's structures monitoring program

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
T-15	III.A6.1-a	Concrete: Exterior above and below grade; foundation; interior slab	Reinforced concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking/freeze-thaw	<p>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</p> <p>As described in NUREG-1557, freeze-thaw does not cause loss of material from reinforced concrete in foundations, and in above- and below-grade exterior concrete, for plants located in a geographic region of negligible weathering conditions (weathering index <100 day-inch/yr). Loss of material from such concrete is not significant at plants located in areas in which weathering conditions are severe (weathering index >500 day-inch/yr) or moderate (100-500 day-inch/yr), provided that the concrete mix design meets the air content (entrained air 3-6%) and water-to-cement ratio (0.35-0.45) specified in ACI 318-63 or ACI 349-85. Therefore, if these conditions are satisfied, aging management is not required.</p>	No

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 weathering index is defined in ASTM C33-90, Table 3, Footnote E. Fig. 1 of ASTM C33-90 illustrates the various weathering index regions throughout the U.S.	

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
T-16	III.A6.1-b	Concrete: Exterior above and below grade; foundation; interior slab	Reinforced concrete	Water – flowing	Increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide	<p>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</p> <p>As described in NUREG-1557, leaching of calcium hydroxide from reinforced concrete becomes significant only if the concrete is exposed to flowing water. Even if reinforced concrete is exposed to flowing water, such leaching is not significant if the concrete is constructed to ensure that it is dense, well-cured, has low permeability, and that cracking is well controlled. Cracking is controlled through proper arrangement and distribution of reinforcing bars. All of the above characteristics are assured if the concrete was constructed with the guidance of ACI 201.2R-77. Therefore, if these conditions are satisfied, aging management is not required.</p>	No

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
T-20	III.A6.1-h	Concrete: Exterior above and below grade; foundation; interior slab	Reinforced concrete	Water – flowing	Loss of material/ 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	No
T-09	III.A6.1-g	Concrete: Foundation; subfoundation	Reinforced concrete; porous concrete	Flowing water under foundation	Reduction in foundation strength, cracking, differential settlement/ erosion of porous concrete subfoundation	Chapter XI.S6, “Structures Monitoring Program” Erosion of cement from porous concrete subfoundations beneath containment basemats is described in IN 97-11. IN 98-26 proposes Maintenance Rule Structures Monitoring for managing this aging effect, if applicable. 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.	No, if within the scope of the applicant’s structures monitoring program

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
T-22	III.A6.4-a	Earthen water-control structures: Dams, embankments, reservoirs, channels, canals and ponds	Various	Water – flowing Water – standing	Loss of material, loss of form/ erosion, settlement, sedimentation, frost action, waves, currents, surface runoff, seepage	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.	No
T-12	III.A6.3-a	Masonry walls: All	Concrete block	Air – indoor uncontrolled	Cracking due to restraint shrinkage, creep, and aggressive environment	Chapter XI.S5, “Masonry Wall Program”	No
T-21	III.A6.2-a	Metal components: All structural members	Steel; Copper alloys	Air – indoor uncontrolled or air - outdoor	Loss of material/ 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 If protective coatings are relied upon to manage the effects of aging, this AMP is to include requirements to address protective coating monitoring and maintenance.	No

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

Systems, Structures, and Components

Class 1 structures are organized into nine groups and are discussed separately under subheadings A1 through A9. 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.

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
T-03	III.A7.1-c	Concrete: All	Reinforced concrete	Any	Expansion and cracking/ reaction with aggregates	Chapter XI.S6, "Structures Monitoring Program" Accessible Areas: Inspections/evaluations performed in accordance with "Structures Monitoring Program" will indicate the presence of expansion and cracking due to reaction with aggregates. Inaccessible Areas: Evaluation is needed if testing and petrographic examinations of aggregates performed in accordance with ASTM C295-54, ASTM C227-50, or ACI 201.2R-77 (NUREG-1557) demonstrate that the aggregates are reactive.	No, if within the scope of the applicant's structures monitoring program and the stated conditions are satisfied for inaccessible areas
T-08	III.A7.1-h	Concrete: All	Reinforced concrete	Soil	Cracks and distortion due to increased stress levels from settlement	Chapter XI.S6, "Structures Monitoring Program" The initial Licensing Basis for some plants included a program to monitor settlement. If no settlement was evident during the first decade or so, the NRC may have given the licensee approval to discontinue the program. However, if a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the	No, if within the scope of the applicant's structures monitoring program

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
						de-watering system through the period of extended operation.	

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
T-05	III.A7.1-e	Concrete: Below-grade exterior; foundation	Reinforced concrete	Aggressive environment	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	<p>Inaccessible Areas: A plant-specific aging management program is required (may be a part of structures monitoring program) if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1500ppm). Examination of representative samples of below-grade concrete, when excavated for any reason, is to be included as part of a plant-specific program.</p> <p>Note: Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.</p>	Yes, a plant-specific aging management program is required for inaccessible areas as stated

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
T-07	III.A7.1-g	Concrete: Below-grade exterior; foundation	Reinforced concrete	Aggressive environment	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	<p>Inaccessible Areas: A plant-specific aging management program is required (may be a part of structures monitoring program) if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1500ppm). Examination of representative samples of below-grade concrete, when excavated for any reason, is to be included as part of a plant-specific program.</p> <p>Note: Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.</p>	Yes, a plant-specific aging management program is required for inaccessible areas as stated

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
T-01	III.A7.1-a	Concrete: Exterior above and below grade; foundation	Reinforced concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking/freeze-thaw	<p>Chapter XI.S6, “Structures Monitoring Program”</p> <p>Accessible Areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw.</p> <p>Inaccessible Areas: Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557). Documented evidence to confirm that existing concrete has air content of 3% to 6% and subsequent inspections did not exhibit degradation related to freeze-thaw, should be considered a part of the evaluation.</p> <p>The weathering index for the continental US is shown in ASTM C33-90, Fig.1.</p>	No, if within the scope of the applicant’s structures monitoring program and stated conditions are satisfied for inaccessible areas

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
T-02	III.A7.1-b	Concrete: Exterior above and below grade; foundation	Reinforced concrete	Water – flowing	Increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide	<p>Chapter XI.S6, “Structures Monitoring Program”</p> <p>Accessible Areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of increase in porosity and permeability due to leaching of calcium hydroxide</p> <p>Inaccessible Areas: A plant –specific aging management program is required for below-grade inaccessible areas (basemat and concrete wall) if the concrete is exposed to flowing water (NUREG-1557). An aging management program is not required, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R-77</p>	No, if within the scope of the applicant’s structures monitoring program and a plant-specific aging management program is required for inaccessible areas as stated

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
T-09	III.A7.1- l	Concrete: Foundation; subfoundation	Reinforced concrete; porous concrete	Flowing water under foundation	Reduction in foundation strength, cracking, differential settlement/ erosion of porous concrete subfoundation	Chapter XI.S6, "Structures Monitoring Program" Erosion of cement from porous concrete subfoundations beneath containment basemats is described in IN 97-11. IN 98-26 proposes Maintenance Rule Structures Monitoring for managing this aging effect, if applicable. 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.	No, if within the scope of the applicant's structures monitoring program
T-06	III.A7.1- f	Concrete: Interior and above-grade exterior	Reinforced concrete	Aggressive environment	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	Chapter XI.S6, "Structures Monitoring Program" Accessible Areas: Inspections performed in accordance with "Structures Monitoring Program" will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack.	No, if within the scope of the applicant's structures monitoring program

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
T-04	III.A7.1-d	Concrete: Interior and above-grade exterior	Reinforced concrete	Air – indoor uncontrolled or air - outdoor	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	Chapter XI.S6, “Structures Monitoring Program” Accessible areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel.	No, if within the scope of the applicant’s structures monitoring program
T-11	III.A7.2-a	Steel components: All structural steel	Steel	Air – indoor uncontrolled or air - outdoor	Loss of material/ corrosion	Chapter XI.S6, “Structures Monitoring Program” If protective coatings are relied upon to manage the effects of aging, the structures monitoring program is to include requirements to address protective coating monitoring and maintenance.	No, if within the scope of the applicant’s structures monitoring program
T-23	III.A7.2-b	Steel components: Fuel pool liner	Stainless steel	Water – standing	Cracking/ stress corrosion cracking Loss of material/pitting and crevice corrosion	Plant-specific aging management program	Yes

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

Systems, Structures, and Components

Class 1 structures are organized into nine groups and are discussed separately under subheadings A1 through A9. 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.

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
T-03	III.A8.1-c	Concrete: All	Reinforced concrete	Any	Expansion and cracking/ reaction with aggregates	Chapter XI.S6, "Structures Monitoring Program" Accessible Areas: Inspections/evaluations performed in accordance with "Structures Monitoring Program" will indicate the presence of expansion and cracking due to reaction with aggregates. Inaccessible Areas: Evaluation is needed if testing and petrographic examinations of aggregates performed in accordance with ASTM C295-54, ASTM C227-50, or ACI 201.2R-77 (NUREG-1557) demonstrate that the aggregates are reactive.	No, if within the scope of the applicant's structures monitoring program and the stated conditions are satisfied for inaccessible areas
T-08	III.A8.1-f	Concrete: All	Reinforced concrete	Soil	Cracks and distortion due to increased stress levels from settlement	Chapter XI.S6, "Structures Monitoring Program" The initial Licensing Basis for some plants included a program to monitor settlement. If no settlement was evident during the first decade or so, the NRC may have given the licensee approval to discontinue the program. However, if a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the	No, if within the scope of the applicant's structures monitoring program

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
						de-watering system through the period of extended operation.	

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
T-05	III.A8.1-d	Concrete: Below-grade exterior; foundation	Reinforced concrete	Aggressive environment	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	<p>Inaccessible Areas: A plant-specific aging management program is required (may be a part of structures monitoring program) if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1500ppm). Examination of representative samples of below-grade concrete, when excavated for any reason, is to be included as part of a plant-specific program.</p> <p>Note: Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.</p>	Yes, a plant-specific aging management program is required for inaccessible areas as stated

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
T-07	III.A8.1-e	Concrete: Below-grade exterior; foundation	Reinforced concrete	Aggressive environment	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	<p>Inaccessible Areas: A plant-specific aging management program is required (may be a part of structures monitoring program) if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1500ppm). Examination of representative samples of below-grade concrete, when excavated for any reason, is to be included as part of a plant-specific program.</p> <p>Note: Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.</p>	Yes, a plant-specific aging management program is required for inaccessible areas as stated

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
T-01	III.A8.1-a	Concrete: Exterior above and below grade; foundation	Reinforced concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking/freeze-thaw	<p>Chapter XI.S6, “Structures Monitoring Program”</p> <p>Accessible Areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw.</p> <p>Inaccessible Areas: Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557). Documented evidence to confirm that existing concrete has air content of 3% to 6% and subsequent inspections did not exhibit degradation related to freeze-thaw, should be considered a part of the evaluation.</p> <p>The weathering index for the continental US is shown in ASTM C33-90, Fig.1.</p>	No, if within the scope of the applicant’s structures monitoring program and stated conditions are satisfied for inaccessible areas

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
T-02	III.A8.1-b	Concrete: Exterior above and below grade; foundation	Reinforced concrete	Water – flowing	Increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide	<p>Chapter XI.S6, “Structures Monitoring Program”</p> <p>Accessible Areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of increase in porosity and permeability due to leaching of calcium hydroxide</p> <p>Inaccessible Areas: A plant –specific aging management program is required for below-grade inaccessible areas (basemat and concrete wall) if the concrete is exposed to flowing water (NUREG-1557). An aging management program is not required, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R-77</p>	No, if within the scope of the applicant’s structures monitoring program and a plant-specific aging management program is required for inaccessible areas as stated

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
T-09	III.A8.1-g	Concrete: Foundation; subfoundation	Reinforced concrete; porous concrete	Flowing water under foundation	Reduction in foundation strength, cracking, differential settlement/ erosion of porous concrete subfoundation	Chapter XI.S6, "Structures Monitoring Program" Erosion of cement from porous concrete subfoundations beneath containment basemats is described in IN 97-11. IN 98-26 proposes Maintenance Rule Structures Monitoring for managing this aging effect, if applicable. 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.	No, if within the scope of the applicant's structures monitoring program
T-11	III.A8.2-a	Steel components: All structural steel	Steel	Air – indoor uncontrolled or air - outdoor	Loss of material/ corrosion	Chapter XI.S6, "Structures Monitoring Program" If protective coatings are relied upon to manage the effects of aging, the structures monitoring program is to include requirements to address protective coating monitoring and maintenance.	No, if within the scope of the applicant's structures monitoring program
T-23	III.A8.2-b	Steel components: Fuel pool liner	Stainless steel	Water – standing	Cracking/ stress corrosion cracking Loss of material/pitting and crevice	Plant-specific aging management program	Yes

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
					corrosion		

This Page Intentionally Left Blank

A9. GROUP 9 STRUCTURES (BWR UNIT VENT STACK)

Systems, Structures, and Components

Class 1 structures are organized into nine groups and are discussed separately under subheadings A1 through A9. This section addresses the elements of BWR unit vent stack. For this group, the applicable structural elements are 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.

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
T-03	III.A9.1-c	Concrete: All	Reinforced concrete	Any	Expansion and cracking/ reaction with aggregates	Chapter XI.S6, "Structures Monitoring Program" Accessible Areas: Inspections/evaluations performed in accordance with "Structures Monitoring Program" will indicate the presence of expansion and cracking due to reaction with aggregates. Inaccessible Areas: Evaluation is needed if testing and petrographic examinations of aggregates performed in accordance with ASTM C295-54, ASTM C227-50, or ACI 201.2R-77 (NUREG-1557) demonstrate that the aggregates are reactive.	No, if within the scope of the applicant's structures monitoring program and the stated conditions are satisfied for inaccessible areas
T-08	III.A9.1-h	Concrete: All	Reinforced concrete	Soil	Cracks and distortion due to increased stress levels from settlement	Chapter XI.S6, "Structures Monitoring Program" The initial Licensing Basis for some plants included a program to monitor settlement. If no settlement was evident during the first decade or so, the NRC may have given the licensee approval to discontinue the program. However, if a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the	No, if within the scope of the applicant's structures monitoring program

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
						de-watering system through the period of extended operation.	

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
T-05	III.A9.1-e	Concrete: Below-grade exterior; foundation	Reinforced concrete	Aggressive environment	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	<p>Inaccessible Areas: A plant-specific aging management program is required (may be a part of structures monitoring program) if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1500ppm). Examination of representative samples of below-grade concrete, when excavated for any reason, is to be included as part of a plant-specific program.</p> <p>Note: Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.</p>	Yes, a plant-specific aging management program is required for inaccessible areas as stated

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
T-07	III.A9.1-g	Concrete: Below-grade exterior; foundation	Reinforced concrete	Aggressive environment	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	<p>Inaccessible Areas: A plant-specific aging management program is required (may be a part of structures monitoring program) if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1500ppm). Examination of representative samples of below-grade concrete, when excavated for any reason, is to be included as part of a plant-specific program.</p> <p>Note: Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.</p>	Yes, a plant-specific aging management program is required for inaccessible areas as stated

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
T-01	III.A9.1-a	Concrete: Exterior above and below grade; foundation	Reinforced concrete	Air – outdoor	Loss of material (spalling, scaling) and cracking/freeze-thaw	<p>Chapter XI.S6, “Structures Monitoring Program”</p> <p>Accessible Areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw.</p> <p>Inaccessible Areas: Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557). Documented evidence to confirm that existing concrete has air content of 3% to 6% and subsequent inspections did not exhibit degradation related to freeze-thaw, should be considered a part of the evaluation.</p> <p>The weathering index for the continental US is shown in ASTM C33-90, Fig.1.</p>	No, if within the scope of the applicant’s structures monitoring program and stated conditions are satisfied for inaccessible areas

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
T-02	III.A9.1-b	Concrete: Exterior above and below grade; foundation	Reinforced concrete	Water – flowing	Increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide	<p>Chapter XI.S6, “Structures Monitoring Program”</p> <p>Accessible Areas: Inspections performed in accordance with “Structures Monitoring Program” will indicate the presence of increase in porosity and permeability due to leaching of calcium hydroxide</p> <p>Inaccessible Areas: A plant –specific aging management program is required for below-grade inaccessible areas (basemat and concrete wall) if the concrete is exposed to flowing water (NUREG-1557). An aging management program is not required, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R-77</p>	No, if within the scope of the applicant’s structures monitoring program and a plant-specific aging management program is required for inaccessible areas as stated

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
T-09	III.A9.1-i	Concrete: Foundation; subfoundation	Reinforced concrete; porous concrete	Flowing water under foundation	Reduction in foundation strength, cracking, differential settlement/ erosion of porous concrete subfoundation	Chapter XI.S6, "Structures Monitoring Program" Erosion of cement from porous concrete subsfoundations beneath containment basemats is described in IN 97-11. IN 98-26 proposes Maintenance Rule Structures Monitoring for managing this aging effect, if applicable. If a de-watering system is relied upon for control of erosion of cement from porous concrete subsfoundations, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	No, if within the scope of the applicant's structures monitoring program
T-06	III.A9.1-f	Concrete: Interior and above-grade exterior	Reinforced concrete	Aggressive environment	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	Chapter XI.S6, "Structures Monitoring Program" Accessible Areas: Inspections performed in accordance with "Structures Monitoring Program" will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack.	No, if within the scope of the applicant's structures monitoring program

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
T-04	III.A9.1-d	Concrete: Interior and above-grade exterior	Reinforced concrete	Air – indoor uncontrolled or air - outdoor	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring Program" Accessible areas: Inspections performed in accordance with "Structures Monitoring Program" will indicate the presence of cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel.	No, if within the scope of the applicant's structures monitoring program

This Page Intentionally Left Blank